Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/electricalworld46newy

INDEX TO VOLUME XLVI.

GENERAL INDEX.

Entries from the Digest of Current Electrical Literature are indicated by D. (Digest) and D. R. (Digest Reference.)

A

Abrasives, Manufacture of artificial, 170
Acceleration, Measurement of. By Lanchester, (D.) 448
Accident swindling in the electrical field, 762
Accumulator. (See Storage batteries.)
Acetylene, Use of, 85
Acheson Graphite Works, 626
Acid pickle. By Burgess, (D.) 703
Aerial navigation, Old book on. By Potamian, 619
Agriculture, Electricity in. By Baker, 489; Koester, 571; 740
Air, Electrical properties of, 125
Air gap and condenser, High-pressure. By Fessenden, (D.) 953
Air-gap reluctance in dynamos, Determination of. By Smoot, 721, (D.) 740
Alliance Against Accident Frauds, 762
Allis-Chalmers Co., 74, 1017, 1042
Alloys:
——Investigation of magnetic non-iron, by Fleming and Hadfield, 15
——Magnetic, from non-magnetic metals. By Fleming and Hadfield, (D.) 233
——Magnetic irreversibility of certain, 889
Alpha rays, Deflection of. By Mackenzie, (D.) 1083
Alternating-current nomenclature. By Woodbridge, 445; Williamson, 531
Alternating currents, Measuring. By Price, (D.) 69
Alternators:
——Armature reaction, Influence of, on the wave form. By Benischke, (D.) *1081
——Belted-type rotating field, Westinghouse, *30
——Building small dynamo without castings. By Hopkins, (D. R.) 996
——Calculating the core-loss in large alternators. By Allen, 21
——Determining the stray flux of the exciting field. By Preuss, (D. R.) 400
——Evolution of electric machines. By Tischendoerfer, (D.) 532
——Heyland three-phase. By Reyval, (D.) *619
——Origin and development. By Rushmore, (D. R.) 869
——Potential control, Finzi patent, *1112
—Revolving field, United Electric, *321
—Self-excited alternators. By Heyland, 312
—Synchronizing alternators. By Dieny, (D. R.) 620
—Tendencies in electrical engineering. By Janet, (D.) 185
—Testing, Suggestions by Mordey, Ayrton and Behrend. By Smith (D.) 274
—Testing, by a method on the Hopkinson principle. By Parshall, (D.) 355
—Testing of, under full-load conditions, Observations by S. P. Smith, 335
—Testing hints. By Remar, (D. R.) 400
—Turbo-alternator at the Liege Exposition. By Reyval, (D.) 1080
—Turbo-alternators, Dick, Kerr & Co., (D. R.) 1081
—Voltage drop, Determining by a graphical method. By Rezelman, (D. R.) 446
minothermic process used by A. Colani, 309
minum conductors. By Esson, (D.) 69
minum industry in the U. S., (D.) 661
minum paper, 212
minum rectifier, Efficiency of. By Peters and Longe, (D. R.) 403
rican Arc Lamps Co., 624, 792
rican Automatic Clutch Co., 280
rican Beck Arc Light Co., 873
rican Blower Co., 114, 877
rican Electrical Salesmen Association, 668, 1086, 1110
rican Electrochemical Society, 428, 512, 557
rican Institute of Electrical Engineers:
Asheville, N. C., meeting, 4, 10, 23, 46, 64
December meeting, 1077, 1107
'Doing the work of the Institute," 66
Italian testimonial, 764
November meeting, 933
October meeting, 779
September meeting, 556
Use of the third person in discussions. By Behrend, 445; Hutchinson, 531; Lyndon, 57
ican Railway, Mechanical and Electrical Association, 552, 555
ican Society for Testing Materials, 51
can Street and Interurban Railway Association, 603
can Street Railway Association:
hiladelphia convention, 509, 513, 551, 603
eorganization, 473
alue of membership in, 476
ter, Atwater Kent pocket size, *31
lsen's work, 1062
ibration suspension. By Julius, (D.) 918
on Electric Co., 707
rbon wastes, Utilizing. By Bernard, (D.) 533

Arc carbons, Manufacture of. By Solomon, (D.) 996
Arc lamps:
——"American," *624
——Arm or duct flame arc, (D.) 1038
——Beck flame arc lamp. By Arendt, (D.) *26
——Carbone lamp, (D. R.) 67
——Clutch for, British patent, (D.) 741
——Economy of. By Hoppe, (D.) 620
——Flaming arc, *873
——Gilbert lamps, (D.) *1127
——Jandus lamp, (D.) 1038
——Olympia Exposition in London, (D.) 869, *996
——Operating mechanism of the "American," *792
——"Oriflamme" lamp of Oliver & Co., (D.) *996
——Standardizing arc lamps. By Norden, (D.) 106
Arcs, Electric:
——Alternating-current arc. By Simon, (D.) 828
——Experiments in the flux of light from the arc with varying power. By Dyke, (D.) 314
——Experiments performed between different kinds of electrodes in a vacuum and in hydrogen. By Child, (D.) 67
——High potential surges, 10, 64
——Power factor of alternating-current arcs, 3
——Residual E. M. F. in the carbon arc, 806
——Singing arc, Properties of the. By Blondel, (D. R.) 314
——Temperature of the arc and of the sun. By Weidner and Burgess, (D.) 532
Arcs, Metallic:
——Electrochemistry of. By Ladoff, (D. R.) 355, 533
——Investigation by Stark and Kuech, (D.) 951
Armature losses in double-current generators. By Still, *265
Armature reaction, Influence of, on the wave form of alternators. By Benischke, (D.) *1081
Armature reaction and commutation, (D.) 1081
Armature reaction in rotary converters. By Fechheimer and Berthold, 600, *611
Armature windings of alternators. By Newbury, (D. R.) 146
Armatures:
——Measuring the moment of inertia. By Boehm-Raffay, (D. R.) 234
——Vickers Sons & Maxim, (D.) *869
Asbestos, Removal of, from armature leads. By Weeks, (D. R.) 490
Assay furnace tools. By Keller, (D. R.) 955
Atoms:
——Darwin on the atom, 386
——Space occupied by atoms. By Traube, (D.) 575
Atwater Kent Mfg. Co., 876
Australia, Municipal ownership in, 378
Austrian Association of Central Stations, (D.) 493
Automobiles:
——Combined engine and motor automobile, *517
——Electric, Manufacture of, *405
——Electric automobiles—a field for investigation, 254, 293
——English stage lines, 909
——Fifth Avenue stages, 515, *724
——Freight, Electric, (D. R.) 314
——Speed-time curves for automobile motors. By Ral, 693
——Steam motor-vehicles. By Garvius, (D. R.) 274
——Vedrine electric, (D. R.) 1128

B

Baking, Electric, with Niagara power, by the Natural Food Co., *268
Balancers, Lighting, Regulation and compounding of. By Frankenfield, 1055, *1067
Balancers for Edison three-wire system, *409
Ball and bearings: How can the ball roll? By Hallock, *700; MacGahan, *827
Ball & Wood Co., 747
Ball Engine Co., 626
Barnard medal, 11
Bell Telephone Co., Frankfort, Ind., 50
Bellinzona, Italy, hydro-electric station. By Herzog, *482
Belt-tightening idler, Automatic, *706
Belt transmission of power. By Carle, (D. R.) 106
Belt transmission of power as an analogue of electric transmission. By Brackett, 974, 986
Berlin Electricity Works, (D.) 402
Blackstone River, Mass., electric power development, *649
Blast furnace gas, Cleaning. By Sahlin, (D.) 742; Krull, (D. R.) 996
Blower for hot gases, *877
Boiler-feeding apparatus. By Hubbard. (D. R.) 574
Boiler-room trouble. By Henry, (D. R.) 491
Boilers:
——Efficiency of steam boilers. By Booth, (D. R.) 68
——Estimating boiler capacity. By Hubbard, (D. R.) 1128
——Feed water, heaters and pumps, 128

Book Reviews:
——American Street Railway Investments, 29
——Automobile Pocketbook. By E. W. Roberts, 664
——Causeries sur le Radium et les Nouvelles Radiations. By Georges Claude, 705
——Cement and Concrete. By L. C. Sabin, 110
——Chicago Transportation Problem. By B. J. Arnold, 536
——Die Fernleitung von Wechselstromen. By G. Roessler, 787
——Die für Technik und Praxis Wichtigsten Physikalischen Grossen. By Olof Linders, 234
——Die Wechselstromtechnik. By E. Arnold and J. L. La Cour, 317
——Einleitung in die Theoretische Elektrizitatslehre. By I. Wallentin, 189
——Electric Railways Theoretically and Practically Treated. By S. W. Ashe and J. D. Keiley, 787
——Elektrotechnischer Fabriken. By F. Niethammer, 71
——Elementare Vorlesungen Uber Telegraphie und Telephonie. By Richard Heinbrun, 110
——Elemente der Vektor-Analysis. By A. H. Bucherer, 1042
——Entwurf und Konstruktion. By Ernst Schulz, 277
——Étude sur les Resonances. By G. Chevrier, 189
——Experimental Elektrizitatslehre. By H. Starke, 71
——Hand Book of Patent Law. By W. D. Thompson, 955
——High-Tension Power Transmission, 705
——L'Annee Electrique, Electrotherapique et Radio-Graphique, 705
——Le Turbine. By G. Belluzzo, 149
——Lehrbuch der Praktischen Physik. By F. Kohlrausch, 1131
——Mathematische Einführung in die Elektronentheorie. By A. H. Bucherer, 358
——Maxwell's Theory and Wireless Telegraphy, 189
——Moody's Manual, 277
——Radioactive Substances. By Mme. Sklodowska-Curie, 576
——Radioactivity. By C. R. Stevens, 576
——Resistance, Inductance et Capacite. By J. Rodet, 71
——Smithsonian Institution, 1131
——Subject List of Works in Electricity, Magnetism and Electrotechnics, 1131
——Telegraphie und Telephonie Ohne Draht. [illegible] Otto Jentsch, 71
——Testing of Electro-Magnetic Machinery and Other Apparatus. By B. V. Swenson and B. Frankenfield, 234
——Theorie der Elektrizität. By M. Abraham and A. Föppl, 189
——Traité Théorique et Pratique D'Electricité. By H. Pécheux, 358
——Transactions of the International Elect[illegible] Congress, 663
——Wireless Telegraphy. By A. F. Collins, 1131
Boosters:
——Alternating-current boosters, (D) 188
——Field control. By Lyndon, 106; Nachod, 272
——Reversible, for charging and discharging batteries. By Friedlander, (D.) 740
Borehole surveying, Electrical devices for. By Marriott, (D. R.) 234
Boring, milling and drilling machine, Espan-Lucas, *580
Brakes:
——Air brakes for electric cars. By Bartholomew, (D. R.) 1083
——Discussion. By Dawson, (D. R.) 147
——German report on, (D.) 997
——Hydraulic arrangement for controlling brakes, (D) 1039
Braking of electric lifting motors, (D.) *490
Bridge, Duluth aerial ferry, *488
British Association in Africa, 425
British Weights and Measures Association, Annual report, 511
Brooklyn Rapid Transit Co.'s power plant, *[illegible]19
Brunswick Refrigerating Co. Ice plant, [illegible]37
Brush holders:
——New British patent, (D.) *659
——Pneumatic, *1044
Buckboard, Making an electric. By Brocksmith, (D. R.) 187, 448
Buckets, Pressed steel, *319
Bulkhead doors, Electrically-operated, *[illegible]
Burke Electric Co., 407
Burt Mfg. Co., 709

C

Cable clamp, Kearney, *748
Cable dog, Star, *32
Cable drum carriage, (D. R.) 28
Cable laying, using coal tar, (D. R.) 275
Cables:
——Aluminum conductors. By Esson, (D.)
——Calculating the cross-section of a [illegible] Sarratt, (D.) 785

* indicates illustrated articles.

Cables: (Continued).
—Heating of three-core cables in earth. By Humann, (D.) 69
—Overhead vs. underground central station circuits, 656
—Size of transmission circuits. A method for determining. By Stone, 271
Cables, Submarine:
—Alaska, Situation in, 763
—Atlantic cables, New, 599, 642, 720
—French cable in Venezuela, 297, 475, 5
—Measuring capacity. By Devaux-Charbonnel, (D.) 148
—Pacific cables and the island of Yap, 211
—Pacific-Canada cable, 380
—South American, New, 11
Cables, Telephone, in Lake Como, Italy, (D.) 703
Cableway system of handling cargoes at Manaos Harbor, Amazon River. By Seibert, *308
Cadmium, Estimation of. By Flora, (D. R.) 1129
Calcium carbide and acetylene. My Morehead, (D. R.) 449
Calcium carbide in France, 131
California plants, Scarcity of water for, 847
Canal, Danube-Oder, Electric hoisting plant. By Kronstein, (D. R.) 314
Cancer and radium rays. By Rehns and Salmon, (D.) 449
Candle, Electric, (D.) *996
Candle-power:
—Calculations of mean spherical candle-power of an incandescent lamp. By Wild, (D.) 701
—Candle-power ratings discussed at the Ohio Electrical Association, 373
—Mean spherical and mean horizontal. By Fleming (D.) 533
Candle-power photometers, spherical, 1100
Capacity:
—Absolute measurements of. By Rosa and Grover, (D. R.) 575
—Variation of, with temperature. By Terry, (D. R.) 70
Capstan, Electrically operated, *919
Car builders consolidate, 209
Cars:
—Direct-current, single-phase motor car of the Allgem. Elek. Ges. By Richter, Cronbach, (D.) 491
—Roller bearings for electric cars, 818
—Steel, in England, (D.) 660
—Steel, for motor cars. By Guillet, (D.) 829
Carbon arc. By Becknell, (D.) 574
Carbons, Manufacture of arc. By Solomon, (D.) 996
Carnegie School of Technology, 686
Carnegie Schools, Tuition at, 52
Carnegie teachers' foundation, 897
Cathode-ray tube:
—Braun. By Varley and Murdoch, (D. R.) 234
—Modified Braun. By Wehnelt, (D.) *998
Cathode rays, Path of. By Wehnelt, (D. R.) 998
Cells:
—Concentration. By Cady, (D. R.) 148
—Dry cell on Daniell's principle. By Brown, (D. R.) 744
—Valve action of cells. By Holtz, (D.) 493
Census Bureau, Work of, 1020
Central station companies and the law of negligence, Manchester, 430
Central station daily newspaper in a franchise fight, 851
Central station employees, Instruction of, 605
Central station rates. (See Charging for electric current.)
Central station situation, 847
Central stations:
—Ada, Ohio, Water, Heat & Light Co. By Buchenberg, *563
—Ashland, Ore., municipal plant, 89
—Australasia, List of stations in, (D. R.) 998
—Austria, at Zwömalgreien. By Steens, (D.) 187
—Baltimore lighting plant, 762.
—Brigham City, Utah. By Hardesty, (D. R.) 491
—China, in Peking, (D.) 1083
—Chittenden Power Co., Vermont, 930, *939
—Combination and operation of small central station plants, 430
—Combined lighting and traction stations, Results and advantages. By Rider, (D.) 356
—Connecticut, Electrical development in, 296
—Cusset, near Lyons, France. Hydraulic station. By Bryan, *983
—Depreciation of plant, Allowance for, in Mass., 1016
—Design of power plants. By Koester, (D.) 314, 533, 620, 829
—District electrical supply discussed by Pinckard, 651
—Dublin, Extensions, (D. R.) 492
—Edison Co. of New York, Waterside station No. 2, *383, *435
—Efficiency of generating stations. By Hobart, 88, 901
—England:
  Development in. By Mountain, (D.) 952
  Frome-Selwood plant, (D.) 534
  Gas-driven stations, Reports on, (D.) 402
  Lancashire Electric Power Co., (D.) 784; *1065
  London. Bow generating station, 10,000-volt transmission system without transformers, *1114
  London, Unified current supply in. By Britton, 45, 59
  London's power supply, 989
  Manchester, England, Works accounts, (D. R.) 275
  Statistics, (D. R.) 187
  Walthamston, Gas-driver station (D.) 620
  Yorkshire Electric Power Co., (D.) 533
haust steam for auxiliaries, 321
problems. By Newington, (D.) 187
nce, Lille power house, (D.) 448

Central stations: (Continued).
—Free lamp renewals, 720
—Gas-driven station at Walthamston, England, (D.) 620
—Germany:
  Dresden, Operating results for three years, (D.) 952
  Durlach. By Freyss, (D.) 661
  Financial results. By Hoppe, (D.) 274
  Hamburg stations. By Rapprecht, (D. R.) 871
  Statistics, (D.) 232; by Seyffert, (D.) 1129
—Harrisonburg, Va. By Coleman, *1121
—Illuminating engineering and central stations. By Cravath, 374, 398
—Italy, Bellinzona hydro-electric station. By Herzog, *482
—Johannesburg, South Africa, (D.) 108
—Kansas City, Building up business, 894
—Kewanee, Ill., 1076
—Load factor. By Sinclair, (D.) 187
—Management of central stations, Discussion at N. E. L. A., 650
—Melbourne, Australia, Report, (D.) 492
—Mexico, Notes. By Blackwell, (D. R.) 232
—Municipal electricity works. By Munro, (D.) 1083
—New York proposed municipal lighting plant, *48, 932, 978
—New York Central R. R. generating plants, *95, *822
—Norway, Hydro-electric development in. By Ramakers, (D.) 446
—Portland, Ore., electrical power development, *174; By Sykes, (D.) 448
—Profits, Increasing. By Walsh, (D. R.) 952
—Providence, R. I., Report, 1113
—Rates. (See Charging for electric current.)
—Relations of the central station with the public. By Kingan, 389
—Report of Census Bureau, 554
—Rockland Electric Co., Gas Engines, 788
—Scotland:
  Clyde Valley power system, Glasgow, Scotland, *215
  Edinburgh, Electric motor service, 211
  Fife Electric Power Co., (D.) 533
  Glasgow, Port Dundas station, (D. R.) 996
—Size of units in power houses, (D.) 69; By Bushnell, (D.) 659
—Supply voltage for new stations, in Germany. By Wikander, (D.) 830
—10,000-volt transmission system without transformers, *1114
—Topeka Edison Co., 905, 946
—Turners Falls, Mass., Hydro-electric development, *263
—Waste products of a central station, 350
—Williamsburg station of Brooklyn Rapid Transit Co., *519
—Window-lighting loads after business hours. By Roberts, (D. R.) 870
—(See also Isolated plants; Transmission plants.)
Chain, Galvanized, for arc lamps, 624
Chain blocks, Yale & Towne, *75
Chain making by electric welding, *235
Charging apparatus for blast furnaces, Electric. By Collischonn, (D. R.) 742
Charging for electric current:
—Discounts. Motor load factor and station load factor. By Taylor, (D.) 403
—Massachusetts. By Adams, 310, 348, 391, 442, 484
—Maximum demand. By Codman, 527
—Methods of selling current as applied to cities of 20,000 inhabitants, 352
—"Readiness-to-serve" and "two rate" methods of charging, 427, 572
Charging receptacles, Westinghouse, *1085
Chemical and electrical energy. By Haber, (D.) 315
Chemical elements, Genesis of, (D.) 108
Chemical energy transmission, (D.) 109
Chicago Electrical Show, 979
Chicago Pneumatic Tool Co., 790
China, Electrical field in, 766
Chittenden Power Co., 580
Chloride electrolysis, Patents, *23
Christmas decorations, Danger of, 1002
Circuit-breakers:
—Andrews "reverse current," improved, (D. R.) 69
—Choulet three-phase, (D.) *147
—Mercury vapor, Cooper-Hewitt patent, *530
—Overload and no-voltage, *793
—Westinghouse, for direct-current uses, *155
Civil engineers and other engineers, 973
Clark Electrical Engineering Co. Wireless telegraphy set, *191
Classification for electrical engineering references. By Parsons, 910
Cleveland Electric Club, 1107
Clocks, Electric, (D.) *662
—Electric magneto watchman's, *279
Clutch, Automatic self-adjusting, *280
Coal field of South Wales, (D.) 536
Coal handling, Cost of, 685
Coal handling at power house near coal mine, *1065
Coal imports at San Francisco, (D.) 916
Coherers:
—Electron theory of the coherer. By Blanc (D.) 1083
—Massie, *561
—Telephony, Coherer in., By Steadle, (D. R.) 316
Color in platinum films. By Isabelle Stone, (D. R.) 403
Colorado Electric Light, Power and Railway Association, 555
Commercial Electric Co, 320
Commonwealth Electric Co., 793
Commutation poles. By Friedlander, (D.) 701

Commutation poles in direct-current machines. By Breslauer, (D.) 231; Arnold, (D. R.) 1038
Commutation theory. By Press, *1027
Commutator grinding machine, Philips, (D.) 741
Commutators:
—Maintenance of. By Lees, (D. R.) 659
—Sparking at, (D.) 619
Compressor plant, Electrical, at Chicago terminal, *113
Concentric diffuser for incandescent lamp, *192
Condenser, Adjustable. By Swayne, (D. R.) 535
Condenser for jump-spark coil, (D. R.) 872
Conductivity of air, Measuring. By Gardien, (D. R.) 1040
Conductor, Leading-in, Cooper-Hewitt, *938
Conduits:
—Requirements for urban electric traction. By Heywood, (D. R.) 402
—Underground conduits for long distance telephony, 336
—Wire conduits for Greater New York, 933
Connecticut Telephone & Electric Co., 539, 706
Contact for carbon brush, Hallberg, *708
Contract work, Estimating on. By Auerbache, (D. R.) 873
Contractor's plant, Electric power for, (D.) 446
Controllers:
—Alternating-current motor controller, *432
—Construction of. By Dubois, (D. R.) 660
—Jackson patents for alternating-current motor 341
—Liquid controller at the Olympia Expositio (D.) *829
—Machine tool controller, *538
—Magnetic switch controllers for automatic ore unloaders, *495
—Printing press controller, *835
—Series-parallel, for electric motors, (D. R.) 357
—Ward Leonard, 707
Converter substations, 1055
Converters:
—Armature reaction in rotary. By Fechheimer and Berthold, 600, *611
—Cascade converter of the Arnold system. By Reyval, (D.) *828
—Cascade rotary, *230, 679, *698
—Inverted rotary; By Clinton, (D.) 231
—New type of converter at the Liege Exposition. By Corsepius, (D.) *827; 1057, *1072.
—Starting rotary. By Wagner, (D.) 147, 448, 574
—Synchronous converters in parallel with batteries. By Jakobi, (D.) *492
—Testing. By Bercovitz, (D. R.) 999
Cooking, Electric, (D.) 786
Copper:
—Exhaustion of the world's supply, 338
—Rapid electrodeposition of. By Cowper-Coes, (D.) 275
Copper oxide cell. By Rammelsberg, (D. R.) 140
Copper slag, Analysis of. By Smith, (D. R.) 72
Copper smelting as a process for recovering gold and silver, (D.) 872
Core-loss in large alternators, Method of calculating. By Allen, 21.
Core losses in induction motors. By Hellm *1071
Cornwell, R. M., Co., 412, 836.
Corpuscles, Negative, from alkali metals. Thomson, (D.) 953
Corrosion of condenser tubes. By Sexton, (D. 870
Countershaft for motors, Douglas patent, *12
Couplings of electric cables. By Mykisch, (D. 574
Crane Co., 746
Crane controllers, Cutler-Hammer, *154
Cranes, Electric:
—Electrically-operated pillar crane. By Sn *993
—Electrically-released brakes on. By We (D. R.) 447
—European manufacture. By Herzog, (D. 447
—High-speed crane. By Egger, (D. R.) 742
—Large electric, (D. R.) 1039
—Locomotive cranes. By Howlett, (D. R.)
—Shunt motors for cranes. By Hill, (D.)
—Single-phase cranes at Cologne-Dentz ha By Perlewitz, (D.) 401
—Walking jib crane, *497
Crescent Electrical Mfg. Co., 499
Cuba, Double trolleys in, 45, 73
Current Classification and Nomenclature, R of Committee on, 426
Cutler, H. H., Biographical sketch of, *173
Cutler-Hammer Mfg. Co., 154, 237

D

Damping the oscillations of the galvano needle. By Einthoven, (D.) *357
Dam, Removal of the diverting, of the O Power Co., Niagara Falls, *184
Darby, Edward, & Sons. Co., 920
Darwin on celestial evolution, 429, (D.) 448
Davidson, J. E., Biographical sketch of, *72
Davis, David, Portrait of, *643
Davy, Sir Humphry, Memorial to, 219
Day-and-Night Sign Co., 706
Dayton Hydraulic Machinery Co. Pump, *24
Death by electric shock. By Kratter and Je (D.) 918
Definitions of the electric properties of cond (D. R.) 357
De Forest, Lee, Biographical sketch of, *11
De Laval Steam Turbine Co. Turbine, *19
De Muralt, C. L., Sketch of, *1061
De Veau Telephone Mfg. Co., 404, 874
Diagrams of railway passenger travel. By I *229
Diamonds, Production of artificial. By C (D.) 662

* indicates illustrated articles.

Dictionary, Electric railway, (D. R.) 621
Dielectric constant of air and density, Relation between. By Occhialini, (D.) 830
Dielectric constants, Bibliography on. By Mathews, (D. R.) 953
Dielectric strength, Contact with dielectrics in tests of. By Appleyard (D.) 743; 848
Dielectric strength of insulating materials. By Symons, (D.) 703; Kinzbrunner, (D.) *742, *785
Dielectrics, Heat developed in. By Guye and Denso, (D. R.) 621
Diesel engine in electric stations. By Behrend, (D. R.) 356
Digest" references in the Electrical World and Engineer. By Packard, 444
Discharge potentials. By Bouty, (D.) 535
iseases of electrical machinery. By Crocker and Wheeler, (D. R.) 146
istribution boards in telephone exchanges. By Abbott, *140
rainage area, Discharge value of. By Church, (D. R.) 146
rilling machine, Niles, *195
Drills:
——Duntley air-cooled electric, *790
——Sensitive bench, *576
Duluth aerial ferry, *488
Duncan meter patents, 298
Du Vivier electrical recording instruments, *411
Dynamite, Thawing. By Kelly, (D. R.) 873
Dynamo field coils, Experiments with the breaking of, 510
Dynamo heating time constants. By Press, 735, 760
Dynamometer, Rieter. By Guarini, (D. R.) 1041
Dynamos:
——Air-gap reluctance. By Smoot, 721, (D.) 741
——Commutation of direct-current machines, 64
——Commutation poles. By Breslauer, (D.) 231; Rotth (D. R.) 401
——Design, Formulas for use in. By Frith, (D. R.) 25
——Direct-current, with commutation poles. By Arnold, (D. R.) 1038
——Dittmar dynamo. By Winkelmann, (D.) *701
——Electromagnetic field in machines. By Emde, (D. R.) 106
——Homopolar dynamo, *913
——Interpole dynamos of Thomas Parker, (D.) 1038
——Iron loss increment on full load. By Press, 612
——Locating short circuits between armature coils. By Gilliam, (D.) *532
——Magnetic pull. By Niethammer, (D. R.) 231
——Measuring efficiency, Swinburne's method. By Boehm-Raffay, (D. R.) 277
——Phoenix direct-current machines, (D.) 828
——Reactance E. M. F. and the design of commutating machines. By Adams, 346
——Separating losses. By Linke, (D.) 146; Roehle, (D. R.) 490
——Train lighting dynamo, Rosenberg, 87, *104.

E

Earth conections, Testing. By Corsepius, (D.) 918
Eddy current losses in the armature copper of electric machines. By Loewenherz and Van der Hoop, (D.) 446
Edison Electric Co. of Brooklyn, Lighting Campaign, *789
Edison Illuminating Association, Convention, 428, 472
Electric connections. By Bernard, (D. R.) 492
Electric discharges, Chemical effects of, (D. R.) 1083
Electric fields, Comparison of. By Owen, (D.) 316
Electric lamps. (See Arc lamps; Incandescent lamps.)
Electric oscillations in wireless telegraphy. By Gehrcke, (D.) 358
Electric shock, Resuscitation from, 352
Electric spark recorder. By Springer, *16
Electric Water Purifier Co. Water purifier, *191
Electric Water Purifying & Filter Co., 787
Electric wave transmission. By Franklin, (D.) 189, 207
Electric wind. By Janus-Zkiewicz, (D. R.) 703; Schaffers, (D.) 998
Electrical progress. By Pearce, (D.) 1085
Electricity:
——An experiment in. By Worthington, (D.) 575
——Conduction through gases. By Robb, (D. R.) 1129
——Direct from coal, Radcliff, England, *1065
——Flow of, in metals under changes of pressure. By Thwing, (D.) 29
——Meteorology and the dynamo. By Cromack, 177
——Velocity of, along wires. By Slaby, (D.) *954
——What is electricity, 89
Electrochemical developments, *23, *66, *182, 272, *395, *531, 570, 700, 739, 826, 1036
Electrochemical industries:
——Europe. By Lemeau, (D.) 786
——Niagara Falls. By FitzGerald, (D.) 108; Green, (D.) 315
Electrodes, Evolution and absorption of gases by. By Skinner, (D.) 621
Electro-Dynamic Co., 1132
Electrolysis, Alternating-current, between lead electrodes. By Wilson, (D.) 622
Electrolysis:
——Gas pipes, 1059
——Germany, due to tramway return currents, (D. R.) 314
——Railway return currents and electrolysis of water pipes, (D.) 448
——Tramway return currents with alternating current systems. By Kintner, (D.) 952
Electrolysis of water. By Richards, (D. R.) 953
Electrolytic Alkali Co., Middlewich, Cheshire, England. By Kershaw, *101
Electrolytic deposition of metals from mixed solutions. By Jacobs, (D.) 109
Electrolytic deposition of metals. Patents, 24
Electrolytic wave detectors. By Merritt, 185; Ferrie, (D.) 493
Electrolytic wave detectors in wireless telegraphy. By Carroll, *145
Electromagnets:
——Action of lifting. By Schiemann, (D.) 401
——Alternating-current. By Underhill, (D. R.) 492
——Approximate calculation of plunger. By Underhill, *1035
Electromechanics of galvanism and heat. By Riecke, (D.) 952
Electronic theory, Results and problems of. By Lorenz, (D. R.) 108; Lorentz, (D. R.) 357; Tommasina, (D. R.) 953
Electrostriction. By More, (D. R.) 1129
Electrotherapeutics. By Renault, (D.) 704; Jones, (D.) 1130
Elevated railways, New York, Accident at 53d Street, 474
Elevators, Electric:
——Mabbs, *453
——Swiss mountain. By Chignaterie, (D. R.) 870
Elks' Carnival at Buffalo, Electrical features of, *144
Emery grinder, Motor-driven, *962
Empire State Gas & Electric Association, 759, 765
Employees, Central station, Instruction of, 605
Endosmosis, Electric, Investigations of Wiedemann. By Reiff, (D.) 276
Engineers:
——College graduates and engineering. By Buck, (D.) 955
——Electrical engineers of the times, 13, 53, 94, 134, 173, 214, 262, 302, 342, 382, 434, 478, 518, 562, 608, 648, 688, 728, 770, 811, 853, 895, 935, 980, 1021, 1061, 1109
——Moral qualifications of, 562
——Place of the illuminating engineer. By L. B. Marks, 782
——Qualities of the testing engineer, 91
Engines:
——Ball side-crank automatic engines, *626
——Diesel, in electric stations. By Behrend, (D. R.) 356
——Jacketing steam engines. By Mellondy, (D.) 447
——Reeves vertical cross-compound, Test of, 30
——Vacuum, Effects of, on economy. By Neilson, (D. R.) 232
——(See also Gas engines).
Espen-Lucas Machine Works, 580, 957
Ether:
——Defining the, 336
——Maxwell's theory of the, 207
Evaporation of metals, (D.) 69
Evolution of inanimate and living nature. By Darwin, 429, (D.) 448
Exhaust steam for station auxiliaries, 321
Export trade:
——Electrical exports for the year, 205
——Satisfactory condition, 1

F

Factories. (See Isolated plants.)
Factory testing of electrical machinery. By Workman, (D. R.) 67, 358, 535
Fan motors:
——Battery, 877
——Increasing use of, 397
Faraday, Michael, Memorial to, 219
Farm, The, and electricity, 1014
Feed-water heaters:
——Loew, *792
——Open type. By Edwards, (D. R.) 574
Ferry, Duluth aerial, *488
Filter presses, Materials for the construction of. By Hatschek, (D.) 29
Fire alarm service of New York, 637, 640
Fires from electrical causes, 934
Fisher, H. W., Biographical sketch of, *688
Fishing made easy, 170
Flames, Electric conductivity of. By Wilson, (D.) 742
Flatirons, Electric, *362
Floy, Henry, Biographical sketch of, *382
Flux in induction motors, 556
Ford, Arthur H., Biographical sketch of, *518
Fort Wayne Electric Works, 407, 791
Fountain, Electro-luminous, *836
Fowle, F. F., Biographical sketch of, *13
Franklin, Benjamin:
——Anniversary, 254, 296, 377
——Books relating to, 977
Freeman, E. H., Electric Co., 748
Frequency meter. By Langsdorf, 1015, *1029
Furnace charging machines, Electric, (D. R.) 314
Furnace hoist, Electric. By Ramakers, *1000
Furnaces, Electric:
——Benjamin furnace, *531
——Bölling patent, 739
——Carbon tube furnaces. By Hutton and Patterson, (D.) 1129
——Efficiency of furnaces. By Richards, (D.) 357
——Galbraith furnace, (D.) 275
——Gin, Colby & Kjelliv furnaces. By FitzGerald, (D.) 315
——Iron and steel industries. By Borchers, (D.) 29
——Patents, *66, 182
——Potter patent, *395
——Refractories. By Johnson, (D. R.) 29
——Ruthenburg and Acheson furnaces. By Fitz Gerald, (D.) 872
——Steel-making in England. By Harbord, (D.) 403
Fuse plug. National Code, *458
Fuses:
——Standardization of. By Schwartz, (D.) 1082
——Standardization of enclosed, 556
——Zinc. By Schwartz and James, (D.) 1082

G

G. & W. Electric Specialty Co., 875
Galvanism, Electromechanics of. By Riecke, (D.) 952
Galvanometer needle, Damping the oscillations of. By Einthoven, (D.) *357
Galvanometers:
——Alternating-current galvanometer, 761
——Cable testing, *539
——Methods of using the differential ballistic. By Raymond, (D. R.) 316
——Portable moving coil, *875
——Recording readings photographically, (D.) 786
Garbage and refuse as fuel in English cities. By Walsh, (D. R.) 146
Gary, Theodore, Portrait, *4
Gas:
——Compresed, as an insulator. By Ryan, (D.) *148, 470
——Electricity in gases. By Stark, (D. R.) 1040
——Ionization of gases. By Lewis, (D. R.) 1129
——Rare atmospheric gases. By Valentiner and Schmidt, (D.) 872
Gas arcs and electric, 523
Gas engines:
——Blast furnace gas driven, (D. R.) 951
——California Gas & Electric Co. Use of gas engines with long-distance electric transmission. By Martin, 206, 220
——Comparison with the electric motor, 426
——Discussion at Railway Convention, 603
——English central station, (D.) 620
——Europe, Use in. By Wathot, (D. R.) 401
——German engines. By Riedler, (D. R.) 27
——Governing four-cycle engines. By Mathot, (D. R.) 1128
——Pockland Electric Co.'s station, 788
——Single-phase railway system driven by gas engines, 788
——Small gas engine plant in drug store. By Howard, (D.) 661
——Starting methods. By Mathot, (D. R.) 274
——Walrath engines, 409
Gas pipes, Electrolysis of, 1059
Gas producers. By Richards, (D.) 829, (D. R.) 1128
——Small plant using soft coal, in Indiana, (D. R.) 829
Gas rates.
——Differential, 808
——Regulation in Massachusetts. By Adams, 310, 348, 391, 442
Gas situation in Chicago, 973, 976
Gas turbine. By Clerk, (D. R.) 951
Gauge, B. & S., Approximation of. By Nachod, 529; White, 658; Burt, 914
General Electric Co.:
——Concentric diffuser, *192
——Flatirons, *362
——Fuses and cut-outs, *195
——Lamps, *279
——New carbon lamp, *93
——Portland Exposition, *705
——Rheostats, *958
——Sales in the Far East, 320
——Switches for lamp circuits, *792
——Watt-hour meter, *625, *707
Generators:
——Armature losses in double-current generators. By Still, *265
——Burke three-wire, *407
——Compound generators in parallel with storage battery. By E. K. Scott, (D.) *187
——Curves, Plotting saturation. By Gray, *397
——Direct-current machines with commutation poles. By Friedlander, (D.) 701
——Double-field alternating-current generator. By Ziehl, (D.) *273
——Kinetic variation of pressure of generators. By Russell, (D.) *400
——Lahmeyer's motor-generators, *1115
——Parallel operation. By Boucherot and Mougin, (D. R.) 915
——Polyphase rotary, Winding of. By Pumphrey, (D.) 400
——Size of generating units, 295
——Testing of generators. By Drysdale, (D.) 1100, 1129
——Unipolar generator, *1022
——Vertical-shaft direct-current generator, *913
——Westinghouse direct-current engine-driven, *71
——"Wonder" alternator for either alternating or direct current, 412
George Washington University, 559
German Reichsanstalt, Report for 1904, (D.) 575
Germany:
——American patents in, 805, 809
——Electrical industries of, 339
——Tariff matters, 723
Globes, Lamp, Absorption by; Determining the mean spherical candle-power. By Solomon, (D.) 915
——(See also Reflectors.)
Gold production, Cyanide process for. By Davis, (D.) 148
Gordon Battery Co., *788
Graphite, Production of artificial, 91
Great Britain, Obstacles to electrical development in. By Ball, 1032
Grinding machine, Philips commutator, (D.) 741
Ground detectors. By Coe, (D. R.) 1130
Grounding interior conduit sheathings, 639
Gun factory, Electric power in. By Holden, (D. R.) 1081
Gutmann, Ludwig. The patent law situation, 354
Guy anchors:
——D. & T., *668
——Stombaugh, *242

* indicates illustrated articles.

H

Hallberg, J. H., Biographical sketch of, *94
Harbor of Manaos on the Amazon River, Electrical equipment of. By Seibert, *308
Harmonics in three-phase systems, 638
Hartford, Conn., Electrical supply in, *689
Hartford Time Switch Co., 668
Hartman Circuit-Breaker Co., 790
Heat insulation. By Hutton and Beard, (D.) 276
Heating:
——Central hot-water installation, Ada, Ohio. By Buchenberg, *563
——Majestic Theatre, Boston, 283
——Progress in, 254; By Jepson, (D. R.) 1042
——Theater Royal, Drury Lane, (D.) 1130
Heating and working metals by electricity. Hoho process, 565
Henshaw, F. V., Biographical sketch of, *214
Hertzian waves, Transparency to. By Busceim, (D.) 108
Heyland diagram for induction motors, Practical application of. By Way, *1069
High frequency currents, 1120
High frequency currents and electric waves. By Fleming, (D.) 1130
Hines, C. H., Biographical sketch of, *648
Hoge, J. B., Portrait, *4
Hoho process of heating and working metals by electricity. By Hoho, 565
Hoists Electric:
——Belgium colliery. By Guarini, (D. R.) 829
——Hoisting plant, 691
——Niles traveling, *32
Holophane-Pagoda Ball *748
Hospital, Electrical equipment of, (D. R.) 1040
Hubley, G. W., Biographical sketch of *434
Hydraulic accumulation plant. By Herzog, (D. R.) 491
Hydraulic installations. By Barr, (D. R.) 491
Hydrogen, Evolution of, from the cathode. By Skinner, (D.) 403
Hypochlorite solution for disinfecting purposes, (D. R.) 743
Hysteresis:
——German report on, (D.) 108
——Hysteresis in a revolving field under the action of direct current interrupted current, alternating current and Hertzian waves. By Arno, (D.) 233
——Iron in a revolving field. By Herrman, (D.) 403
——Linear and rotating. By Wecken, (D.) 917
——Rotating hysteresis. By Hiecke and Hermann, (D. R.) 1129
——Steinmetz law and high densities. By Lydall, (D.) 355

I

Illinois State Electrical Association, 637, 643
Illuminating engineering and central stations. By Cravath, 374, 398, (D.) 1081
Illuminating Engineers, Society of, 1102
Incandescent lamps:
——Canello lamp, (D. R.) 186
——Charging for current supply, *665
——Concentric diffuser, *192
——Edison lamp, Improvement in, 166; By Marshall, (D.) 185
——Efficiency meter for lamps. By Hyde and Brooks, *942
——Efficiency of, Tests made in Paris by Laurival and Janet, (D.) *573
——Filament patents expired. By Thompson, 892
——Graphitized filament lamp, English patent, 657; By Davis, 1126
——High efficiency carbon filament lamps, 353
——Inefficiency meter for, 931
——Intermittent flash signs, Lamp for, (D.) *449
——Luminous phenomena in lamp bulbs. By Fuerstenau, (D.) 741
——Miners' safety lamps, (D.) 741
——Modulating electric lamps. By Phelps, 746
——New "metallized" carbon filament lamp, 46, 65, *73
——Notes on a small lamp. By Laflargue, (D.) 355
——Osmium lamp, *390
——Potential regulation based on the different resistance behavior of carbon and tantalum lamps. By Kennelly and Whiting, 2, *20
——Ratio between mean spherical and mean horizontal candle-power. By Fleming, (D.) 232
——Reflectors, shades and globes. By Cravath and Lansingh, *907, 930, *947, *991, *1033
——Selection of. By Dawson, (D.) 828
——Standardization of, (D.) 1127
——Theory of incandescent lamps. By Roeber, 552, 567
——220-volt foreign lamps, Claims for, 2
——Waterproof receptacle, *748
——Wolfram glow lamp, (D.) 1081
Incubators, Electric regulation of temperature in, (D.) 536
Independent Electrical Contractors' Association of Greater New York, 50
Index, Electrotechnical 12
Indiana Independent Telephone Association, 646, 682, 723, 810
Indiana telephone associations merge, 129
Indiana telephone companies, Assessments of, 257
Indiana municipal code, 602
Indiana Municipal League, 890
Inductance:
——Absolute measurements of. By Rosa and Grover, (D. R.) 575
——Comparison of mutual inductance. By Taylor, (D.) 109
——Standards in varying temperatures. By Taylor, (D.) 29
Induction regulator, Single-phase. By Bergman, *56
Industrial engineering, Financial end of. By Dixon, (D. R.) 704
Installation and wiring regulations, (D. R.) 28
Institution of Electrical Engineers of Great Britain, 848
Insulated vs. bare neutral wire. By Erens, (D.) *702
Insulating materials:
——Dielectric strength of. By Symons, (D.) 703
——Table giving properties of, (D. R.) 28
——Testing high-tension. By Kinzbrunner, (D.) 622
——Tests of high-tension materials. By Kinzbrunner, (D.) *742, *785
Insulation resistance of third rail, Berlin, (D.) 491
Insulators:
——Compresed gas as an insulator, 470
——Split porcelain, *876
——Telephone transposition, *835
Insurance and inspection of electrical machinery in Great Britain, (D.) 704
International Association of Municipal Electricians, 378
International Commission on electrical units and standards, 255
International Congress of Radiology and Ionization, (D.) 998
International Electrical Congress at St. Louis, 127
International electrical engineering standardization, 601
International Waterways Commission, 1020
Interrupter, Motor-driven mercury-jet, *959
Ions:
——Rate of recombination of ions in air, 887
——Recombination of, in gases. By Richardson, (D.) 315; Hendren, (D.) 953
Iron:
——Acids, Action of, on iron. By Burgess, (D. R.) 535, 703
——Exhaustion of the world's supply, 338
——Testing magnetic permeability of. By Edler, (D.) 449
——Testing magnetic properties of sheet iron, Germany, (D.) 316
—Zinc-plated iron, Resistance to rust. By Szirmay, (D.) 275
Irrigation, Cost of, by electrically driven pumps. By Wheeler (D.) 620
Isolated plants:
——Accumulators with reversible boosters for factory installations. By Birkett, (D.) 534
——Blackstone Mfg. Co., *649
——Boston, Post Office Square Building, 486
——Cost of energy for power in small engineering works, (D.) 533
——Department store in Munich. By Weil, (D.) 916
——Driving of reversing rolling mills, Ilgner electric system, (D.) *355, 742
——Engineering practice in small plants. By Hobart, (D. R.) 661
——Gas engine plant in drug store. By Howard, (D.) 661
——Gotham Hotel, New York, (D. R.) 917
——Individual vs. belt drive in electrically operated shops. By Bates, (D.) 146
——Ingersoll-Sergeant Drill Co., (D. R.) 68
——Lackawanna R. R. shops at Keyser Valley, (D.) 871
——Metallurgical plants. By Jansen, (D. R.) 742
——Natural Food Co., at Niagara Falls, *268
——Newspaper plant in Winnipeg, Canada, (D.) 952
——Powder mill, Electric drive in (D. R.) 356
——Repair shops, Direct-connected motors in, (D.) 356
——Robert Gair Co., Brooklyn. By Coleman, *833
——Rolling mills, Driving of, (D.) 274
——Spinning mills, Electric motors in, (D. R.) 356
——Stamp driving by electricity. By Heathen, (D.) 446
——Sturtevant, B. F., Co. By Knowlton, *576
——Textile mill driving. By Woodhouse (D.) 620
——Three-wire distribution in workshops. By Birkett, (D. R.) 356
——United Shoe Machinery Co. By Knowlton, (D. R.) 401
——Wanamaker power house, Phil., (D. R.) 232, 829
——Washington, Congressional Buildings, 819, 1003
——Willimantic mills of the American Thread Co. By Burnham, (D.) 534
Italian testimonial to the A. I. E. E., *764

J

Jacketing steam engines. By Mellandy, (D.) 447
Japanese mines, Electrical apparatus for, 957
Johnson & Morton, Utica, N. Y., 362
Joule-Thomson effect. By Kester, (D.) 703
Joyce Mfg. Co., of Columbia, Announcement of, 376
Jump spark coil, Construction of, (D. R.) 662
Junkersfeld, Peter, Biographical sketch of, *895
Jurymen, Isolation of, 86

K

Kansas Gas, Water, Electric Light and Street Railway Association, 722
Kellogg Switchboard & Supply Co., 362, 498
Kintner, S. M., Biographical sketch of, *262
"Kupron system" of plating, (D.) 917

L

Laboratory appliances in a Baltimore laboratory. By Keller, (D. R.) 493
Laboratory of the Institute of Technology at Dresden, (D. R.) 494
Lansingh, Van Rensselaer, *853
Lardner, H. A., Biographical sketch of, *342
Lead soldering. By Schoop, (D.) 148
League of American Municipalities, 377
Leakage coefficient of induction motors. By Pres 425, 443
Leakage indicator. By Raphael, (D. R.) 234
——English, (D.) *661
Leeds & Northrup Co., 539, 875
Legal decisions:
——Incandescent lamp litigation, 808
——Lamp cluster litigation, 763
——Telephone service, Restriction of right to, 10
Liege Mining Congress, Electricity at, 209
Light:
——Absorption of, by dust. By Lansingh, *623
——Photometry of non-symmetric sources of ligh By Bloch, (D.) *316
Lighting:
——Arc lighting in cities, 760
——Berlin, Public lighting of, 1108
——Christmas lighting, 1099
——Church lighting, Berlin, Germany, (D.) 659
——Cost of electric light and gas for street ligh ing, (D.) 828
——Croydon, Eng. Report on street lighting, (D 490
——Denver municipal plant, 937
——Detroit municipal statistics, 170, 257, 890
——Dirt vs. illumination, 205
——Domestic electric lighting. By Swinburne, (D.) 784
——Emergency system, Hochenegg, (D. R.) 446
——Fort Wayne series alternating-current system of arc lighting, *407
——Free lamp renewals, 720
——Government control in Great Britain, 253
——Illuminating engineering discussed by J. R. Cravath, 678, 680
——Illumination of rooms. By Meisel, (D. R.) 620
——Lamp efficiencies, 638
——Lighting and power from railway circuits, (D.) 232
——London street lighting, (D.) 401, 869
——Lowell, Mass., No electric bid entertained, 850
——Mass., Regulation of rates in. By Adams, 310, 348, 391, 442, 484
——Modern electric lighting, 334
——Milwaukee street lighting contract, 895
——New York proposed municipal plant, *48, 932, 978
——Newark, N. J., Municipal plant, 854
——Paris, Public lighting of, 1108
——Potsdam, N. Y., enjoined from establishing municipal plant, 932
——San Francisco developments, 376
——School room lighting. By Mueller, (D.) 532
——Store lighting in small towns, 1014
——Street lighting by incandescent lamps. By Howatt, (D. R.) 446
——Street lighting with Nernst lamps. B. Hoadley, (D.) 186; 498
——Tablecloth, Electric, (D.) *785
——Topeka Electric Co.'s campaign for new business, 905, 946
——Window-lighting, Advantages to central stations. By Roberts, (D. R.) 870
——(See also Train lighting.)
Lighting arguments, Some suggestive, 977
Lighting balancers, Regulation and compounding of. By Frankenfield, 1055, *1067
Lighting "units," 1013
Lightning:
——Lack of progress in the study of, 374
——Nature of, 806
——Protection from, Discussion at A. I. E. E., 807
Lightning arresters:
——Air-gap, Obtaining suitable length of, at low voltages. By Dina, (D.) *28
——American practice. By Neall, (D.) 68, 492
——Condenser, Use of, 53
——Experience of the Shawinigan Water & Power Co., *780
——Gola, *781
——Horn arrester and resistance, *780
——Mercury vapor, Cooper-Hewitt patents, *530
——New types. By Balois, (D. R.) 621
——Shaw non-arcing, 31; (D. R.) 998
Lightning Research Committee of Great Britain, Report of, 47
Lignite and peat for gas generators. By Zlaman, (D. R.) 620
Lincoln, P. M., Biographical sketch of, *811
Line disconnector, Safety, *875
Link-Belt Engineering Co., 319
Liquid air. By Pictet, (D.) 872
Live wire indicator, *876
Load factor. By Sinclair, (D.) 187
Locke Insulator Mfg. Co., 835
Lockers, Expanded metal, *920
Locomotives, Frahm speed measuring device, (D.) 534
Locomotives, Electric:
——Alternating-current locomotives on the New York and Stamford division. By Sprague, (D.) 916, 935
——London & North Western Ry., (D. R.) 039
——Metropolitan Ry., London, *236
——N. Y. C. R. R., Single-phase, 554, (D.) 829, 1104
——Siemens-Schuckert, *816
——Single-phase, at International Railway Congress. By Storer, (D. R.) 28
——Storage battery locomotives, *236, (D. R.) 1040
——Three-phase on the Valtellina road, *221
——Ward Leonard, in Switzerland, *50
——Westinghouse, *359
Loew Supply & Mfg. Co., 792
Loewenthal, Max., Biographical sketch of, *302
"Long-Arm" System Co., 496
Lubrication, Steam engine. By Strohm, (D. R.) 1039
Luminescence of Sidot blende. By Nichols and Merritt, (D.) 741
Lunkenheimer Co., 412, 790

* indicates illustrated articles.

M

McGeorge Mfg. Co., 576
McLeod, Ward & Co., 747
Magnet, Valve, Test of. By Nachod, *1071
Magnet windings. By Underhill, (D. R.) 1127
Magnet wire, Tests of. By Barrett, 272
Magnetic clutch, Holden, (D.) *762
Magnetic double refraction and rotation of liquids, 439
Magnetic effect of electric displacement. By Whitehead, (D.) *315, 510
Magnetic irreversibility of certain alloys, 889
Magnetic rotation of sodium vapor. By Wood and Springsteen, (D. R.) [illegible]
Magnetic separators:
——Ball & Norton, (D. R.) [illegible]
——Buchanan, (D. R.) [illegible]
Magnetism, Theory of. By Langevin, (D.) 953
Magnetite as a resistance material, 1022
Magnetization within wide limits of temperature. By Honda and Shimizu, (D.) [illegible], 1129
Magneto-optics of sodium vapor. By Wood, (D. R.) 315, 743
Management of industrial organizations. By Nichols, (D.) 277
Manaos Harbor, Amazon River, Electrical equipment of. By Seifert, *308
Marconi and Italy, 807
Marinette Gas Engine Co., 409
Massachusetts, Regulation of gas and electric rates in. By Adams, 310, 348, 391, 442, 484
Massachusetts Commission of Gas and Electricity. By Adams, 97, 1016, 1107
Massena, N. Y., Electric operations about, *6$9
Mather & Platt, Pumps, *240
Matthews, C. P., Biographical sketch of, *134
Matthews, W. N., & Bro., 748
Measuring:
——Alternating current, Measuring. By Price, (D.) 69
——High electrical pressure, Various devices for, discussed by S. M. Kintner, 46, 64, 229
——Low resistances, Measuring. By Wild, (D.) *315
——Magnetic field strength. By Paschen, (D. R.) 70
——Measurement of current by a quadrant electrometer. By Steward, (D.) 403
——Permeability of iron. By Thornton, (D.) 1085
——Radiation, Bolometer for. By Callendar, (D.) 29
——Small resistances, Measuring. By Hausrath, (D.) *403
——Thermo electric measurements of temperature. By Palmer, (D.) 316
——Three-phase power measurement without wattmeters, (D.) *276
Measuring and mixing machine, Automatic, *540
Measuring instruments:
——"Accelerometer," for use on vehicles. By Lanchester, (D.) 448
——Calculation of. By Janus, (D.) 109
——Dietze instrument for measuring alternating current in wire without cutting it. By Marxen, (D.) *440
——Handling of electrical instruments in relation to their accuracy. By Taylor, (D.) 357
——New electrical instrument. By Snyder and Herzberg, *278
Mechanical draft, Advantages of, 628
Mechanical stokers, Boilers and, 259
Megaphone, Flame. By Laudet and Beaumont, (D.) *449
Mercury arc lamp for ultra violet rays. By Axman, (D.) 231
Mercury-jet interrupter, Motor-driven, *650
Mercury vapor converter. By Thomas, (D. R.) 185
Mercury vapor lamps:
——Automatic starter for, *172
——Heraeus lamp. By Mareschal, (D.) *314
——Researches of Cooper Hewitt and his co-workers. By Lethuile, (D. R.) 1030
——Starter for, Lunt patent, *854
Metallic calcium. By Goodwin, (D. R.) 998
Meteorology and the dynamo. By Cromick, 177
Meter testing departments, Equipment of. By Gerhardi, (D. R.) 999
Meter-testing methods. By Cornwall, (D. R.) 403; Ellis, (D.) 872; Gerhardi, (D. R.) 872
Meters, Electric:
——Double tariff meters. By Gerhardi, (D. R.) 493
——Duncan patents, 208
——Fricker demand indicators. By Gerhardi, (D. R.) 622
——Hookham prepayment meter. By Gerhardi, (D. R.) 274
——"Isaria" alternating current meter, (D.) *276
——Maximum demand meters. By Gherardi, (D. R.) 493
——Merz. By Gerhardi, (D. R.) 622
——Mordey-Fricker meter. By Gherardi, (D. R.) 70, 274
——Motor meter, Direct current, (D.) *188
——Practical information on central station meters, 392
——Prepayment meters. By Gerhardi, (D. R.) 274, 449
——Rivers, Measuring the flow of water in, [illegible]
——Storage batteries, Meter for. By Reyval, (D.) 786
——Theory of phase meters. By Sumpner, (D.) 1041
——(See also Charging for electric current.)
Metric movement, 1099
Mica. By Zoller, (D.) 973
Micrometer, Electric, 224
Microphone, Majorana, (D.) 662
Miller, K. B., Biographical sketch of, *689
Milling machine, Motor-driven, *1045
Mineralite Co., 876
Miners' safety lamps, (D.) 711
Mines, Electric power in:
——Alternating current service. By Randolph, (D. R.) 696
——Cantor lectures. By Ravenshaw, (D.) 870, 951
——Gayley, James, Statement by, 169
——German collieries. By Brown, (D. R.) 68, 574
——Marble quarry work, 298
——Mesaba range, [illegible]
——Power station and winding engines. By Scholl, (D. R.) [illegible]
——Protection of workmen. By Walker, (D. R.) 703
——Reduction in operative costs. By Essen, (D.) 910
——South Africa. By Welsh, (D. R.) [illegible], Hammond, [illegible]
——Switchboard arrangement and wiring. By Mack, (D. R.) 228
Monophone. By Gaumont, (D.) *530
Morgan Crucible Co., 1044
Motor connections and their effects. By Gough, (D. R.) 187
Motor meters:
——Direct current, (D.) *188
——Mix and Genest meters, (D.) 316
——Steinmetz, [illegible]
Motor rating diagram. By Nachod, *481
Motor starter, New type, *486
Motor-testing equipment, Small motors. By Wels, 909
Motors, Electric:
——Auxiliary poles for single-phase motors, (D.) 915
——Braking of lifting motors, (D.) *490
——Calculation of three-phase induction motors. By Sumec, (D. R.) 490
——Circular current diagram for the polyphase induction motor. By Rosskoff, (D. R.) 67
——"Commercial" induction motors, *320
——Compensated repulsion motor. By Reyval, (D.) *573; Bethenod, (D. R.) 915
——Compensated single phase shunt motor. By Bethenod, (D.) 67
——Compensating armature reaction. By Brown, (D. R.) 25
——Control apparatus for direct-current motors. By Mather, (D. R.) 69
——Core losses in induction. By Hellmun, *1071
——Design of induction, 65
——Dimensions of single-phase commutator motors. By Bethenod, (D.) 950
——Direct-current, Various applications of. By Dubois, (D.) 313, 951
——Direct-current traction, Oerlikon, (D.) *1039
——Erecting a large motor. By Burns, 487
——Evolution of. By Tischendoerfer, (D.) 532
——Fields vs. armatures nearest trolley. By Andrews, (D. R.) 147
——1500 volt direct-current traction motor. By Rikli Kohlstadt, (D.) *783
——Handling of direct current motors. By Viall, (D. R.) 146
——Heyland diagram for induction, Practical application of. By Way, *1060
——Induction, Locked saturation test of. By Workman, (D. R.) 185
——Induction motor and the effect of variation in the supply circuit. By Welsh, (D.) *572
——Induction motor as generator at Johannesburg. By Butt, (D. R.) 403
——Induction motors with short circuited and with wound rotors. By Churton, (D.) 869
——Induction motors for traction, 888
——Installation and care of railway. By Schoepf, (D. R.) 907
——Iron losses in induction. By Bragstad, (D.) 67
——Jigouzo induction motor for operating bridges, lifts, etc., 209
——Lamme alternating current motor used on direct-current circuits, *134
——Leakage coefficient of induction motors. By Press, 425, 443
——Lundell single phase, (D.) *313
——Magnetic pull. By Niethammer, (D. R.) 231
——Measuring the power of induction motors. By Babcock, 869
——Milch repulsion induction motor, *173
——Polyphase motors on single phase circuits. By Goreleon, (D.) *576
——Power factor in induction motors. By Averrett, 278
——Regenerative control of tramway motors, (D.) 356
——Shunt wound traction motors. By Johnston, (D.) 1182
——Siemens induction motors, (D.) *1037
——Single phase commutator. By Richter, Sumec, Pichelmayer, Niethammer, Eichberg, (D.) [illegible]
——Single phase elevator motor of the "reactance [illegible]," (D.) 1038
——Single phase induction designed by Heyland. By Reyval, (D.) 607
——Single phase motor with large torque. By Zeeberach, (D.) 277
——Single phase motors for commercial purposes. By [illegible], (D.) 620
——[illegible] traction, Brown Boveri & Co., (D.) [illegible]
——Single phase induction motors, Measuring. By Churton, (D.) 331; [illegible], (D.) *[illegible]; Sumec, (D. R.) 67
——Single phase commutator motors. By Heer, [illegible] (D. R.) [illegible]
——Single phase induction motors, Theory of. By Hoeroldes, (D.) 1117
——Small direct current motors. By Coleman, (D. R.) 1127
——[illegible] induction motors. By Lewis, (D.) 187
——[illegible]. By [illegible], (D.) [illegible], *[illegible]
Motors, Electric: (Continued).
——Testing synchronous motors. By Rows, (D. R.) 449
——Tests of induction. By Workman, (D. R.) 67
——Three-phase motors operated from single phase mains. By Dalemont, (D.) *914
——Variable speed alternating current motors in industrial service. By Ionides, (D.) 26
——Variable speed alternating current exhibited by the Societe Alsacienne. By Reyval, (D.) 656
——Vector diagram for induction motors. By Specht, 1126
——Vertical pump motors, *1132
——Westinghouse, *193, *530
——Winter Eichberg, Theory of. By Fleischmann, (D. R.) 446
——Worm gear traction motors, 564
Multiple coil windings, Design of. By Underhill, *[illegible]
Municipal indebtedness in the United States, 51
Municipal ownership:
——Australia, 378
——Boston Edison Co. fights municipal ownership, 345
——Brooklyn plant report, 1017
——Chicago, 93, 853
——Chicago's Civic Federation against, 10
——Electric lighting at Detroit, 170, 257, 890
——Freiburg, Germany, 266
——Great Britain, 253, 294, 970
——Greenfield, Ind., 93
——Indiana code, 602
——Vs. private ownership. By Hale, 1116
Municipal ownership investigation in United States and in Europe, 256, 641, 894, 929
Municipal Ownership University, Chicago, 210
Murdt, C. L. de, Sketch of, *1061

N

Nantucket lightship saved by wireless telegraphy, 1064
National Association of Electrical Contractors, Boston Electrical Exposition, 9, 88, 128, *140, 169
National Carbon Co., 580, 709
National Conference on Standard Electrical Rules, 976
National Electric Co., 623
National Electrical Code, Suggested changes, 932, 1017
National Electrical Trades Association, Convention, 6
National Interstate Telephone Association, Convention, 4, 32
National Reciprocity Convention, 377
National Underwriters' Electric Association, 1017
Natural gas under steam boilers, 977
Natural gas production, Value of, 259
Necapa, Mexico, transmission plant, 719, *729
Negative corpuscles from alkali metals. By Thomson, (D.) 953
Nernst lamps:
——Absorption by lamp globes. By Solomon, (D.) 915
——Inter relation of ballast and glower. By Serven, 294, *305
——Street lighting with. By Hoadley, (D.) 186
——Use of, in store, *410
Nevada Power, Light & Water Co., 377
New England Independent Telephone Association, 851
New York an engineering center, 1090
New York Commission of Gas and Electricity. By Adams, 97; 808
New York Edison Co.:
——Instruction of station employees, 605
——New plant, 153
——Reduction of rates, 254
——"Welfare work," 566
New York Electrical Exhibition, 955, 1021, *1087
New York Lighting Commission, 12, 171, 253, [illegible]
New York Magnetic Club, 801
New York State Independent Telephone Association, 5
New York State Street Railway Association, Convention, 9
Niagara Falls:
——Electrochemical industries of. By Fitz Gerald, (D.) 108
——Power and preservation of Niagara, 1108
——(See also Transmission plants.)
Niles Bement Pond Co., 32, 195
Nitric acid:
——Electric production of. By Carveth and Rond, (D.) 576
——Production from air by means of electric discharges. By Scheuer, (D.) 953
Nobel prizes, 1062

O

Ohio Electric Light Association, [illegible], 332, 35[illegible], 360, 373
Ohio Mechanical, Electrical and Steam Engineers, 933
Oil filter, Burt "unit type," 709
Oil fuel:
——Electric power in California, (D. R.) 626; (D.) 616
——Power plants and oil fuel, (D.) 401
——United R. R. of San Francisco. By Chamberlon, (D.) 232
Old Time Telegraphers' and Historical Association, 339, 428
Omnibuses vs. electric tram cars. By Huntley, (D.) 357
Ontario Power Co., Hydro-electric developments of, 91, *343, *387, *440
Open shop, The, [illegible]
"Open Shop" Electrical Contractors' Associati[illegible] of Boston, 723
Ore unloader, Hulett automatic, *230, *405
Organ blower, Electric, *961
Oscillator, Stationary electric. By Grimsehl me[illegible] 34[illegible]
.rkett,
' 492

[illegible] illustrated article.

Oscillograph:
——Cathode ray. By Rankin, (D. R.) 743
——Glow-light. By Gehrcke, (D.) 743
——Siemens & Halske. By Hornauer, (D. R.) 316
Osmium lamp, *390
——Tests in Vienna, (D.) 574
Osmotic experiments on mixtures of alcohol and water. By Barlow, (D.) 276
Outlet box, Fullman water-tight, *155
Outlook for 1906, 929
Overhead vs. underground central station circuits discussed by H. B. Gear, 650
Ozone:
——Production and utilization of. By Ewell, 266
——Production from oxygen. By Fischer and Braehmer, (D.) 621

P

Packings, Metallic, on steam engines. By Strohm, (D. R.) 702
Painting feed wires on poles, *960
Panel, Universal direct-connection, *362
Panel-board, Crescent three wire, *499
Patent law situation. By Gutmann, 355, 559, 849, 864, 894, 1126; Johnston, 1056, 1080
Patents:
——American, in Germany, 475, 805, 809, 892; By Magee, 913.
——Report of U. S. Patent Office, 514
Pawling & Harnischfeger, 497
Peat as a fuel. By Stillings, (D. R.) 916; Collins, (D. R.) 910
Pennsylvania Independent Telephone Association, 909
Permeability of iron, Measuring. By Thornton, (D.) 1085
Peru Electric Mfg. Co., 458
Petrol motor, (D.) 1039
Phantoplex, Jones, *458
Phase regulator, A proposed, and its applications. By Watmough, Jr., *691
Photographs, Transmission of. By Will, (D.) 29
Photometer rooms, White walls for. By Hyde, (D.) *1084
Photometers:
——Ulbricht spherical, Theory and practice of. By Bloch, (D.) 1083, 1100
——Street photometer. By Bloch, (D.) *1084
——Watt-photometer exhibited at the Olympia Exposition in London, 760, (D.) *786
Photometric lamps. By Wild and Fleming, (D.) 357
Photometry:
——Mean spherical and mean horizontal candlepower. By Fleming, (D.) 533; Hyde, (D. R.) 575
——Non-symmetric sources of light. By Bloch, (D.) *316
Piano player, Electrical. By Lyon, *744
Pipe flanges, Welded, for steel pipes, 747
Pipe thawing apparatus, Electric, *1045
Piston rod packing. By Strohm, (D.R.) 574
Pittsburg Transformer Co., 1132
Plating, "Kupron" system of, (D.) 917
Platinum:
——Positive leak from hot. By Richardson, (D.) 188
——Production and use of, 724
Platinum contact, New. By Gildemeister and Weiss, (D.) *149
Plotting saturation curves. By Gray, *397
Plug, Weather-proof socket, *580
Plunger electromagnet. By Underhill, 25
Point discharges in pure gases. By Ewers, (D.) 831
Polarization of cadmium cells. By Ramsay, (D. R.) 403
Pole lines:
——Consolidation of, at Los Angeles, [illegible]
——Steel tower line, 1086
Poles:
——Cement foundation for wooden. By Herzog, (D.) [illegible]
——Preservation of, 210.
——Reinforced concrete, (D. R.) 871
Porcelain electrical supplies, Statistics, 336
Portland, General Electric at, *705
Portland Exposition, An engineering congress at, [illegible]
Pot head for high tension circuits, *793
Potential differences, Billitzer's method for determining absolute. By Goodwin and Sosman, (D.) 575
Potential regulation based on the differential resistance behavior of carbon and tantalum lamps. By Kennelly and Whiting, 2, *20
Powder mill, Electric drive in, (D. R.) 356
Printing telegraph apparatus. By Guarini, (D.) [illegible]
Projection apparatus, new German electric. By Smith, [illegible]
Pulsometer Engineering Co. Water softener, [illegible]
Pumping plants:
——Electric, Hawaii, [illegible]
——Recommendations against an electrically-driven, at Buffalo, (D.) [illegible]
Pumps:
——Boiler feed pump, Automatic. By Schmidt, (D. R.) 553
——Centrifugal, Brooks, *241
——Electric centrifugal for elevator service in Kansas City, (D.) 68
——Electric high-pressure turbine pump in English colliery, (D. R.) 27
——Electrically-driven. Allg. Elek.-Ges., [illegible]
——Revolving mercury air pump. By Gaede, (D. R.) 1031
——Sinking pump, Electric, *240
——Water high-pressure centrifugal. By Herzog, (D. R.) [illegible]
——[illegible], Construction and tests. By Mueller, (D. R.) 951
Push button, "Noscru" Midget, *790
Pyrometry, Optical. By Waidner and Burgess, (D.) 535
Pyrrhotine, Magnetic properties, (D.) 148

Q

Quadrant electrometer for measuring current. By Stewart, (D. R.) 704

R

Radiations given off in an alternating condenser field. By Sanford, (D.) 1040
Radioactivty:
——Methods of testing radioactive substances, (D. R.) 403
——New radioactive element. By Hahn, (D.) 69
——Radioactive matter in the atmosphere, 375
——Radioactive water, 896
——Some phases of radiomania, 166
Radiology, International Congress of, (D.) 998
Radium:
——Alpha particles of radium. By Bragg and Kleeman, (D.) 660
——Burke's radiobes, 12, 52
——Cancer and radium rays. By Rehns and Salmon, (D.) 449
——Darwin on, 298
——Emission of negative electricity. By Slater, (D.) 743
——Excited activity. By Makower and Jackson, (D.) 998
——Investigation of the charge carried by the alpha and beta rays. By Rutherford, (D.) 315; 470
——New phenomena. By Petri, (D.) 108
——Origin of life and radium, 469
——Production from uranium. By Soddy, (D.) 28; Boltwood, (D.) 575
——Radium and uranium in minerals. By Rutherford and Boltwood, (D.) 534
Rail bonds, Wood testing method, *726
Rail joints, Measuring the resistance of. By Soulier, (D.) *660
Rails, Corrugation of tramway, (D.) *574
Railway accidents due to live rail, British law. By Ball, 523
Railway construction electric plant, (D.) 534
Railways, Electric:
——Alternating-current railway situation, 600
——Atlanta-Marietta single-phase, *494
——Atlantic City-Philadelphia line, 1102
——Austria, Statistics, (D. R.) 402
——Belfast municipal tramways, (D.) 1128
——Belgium, Single-phase traction in, 94; By Dietl, (D.) 401; 701, 995; Latour, *1126
——Boston, compared with those of Glasgow, 7
——Brooklyn Rapid Transit:
    Annual report, 474
    Power plant, *519
——Buenos Ayres underground roads, 934
——Calcutta, India, (D. R.) 28, 402
——Chicago municipal railway system, 429
——Comparison of electric traction systems, 851
——Cuba, Double trolleys, 45, 73; By Billings, 230
——Diagrams of railway pasenger travel. By Badger, *220
——Direct-current operation, New and higher standard of. By Sprague, 1058
——Double trolley in Cuba, 45, 73; by Billings, 230
——England:
    Erith system, (D. R.) 574
    Law on live rail accidents. By Ball, 523
    Mileage, 272
——Finances and trolleys, 475
——Germany:
    Berlin projects, (D.) *916
    Berlin-Zossen experiments, (D. R.) 534, 829, 1040
    Development. By Haas, (D.) 147
    Mileage, 272
    Seebach-Wettingen road, Alternating-current traction. By Herzog, (D. R.) 356, [illegible]
    Single-phase road from Murnau to Ober-Ammergau. By Ehnhart, (D.) 447
    Single-phase traction. By Schimpff, (D.) 107
    Three-wire system between Tabor and Bechyne, (D.) *871
    Vienna to Pressbing, Three-phase road, (D.) 491
——Glasgow, compared with those of Boston, 7
——Hartford-Worcester trolley, 212
——Hastings, England, (D.) 785; 955
——Heavy electric railroading. By Valatin, *860
——Holland, Development in, 642
——Hungary:
    Combined electric and steam traction, (D.) 997
    Statistics, (D. R.) 402
——Indianapolis-Rushville line, single-phase, 525
——Italy, Valtellina Ry., Three-phase traction. By Osorhati, (D.) 417, 716
——Labor-saving and safety devices on tramways, (D.) 68
——London:
    Pasenger traffic problem, 300
    Report of Royal Commission, (D. R.) 336
——Long Island R. R. electric system, *774
——Lyon, France, Series direct-current system, (D.) [illegible]
——Mail and express transportation at high speed, Paris, (D.) 574
——Mersey Ry. Financial aspects. By Barker, (D.) 233
——Mountain railway Jungfrau. By Regelsperger, (D.) [illegible]
——Mountain railway to the top of the Zugspitze. By Mueller, (D.) [illegible]
——Multiple unit system, [illegible]
——Municipal trolleys in Glasgow and private ownership in Boston, 7

Railways, Electric: (Continued).
——New York subway:
    Battery to the Bronx, 85
    Development in suburbs, 380
    "Frenzied thermodynamics," 3
    Harlem River tunnel, 93
    High temperature, 94; (D.) 27; 171
    Regenerative control proposed, (D.) 871
    Stillwell on the Tesla criticisms of the subway, 6
    Ventilation of subway, 94; (D.) 27; 171
    Year's figures, 762
——New York traction interests consolidated, 1102
——Paris:
    Single-phase traction. By Reyval, (D.) *106
    Single-phase traction on the Malakoff line. By Montpellier, (D. R.) 447
——Philadelphia subway, 1058
——Philadelphia systems, (D. R.) 621
——Philippines. By Lauser, (D.) 660
    Manila, P. I., *397
——Pontiac-Odell single-phase line, 526
——Port Chester R. R., 1060
——Rail-less traction system. By Schiemann, (D.) 233
——Retardation tests. By Saguno Tanabe, (D.) 534
——San Jose & Los Gatos Interurban Ry., (D. R.) 402
——Schenectady-Ballston line in practical operation, *524
——Scotland, at Leith, 1086
——Single phase:
    American railways, *524
    Discussion of papers by Scott and Potter, 604, 617
    European railways, 677, *696
    Paris, Latour motors. By Gratzmuller, (D.) 146
    Place of. By R. B. Tenney, Jr., 782
    Progress of, 45, 145; By Scott (D.) 146; 168; De Muralt, 312
    Roma-Civita Castellana line, Italy. By Kerbaber (D.) *27
    Swedish Government experiments, *815
——Single-phase and direct current systems for heavy traction, Parshall's views, (D.) *907
——Single-phase car control. By Jackson (D.) *533
——Spokane single-phase railway, 666
——Statistics of street railway development, 296
——Surface contact systems in England, (D.) 1030
——Suspended railway proposed for Berlin, (D.) 916
——Swedish Government electric traction experiments. By Westerberg, 805, *815; Dahlander, 1120
——Switzerland:
    1500-volt direct-current traction. By Rikli-Tehlstadt, (D.) 785
    Gruyeres, Line of. By Guarini, (D. R.) 1128
    Narow-gauge line. By Semach, (D. R.) 447
    Ward Leonard system in, 50; (D.) 401
——Third rail on N. Y. Central electric traction system, *396, (D. R.) 492
——Third-rail insulation resistance of third rail, Berlin, (D.) 491
——Third rail insulator of Monte-Callar, (D.) *1052
——Three-phase, First Ganz, in America, 979
——Three-phase traction, Discussion at Asheville meeting, [illegible]
——Three-phase traction on the Valtellina Road, *221
——Three-phase vs. direct-current traction for trunk railroads. By Kromozay, (D.) [illegible]
——Three-wire system, Nurnberg-Furth, 610
——Three-wire system in Germany, (D.) *871
——Tractional Co.—around the Great Lakes, 339
——Unit of acceleration. By Mailloux, (D. R.) 916
——U. S. Street and elevated railway statistics, (D.) 314
——Vienna, High tension direct current traction in. By [illegible] Rattay, (D.) 829
——Ward Leonard system in Switzerland, [illegible], (D.) [illegible]
——Warren & Jamestown alternating current system, 788
——Westinghouse single-phase traction system, Tests of. By Bright, (D.) [illegible]
——Yellowstone Park trolley suggested, 514
Railways, Steam, Statistics of American, 337, 765
Railways, Steam, Electric traction:
——Discussion by William McClellan, 128
——Erie, Plans, [illegible]
——Financial aspect of the Mersey Ry. By Barker, (D.) 233
——Long Island R. R., 477, *774, 1015, [illegible]
——New York Central:
    Electrical equipment, 1103
    Power houses, [illegible]
    Type of third rail, *396
    Weehawken, N. J. plant, (D.) [illegible]
——N. Y. C. New Haven electric traction situation, 677; By Sprague, 682; Townley, Bell, Boynton, 810, (D.) 829; (D. R.) 997
——N. Y., N. H. & H. R. R., 722, [illegible]
——West Shore R. R., 404
Rateau steam regenerator system, *451
Reactance E. M. F. and the design of commutating machines. By Adams, 346
Reading errors of indicating instruments. By Brackett, (D.) [illegible]
Recorder, Electric spark. By Springer, [illegible]
Recording instruments, Du Vivier electrical, *411
Rectifiers:
——Alternating current, Robertson, [illegible]
——Alternating current at Liege Exposition. By Corsepius, (D.) *827; 1057, *1072
——Aluminium, Efficiency of. By Peters and

* indicates illustrated articles.

Rectifiers, [illegible]
Jones, (D. R.) [illegible]
——Theory of [illegible]
Reflectors, [illegible] and [illegible] *[illegible]
——(See also Globes.)
Refrigerating plant, [illegible] (D. R.) 1128
Refrigeration, Central station current for, 599, 606
Refrigeration [illegible]
Refuse destruction plant of Fiume, Germany, (D.) [illegible]
Refuse destructor plant for [illegible] in New York City, *[illegible]
Refuse destructors, [illegible] and their by-products. By Watson, (D.) 1127
Regulators:
——Chapman automatic voltage regulator, (D.) *907
——Single-phase induction regulator. By Bergman, *56
——Thury automatic [illegible]
Reinforced concrete. By Noaillon, (D. R.) 234
[illegible] Order of, [illegible]
Resistances:
——Metallic resistance at high frequencies. By Broca and Turchini, (D.) [illegible]
——Variation of electrical resistance in the contact of carbon and metal [illegible]. By [illegible]
Reverse power relay at [illegible] Exposition, (D.) 871
Rheostats:
——Automatic starting with liquid resistance, (D.) 703
——Determination of [illegible] shunt [illegible], (D.) *1128
——Water rheostat. By [illegible], (D. R.) 662
Robert Gair Co.'s electrical equipment, *833
Roberts, H. C., Electric Supply Co., [illegible]
Roentgen rays, Velocity of. By Marx, (D.) 871
Roller bearings. By How, (D.) 702; (D.) 952
Roller bearings for electric cars, 818
Rolling mills, Electric driving of:
——Discussion by [illegible], (D. R.) [illegible]
——German mills, (D.) [illegible]
Rontgen Congress, International, (D. R.) 71
Royal Society Conversazione, (D.) [illegible]
Russo-Japanese Peace Conference, Telegraph and telephone arrangements, 256, 340

S

St. Louis independent telephone situation, 168
Sangamo Electric Co., 956
Sarco Co., 283, 790, 835
Saturation expressed in per cent. By Baker, 1014, 1037
Scientific Alliance of New York, 558
Screening effect, Electro-magnetic, of metallic inductors. By Kunito Ogawa, (D. R.) 575
Selenium, Resistance of. By Coste, (D.) 1129
Self-induction, Determining the coefficient of. By Penkert, (D.) *743; Zipp and Penkert, (D.) 1085
Sewage disposal and electricity in England, *1025
Shades. (See Reflectors.)
Sheerin, S. P., Resolutions on death of, 10
Shop system for electrical contractors. By Auerbacher, (D. R.) 662
Short circuits between armature coils, Locating. By Gilliam, (D.) *532
Side discharge of electricity, comparison of condensers. By Trowbridge, (D.) *534
Signal Service annual report, 919
Signals, Deep sea, 93
Signals and signaling:
——Cape Colony railways. By Hamilton, (D. R.) 702
——Grassman's block system for single-track railroads. By Kohlfuerst, (D. R.) 997
——Gt. Northern & City Ry., (D.) 871
——Interlocking machine, Description of the. By Scott, (D. R.) 449
——Locomotive cab electric signal, *213
——Midland Ry., (D. R.) 23
——Primary batteries for operating, 961
Signs:
——Day and night, [illegible]
——Legibility of electric, 334
Silicon alloys. By Albro, (D.) 1083
Sine or cosine diagram, *950
Single-phase induction regulator. By Bergman, *56
Slide rule for wire table. By Sakai, (D. R.) 742
Slip of induction motors, Measuring. By Drysdale, (D.) *403; Stan[illegible], (D. R.) [illegible]
Smith, H. B., Biographical sketch of, *608
Smith Storage Battery Co., 412
Sodium vapor. By Wood, (D.) 917
Soldering, Lead. By Schoop, (D.) 148
Solenoids, Relation of pull to diameter of. By Underhill, *615
Solvay Process Co., 540
South Africa:
——Electrical development in, 977
——Power transmission possibilities, 6, 480
Southern water powers, Electricity from, 429
Spark coils, Efficiency of. By Carpenter, [illegible]
Spark gap discharge detector, *1116
Spark gaps. By J. F. King, [illegible]
Spark length and E. M. F. By H[illegible], (D.) 1129
Sparking:
——Prevention of, in alternating current commutator motors, (D.) *[illegible]
——Sparking at commutators, (D.) [illegible]
Specific heats. By Richards, (D. R.) [illegible]; Holborn and Austin, (D. R.) 743
Specific inductive capacity of metals. By Broca, (D.) [illegible]
Spectrum, Energy of visible. By Nichols, (D. R.) [illegible]
Speed indicator, Vulcan, (D.) [illegible]
Speed-time curves for automobile motors, 693
Sprague, F. J., on the New York Central—New Haven electric traction [illegible]
Stamp mills:
——[illegible]. By W[illegible], (D. R.) [illegible]
——[illegible] South Africa [illegible], (D.) [illegible]
[illegible], (D.) [illegible]
[illegible]elain Co., 876
[illegible]
[illegible] Rateau, *[illegible]
[illegible]
[illegible], (D. R.) [illegible]
[illegible], *[illegible]
[illegible]
——[illegible], *[illegible], *[illegible]
——[illegible]. By [illegible], (D. R.) [illegible]
——[illegible], *[illegible]
——[illegible]
——[illegible] Rapid Transit Co., 1060
——[illegible]
——[illegible], (D. R.) [illegible]
——[illegible], (D.) [illegible]
——[illegible]. By M[illegible], (D. R.) [illegible]
——[illegible]. By [illegible], (D. R.) [illegible]
——[illegible]
——[illegible] West Virginia Pulp & Paper Co. By [illegible], (D.) [illegible]
——[illegible], (D. R.) [illegible]
——[illegible], *[illegible]
[illegible]
——[illegible], (D. R.) [illegible]
——[illegible], [illegible]
[illegible]
——[illegible]. By [illegible], (D. R.) [illegible]
——Improved [illegible], (D. R.) [illegible]
Stone, John S., [illegible], *[illegible]
Storage batteries:
——Aluminum, Action of, on electrolyte of batteries. By [illegible], (D.) [illegible]
——D'Arsonval-Fulmen, *[illegible]
——Edison battery, [illegible]. By Schoop, (D.) 448
——Grand and [illegible] lead storage [illegible], (D.) 998
——Lead antimony alloys for [illegible]. By Rosset, (D. R.) [illegible]
——Manufacture. By Reyval, (D.) 886
——Patents, [illegible]
——Traction accumulator. By Rosset, (D. R.) 448
——Tray type, *[illegible]
——Ziegenberg lead zinc. By Gradenwitz, (D. R.) 104
Stove, Electric cooking, Thomson patent, 301
Stow Mfg. Co., [illegible]
Streams, Horse-power value of. By Church, (D. R.) 146
Sturtevant, B. F. Co.:
——Generating unit, *[illegible]
——Works, Electrical equipment of. By Knowlton, *576
Submarine boats, Early book on, 572
Sub-stations:
——Acton station, Linden, (D. R.) 357
——Converter sub-stations, [illegible]
——London, Metropolitan Electric Supply Co., (D. R.) 785
——Portable station. By Hewett, (D.) 147
——Portable, Seabrook Beach, N. H., (D. R.) 448
——Stations erected by the Felten and Guilleaume Lahmeyer Works. By Collischonn, (D.) 661
——Waterbury, Conn., (D.) 26
Subway. (See Railways, Electric, New York.)
Surges, High-potential, in electrical distribution systems of great magnitude, 64
Surging in alternating systems, [illegible]
Swedish Electrical Engineers, Congress of. By W[illegible], [illegible]
Swiss Electrical Society, (D.) 873
Switchboards:
——Barriers in alternating current switchboards, [illegible]
——Design of hand-controlled, high-tension switchboards. By Peck, (D. R.) 357
——Improvements in details. By Edwards, *318
——Mission of. By Howard, (D. R.) 1130
Switchgear, Oil bath. By Pumphrey, (D.) [illegible]
Switches:
——Electrically controlled oil switches, *[illegible]
——Hughes & Young, switch for railways, *74
——Operation of high-tension switches. By [illegible], (D. R.) [illegible]
——Sarco pendant switch, *283
Synchronizing system, Ribbe patent, *342

T

[illegible] Electric, (D.) *785
[illegible] & Budenberg, *75
Tantalum lamps:
——Alternating currents, Use on. By Zingler, (D.) [illegible]
——[illegible] investigation. By Wedding, (D.) [illegible]
——[illegible] based on the different [illegible] of carbon and tantalum lamps. By Kennelly and Whiting, [illegible]
——Tests. By [illegible]
Tar burning in gas and electric plants. By Field, [illegible]
[illegible]
[illegible]
——[illegible], *[illegible]
——[illegible]tain, Statistics, 337
——[illegible], *[illegible]
——[illegible] telegraph [illegible], *[illegible]
——[illegible] Australia, [illegible]
——[illegible], *[illegible]
——[illegible]graphic telegraphy, 768
Telegraphy—Continued.
——Printing telegraph apparatus. By Guarini, (D.) *[illegible]
——Protection of apparatus, (D.) 189
——Speed of different telegraph systems. By [illegible], (D.) 699
——Wireless, [illegible] transmission of. By English, (D.) [illegible]
——(See also Wireless Telegraphy.)
Telephone companies, Independent:
——[illegible] in large cities, 602
——New York, Struggle for independence, 603, [illegible]
——[illegible] Independent Telephone Co., 640
Telephone [illegible], *312
Telephone [illegible]
Telephone [illegible], *1070
Telephone [illegible] lamp, (D.) [illegible]
Telephone exchanges:
——[illegible]. By Knowlton, (D. R.) 623
——Terminal and distribution boards. By Abbott, *[illegible]
——Transfer systems and the multiple board. By Abbott, *[illegible], *[illegible]
Telephone [illegible], hanging, *618
Telephone lines, [illegible], and their [illegible] the country, 515
Telephone patents, *[illegible], 63, 144, *184, *311, *399, [illegible], *618, 658, *739, 782, [illegible], *1079
Telephone receiver, Murdock, *739
Telephone repeaters, Shreeve patents, *[illegible]
Telephone ringers:
——Campbell combined ringer and generator, *399
——Kellogg, *[illegible]
Telephone speech curves, (D.) *999
Telephone switchboards:
——Cedergren circuit, *1070
——Webster circuits, *312
Telephone transmitter head fastening, *618
Telephone transmitters:
——Harkness, *184
——Snyder, *[illegible]
Telephones:
——Automatic intercommunicating, *404
——Automatic switchless, *874
——Kellogg desk telephone, *498
——McBerty protective apparatus, *739
Telephony:
——Advance of the rural telephone, 297
——Army and navy maneuvres, Use of telephone in. By E. K. Roberts, *773
——British telephone agreement, 376
——Central battery system in Austrian exchanges. By Mueller, (D. R.) 277
——Central battery system of Wuerzberg, Bavaria. By Jacobs, (D. R.) 576
——Coherer in telephony. By Steadle, (D. R.) 316
——Combined telephony and telegraphy, *102
——Distinctness of telephone sounds. By Wiersch, (D.) 786
——Election returns by telephone in Philadelphia, *852
——Electrolytic rectifiers for telephone stations, (D.) 954
——Great Britain, Statistics, 337
——Kitsee transmission system, *949
——Land exchange system, *185
——Leich selective system, *570
——London's telephones. By Stanton, 995
——Long-distance experiments from Rome to London, (D.) 662
——M'Berty exchange system and selective call signal, *311
——Mexico, Development in, 80, 376
——Miller circuit system, *399
——New York City, Service and rates, 208, 254
——Protection of apparatus, 189
——Secret telephony. By Thompson, *831
——Transmitter tests, High power, Adams-Randall. By Maver, Jr., 45[illegible]
——Turchi composite system, *950
——Voice overtones, or harmonics, as affecting long-distance telephone transmission. By Therrell, *818
——Webster exchange system, *868
——Wireless telephony, Orling-Armstrong system. By Collins, *1122
——Wires on power transmission lines. By Apsler, (D.) *622
Telluric currents. By Guarini, (D. R.) 955
Temperature, Thermo-electric measurements of. By Palmer, (D.) 316
Temperature curves of field coils. By Glazebrook, (D.) [illegible]
Temperature effects in spans. By Nachod, 988
Temperature rises, Calculating, with a slide rule. By Walker, (D.) [illegible]
Temperatures, Thermochemistry of high. By Richards, (D.) 188
Terminal and distribution boards in telephone exchanges. By Abbott, *140
Tesla on the Peary North Pole expedition, 130
Test set, Portable, for installing telephone cables. By Cory, *1001
Testing, Laboratory, Alternating current. By Ross, (D. R.) 403
[illegible]ion, Apparatus for, 2
[illegible], Electrical equipment of, *778
[illegible], [illegible] of, [illegible]
[illegible], Temperature and efficiency of. By [illegible], (D.) [illegible]
[illegible], Temperature and E. M. F. in. By Palmer, (D.) *18
[illegible], Vacuum. By Schaefer, (D.) *60
[illegible]. By Schmitz, (D. R.) [illegible]
"[illegible] eye," 302
[illegible] of Monte C[illegible], (D.) *952
[illegible] measurement without watt meters, (D.) *[illegible]
[illegible]. By Bi[illegible]kett, (D. R.) [illegible]
[illegible]. By S[illegible], (D. R.) [illegible]
[illegible]. By [illegible], (D. R.) 402

[illegible] article

Tin, Electrolytic recovery of, (D. R.) 440
Titanium. By Goldschmidt, (D. R.) 70
Tool post, Portable, *957
Towers on Niagara-Toronto transmission line, *14, *54
Towing, Electric, a "proportional adherence tractor," *805
Traffic in great cities, 293
Train dispatching, First telegraphic, 934
Train lighting:
——Car lighting hints. By Tweedy, (D.) 533
——Dynamo and storage battery system. By Dick, (D.) 1039
——Leitner-Lucas system, (D. R.) 355
——L'Hoest Pieper system, *945
Transformers:
——Arrangement of, for testing purposes. By McCarty, (D.) *1041
——Calculation of. By Pohl and Bohle, (D.) 701
——Insulation tests. By Nesbit, (D.) *402
——New York Central R. R. contract, 337
——No load loss, Avoiding. By Schmidt, (D. R.) 952
——Static disturbances in. By Kintner, (D.) 28
——Tesla, Formulas for the rational construction of. By Drude, (D. R.) 357
——Testing central station transformers. By Nesbit, (D.) *402
——Tests. By Druebert, (D. R.) 909, 1127
——Thawing transformers, *1132
——Voltage drop, Graphical method of determining. By Haknamann, (D. R.) 355
——Wave shapes in three-phase transformers. By Clinker, (D.) 950
——Westinghouse core-type, *406
Transmission lines:
——Ayrton's plea for direct-current transmission, 679
——Belt transmission of power as an analogue of electric transmission. By B. B. Brackett, 974, 986
——Composite transmission. By Bruell, (D.) *1127
——Direct-current for power transmission. By Ayrton, (D.) 659
——Favorable conditions for the transmission of energy. By Sarrat, (D.) 871
——Hartford, Conn., Electrical supply in, *689
——High-voltage power transmission. By Fowler, (D. R.) 533
——Historical review of power transmission. By Esson, (D.) 784
——Lewiston-Clarkston system. By Ransom, (D.) 951
——Load loss, Variable. By Ashe, (D.) 146
——Long-distance power transmission by direct current. By Sprague, 1101, 1117
——Losses in an electric transmission, 259
——Niagara Falls to Toronto, *14, *54, 469, *479
——Ontario Power Co., *440
——Protective apparatus. By Neall, (D. R.) 742
——Puyallup River, Wash. By Vaughan, (D. R.) 187
——Regulation and efficiency of. By Pender, 18
——Safety devices, (D.) *68
——Single-phase and direct-current transmission, 848
——Single-phase vs. polyphase lines. By Watson (D.) 741
——Size of transmission circuits, A method for determining. By Stone, 271
——South Africa, Possibilities in, 6, 489
——Surges of transmission lines, 553
——Wave transmission. By Franklin, (D.) 189
——Zambesi power scheme, 975, 976, 1059
Transmission plants
——Bourhillon, Isere. By Soulier, (D.) 232
——California Gas & Electric Cor., De Sabla, Cal. By Galloway, (D.) 314
——Clyde Valley power system, Glasgow, Scotland, *215
——France:
Champ hydro-electric station. By Steens, (D.) 1127
Clermond Ferrand plant, (D.) 741
Saut Mortier plant. By Ryan, (D.) 491
Sioule River plant, for transmission to Clermont. By Solier, (D.) 951
——Gas engines, Use of, by California Gas & Electric Co. By Martin, 206, 220
——Glommen, Norway. By Smith, *135
——Gravfos Falls to the City of Drammen, Norway. By Thune, (D. R.) 27
——Innsbruck, (D. R.) 401
——Italy
Cellina Vermee line, (D.) 7[illegible]1
40,000-volt transmission plant at Gromo. By Koester, *303
——Montereale-Cellina plant. By Ramakers, (D. R.) 1128
Societe Lombarda's distribution, (D.) 660
——Massena, N. Y., *609
——Missouri Power Co., Montana. By Scott, (D. R.) 996
——Montiers in Savoy, France, for railways of Lyon. Series direct-current system, (D.) *[illegible]
——Necaxa, Mexico, water power development, [illegible]
——Nevada Power, Mining & Milling Co. By Prince, (D.) 1[illegible]
——Niagara Falls:
Buffalo & Niagara Falls Electric Light & Power Co., central station campaign, [illegible]
Electrical Development Co. of Ontario, (D. R.) [illegible]
Niagara power in the Gorge, *[illegible], *899. By Adams, (D.) [illegible]
Niagara Falls Hydraulic Power & Mfg. Co., *899
Niagara-Toronto transmission line, 469, *479
Ontario Power Co. Hydro-electric de-

Transmission plants:
—— Niagara Falls. (Continued).
velopment, 91, *343, *387, *440
Rise of Niagara power, 654
——St. Lawrence River Power Co., Massena, *609
——San Joaquin power development, 516
——Telluride plant. By Munn, (D. R.) 356
——Toulon, Power plant for, (D. R.), 401
——Troubles in the Far West. By Appler, (D.) 574
——Washoe Power & Development Co. By Allen, (D. R.) 870
Triumph Electric Co., 538
Trolley bow, Davis & Aalborg, *687
Trolley head invented by Blaney, (D.) *621
Trolley wheels. By Cooper, (D.) 1039
Trolley wire, Flexible suspension for, *920
Trolley wire suspension, (D. R.) 997
Troy Electrical Co., 747
Trusts, The vulnerability of, 257
Tunnels:
——Chicago freight service, (D.) 997
——Chicago telephone tunnels, 320
——Hudson River, N. Y. & N. J. R. R. Co., Completion, 602
——Hudson River, new tunnel, 560
——Karavanken, Austria, Electric power in construction work. By Herzog, (D. R.) 401
——Simplon, Three-phase traction for, 1020

U

Underground wires for Hartford, Conn., 764
United Electric Co., 321
United Engineering Building, *1018
United Gas & Electric Co., Convention, 336
United States Independent Telephone Co., 640
Units, Electrical Discussion. By Wolff, (D. R.) 535
Units, New system of. By Rossi, (D.) 492
University of Minnesota. Lectures at, 11
Unloading ore by electricity, *239
Uranium a radioactive parent, 18

V

Valve magnet, Test of. By Nachod, *1071
Valves:
——Crane self-packing, *746
——Electrolytic. By Holtz, (D.) 493
——Regrinding globe valve, *412
——Victor gate valve, *790
Vanadium, (D. R.) 110
Vaporization of metals by high frequency discharges, 906
Variation of electrical resistance in the contact of carbon and cast iron. By Schoenau, 99
Variometer, Vertical intensity. By Von Bueky, (D.) 704
Vector diagram for induction motors. By Specht, 1126
Vehicle Equipment Co., *405
Ventilators, Electric mine, Regulation, (D.) 67
Vibrations, Electrical between confocal elliptic cylinders. By Nicholson, (D. R.) 315
Voltage drop of alternators, Determining by a graphical method. By Rezelman, (D. R.) 446
Voltage regulators discussed at Ohio Electric Light Association, 350
Voltage series. By Danneel, (D. R.) 276
Volt-ammeters:
——Atwater Kent, *876
——Battery, *539
Voltameters:
——Silver. By Guthe, (D. R.) 535
——Titration voltameter. By Kreider, (D. R.) 743
Voltmeters:
——Bristol recording, for both direct and alternating-current circuits, *31
——High tension, with dielectric needle. By Thornton, (D.) 1084
——Jona electrostatic, (D.) *661
Voltoscope. By Thornton, (D.) 1084
Vulcanized fibre. By Wernicke, (D.) 1040

W

Ward Leonard Electric Co., 111, 538, 707, 793, 835
Warren Electrical Mfg. Co., "Graft" in, 873
Warships, Electric motor applications. By Brooks, (D. R.) 491
Water hoist, Motor driven, *958
Water pipe, Steel, of Ontario Power Co., *387
Water power:
——Bavarian plant, (D.) 741
——Chittenden Power Co., Vermont, 930, *939
——Gravfos Falls, Norway, (D. R.) 27
——"Our unused water powers," 165
——Problems of operation, [illegible]
——Southeastern Appalachian region, 65
——Vancouver Island, 61
Water purification:
——Electrolysis, *787
——French apparatus for, 1[illegible]
——Ozone treatment, 52
Water purifier, Electric, *101
Water softener, "Criton," *[illegible]
Water softening for steam raising. By Le Clair, (D. R.) 27
Water storage for power plants, 930, *939
Waterworks, Electricity in, at Breda, Netherlands. By Gerard, (D.) 403
Waters, W. L., Biographical sketch of, *1021
Waterside station of the New York Edison Co., *[illegible], *135
Water turbine plants, Calculations for. By Baashuus, (D.) 87[illegible]
Watthour meter, Induction. Hamilton and Ferranti, *1062
Wattless current, (D. R.) 357

Wattmeters
——Correcting factors of. By Smith (D.) 234; Edgecumbe, Wilson, Drysdale, (D. R.) 357
——Duddell-Mather standard, (D.) *953
Wave measurer for wireless telegraphy. By Fleming, (D.) *704
Wave shapes in three-phase transformers. By Clinker, (D.) 950
Weather prophecies, 489
Weather-Proof Socket Plug Co., 580
Weights and measures, British report on, 511
Welding Electric:
——Cleveland Cap Screw Co., (D. R.) 662
——Development of. By Wallis-Jones, (D. R.) 450
——German system, (D.) 110
Wells, Walter F., Biographical sketch of, *53
Wesco Supply Co., 1003
Western Association of Electrical Inspectors, 88, 646
Western Union Telegraph Co.:
——Annual report, 680
——Racing service, 131, 514
Westinghouse, George, Sketch of, 379
Westinghouse Electric & Mfg. Co.:
——Charging receptacles, *1085
——Circuit breaker, *155
——District managers, *918
——Generators, *71
——Motors, *193, *536
——Portland exhibit, *457
——Transformer, *406
Westinghouse Machine Co., 793
Wheels, Comparison of cast iron and steel. By Fowler, (D. R.) 28
Winchester, A. E., Biographical sketch, *562
Winding machines, Electric. By Habets, (D.) *186, 232
Windings, Design of multiple-coil. By Underhill, *653
Windmills, Work of. By Ringelmann, (D.) 996
Wireless receivers, A method of testing. By Pickard, *912
Wireless telegraphy:
——Braun patents, *341
——Demonstration apparatus. By Collins, *613
——Directed impulses, 125; By Braun, (D.) *1041
——Earth, Effect of the, on wireless telegraphy. By Sachs, (D.) 358
——Earth connection. By Evans, (D.) *535
——Earthed and unearthed radiators. By Eccles, (D.) 954
——Earthing of wireless telegraph aerials. By Monckton, (D. R.) 704
——Electric oscillations. By Gehrcke, (D.) 358
——Electrolytic wave detectors. By Carroll, *145
——Electromagnetic waves in wireless telegraphy. Prof. Fleming's lecture, 294
——Fessenden system, *90
——Future of, 720
——Germany. By Fournier, (D.) 1085
——Great Britain:
Development in. By Preece, (D.) 535
Quarterly report, 510
Statistics, (D.) 404
——Heysham Harbor plant, (D.) 317
——International aspects of, 86
——Litigation favoring Fessenden, 681
——Massie system. By Collins, *178
——Mexico, 340, 700
——Murgas system, *100, [illegible]
——Orling-Armstrong system. By Collins, *1122
——Portable sets, Clark, *191
——Quantitive data. By Duddell and Taylor, (D. R.) 70
——Regulation of, by the Government, 11, 165
——Resonance effects in the receiving st[illegible] By Hettinger, (D.) *100
——Spark timing apparatus, *768
——South Boston, Mass., station, 499
——Stone patents, *61, *825
——Telefunken system. By Collins, *136
——Telefunken system, Subsidiary apparatus of. By Collins, *269
——Tests and discussion. By Dudell and Taylor, (D.) 70
——Trees in wireless telegraphy. By Schmidt, (D.) 704
——Tuned wireless telegraphy. By Slaby, (D.) 1041
——Velocity of electricity along wires. By Slaby, (D.) *954
——Wave measurer for. By Fleming, (D.) *704
——Wireless telegraphy in one direction. By Artom, (D.) *358
Wireless telephony. By Mester, (D.) *70
Wireless transmission of mechanical action. By Branly, (D.) 140
Wires and wiring:
——Acetate wire, (D.) 66[illegible]
——Approximations of the B. & S. gauge and of the properties of copper wire. By Nachod, [illegible]; White, [illegible]58
——Calculating networks. By Li Gotti, (D. R.) [illegible]; Soschinski, (D. R.) 1129
——Calculations by the slide rule. By Howard, 1125
——Covering, New process of, (D.) *1081
——[illegible] copper wire, 515
——Electrolytic manufacture. By Abraham, (D.) [illegible]
——[illegible] of, 59
——[illegible] interior conduit sheathings, 639
——House wiring. By Kermode, 373, 374
——Insulated vs. bare neutral wire. By Erens, (D.) [illegible]
——Lead-covered wiring. By Mackenzie, (D.) [illegible]
——Magnet wire, Tests of. By Barrett, 1072
——Making copper wire, (D. R.) 1040
——Overhead vs. underground central station circuits discussed by H. B. Gear, 656
——Practical rules. By Auerbacher, (D. R.) 1120
——Resistance of submerged, 865

* indicates illustrated articles.

Wires and wiring: (Continued).
——Specific inductive capacity of metals. By Broca, (D.) 448
——Temperature effects in spans. By Nachod, 988
——Temporary wiring. (D.) *314
——Testing rubber-insulated wire, 168
Writing, Electric transmission of. By English, (D.) [illegible]
Wurts, A. J. Biographical sketch of, *770

Y

Yale & Towne Mfg. Co., *7[illegible]
Youngstown Steam Trap Co., 962

Z

Zinc cases. By Schwartz and James, (D.) 1082

AUTHOR INDEX.

ABBOTT, A. V. Terminals and distribution boards in telephone exchanges, *140
——Transfer systems and the multiple board in telephone exchanges, *181, *224
Adams, A. D. New York and Massachusetts Commissioners of Gas and Electricity, 97
——Regulation of gas and electric rates in Massachusetts, 310, 348, 392, 44[illegible], 424
Adams, C. A. Reactance E. M. F. and the design of commutating machines, 346
Allen, T. S. Method of calculating the core loss in large alternators, 21
Averrett, A. A. Power factor in induction motors, 278

BABCOCK, A. H. Measuring the power of induction motors, 868
Badger, J. S. Diagrams of railway passenger travel, *229
Baker, E. W. Electricity in agriculture, 489
Baker, H. S. Saturation expressed in percent, 1037
Ball, W. V. British law on live rail accidents, 523
——Obstacles to electrical development in Great Britain, 1032
Barrett, C. H. Tests of magnet wire, 1072
Behrend, B. A. Use of the third person in A. I. E. E. discussions, 445
Bergman, B. G. Single-phase induction regulation, *56
Berthold, H. A., and C. J. Fechheimer. Armature reaction in rotary converters, *611
Brackett, B. B. Belt transmission as an analogue of electric transmission, 986
Britton, A. Supply of electric power to London, 59
Brooks, H. P., and E. P. Hyde. An efficiency meter for electric incandescent lamps, *942
Brower, A. T. Sine and cosine diagram, 950
Brown, Morris. Doing the work of the Institute, 66
Bryan, F. M. Hydraulic station at Cusset, near Lyons, France, *983
Buchenberg, A. E. Electric light, water-works and central heating installation at Ada, Ohio, *563
Burns, William. Erecting a large motor, 487
Burt, Austin. Approximations of the B. & S. gauge, 914

CARPENTER, C. A. Efficiency of spark coils, 400
Carroll, W. R. Electrolytic wave detectors in wireless telegraphy, *145
Coar, C. H. Portable test set, *1001
Codman, J. S. Central station rates, 772
——Maximum demand, 527
Coleman, F. F. Electrical equipment of a paper box and bag factory, *833
——Hydro-electric lighting and power plant at Harrisonburg, Va., *1121
Collins, A. F. Demonstration apparatus for wireless telegraphy, *613
——Massie system of wireless telegraphy, *178
——Orling-Armstrong system of wireless telegraphy and telephony, *1122
——Subsidiary apparatus of the Telefunken system, *269
Cravath, J. R. Illuminating engineering and central stations, 398
Cravath, J. R., and V. R. Lansingh. Reflectors, shades and globes, *907, *947, *991, *1033, *1074
Cromack, M. I. Meteorology and the dynamo, 177

DAHLANDER, R. Swedish traction experiments, 1126
Davis, A. G. The metallized filament lamps, 1[illegible]6
De Muralt, C. L. Single-phase vs. polyphase traction, 312

EDWARDS, F. P. Improvements in switchboard details, *318
Ewell, A. W. Production and utilization of ozone, 266

FAST, J. R. A prize for a prophet, 480
Fechheimer, C. J., and H. A. Berthold. Armature reaction in rotary converters, *611
Frankenfield, Budd. Regulation and compensating of lighting balancers, 1067

GRAY, A. M. Plotting saturation curves, *[illegible]
[illegible], Ludwig. The patent law of the new [illegible], 1126

HALE, R. S. Municipal ownership vs. private ownership, 1116
Hallock, William. How can the ball roll? *700
Hellmund, R. E. Core losses in induction motors, *[illegible]
Herzberg, H., and W. P. Snyder. A new electrical measuring instrument, *278
Herzog, S. The Bellinzona, Italy, hydroelectric station, *482
Heyland, A. Self-excited alternators, 31[illegible]
Hobart, H. M. Efficiency of electrical power generating stations, 9[illegible]1
Hoho, Paul. The Hoho process of heating and working metals by electricity, [illegible]
Howard, M. S. Wire calculations by the slide rule, 1125
Hutchinson, C. T. Use of the third person in the A. I. E. E. discussions, 531
Hyde, E. P., and H. B. Brooks. An efficiency meter for electric incandescent lamps, *942

JOHNSTON, J. J. Patent question, 1080

KENNELLY, A. E., and S. E. Whiting. Potential regulation based on the different resistance behavior of carbon and tantalum lamps, *20
Kershaw, J. B. C. Works of the Electrolytic Alkali Co. at Middlewich, Cheshire, England. By Kershaw. *101
King, J. F. Spark gaps, 529
Kingan, W. F. Relations of the central station with the public, 389
Kintner, S. M. Measurement of high electrical pressures, 229
Kirkland, J. W. Coal and power in South Africa, 489
Knowlton, H. F. Electrical equipment of the B. F. Sturtevant Co.'s Works, *576
Koester, Franz. An Italian 40,000-volt transmission plant, *303
——"Made in Germany," 571

LANGSDORF, A. S. Frequency meter, 1015, *1020
Lansingh, V. R. Absorption of light by dust, 623
Lansingh, V. R., and J. R. Cravath. Reflectors, shades and globes, *907, *947, *991, *1033, *1074
Latour, Marius. Belgian single-phase railway, 7[illegible], *1126
Lyndon, Lamar. Booster field control, 166
——Use of the third person in A. I. E. E. discussions, 571
Lyon, S. C. An electrical piano player, *744

McGAHAN, PAUL. "How can the ball roll?" *827
[illegible], J. J. American inventors and the German Patent Office, 913
Marks, L. B. Place of the illuminating engineer, 782
Martin, John. Utilization of gas engines in connection with long-distance electric transmission, 2[illegible]
Maver, William, Jr. Adams-Randall high power telephone transmitter tests, 45[illegible]
Merritt, Ernest. Electrolytic detector for electric waves, 8[illegible]
Marshall, F. H. London's power supply, 98[illegible]

NACHOD, C. P. Booster feed control, 272
——Motor starting diagram, *181
——Some approximations of the B. & S. gauge and of the resistance of copper wire, 5[illegible]
[illegible]

Nachod, C. P. (Continued).
——Temperature effects in spans, 988
——Test of a valve magnet, *1071

PARSONS, GEORGE. A topical classification for electrical engineering references, 91[illegible]
Pender, Harold. Regulation and efficiency of transmission lines, 18
Phelps, W. J. Modernizing electric lamps, 746
Pickard, G. W. A method of testing wireless receivers, *913
Petanaan, B. Pressure due to radiation-aerial navigation, 616
——Submarine boats. The compass, [illegible]
Press, A. Commutation theory, *102
——Dynamo heating time constants, 735
——Dynamo iron loss increment on full load, [illegible]
——The induction motor leakage coefficient, 44[illegible]

RAE, F. B. Speed-time curves for automobile motors, 693
Ramakers, J. Electric furnace hoist, *100
Roberts, B. T. Use of the telephone in army and navy manœuvres, *773

SCHOENAU, ERIC. Variation of electrical resistance in the contact of carbon and cast iron, 99
Scott, C. F. Situation in single phase traction, 168
Seibert, C. J. Electrical equipment of Manaos Harbor, Amazon River, *308
Smith, C. A Norwegian hydroelectric plant, *135
Smith, Charles. Electrically-operated pillar cranes, *993
Smith, C. J. Some new German electric projection apparatus, *736
Snyder, W. P., and H. Herzberg. A new electrical measuring instrument, *278
Specht, H. C. Practical vector diagram for induction motors, 1126
Sprague, F. J. Standard of direct-current operation, 1058
——Long-distance power transmission by direct current, 1117
Springer, F. W. Electric spark recorder, *16
Stanton, A. L. London's telephones, 605
Still, Alfred. Armature losses in double-current generators, *265
Stone, C. W. A method of determining the size of transmission circuits, 271

TENNEY, R. R., JR. Place of the single phase railway, 782
Terven, L. A. Inter-relation of ballast and glower in the Nernst lamp, *305
Therrell, D. Mac L. Voice overtones, or harmonies, as affecting long-distance telephone transmission, *818
Thompson, E. P. Graphitizing filament patents expired, 892
——The problem of secret telephony, *831

UNDERHILL, C. R. Approximate calculation of plunger electromagnets, *1035
——Design of multiple-coil windings, *652
——Relation of pull to diameter of solenoids, *615
——The plunger electromagnet, 25

VALATIN, BELA. Heavy electric railroading, *860

WALMOUGH, P. G., JR. A proposed phase regulator and its applications, 691
Way, W. C. Practical application of the Heyland diagram for induction motors, *1060
Wells, R. E. Small motor testing equipment, 909
Westerberg, Arvid. Congress of Swedish Engineers, 690, [illegible], *815
White, W. I. Approximation of the B. & S. gauge, 658
Whitehouse, John. Scott on single phase traction, 11
Whiting, S. E., and A. E. Kennelly. Potential regulation based on the different resistance behavior of carbon and tantalum lamps, *20
Williamson, R. B. Alternating-current nomenclature, 31[illegible]
Woodbridge, J. E. Alternating-current nomenclature, 44[illegible]

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI, NEW YORK, SATURDAY, JULY 1, 1905. No. 1.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE ....1139 Monadnock Block
PHILADELPHIA OFFICE ....929 Chestnut Street
CLEVELAND OFFICE ....402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. In requesting your address changed give OLD as well as new address.

Copyright, 1904, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **14,500** *copies are printed. Total circulation for* 1905 *to date,* **365,500.**

NEW YORK, SATURDAY, JULY 1, 1905.

CONTENTS.

Editorial 1
The Institute at Asheville 4
Convention of the National Interstate Telephone Association 4
New York State Independent Telephone Association 5
Sixth Annual Meeting of the National Electrical Trades Association 6
Power Transmission in South Africa 6
Mr. Stillwell on the Tesla Criticisms of the Subway 6
Municipal Trolleys in Glasgow and Private Ownership in Boston 7
The Boston Electrical Show 9
Convention of the New York State Street Railway Association 9
High Potential Surges 10
Restriction of Right to Telephone Service 10
Resolutions on Death of S. P. Sheerin 10
Chicago Civic Federation Against Municipal Ownership 10
Current News and Notes 11
Electrical Engineers of the Times—XVI—Mr. F. F. Fowle 13
Transmission of Niagara Power to Toronto. I 14
Magnetic Non-iron Alloys 15
Electric Spark Recorder. By F. W. Springer 16
Regulation and Efficiency of Transmission Lines. By Harold Pender, Ph.D. 18
On a Method of Potential Regulation Based on the Different Resistance Behavior of Carbon and Tantalum Lamps. By A. E. Kennelly and S. E. Whiting 20
A Method of Calculating the Core-Loss in Large Alternators. By T. S. Allen 21
The Preservation of the Southern Appalachian Streams 23
Recent Electrochemical Developments 23
New Telephone Patents 25
LETTER TO THE EDITORS:
The Plunger Electromagnet. By Charles R. Underhill 27
Digest of Current Electrical Literature 28
Tests of Reeves Vertical Cross-Compound Engine 30
Belted Type-Rotating Field Alternator 30
Recording Voltmeter for Both Direct and Alternating Circuits 31
A Pocket Size Ammeter 31
Shaw Non Arcing Lightning Arresters 31
New Niles Electric Traveling Hoist 32
Star Cable Dog 32
Exhibits at the National Interstate Telephone Convention 32
Industrial and Commercial News 34
General News of the Week 38

SATISFACTORY EXPORTS.

General trade and industrial conditions throughout the country are satisfactory and the latest crop reports all promise a continuance and extension of the prosperity that has been enjoyed recently. The Bureau of Statistics at Washington now supplements the data as to trade in general with some very cheering figures as to exports. This bids fair to be a notable year. May exports ran up to $123,735,529, as compared with $89,859,359 last May and about $101,000,000 in May, 1903. That is marked improvement. The imports were also $92,828,107, as compared with $80,694,749, showing a reciprocal expansion. The total exports for the nine months of the fiscal year are $1,397,350,140, or about ten millions more than in 1904, and nearly $75,000,000 better than 1903. The balance of exports over imports for the eleven months is almost exactly $370,000,000. There is no cause for grief in such an exhibit.

The gain in manufactured exports recently has been very striking. For May the amount was $48,269,705, or nearly ten millions better than last year, and over thirteen millions better than 1903. For the eleven months the total is $493,396,788, or nearly $80,000,000 better than 1904, and $120,000,000 better than 1903. It may be implied that a firmer grip on export trade and improved international trade relationships have been secured. Turning more particularly to electricity, conditions are encouraging. The exports of electrical machinery for the ten months ending April were $5,854,974, a gain of one million over 1903, and of at least $1,250,000 over 1904. The figures for April itself were $564,883, or nearly $35,000 better than in 1904. The exports of electrical instruments, additional to the above, also continue large. While a little less than in 1904, the total is nearly $500,000 better for the ten months than in 1903, being $3,060,126; while for April it was $443,478, as compared with $311,440 in April a year ago. Such figures must surely strengthen the resolve of American manufacturers to cultivate foreign trade steadily and push for new custom.

THE VALUE OF THEORY.

That the electron hypothesis is weakening faith in some of our most cherished theories of electrical action cannot be denied; and the time-honored tenets of magnetism are now subject to challenge as a consequence of the researches in non-ferric alloys by Fleming and Hadfield, an account of whose latest work appears in this issue. In view of this condition, which may be disturbing to the minds of those who do not properly recognize the real function of theory, it is well to remember that established theory should never be held as an article of faith—as is too often done when connected with names of high authority—but considered only as an acceptable generalization on all the facts in existence coming within the range of the theory. To hold any theory as an ultimate explanation of any set of phenomena implies that every fact relating to the phenomena is known—that nature has nothing more to reveal. It is, moreover, a condition of the growth of human knowledge in any department of science that whereas the advance never ceases in the acquisition of facts, yet the interpretation placed upon series of facts may vary markedly from time to time. The wealth of acquired material does not shrink, but always advances, sometimes rapidly and at other times more slowly. Nevertheless, the theories embracing the facts, and attempting to explain them, often wax and wither in a single decade. It might really be questioned whether in view of the history of mortality in theories it were worth while attempting to find a theory to fit observation, and whether it would not be better to go on accumulating new materials of fact, heedless of their theoretical relations. The value of theory is, however, that it co-ordinates, or at least seeks to co-ordinate, the facts so as to permit of their proper grouping and presentation in natural sequence. Without the aid of theory, knowledge would constantly become more difficult, by accumulation; whereas, with the aid of theory, knowledge may actually grow easier to acquire, from age to age, in spite of the constant accumulation of material.

Apparatus for Testing Insulation.

It is only a few years since 2,000 volts pressure for testing in the factory was regarded as very high. Now testing pressures of 150 kilovolts are commonly used and 250-kilovolt pressures are occasionally used. The adjustment, measurement and application of such pressures call for special apparatus and design. In practically all cases, as pointed out by Mr. C. E. Skinner in his recent N. E. L. A. paper, high pressures for testing are applied through the medium of step-up transformers. Occasionally cables are tested by direct-current dynamos of, say, 1 kilovolt pressure; but machinery in the factory is more conveniently tested by the use of portable alternating-current testing sets. The measurement of the high pressure offers considerable difficulty. There is objection to placing the measuring instruments on the high-pressure side, because not only is the resistance required in their circuit large and expensive, but there is also considerably increased personal danger incident to the use of high-tension measuring instruments. On the other hand, although the placing of instruments on the low-tension side is very convenient and simple, yet there is always a certain range of error involved by the charging current at high-pressure terminals affecting the ratio of transformation irregularly, and thus interfering with the precision of the measurements. A simple and reliable voltmeter for very high tension is much to be desired.

A New Method of Potential Regulation.

A striking point of difference between filaments is with respect to the change in resistance with variation in temperature. As is well known, the resistance of carbon continually decreases with increase of temperature, so that the current taken by the carbon filament varies at a rate considerably greater than the change in the impressed electromotive force, and the lamp is exceedingly sensitive to voltage variation. On the other hand, the tantalum filament possesses in a marked degree the property, common to metallic conductors, by which its resistance increases with increase of temperature, so that a change in the electromotive force across the terminals of a tantalum lamp results in a much smaller change in the current taken by the lamp. A practical advantage of this characteristic of the material is found in the fact that the illumination furnished by the tantalum lamp is much less dependent upon the value of the impressed electromotive force than in the case of the carbon lamp. In an article on page 20 of this issue Dr. A. E. Kennelly and Mr. S. E. Whiting show how the difference in the temperature resistance characteristics of the two lamps may be employed advantageously for regulating the electromotive force of a generator. The method suggested requires the use of two separate circuits connected to the terminals of the generator. In one of these circuits are placed tantalum lamps, while the other circuit contains carbon lamps. At normal voltage the currents taken by the individual circuits are equal in value Any increase in voltage causes the current in the carbon lamps to exceed that in the tantalum lamps, while a decrease in voltage produces the opposite effect. The authors describe two methods by which the relative change in the values of the two currents may cause a relay to operate the field rheostat so as to bring the electromotive force to its normal value. In one method—the Wheatstone bridge arrangement—the current in the coil of the relay is of zero value at normal voltage, and it assumes a value in one or the other direction according to the excess or deficiency of the electromotive force. In the second method—the differential relay system—it is merely the difference in magnetomotive forces of the two currents acting simultaneously upon the same circuit-changing device which tends to cause the electromotive force of the generator to remain at its normal value.

It is evident that the practical value of any method of potential regulation is determined by the relative freedom from complication, and by the sensitiveness of the controlling devices to change in electromotive force. A study of the article referred to will convince one that the apparatus is extremely simple, while the fact that under test the voltage was kept within one-half of one per cent of normal seems to indicate that the sensitiveness is satisfactory. The authors direct attention to the fact that the lamps are more sensitive to changes in voltage when operated at a low value of impressed e.m.f., and they give an equation for showing the relative sensitiveness for assumed conditions. Since, with the differential relay system the operation depends entirely upon the difference in currents in the two coils of the relay, it would seem that an arrangement by which the current in the one coil is kept at a constant value while that in the other fluctuates greatly with a change in electromotive force, would give the maximum possible sensitiveness. Such an arrangement is to be found in the use of a separate source of constant e.m.f. for the one coil (a storage battery) and the use with the other coil of carbon lamps in series across the mains of the generator. It is evident that this latter arrangement would eliminate the undesirable effects due to the thermal time lag, mentioned by the authors.

High-Voltage Incandescents.

We have read with much appreciation Mr. Howell's paper dealing with the claims made for the 220-volt foreign lamps. A thorough round-up of the situation was much needed, for the high-voltage lamps present so many disadvantages in the matter of distribution that a knowledge of their actual qualities has really become essential. The result confirms what previous experience has indicated, that it is a very difficult matter to make a lamp which at 220 volts or thereabouts shall be reasonably efficient and durable. We think that in incandescent lamp manufacture our American makers are rather ahead of the game. In fact, it would be rather discreditable to them were they not, since the lamp was American in its origin and is used more freely here than anywhere else in the world. From Mr. Howell's tests it appears not only that the foreign lamps for which so much has been claimed are decidedly inferior to the best American lamps, but they are far from bearing out the earlier reports of efficiency. In particular, American lamps seem to be much more closely and carefully rated so that their performance is more uniform and reliable. There is no doubt that a good 220-volt lamp would have a wide field of usefulness, but the tendency of improvements nowadays is strongly in the direction of increased efficiency, and the consumer is so potent a factor in the situation that increased efficiency must come. Improvements are already announced in carbon filaments that may have a very great effect on future practice. It is evident, however, from Mr. Howell's tests that the really economical high-voltage lamp will be likely to come rather through improvements here than through the example of existing foreign practice. Present lamps, of course, are not to be despised for special uses and in particular situations, but there is small prospect that high-voltage incandescents will even be as easy to make of high efficiency as those for more moderate pressure.

Frenzied Thermodynamics.

We observe with joy that our Subway friends have been stirred to strenuous measures. Whether the gloomy computations recently published have struck them with panic or whether some of them were caught, unhappy, in their own trap when the deadly water main got in its fine work the other day, we know not, but anyhow something is doing. The figures alleged are fearful and wonderful to contemplate. They would have struck with awe even the philosophers of Laputa, but no citation of authorities can give them much quantitative value since no one has yet investigated the case of conduction through the walls of a very long and narrow channel in which the air is given altogether abnormal convective action by continual stirring, nor has anyone yet evaluated the probable effect of a rigid embargo laid on Limburger, garlic and stogies. These add their terrors to the situation and defy both the computer and the bacteriologist. No analysis can ever do justice to the properties of Subway air—it has the peculiar lifeless qualities generally only to be found in a country town hall the day after town meeting. But it is not of record that a town hall ever was ventilated, while to the credit of the powers that rule the Subway be it said that they are just as anxious as the public for a good supply of fresh air. And fresh air they propose to have if there is any way of securing it. The fact is that, all computations to the contrary notwithstanding, a very long and relatively narrow subterranean gallery will not ventilate itself through infrequent and tortuous passages of small area leading to the exterior air. Nor will the trains, unless they fit so closely as to act as pistons, help to any adequate extent.

They keep the air stirred up, but fail to displace it in bulk. Here is the root of the difficulty. The obvious remedial measure is to provide forced draft, as has been done elsewhere under similar conditions. Bad air will not leave unless it is ejected with violence. All joking aside, it is certain that it would have been wise to put in forced ventilation at the start, and the sooner it is now done the better. The air in tunnels is never of the best. A tunnel used by some hundreds of thousands of people daily is certain to have an atmosphere which, if not seriously vitiated, is at least unpleasant and unwholesome, let alone the matter of temperature. We shall be interested to note the result of the reported refrigeration experiments if they are carried to a conclusion, but if the air is frequently renewed the temperature will take care of itself. The method of ventilation must, however, be carefully studied. The fans for the work must be big enough to move the required volume of air, forceful enough to overcome backwind, and so located that they will remove foul air and not merely create an eddy and pull out most of the fresh air that comes in. It has often happened that a fan of the dimensions and speed required to move a certain computed amount of air, fails dismally of its purpose because of inability to deal with back pressure due to wind, and from setting up eddies. The exhaust fans in such a case as that here discussed should pull from a clear column of air well removed from other ventilating apertures, and should give a normal air velocity high enough to perform the required duty against any probable wind pressure. If installed near or at stations they are likely to fail in clearing the tunnel in general. And from the shape of the area to be ventilated it is obvious that a considerable number of medium-sized fans are better than a few big ones. But this much is sure, that the work can be thoroughly well done, and will be done. The quality of the work can best be judged by its general effect on the passengers. Mere analysis and bacteriological tests only tell part of the story. They can detect the existence of exceptionally bad conditions, but air may be unpleasant and unhealthful without a very large amount of carbonic acid and without a large increase in the number of maleficient bacteria.

The Power Factor of Alternating-Current Arcs.

It is well known that an alternating-current arc lamp has a power factor of marked importance. It varies between 30 per cent and 90 per cent as extreme values and is commonly about 70 per cent. so that the watts consumed by the lamp are commonly about 70 per cent of the volt-amperes delivered at its terminals. When this phenomenon was first observed, it was supposed to be entirely due to the effect of the series coils or reactances in the lamp. A large part of the difference between watts and volt-amperes was indeed traced to these reactances, but it was found that the arc itself had an effective reactance, and that the watts consumed in the arc itself might be in extreme cases as low as 80 per cent of the volt-amperes measured at the carbons. It was then imagined that this might be due to a c.e.m.f. in the arc. Investigation failed, however, to reveal any such c.e.m.f. The oscillograph showed, in fact, that the volts and the amperes crossed the zero line simultaneously, or substantially so, whereas had there been a c.e.m.f. in the arc as in a reactance, the current would have lagged behind the voltage; that is to say, the amperes would have crossed the zero line, in each reversal, after the volts. Finally, the effect was traced to a cyclic variation in the resistance of the arc. When the current through the arc is strong, the resistance of the arc is relatively low, and when the current through the arc is weak the resistance is relatively high. Consequently, the shape of the current wave through the arc is not the same as the shape of the voltage wave at carbons. The current wave is more peaked at the crest than the voltage wave. The fact that the power factor of the arc is not unity is due, or at least principally due, to this relative wave distortion.

A paper on this subject was presented by Prof. Shepardson at the convention of the American Institute of Electrical Engineers last week. This paper shows that the power factor does not vary much with the wave shape of impressed e.m.f. whether that e.m.f. be considered at carbons or at lamp terminals. In other words, whether the impressed e.m.f. be sinusoidal, peaked or flat, the power factor of the arc, and also the power factor of the lamp, will be practically the same. Moreover, the power factor of the arc was found to be distinctly higher with the enclosed arc than with the open arc. This is perhaps due to the difference in physical and chemical properties of the gases between the carbons in the two cases. The power factor was also found to be distinctly higher with cored carbons than with hard carbons. This seems attributable to the lower volatizing temperature of the core than of the carbon, whereby the arc is much more readily started again, with much less ohmic resistance, after each reversal, when cored carbons are used. The oscillographs accompanying the paper show many details of significance. It is shown, for example, that with enclosed arcs and cored carbons, the wave of current was a smooth curve roughly sinusoidal; whereas the wave of voltage at the carbons was nearly rectangular and flat-topped. In the case of the open arc with hard carbons the voltage was rendered even more distorted. The resistance in the arc at the times of feeble current was so great as to force the voltage into sharp peaks, so that the voltage at full current was only about half that at weak current. The voltage peak just after reversal is much higher than that just before reversal, indicating that the reversal of the discharge in the arc gives rise to a larger resistance accompanying a given current strength than when the discharge is merely subsiding. A wide field for research is opened in these directions. The real difficulty is that the field is too wide, owing to the large number of independent variables. The matter would be much easier to elucidate if a number of these variables could be either eliminated or kept uniform.

The Institute at Asheville.

A very full telegraphic account was given last week of the various exercises and functions connected with the annual meeting of the American Institute of Electrical Engineers held at Asheville, N. C. Our report closed on Thursday morning, at which time the Institute was holding its last regular session, including the papers of Messrs. Stanley and Howell.

On Thursday evening an enjoyable entertainment was participated in by the large number of the members and guests who still remained in attendance in the shape of an informal smoker at the Albemarle Club. A very pleasant late afternoon and evening was spent at bowling, billiards, etc., followed by refreshments and music. Many of the ladies and gentlemen resident in Asheville were present also by invitation, and their participation added greatly to the enjoyment of the affair. A feature of the evening was the presentation, accompanied by an appropriate speech by Mr. Charles E. Waddell, chairman of the local committee, of a silver loving cup to President Lieb, of the Institute, as a mark of appreciation from the local reception committee on behalf of the Southern members, with particular reference to the efforts to forward and to hold the meeting in the Southern country and to make the gathering a success. Mr. Lieb, in replying, paid a tribute to development in the South and to the work of the committee, and voiced the thanks of the Institute membership for the hospitality which had been shown every one in the entertainment extended. A silver matchbox was also presented by the local committee to Secretary Pope, of the Institute, as a testimonial of their esteem and as a souvenir of the Institute's first meeting in the South.

On Friday a number of the members took part in a special excursion to Toxoway, in the heart of the mineral and mining country of North Carolina. This excursion was greatly enjoyed by a large number. After this the exercises closed and the convention dispersed, with pleasant memories of a notable and highly enjoyable week.

Convention of the National Interstate Telephone Association.

In last week's issue was published a telegraphic report of the proceedings of the several sessions of the convention of the National Interstate Telephone Association held in Chicago at the Auditorium Hotel, June 20 and 21. The following is a more complete report of the proceedings. As announced last week, the work of the convention on Tuesday, the first day, was suddenly interrupted by the death of S. P. Sheerin, of Indianapolis, while reading an address at the opening of the convention. Immediately upon the occurrence of the sad event the convention adjourned for a few moments, and upon convening again adjourned until 3 p.m. Tuesday, when some necessary routine business was transacted.

At this time a committee of ten was appointed to draft resolutions on the death of S. P. Sheerin. This committee consisted of Jesse W. Weik, of Indiana; J. G. Splane, Pennsylvania; J. B. Ware, Michigan; George W. Beers, Indiana; E. B. Fisher, Michigan; E. L. Barber, Ohio; E. E. Clement, District of Columbia; James B. Hoge, Ohio; Theodore Gary, Missouri, and J. D. Powers, Kentucky.

As the constitution provides for a committee on amendments to the constitution, Colonel Powers, the temporary chairman, at the request of the Executive Committee, appointed a committee on amendments as follows: Theodore Throward, of Indiana; H. A. Price, Michigan; E. W. Dunnaway, Texas; W. G. Thompson, Ohio, and P. T. Spencer, California. A committee on credentials was appointed, consisting of J. G. Splane, of Pennsylvania; Richard Valentine, of Wisconsin; J. S. Bellamy, of Iowa, and G. M. Saltzgaber, of Ohio.

A committee on nominations consisting of one from each state was made up as follows: Stanley S. Lichty, Iowa; W. Roy McCanne, Missouri; W. Gilbert Thompson, Ohio; E. B. Fisher, Michigan; J. C. Harper, Wisconsin; Charles E. Wells, Kansas; P. Kerr Higgins, California; A. C. Davis, West Virginia; H. K. Cole, Kentucky; S. B. Rawson, New York; W. L. Moellering, Indiana; E. W. Dunnaway, Texas; E. E. Conklin, Illinois; W. H. Bryant, Alabama, and E. E. Clement, District of Columbia.

A committee of five was appointed to confer with a committee of the manufacturers for the good of the association. This committee was made up of E. L. Barber, Ohio; J. C. Splane, Pennsylvania; Richard Valentine, Wisconsin; C. Y. McVey, Ohio, O. N. Snyder, Ohio. The convention then adjourned until Wednesday morning at 9 o'clock, out of respect for Mr. Sheerin. The first business Wednesday morning was the reading of the resolutions drawn up by the committee of ten regarding Mr. Sheerin's death. These resolutions were adopted by the association and transmitted to the relatives of the deceased.

The committee on nominations reported in favor of the following officers, who were duly elected: President, James B. Hoge, Cleveland, Ohio; vice-president, Theodore Gary, Macon, Mo.; second vice-president, John Van Liew, Los Angeles, Cal.; secretary, A. L. Tetu, Nashville, Tenn.; treasurer, J. G. Splane, Pittsburg, Pa. Immediately after the election the permanent officers took charge of the association.

JAMES B. HOGE, PRESIDENT.

It was then suggested that, inasmuch as Judge James M. Thomas, one of the founders, and the president of the National Association for several years, and the one who had led its patent litigation, had died since last convention, some action should be taken by the association looking toward a recognition of his services to the independent telephone interests of the country. A committee to draw up such resolutions was appointed consisting of Dwight E. Sapp, of Ohio; E. B. Fisher, Michigan; F. L. Bean, Ohio; George W. Beers, Indiana; B. E. Hubbell.

THEODORE GARY, FIRST VICE-PRESIDENT.

The committee on the standard forms of accounting read a part of its report, leaving the balance to be published. Other papers read in abstract or in total were: "The Value of Telephone Securities," by A. B. Greenshields of Philadelphia; "Standard Toll Signs," by W. F. Laubach, Akron, Ohio; "The National Interstate Telephone Association," by James B. Hoge, Cleveland, Ohio; "Combined Telephony and Telegraphy," by Samuel G. McMeen, consulting engineer, Chicago.

The question of the standard sign to be used by independent telephone companies at local and long distance pay stations the country over was the one most fully discussed, as it was considered important that this convention adopt some such standard sign which would be as national in its character as the familiar Bell sign of the opposition. A sign was adopted at the close, as mentioned later.

Wednesday afternoon a roll call of states was carried out, in which a delegate from each state represented made report on the condition of independent telephony in his State. The two most notable features of this roll call as regards the number of telephone instruments in use were the figures from the city of Los Angeles, Cal., and the state of Iowa. The former reported 20,000 instruments serving a population of about 200,000. Rural development at its highest was shown by the claim of Iowa to 220,000 telephones, the independent movement being probably stronger in Iowa than in any other state in the Union. This is partly due to the fact that rural lines were early developed in Iowa, and such lines have acted as the most valuable feeders of the various independent exchanges. In fact, such lines may be said to control the situation, being necessary to the existence of the smaller exchanges. The Iowa telephone men have an association dating back to 1896. Delegates from other States reported experiences similar to those in Iowa, namely: That the rural lines control the situation as far as all the smaller exchanges are concerned. Many interesting experiences were related as to the struggle between the Independent and Bell interests in different states and the tactics adopted to get control of the situation.

A number of invitations were received from cities desiring the next convention. The first invitation was from Nashville, Tenn., the home of Secretary Tetu. Atlantic City, N. J.; Detroit, Mich., and Put-In-Bay, Ohio, also sent invitations.

It was decided to have a permanent committee of three on operating rules, and also a permanent committee on relations with manufacturers.

The permanent toll sign finally selected by the convention is the one which has been on the letterheads and literature sent out by the committees of the National Interstate Telephone Association; it is in the form of a banner in three colors—red, white and blue. The principal objections urged against this sign were its illegibility and the fact that it requires three colors as against the two colors used by the other signs proposed, the latter being an objection in ordinary advertising. The other signs proposed were the one used by the Michigan association, which is a blue banner with lettering above and below, and the one used by the Iowa association, which is a maltese cross with letters on the cross. The advertising value of the three-color sign was, however, considered by the association to outweigh the practical difficulties of its everyday use, and was adopted. The banner contains the words "Independent Local and Long-Distance Telephone" on its face.

The third day of the convention was given up to the inspection of the extensive exhibits of the manufacturers and to committee meetings. The president appointed the following executive committee, with the approval of the other officers, in according with the constitution: W. D. Barnard, Pennsylvania; Edward L. Barber, Ohio; Col. J. D. Powers, Kentucky; Theodore Gary, Missouri; John Van Liew, California; George W. Beers, Indiana; Richard Valentine, Wisconsin; Charles C. Deering, Iowa.

A committee on litigation and legislation provided for by the constitution was selected as follows: Dwight E. Sapp, Ohio, chairman; Breckenridge Jones, Missouri; E. E. Clement, District of Columbia; J. B. Ware, Michigan, and one member from Illinois to be appointed later.

An auditing committee was appointed, consisting of George W. Beers, of Indiana, and J. G. Splane, of Pennsylvania.

Later in the day the executive committee met and made plans for an aggressive campaign in the various states according to the ideas suggested during the convention. Permanent headquarters for the association for the year will be established in Cleveland, the president's city, where offices will be opened and the work carried on under the direct supervision of President Hoge. John A. Harney, of the Cuyahoga Telephone Company of Cleveland, was made assistant secretary, under salary, to take charge of the association's permanent offices, and give his entire time to the association's work. It was decided that a Department of Publicity should be started to further the interests of independent telephony the country over by keeping the public informed as to the extent of the independent telephone movement and exposing false reports circulated about it from time to time. The organization of this department was left to the president. It has been suggested that W. B. Woodbury, assistant general manager of the Cuyahoga Telephone Company, Cleveland, who acted as chairman of the Press Committee at the convention, and who is an ex-newspaper man, may be induced to take charge of this new department. The satisfactory way in which he handled publicity matters in connection with the Chicago convention demonstrated his fitness to handle such a bureau.

A large party of telephone men went to Indianapolis to attend the funeral of S. P. Sheerin, which took place on the day following the convention.

New York State Independent Telephone Association.

The annual meeting of the New York State Independent Telephone Association was held in Albany, June 16, 1905, at which seventy-eight delegates were present, represnting indpendent telephone companies throughout the state having an investment of more than $15,000,000. At the opening session on Friday morning an address of welcome was delivered by Corporation Counsel Honorable Arthur L. Andrews, representing the mayor, and responded to by Mr. T. Harvey Ferris, of Utica. The remainder of the morning session was spent in inspecting the exhibits of manufacturers and the exchange of the Albany Home Telephone Company.

At the afternoon session the following papers were read: "Toll Line Development," by Mr. T. M. Brush; "Consolidation," by Mr. George R. Fuller, Rochester; "Development in the East," by Mr. W. L. Burke, Troy; "Development in Southern New York," by Mr. George B. Wright, Binghamton; "New Methods of Construction," by Mr. M. R. Eaton, Niagara Falls. In the evening there was a river trip, and at 7 P. M. a clambake was served at "The Abbey."

The tariff report, covering a uniform method of handling and accounting toll business throughout the state, submitted some time ago by a committee consisting of Messrs. S. B. Rawson, T. S. Lane and Edward Davis, was unanimously adopted. The report recommended that the mileage should be based on the air line distance between the centers of the respective blocks in which stations are located. It was recommended that a tariff rate be based upon a minimum charge of .6 cent per air line mile for each conversation not exceeding three minutes' duration, with a minimum rate of 10 cents. A table accompanying the report, giving a scale of rates from 10 to 200 miles based upon the above unit rate, and other tables give the tariff for each additional minute and for a night rate.

It is provided that all stations originating toll messages shall be paid a commission whether the business is sent paid or collect. After deducting this commission, the remainder of the tariff is to be divided between the connectng companies in proportion to the ratio existing between the air line distances from the point of origin to the point of transfer, and the air line distance from the point of transfer to the point of destination, each toll line company assuming the mileage of and settlement with its own connection. Details are given concerning reporting toll business, method of handling tolls, handling of frank business, toll accounting, forms of accounting, tickets, daily toll ledgers, monthly report blanks, methods of determining balances due in general settlement, and toll stationery. Instructions are given for adjusting the division of revenue between a toll line and a group of companies operating in a limited district, each connected with the other, and one of which connects with the toll line.

A resolution was adopted reciting that the various departments and offices of the state of New York, located at various places in the state, are all equipped with the Bell telephone service, and expressing the opinion of the meeting that such departments and offices should not confine their patronage to any one system to the damage and exclusion of citizens who take service from other systems, and asking that departments and offices not already conducted up with independent systems be requested to install independent telephones.

The association is in a flourishing condition, having a membership of more than 200, which is rapidly increasing. The following officers were elected for the ensuing year: President, W. Howard Hendrickson, Albany; first vice-president, Mr. Boyd McDowell, Elmira, N. Y.; second vice-president, Mr. W. R. Campbell, Niagara Falls; treasurer, Mr. T. Harvey Ferris, Utica; secretary, Mr. T. S. Lane, Buffalo, N. Y.

Sixth Annual Meeting of the National Electrical Trades Association.

The sixth annual meeting of the National Electrical Trades Association was held at La Corona Hotel, Montreal, Canada, June 23, representatives being present from all the affiliated local associations in the United States and Canada. The delegates in attendance and the local societies represented were: Mr. G. M. Stuart, of the Stuart-Howland Company, Boston, Mass., representing the New England Electrical Trades Association; Mr. John H. Dale, president of the Dale Company, New York City, representing the Electrical Trades Society of New York; Mr. Charles M. Wilkins, of Partrick & Carter, Philadelphia, representing the Electrical Trades Association of Philadelphia; Mr. James Wolff, Chicago manager of the New York Insulated Wire Company, representing the Electrical Trades Association of Chicago; Mr. C. M. Wood, representing the Electrical Trades Association of the Pacific Coast; Mr. John Forman, Montreal, Canada, representing the Electrical Trades Association of Canada. There were also present General Secretary F. P. Vose, of Chicago, and Local Secretaries J. A. Mann, of Montreal, and F. Neilson, of New York.

At the business sessions, lasting the whole afternoon, questions of considerable importance came up and careful consideration was given them, particularly to the adoption of new operative resolutions and the modification of others. The retiring president and vice-president, Messrs. John Forman and James Wolff, were succeeded by Mr. Wolff as president and Mr. Dale as vice-president. General Secretary Vose was re-elected for the ensuing year. New York City was chosen as the place for next year's meeting.

In the evening the delegates were banqueted by the Canadian Association, Mr. John Forman acting as toastmaster. Besides those already mentioned the following-named gentlemen were at the board: R. E. T. Pringle, president of the R. E. T. Pringle Company, Ltd., Montreal; E. F. Sise, the Wire & Cable Company, Montreal; George Moffatt, the Robert Mitchell Company, Ltd., Montreal; George H. Olney, the E. T. Phillips Electrical Works, Ltd., Montreal; J. A. Burns, Munderloh & Co., Montreal; George H. Rough, the Packard Electrical Company, Ltd., St. Catherines, Ont.; George Leroux, the R. E. T. Pringle Company, Ltd., Montreal; A. Collyer, the Bullock Electrical Manufacturing Company, Montreal; Philip H. Hover, the New York Insulated Wire Company, New York; H. P. Kimball, the Standard Underground Cable Company, New York.

Speeches were made and toasts were offered by Messrs. Forman, Wolff, Wilkins, Dale, Wood, Vose, Mann and Neilson. Others entertained by story, song and instrumental music. The National Electrical Trades Association is composed of over three hundred representative houses in the electrical and allied trades in the United States, Canada and Mexico. It is a sort of credit information bureau, designed to keep the members informed of the credit of customers in those trades, and it effects its aims in a surprisingly simple and certain manner. Incidentally, the members are enabled to secure the collection of accounts which frequently are uncollectible without the assistance of attorneys. The association cannot begin to estimate in dollars and cents the benefit accruing from the credit information disseminated to the members, but it can and does estimate the value obtained through the incidental work of collections. For example, it is computed that the New York Society alone during its ninth year collected for its members approximately $256,000, an average of over $3,000 for each member. For this service there is no additional charge, the entire cost to the member being covered by the annual dues.

◆

Power Transmission in South Africa.

It is reported that the principal mining interests at Johannesburg are now actively engaged in studying, in connection with the officers of the Mashonaland Railroad Co., the possibilities as to cost of installation and transmission of power from Victoria Falls, on the Zambesi River, to Johannesburg, a distance of about 1,100 kilometers, at a tension of 70,000 volts. In view of the cost of coal at Johannesburg, it is said by those who have been studying the problem latterly that the commercial transmission of this power is quite feasible. The available power of Victoria Falls is more than five times that of Niagara. The most serious problem [illegible] not in the technical difficulties, but in the patrol of the long line. The present plan contemplates the transmission of 36,000 hp for the [illegible] installation. The available fall to be utilized is 120 meters.

Mr. Stillwell on the Tesla Criticisms of the Subway.

Last week we cited from the New York *Sun* a letter by Mr. Tesla attacking the New York Subway again. We now give below in full Mr. L. B. Stillwell's reply:

In a letter printed in your issue of June 16 Mr. Nikola Tesla points out what he says he considers a source of danger in the Subway, and reiterates an opinion, which he had previously expressed in your columns, to the effect that a mistake was made in not adopting what he calls "my alternating system of distribution, popularly known as the 'two, three, multi or polyphase.'" It is possible that some of your readers who have read none of Mr. Tesla's prophetic essays which have appeared from time to time during the last ten or fifteen years in the daily press may attach weight to his opinion, and as the public is greatly interested in the Subway and its operation, statement of a few facts seems pertinent and proper.

It will be recalled, perhaps, by your readers that in your issue of November 1, 1904, a letter from Mr. Tesla was published, in which, *inter alia*, he expressed the opinion that polyphase induction motors should have been adopted instead of continuous-current motors. Incidentally, he remarked also that the distributing mains ought to be insulated artificially by refrigeration, that he had recently perfected inventions which, "abolishing all barriers to electrical development, will soon sweep the world with irresistible force," that he approved Mr. Belmont's private car, that he had not seen the tunnel and did not know its location, and was equally ignorant as regards the power house, that the system adopted was of his own invention, but that it represented "the state of the art more than ten years ago"; that a mistake had been made in not asking the electric companies to furnish the best instead of the cheapest equipment, and that the Interborough Rapid Transit Company had never asked him for any expert advice or suggestion.

In a letter which was printed in your issue of November 11, 1904, I stated that Mr. Belmont and his associate directors had imposed upon their engineering advisers no limit of cost; that if any mistake in the selection of electric equipment had been made, it was mine—not Mr. Belmont's—and suggested that, if Mr. Tesla would present before the American Institute of Electrical Engineers a paper containing specific and definite criticism of the equipment, I should be glad to meet him for the purpose of a full and frank discussion.

This suggestion, for reasons which were perhaps satisfactory to himself, Mr. Tesla declined to adopt, and in a long letter, which you printed in your issue of November 27, 1904, in declining to appear before the Institute, he referred to a number of alleged accidents in the Subway—the majority of which never happened—and again stated that the system adopted was one which he had "devised many years ago"; that its adoption in this instance "was altogether too absurd to dignify it with any serious comment"; that polyphase induction motors should have been used, and that he believed in advertising.

In his latest letter, that of June 16, he reiterates some of the statements contained in previous letters, and calls attention in the following words to a new danger which he has discovered: "The danger to which I refer lies in the possibility of generating an explosive mixture by electrolytic decomposition and thermic dissociation of water through the direct currents used in the operation of the cars." His alternating-current, polyphase system, as he says, would be free from this danger. Obviously, a charge so serious as this should rest upon a very substantial foundation of fact, and no consideration of self-interest or of personal animosity will excuse its author unless he can prove his charge. And what does Mr. Tesla offer as evidence that electrolytic decomposition of water is taking place in the Subway? He says: "It will be recalled that an expert found the percentage of free oxygen in the Subway appreciably above that which might reasonably have been expected in such a more or less stagnated channel." In other words, the Subway air contains more oxygen than Mr. Tesla expected, and upon this fact he constructs his theory of the production of oxygen and hydrogen gas by electrolysis. He does not offer in his letter a scintilla of evidence that oxygen is thus being set free. No one has alleged that the air in the Subway contains more oxygen than uncontaminated and free air. If Mr. Tesla, therefore, is comparing an actual analysis with anything more definite than his own notion of the kind of air that might be expected in the Subway, it is for him to make clear his reasoning.

Prof. Charles F. Chandler, who was recently employed by the Health Department of the City of New York to test the condition of the Subway from a sanitary standpoint, with especial reference to the purity of the air, says:

According to the best authorities, as, for example, Dr. John S. Billings, in his work, "Ventilation and Heating," the chemical composition of the atmosphere when uncontaminated is as follows:

Oxygen, 20.80 per cent; nitrogen, 70.20 per cent; carbon dioxide, 0.03 or 0.04 per cent.

The composition is not absolutely constant, the oxygen being sometimes a little higher and sometimes a little lower than the percentage given above.

Thus far fifty samples of Subway air have been carefully analyzed and the percentage of oxygen determined, the result being a maximum of 20.80 and a minimum of 20.30—average 20.55. At the same time, nine samples of surface air were examined, showing a maximum of 20.90 and a minimum of 20.60—average 20.76.

It will be noted that the percentage of oxygen in Subway air, as determined by Dr. Chandler, is a little less than that of normal uncontaminated air; there is, therefore, no excess of oxygen to be accounted for.

Among all that Mr. Tesla has said upon the subject, three charges besides that relating to alleged excess of oxygen perhaps call for reply in order that any part of the public which may have been disturbed by his statements may be reassured. These charges are: (1) That a mistake was made in not adopting polyphase induction motors; (2) that "not a single electrician of the General Electric or Westinghouse Companies was consulted," and (3) that "a mistake was made in not asking the electric companies to furnish the best instead of the cheapest equipment."

The last of these charges I answered in my letter of November 11, 1904. It is absolutely without the slightest foundation in fact. The management of the company aimed to secure the best system available, and no limitation in respect to cost was imposed upon its engineers. Apparently Mr. Tesla seeks to convey the impression that the polyphase induction motor system is more expensive than that adopted. As a matter of fact, the reverse is the case, the chief claim of the induction system residing in the fact that it is less expensive than the system which the Interborough Company has adopted. Several years ago, when tenders were submitted by manufacturers to the Metropolitan and District Underground Railways in London the induction motor system was proposed by Ganz & Co., of Budapest, and the price asked was approximately two-thirds the average price of the competing tenders, which were based upon the system which has since been adopted for the New York Subway.

The responsibility for decision in respect to the system adopted rests primarily upon me, but the plans were duly examined and approved by Messrs. Duncan and Hutchinson, consulting electrical engineers to the Rapid Transit Commission. As regards consultation with electricians and engineers of the General Electric and Westinghouse Companies, I have been in touch with the leading representatives of both companies from the outstart of this work up to the present time. Many of these gentlemen have contributed largely to the success of the installation and operation of the electrical equipment, and, so far as I am aware, are unanimous in believing that the best system available was adopted.

In support of his contention that a mistake was made in adopting the system which is in use, Mr. Tesla has offered simply an expression of his personal opinion. The polyphase motor system, as developed by Ganz & Co., of Budapest, undoubtedly has very strong points to commend it under certain conditions; and for what Mr. Tesla did in the early days of its inception the engineering world is under obligation, which in America has been fully recognized. Since certain United States patents were issued to him in 1888, however, he has done little, if anything, toward perfecting the motors, and still less toward the development of the multitude of other devices which in the aggregate constitute an electric traction system. Scott, Lamme, Steinmetz, Berg and others in Pittsburg and Schenectady have developed and improved the induction motor so that it is now extensively used in stationary work; but it has never been used in America for traction purposes upon any scale which would have justified its adoption by the Interborough Company. In Europe, within the last five or six years, the engineers of Ganz & Co. have developed it for traction purposes, and under certain conditions they have demonstrated its value in this field. Possibly this fact explains Mr. Tesla's recently revived interest in the motor of this type

In conclusion, I may mention the fact that the system adopted for the operation of the Subway and elevated is identical with that adopted in Paris for the operation of the Metropolitan, in London for the operation of the so-called "Twopenny Tube," the Metropolitan and the District Railways; in Brooklyn for the operation of the elevated lines; that it has been adopted by the engineers of the Pennsylvania Railroad, the Long Island Railroad and the New York Central & Hudson River Railroad, and is largely used throughout America for the operation of interurban railways. The induction motor system, as supplied in Europe by Messrs. Ganz & Co., is beyond question an operative, and in many respects most excellent system. Hitherto, however, American manufacturers have not placed such a system upon the market. I think I am safe in saying that at the time when Mr. Tesla thinks the induction motor should have been adopted in the Subway not a single motor of this type was in use in America for traction purposes.

Municipal Trolleys in Glasgow and Private Ownership in Boston.

One of the most critical and exhaustive comparisons between municipal trolleys and private trolleys is that made as follows by Mr. Hayes Robbins in the *American Journal of Sociology:*

Suppose, for example, the comparison is made between the Glasgow experiment, which is decidedly the most favorable for municipal ownership that could be taken, and the Boston system, which, if it is indeed the best in the United States, has many a close second so far as practical operation is concerned, whatever may be said of the general fiscal relations with the community. Of that more later.

Glasgow today has 139 miles of tramway, measured as single track. The population of the city is about 800,000, and in the financial statement and general account issued by the Tramways Committee the total population served, including the suburbs, is given as 1,000,000. The Boston Elevated Railway Company operates, as a unit, some 440 miles of elevated, subway and surface lines, and serves approximately the same aggregate population, including the suburbs. In other words, Glasgow has one mile of track for every 7,200 of population, in round numbers; Boston, one mile for every 2,270. The Glasgow system in 1902-3 carried 177,179,594 passengers; the Boston company carried about 236,000,000 paying passengers, of whom 130,000,000 used free transfers, making 366,000,000 separate trips furnished. The average daily traffic is: Glasgow, 485,000; Boston, 1,000,000. The Glasgow rolling stock consists of about 680 cars of all kinds; the Boston company owns over 3,300. The average number of cars operated in one day in Glasgow is now about 450; in Boston, 1,300. Thus Boston operates one car for every 770 passengers carried each day; Glasgow, one car for every 1,077. This difference is reduced, however, by the fact that practically all the Glasgow cars are "double-deckers," seating from 50 to 55 passengers.

In summer the average seating capacity of the elevated and open surface cars on the Boston system is nearly, if not fully, equal to that of the Glasgow cars, and this with protection from the weather and without the delays and inconvenience in requiring passengers to climb to the roof. Double-deck cars were tried in Boston at one time, but abandoned because it was found impossible to handle heavy traffic with sufficient expedition; and it is chiefly on this account, in fact, that the street railway judgment of this country has been, on the whole, against the use of this type of rolling stock.

The Glasgow system, June 1, 1903, with 130 miles (measured as single track) represented a total capital investment of $13,405,024, or $103,115 per mile. The Boston system, including stock and bonds of leased lines, is capitalized at a little less than $44,500,000; and if to this be added the cost of the city-owned subway, on which cost the company pays interest and a liberal sinking-fund contribution, the total capital investment becomes, approximately, $48,500,000, or $110,227 per mile. There is no presumption of overcapitalization here, as compared with Glasgow, in view of the costly elevated and subway sections which form a part of the Boston service, and of the further fact that labor cost of construction in this country includes a wage rate practically double that of Scotland, and which is only partially offset by the superior skill and energy of our workmen.

The Boston system, with earnings of about $12,000,000 annually, pays a direct tax of seven-eighths of 1 per cent on gross earnings, a state corporation tax of about $16 per $1,000 of market value of the stock, and local taxes on its real property in the various municipalities through which its lines pass, ranging from $15 to $20 per $1,000 of assessed valuation, and in addition is required to remove snow and ice from and maintain the paving on the street surface occupied by its tracks. The interest which it pays on the cost of the subway is sufficiently in excess of the interest the city has to pay on the bonds issued for its construction to retire the bonds and make the subway the city's property free and clear in less than forty years.

The total of these taxes and service obligations and excess interest payment now amounts to upward of $1,550,000 a year, or nearly 13 per cent of the gross earnings. Glasgow, with a street railway revenue of $3,178,471, in 1902-3, paid into the "Common Good" $121,650, to which should be added the taxes which the municipality as a whole assesses upon the tramway property, amounting in 1902-3 to $88,488. A further addition should be made of $83,982, being the average annual payment by the Tramway Committee since 1894 into the sinking fund for reduction of the capital debt; these payments, of course, are profit to the municipality in that they give it that much clear interest in the property as an asset. The total of these payments which go to the public good is $294,120, or slightly over 9 per cent of the gross revenue. The Boston corporation, serving the same population as the Glasgow lines touch, pays to public benefit account more than five times the gross amount so paid by the Glasgow system, and 39 per cent more in proportion to earnings.

The question of fares cannot be considered apart from that of the amount of service furnished. What are the facts, then, as between Glasgow and Boston? Glasgow has a graduated scale of fares, ranging from 1 cent for a little over half a mile to 8 cents for 9 miles. The standard 5-cent fare in this country takes a passenger 5.8 miles in Glasgow. Needless to say, the confusion and complications of such a system, for the varying distances traveled, would prohibit it from meeting the demand for the utmost possible expedition on our large American city transit systems. Even more serious is the increasing rate of penalty it imposes upon the wide distribution of traffic, and hence upon the building up of workingmen's homes in the suburbs.

In Boston the uniform fare is 5 cents, and by means of the free-transfer privilege it is possible for this sum to ride from one end of the system to the other, fully 20 miles. Wage-earners and clerks employed in the business districts can live eight to nine miles out and ride to and from their homes for 5 cents, while the Glasgow "suburbanite," to travel equal distances, if the lines extended that far, would have to pay 7 and 8 cents, respectively. A journey of 15 or 16 miles out from central points in Boston, by connection with outlying suburban lines, may be taken for 10 cents, and 20 to 25 miles for 15 cents. The same distances under the Glasgow rates would cost 13, 14, 18 and 22 cents, respectively.

The short ride and congested district character of the Glasgow service must be borne in mind in connection with the fact that the average amount received per passenger, based on the returns of annual earnings, is a little less than 2 cents. In Boston, counting the free transfer passengers, it is about 3¼ cents. But what is the effect of the sliding scale on Glasgow traffic? Simply that the great bulk of the travel consists of short rides within the city limits. Thirty-six per cent of the passengers pay one-cent fares; that is, ride only half a mile; 56 per cent pay the two-cent fare, covering 2.33 miles; only 8 per cent pay fares of 3 cents and upward; in other words, only 8 per cent make journeys of more than 3.5 miles.

To be even more explicit: The most distant suburban point to which the Glasgow tramways extend is Paisley, 6.95 miles. To get there costs 6 cents, or 7 from the center of the city. The next farthest point is Clydebank, 6.39 miles; fare, 6 cents. Three other suburbs are between four and five miles, and one about three and a third. From Park Street Station, Boston, a passenger may ride 9.53 miles to Arlington Heights for 5 cents; 9.83 miles to Charles River Bridge; 8.23 miles to Arlington Center; 8 miles to Waverley; 7.9 miles to Melrose line; 7.36 miles to Milton; 7.3 miles to Neponset; 6.32 miles to Woodlawn, and 6.04 miles to Lake Street, and the uniform fare for any one of these journeys, or for any two of them in combination, through free transfer, is 5 cents.

The Glasgow system is not doing what it might and ought toward relieving the terrible congestion of workingmen's families huddled within the cramped distance limits. That the need of such distribution is great appears from the fact that more than 30 per cent of the families in Glasgow, according to an investigation made a few years ago, were living in single rooms, as compared with about 1½ per cent in Boston.

But there is yet another most important consideration entering into this matter of fares—the question of wages. The relation of wage-rates paid to the average fare charged is twofold.

First, wages are by far the largest item of operating expenses, and, as between two systems using substantially the same traction methods and carrying approximately the same number of passengers per car, the one paying the higher wages must necessarily charge a higher rate of fare. If the system paying the higher wages also operates more lines and furnishes a larger number of cars for the amount of traffic handled, all the more reason why the rates of fare must be higher.

Both Glasgow and Boston use the system of electric traction. Boston operates more than three times more track, and runs 40 per cent more cars in proportion to traffic. How about the wages? The pay of motormen and conductors in Glasgow ranges from 97 cents per day during the first six months to $1.22 after three years of service. In Boston surface-car conductors and motormen receive $2.25; elevated motormen, $2.30 the first year, $2.40 the second and $2.50 the third; brakemen, $1.85; guards, $2.10; while all these employes receive 3 cents per day additional after five years of service, 10 cents after ten years, and 15 cents after fifteen years. These rates are about double those paid in Glasgow.

From the operating standpoint, therefore, whether it be in respect to wage expense, trackage operated or amount of car movement, or all three, as is actually the case, there is abundant reason for higher average fares per passenger carried on the Boston system.

The second respect in which the wage matter relates to fares charged brings in the question of purchasing power. The differences between Boston and Glasgow street railway wages reflect similarly wide differences between the general "run" of American and Scotch wages all along the line—not so great in some cases, of course; in others greater. It is one of the truisms of economics that prices are to be considered high or low; not absolutely, but solely with reference to the purchasing power of the community, and in a community where wages are practically double the rates prevailing in another an average fare of 3¼ cents would be, if anything, somewhat cheaper than one slightly under 2 cents in the other; at least, so far as concerns the army of wage-earners and clerks, and their families, who constitute the great majority of the patrons of any urban transportation system and are the people to whom the matter of rates and service is of chief importance.

It may be urged, as accounting for some of the relative advantages of the Boston system, that it is surrounded on all sides by "feeder" electric roads which deliver passengers from an area including a considerably larger population than is brought into touch with the Glasgow lines. The fact is, however, that the bulk of the business from this wider area is handled by the suburban service of the steam railroads. Hundreds of trains each day, in and out of the two great terminals in Boston, accommodate an immense traffic, and not only from outlying points, but from stations directly within the territory of the Boston elevated, and in constant competition with it; so that the accounts are probably square in this respect. As a matter of fact, the proportion of traffic on the Boston Elevated Company's lines which does not originate within its own territory, compared with the total business, is small.

The reasonable deduction from these somewhat extensive comparisons seems to be that, while public ownership and operation of street railways, under the favorable civic conditions of British municipalities, in most cases give a better and cheaper service than was afforded by the various private corporations it supplanted, even this improved service is relatively meagre in extent and usually of mediocre quality, compared with American experience, and that the municipalized enterprises would break down entirely if subjected to any such tests as are commonly required under American conditions.

Glasgow was selected for comparison, as already observed, because it makes the best showing for municipalization, probably, to be found anywhere. In other British experiments results are less favorable, some of them markedly so; but in few of them have the facts ever been presented with sufficient clearness and fairness to warrant any very precise comparisons. The experiment of the London County Council in constructing electric lines in the south of London is a case in point. It appears that in 1899 the Council's experts estimated the expense of this undertaking at about $1,242,000. It has only recently been completed and proves to have cost some $4,800,000. In consequence of this excessive expenditure there seems to be a fair prospect, according to the chairman of the Finance Committee of the County Council, that the expenses and charges against these lines will exceed the income and the deficit will have to be added to the tax budget.

The Boston Electrical Show.

The executive committee of the Massachusetts Association of Electrical Contractors held an important meeting, June 22, at which reports were made showing that details of the fifth annual convention of the National Association of Electrical Contractors have been perfected. The exposition will open in Mechanics Building, Saturday evening, July 15, with a musical programme by Reeve's American Band, which will also give concerts throughout the week. A large and efficient reception committee will be at headquarters and will meet the specials due from New York and the west. The open session of the convention on Wednesday will be a notable event. Addresses of welcome will be delivered by F. L. Barnes, president of the Massachusetts State association; by Governor Douglas in behalf of the State, and Mayor Collins in behalf of the city. E. McCleary, of Detroit, Mich., president of the National Association, will then deliver the annual address, after which will come addresses and topics as follows: "The Electric Contractors' Association," by Charles L. Eidlitz, of New York, ex-president of the National Contractors' Association, and ex-president of the Building Trades Association of New York; "The Jobbers." by A. L. Gorman, of New York, general manager of the Manhattan Electrical Supply Company; "The Manufacturers," speaker to be announced; "The Underwriters," by F. E. Cabot, of Boston; "The Relations of Inspector and Contractor," by P. J. Kennedy, of Boston, commissioner of wires. There will also be other prepared addresses and general discussions.

An executive session of the National Association will be held Wednesday afternoon, and the annual dinner to the members of the National Association will be given in the evening. Thursday forenoon will be devoted to a session of the association and at 2.30 p.m. delegates and guests will embark at Rowe's Wharf for a steamer trip down the bay, dining at the Rockland House, Nantasket, and visiting Paragon Park in the evening. Friday will be devoted to executive sessions of the National Association and Saturday will be given up to sight seeing and entertainment.

A ladies' committee of thirty has been appointed to have charge of the entertainment of the lady guests of the association. Concord, Lexington, Bunker Hill, Harvard College and other historic and interesting places will be visited and an extended auto trip will be taken along the picturesque North Shore. Side trips for sight seeing and shopping will be made daily. Delegates have already been reported from 39 States.

Following is a partial list of those exhibitors who have secured space: American Electric Novelty Manufacturing Company, New York; American Circular Loom Company, Chelsea, Mass.; *American Electrician*; American Electric Contractor Company, American Electric Sign Company, Boston; Automatic Electric Train & Station Annunciator Company, Lexington, Mass.; Appleton Electric Co., Bridgeport, Conn.; Booth & Co., Boston; Bryant Electric Company, Bridgeport, Conn.; Benjamin Electric Company, New York; Bova, L. E., Boston; Couch & Seeley Co., Boston; Cotton, Chas. A., Boston; Chase-Shawmut Company, Boston; Condit, S. B., Jr., Electrical Company, Boston; Dale Company, New York; De Veau Telephone Company, New York; Dossert & Co., New York; Delaware Hard Fibre Company, Wilmington, Del.; Dorn, Philip, Boston; Electric Gas Light Company, Boston; Economical Electric Lamp Company, New York; Eastern Carbon Works, Jersey City, N. J.; Electro-Dynamic Company, Bayonne, N. J.; Edison Electric Illuminating Company, Boston; Eastern Electric Cable & Wire Company, Boston; ELECTRICAL WORLD AND ENGINEER, New York; *Electrical Review*, New York; Elm City Engineering Company, New Haven, Conn.; Erickson Electric Equipment Company, Boston; Forg, Peter, Somerville, Mass.; Felkin, A. C. & M. L., Boston; Gleason, John L., Jamaica Plain, Mass.; General Electric Company, Schenectady; Gould Storage Battery Company, Boston; Greenwood & Daggett Co., Boston; Homes Manufacturing Company, New York; Harvey Hubbell, Bridgeport, Conn.; Hill, W. S., Electric Company, New Bedford, Mass.; Johnson & Morton, Utica, N. Y.; Johns-Manville Co., H. W., New York; Knowlés, C. S., Boston; Lowell *Daily Mail;* McKenney & Waterbury Co., Boston; Mullen, Colman J., Brooklyn, N. Y.; Manhattan Electrical Supply Company, New York; Minimax Company, Boston; Marshall Electric Manufacturing Company, Boston; Miller Anchor Company, Norwalk, O.; National Carbon Company, Cleveland, Ohio; Ovington Manufacturing Company, Boston; Pass & Seymour, New York; Pettingill-Andrews Co., Boston; Proctor-Raymond Manufacturing Company, Detroit, Mich.; Poole, J. W., Columbia Street, Boston; Renim Specialty Company, Boston; Ridgeway Dynamo & Engine Company, Boston; Roebling, John A. Sons Co., New York; Steel City Electric Company, Pittsburg, Pa.; Safety Armorite Company, New York; Sprague Electric Company, New York; Smith Premier Typewriter, Boston; Swazey & Smith, Boston; Stuart-Howland Company, Boston; Simplex Electric Company, Boston; Starbuck Sprague, Boston, Mass.; Street Railway Bulletin, Boston; Trumbull Electric Manufacturing Company, Plainville, Conn.; Valentine Electric Sign Company, Atlantic City, N. J.; Westinghouse Electric Manufacturing Company, Boston; White, O. C. Co., Worcester, Mass.; Wireless Railway Company, Philadelphia; Y. M. C. A., Boston.

Convention of New York State Street Railway Association.

The annual convention of the New York State Street Railway Association was held June 27 and 28 at Fort William Henry Hotel, Lake George. The meeting was a successful one and much interest was shown in the exhibits displayed, this feature assuming this year more than usual importance.

The "Question Box," edited by Mr. C. B. Fairchild, Jr., comprised 144 pages, and about 50 questions on practical subjects received answer. The greatest amount of space is occupied by subjects of a general managerial and operating character. Next came mechanical subjects, 34 pages; power house, 17 pages; line department, 17 pages; track department, 18 pages. Questions and answers in the department of advertising indicate the importance that this subject is assuming with street railways. A great diversity of opinion, however, was shown as to the methods of advertising. As in the case of the "Question Box" of the National Electric Light Association, there is, in fact, little concensus of opinion on any subject, the reason doubtless being that local conditions, both physical and with relation to policy, vary so much as to require most questions to be settled on the merits as they appear in a special case. There was, however, considerable unanimity of opinion that fares on suburban lines should be based on mileage; the suggestions as to the proper rate per mile ranged from one cent to two and one-half cents, but the majority were in favor of one and one-half cents. As to the amounts that should be laid aside for claims, the recommendations varied from one per cent to six per cent.

Mr. Henry W. Blake presented a paper entitled "Contrasts Between Company and Municipal Ownership and Management of Public Utilities," which gave an excellent discussion of the question. The difference of the conditions affecting municipal ownership as they exist in this country and Europe were pointed out and it was shown how American railways under private ownership give a vastly better service than British roads. Since in the municipalization of American street railways the present owners would have to be fully compensated, the question resolves itself entirely into one of public policy as to whether or not a better and cheaper service would be rendered under municipal ownership; whether the policy of constantly extending facilities could and would be continued; whether the financial burdens involved would be more equitably distributed than now, and, above all else, whether there would not be introduced into our American political system a corrupting influence and power for evil far greater than any encountered in past American history. The paper discusses in full these several questions, much statistical information being given. The conclusion is that this country should not embark in municipal railway ownership unless there be probable some great compensating advantages not yet apparent from European experience with municipal ownership and management of public utilities.

Dr. P. H. Peck presented a paper entitled "Uniform Standards of Examination of Railway Employes," in which he gave instructions in detail for testing vision, color, hearing and state of physical health.

Mr. J. Harvey White, in a paper entitled "Publicity," gave an account of the advertising methods pursued by the Boston Elevated Railway Company.

Mr. J. N. Shannahan, in a paper entitled "Types of Interurban Cars," described two of the types of cars in service on the Fonda, Johnstown & Gloversville Railway, pointing out their advantages and disadvantages for that service.

High Potential Surges.

Dr. Steinmetz, in discussing his own and Mr. Thomas' paper, at the Asheville meeting of the American Institute of Electrical Engineers, stated that there existed undoubted evidence that the arc is self-rupturing; that is, it mends itself in the extreme suddenness, and the potential at mending may be greater than the striking voltage. After the arc mends itself it immediately ruptures again, and it then becomes an oscillating arc. The frequency of oscillation is determined by the capacity and the inductance, and not by the frequency of the electromotive force. If a condenser and an induction coil be placed in series with each other, by means of a spark gap an oscillating current may be produced in the system even when the supply electromotive force is continuous. One of the conditions under which an arc becomes self rupturing is that the voltage exceeds the striking distance of the arc and that the flow of current in the arc causes the potential difference at the arc to drop practically to zero, and remain at zero a very short time after the arc has ruptured. Therefore, in experimenting with the arc in a circuit containing resistance in series and no capacity, the arc is not oscillating or self-rupturing, and cannot be made so, because simultaneous with the mending of the arc the voltage rises and so prevents the arc from rupturing. When high-frequency oscillations are produced by shunting the arc with capacity and inductance in series the length of time the arc exists is the time required by the charging current of the condenser to heat the air sufficiently to cause an explosion, and also to discharge the condenser and allow the voltage to drop to zero. The period of the zero current is the time required for the condenser to be recharged by the voltage from the inductance. The frequency of the oscillating arc can, therefore, be varied by varying the inductance, the capacity or the length of the spark gap, all three elements entering into the determination of the frequency. The phenomena become more complicated where, instead of localized inductance and capacity, there are distributed inductance and capacity as in cables. In favor of the explanation of the oscillating arc here given may be stated the fact as observed by Mr. Stott that short circuits were always preceded by grounds on the lines and by static displays. If the explanation is correct, and if the e.m.f. reaches 100,000 volts, and the current is as large as 9,000 amperes, there is no possibility of insulating and protecting against these surges. The only course to pursue is that taken by Mr. Stott in avoiding the cause of the surge and eliminating the continued occurrence of the spark discharge between the conductor and ground by disconnecting with the regular automatic circuit breaker, that particular cable in which the spark first appears before the damage can spread farther and produce high-power, low-frequency surges.

◆

Restriction of Right to Telephone Service.

The Appellate Division of the New York Supreme Court for the Second Judicial Department in an opinion recently rendered confirmed the decision of a lower court supporting the New York Telephone Company in its refusal to render a telephone service in a case where there was a suspicion on the part of the police authorities that it was to be used for pool selling purposes. The applicant for the writ of mandamus refused was the proprietor of a cigar shop, in which several persons had been arrested by the police upon the charge that they were engaged in the business of selling pools on horse races. The applicant insisted that he was not chargeable with knowledge of these transactions, but the court held that it seemed improbable that he did not know what was going on. A point upon which the court laid much stress was that the applicant refused to write a letter to the telephone company, stating that he would not and did not intend to use the telephone for illegal purposes, and would not give the company a reference. It held that this did not seem to be an unreasonable requirement, particularly in view of the fact that the New York Telephone Company had been informed by the police department that the premises had been used as a pool room, and that it was also aware that a telephone which it had previously installed therein had been removed by the police. Consequently the officers of the company might not unreasonably pprehend that they would render themselves liable for aiding and betting a violation of the law if they furnished further telephone service on the premises.

Resolutions on Death of S. P. Sheerin.

The resolutions adopted by the National Interstate Telephone Association on the death at the post of duty of Mr. S. P. Sheerin refer in high terms to his character and ability. In the entire field of telephony, they state, a more conspicuous champion of the independent movement, a more zealous laborer for our common cause and mutual good, could not have been found. "He knew no season. At all times and in all places he proved his devotion to the independent telephone interests; and so faithful and unremitting were his efforts that it may be truthfully said he died in the harness—in the very act of appealing to the greatest constituency on earth—the American people—for our just rights and a square deal.

"He was a man of fertile resources and deep usefulness. The son of a mechanic and himself a laborer over the anvil, in his father's shop, he early demonstrated his skill and ability. His associates and neighbors, impressed by his faithfulness and worth, chose him to fill one of the important offices, that of recorder in Cass County, Ind. From that he was promoted to the more noteworthy position of clerk of the Supreme Court of Indiana. But meanwhile his reputation had grown beyond the confines of his State, and in 1888 he was selected and served until 1896 as the secretary of the Democratic National Committee. In whatever station he occupied, to whatever post he was chosen, he demonstrated that he was in every case equal to the demand. His rise in and his successful civic career are admirable illustrations of the great possibilities that lie within the reach of the Amercan youth endowed with a clear head, a brave heart and a strong right arm.

"His private life was clean. His habits were above reproach. Always genial and affable, he was none the less, when occasion demanded it, brave, assertive and tenacious. He was generous and forbearing and his heart overflowed with sympathy for others whom sorrow or misfortune had overtaken. But above all things he was loyal and true. Once admitted to his friendship, he bound you with bands of steel. Nothing could make him do a dishonest act or join with others in a questionable transaction. He held that the faith and trust of his friends were dearer to him than money or any kind of preferment.

"In his death independent telephony has suffered an overwhelming and incalculable loss. Were he living he would still be with us shoulder to shoulder in the great struggle for fair competition and clean, wholesome business methods."

◆

Chicago's Civic Federation Against Municipal Ownership.

The Civic Federation of Chicago at its recent biennial meeting adopted a sharp report against the municipal ownership "frenzy" and said:

"When the city council legislative committee undertook to draw a bill, which, when passed by the general assembly, would give the city the right to increase its bonded indebtedness," said the report as adopted, "it was hoped that the bill would include all reasonable restrictions with respect to the annual increase in the bonded indebtedness and with respect to the character of permanent improvements to be purchased by the proceeds of the sale of such bonds. Not only were safeguards of every kind omitted, but the city council asked for the right to become indebted in a sum equivalent to 5 per cent of the full value of taxable property, and it is also asked in the same bill for the right to manufacture and sell gas and electricity for light, heat and power, and also for the authority to engage in the telephone business.

"The bill as approved by the city council in so many words asked the general assembly for the right to increase the debt of Chicago $45,000,000, and gave notice that this amount—all, or a portion of it, as the wisdom of the council might dictate—might be used, not for permanent improvements, such as schoolhouses, pumping stations, and so forth, but to build gas works, electric lighting stations, telephone exchanges, street railways, etc. The measure fairly represented the sentiment of a portion of the Chicago press and a considerable portion of the Chicago people who are outspoken in favor of municipal ownership, but in the judgment of the Civic Federation it was not a measure which the business community or any thoughtful citizen could possibly indorse.

"The executive committee is unanimously opposed to municipal operation of public utilities, and it regards municipal ownership of any of them under present conditions as impracticable. It does not feel that in the nature of things the city can possibly be successful in the management of any of the so-called public utilities.

"The city has had the management and control of the water department and the electric system for lighting for a good many years, and it cannot be said that, in connection with the water department, at least, it has been successful. More than half of the entire output of the pumping stations is sold on what is known as a flat rate, and is not metered. The flat rate system of selling water is extravagant, wasteful and unfair alike to the city and to the consumer. The rate for water in Chicago is supposed to be about 8 cents for each 1,000 gallons. Last year Chicago pumped 137,515,751,956 gallons. The receipts amounted to 2¾ cents a thousand gallons. If 8 cents for each 1,000 gallons is a fair charge, and if the present service is laid out on a basis of 8 cents for each 1,000 gallons, it is plain that two-thirds of the water is being wasted. We feel that in the reorganization of the pumping, the distributing and merchandizing of the water alone the present administration has a tremendous problem on its hands, which will take considerable time to work out."

The report began its reference to the city electric plant by saying: "The plant has been in operation some fifteen years. It has been successfully and satisfactorily managed throughout. The cost of operating the 5,000 arc lamps owned by the city, adding interest and depreciation, together with the loss of taxes and other proper charges, is in the aggregate $625,000 per annum. On a contract running for a long period with a private corporation the same service doubtless can be had at from $400,000 to $450,000 per annum. As an illustration of the difficulties of municipal ownership and operation the following statement from the report of the electric department, 1904, is interesting: 'It seems impossible to make any substantial reduction in the total cost because of the constantly increasing cost of labor. The average rate of pay to employees is far above that paid by private corporations for the same class of work.'

"Further testimony as to the difficulty of operating the municipal plant, from the standpoint of labor, is in the experience of the department within the past few weeks when it has been compelled to put the wages of lamp trimmers at a uniform price of $75 a month regardless of the character of the work done by the trimmer or the length of his experience in that kind of work.

"The Civic Federation maintains, therefore, that in the management of the two classes of service referred to, the city has not been so successful that it can either expect or claim the right to be permitted to go into the street railway business, the furnishing of telephone service or the manufacture and distribution of gas or electricity."

CURRENT NEWS AND NOTES.

INDEPENDENT TELEPHONE SIGN.—The distinctive Independent telephone sign adopted at the recent convention of the National-Interstate Telephone Association consists of a shield in red, white and blue with a white circle surrounded by a solid blue field.

CORRECTION OF ERROR.—In the article in our issue of June 17 by Mr. Clarence P. Fowler, entitled "External Reactance for Synchronous Converters," the captions of Fig. 3 and Fig. 4 were interchanged. Fig. 3 refers to leading, and Fig. 4 to lagging, current, instead of the reverse, as indicated by the captions.

ELECTRIC ORE SMELTING.—It is stated that the Dominion government has appropriated $15,000 for the purpose of making experiments with the electric process of smelting ores and manufacturing steels. The experiments will take place at the plant of the Consolidated Lake Superior Company, which concern will supply 400 hp for four months without charge.

THE BARNARD MEDAL has been awarded this year by Columbia University, New York City, to Henri Becquerel, of Paris, France, in recognition of his important discoveries in the field of radio activity and for his discovery of the dark rays from uranium. The award comes once in five years, and has been made on the nomination of the National Academy of Sciences.

"ENGINEERS IN AMERICA."—Mr. Ernest C. Brown, editor and publisher of *Progressive Age*, who is issuing the biographical work entitled "Engineers in America," reports encouraging advances toward completion. He has already received data from 2,000 engineers, and expects details from or in regard to the majority of some five or six hundred more. The work of editing is now in hand.

FRENCH CABLE IN VENEZUELA.—The picayune president of Venezuela now claims that he holds evidence to prove that the French Cable Company aided General Matos in his recent revolutionary schemes and actions, and he is trying to prove that it has failed to carry out the terms of its cable concessions. This sounds like a new plan for exacting blackmail and embroiling the nations.

WIRELESS IN SOUTH PACIFIC.—The International Telegraph Construction Company is said to have submitted a scheme to the Postmaster-General of Australia for the erection of wireless telegraph stations linking New Zealand and Australia direct, and also via Tasmania or Lord Howe and Norfolk Islands, and establishing communication between Queensland and Port Moresby and Samari, in Papua.

NEW SOUTH AMERICAN CABLE.—The Central & South American Telegraph Co. has contracted with Siemens Bros. & Co. of London for the laying of a duplicate cable between Chorillos, Peru, and Valparaiso, Chili, touching at Iquique. The contract stipulates that the cable be laid and in operation before March 1 next. Its cost, with new instruments and apparatus required, is estimated at $988,000.

LECTURES AT UNIVERSITY OF MINNESOTA.—The closing non-resident lectures before the electrical engineering department of the University of Minnesota were given by Mr. Benjamin Waller, chief engineer of the Northwestern Telephone Company; Mr. A. L. Rohrer, electrical superintendent of the Schenectady Works of the General Electric Company, and Mr. Chas. L. Pillsbury, consulting engineer, St. Paul. Mr. Waller discussed the growth of the telephone business since its beginning in 1876, showing the intimate relations between the engineering and economic problems in telephony, and the importance of a thorough knowledge of human nature. He emphasized the possibility and the desirability of good engineering in telephony. Mr. Rohrer showed a large number of views of the works of the General Electric Company, and explained the operation of its student apprentice system. Mr. Pillsbury discussed the importance of the "Electric Motor in Modern Industries," showing the reasons for its rapid adoption in shop driving, its convenience and economy being of no less importance than the ability to arrange a factory with reference to the most economical handling of material. Numerous slides illustrated the use of the motor in various industries, special attention being given to the advantages of variable-speed motors.

THE GOVERNMENT AND WIRELESS.—A special dispatch to the New York *Tribune* of June 24 says: "The wireless experts of the government are applying themselves with energy to the problem of getting rid of the influences which are destined to interfere with that form of communication in time of war, or at least to prevent secret exchange of messages. There have been many assurances that this would be possible by means of special devices used, but it is found that the wireless stations along the coast obtain many messages, in whole or part, which are not intended for them. Thus, at the Washington Navy Yard recently there were received messages evidently being exchanged between ships in distant Southern waters. There is nothing to account for this irregularity in the action of the messages; so much depends upon the wave influences. At the same time, it is realized that something must be done toward a regulation of the wireless communication. Much may be accomplished by governmental control, but this may not be possible, now that the wireless companies are fully organized and have sold stock to people who may feel that their interests would not be helped by legislation along the lines suggested by the special joint board of which Rear Admiral Evans was the senior member. There is also much to be obtained from an international discussion of the subject, but this appears to be out of the question during the war between Russia and Japan and until the British and Italian governments adjust their relations with the Marconi people."

TORONTO BRANCH OF THE INSTITUTE.—The following-named officers were elected at the recent annual meeting of the Toronto branch of the American Institute of Electrical Engineers: H. A. Moore, chairman; R. G. Black, vice-president; R. T. MacKeen, secretary. Executive committee: W. A. Bucke, J. A. Price and K. L. Aitken.

ELECTROTECHNICAL INDEX.—The Association Presse Technique, 1 rue de Musée, Brussels, Belgium, has added to the several indexes which it prints, a monthly electrotechnical index in English and French, printed on only one side of a sheet for card index purposes. The subscription price is $1.00 per annum, and a specimen copy will be sent free upon application.

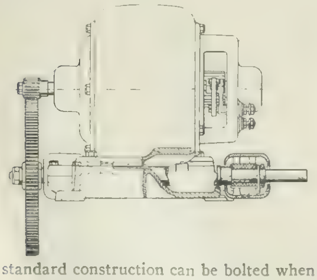
MARCONI AT POLDHU.—Signor Marconi is at the Poldhu, England, station supervising the installation of apparatus which is practically a duplicate of that installed at Glace Bay, Nova Scotia. The Canadian station, it is said, will be completed in a very short time, and interests of the Marconi Company declare that this warrants the belief that transatlantic service will be established in the near future.

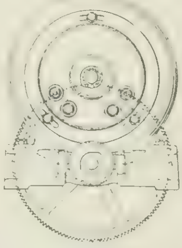
NEW YORK LIGHTING COMMISSION.—The Governor of New York has nominated three men for the new State Lighting Commission. The salary is $8,000 a year each. The nominees are Messrs. James R. Sheffield, of New York City; B. B. Shedden, of Plattsburg, and John C. Davies, of Camden, Oneida County. None of them has any technical acquaintance with the subject, but all are well known in politics, particularly Mr. Sheffield, who was formerly fire commissioner of New York under Mayor Strong. It is not yet sure that all will accept and be confirmed. Mr. Sheffield is understood to have declined.

CHICAGO'S MUNICIPAL RAILWAYS.—A despatch from Chicago says: It begins to look as though the traction question with its side issue of municipal ownership will outlast the term of Mayor Dunne. The whole plan of sale to the city hinges on the result of the legal contest as to the value of the 99 year act. Until the Supreme Court has passed on this measure the value of traction stocks and bonds cannot be estimated. Pending this long delayed decision the city can take a minor hand in running the companies and cost of improvements will be added to the final bill when municipal ownership obtains.

GOVERNMENT CONTROL OF ELECTRIC POWER.—Government ownership of the Canadian Niagara Falls power and the transmission lines in connection therewith, is the bold enterprise that many prominent citizens of Ontario expect to see carried out by the new local government of the province. The report of the commission appointed by the municipalities of Ontario lying within a hundred miles of the falls, to inquire into the best means to be adopted to secure cheap power, will be made public shortly, and sufficient has been let out to warrant the statement that the commission will recommend that the government make the development and transmission of power a public enterprise.

COUNTERSHAFT FOR MOTORS.—In order to eliminate the need of special frames for such motors as are to have countershafts, Mr. E. R. Douglas, according to a patent issued June 20, proposes to mount the countershaft on a special bedplate to which a motor of standard construction can be bolted when desired. When this design is used it becomes unnecessary for manufacturers to carry in stock entire motors constructed both with and without countershafts.





HISTORY OF THE TROLLEY.—One of the best popular technical articles seen in a long time is that by Mr. Frank J. Sprague on the American electric railway and trolley system, in the *Century Magazine* for July. The first part appearing in that issue is a brilliant and fascinating narrative of great achievement in an industry on which the American public now spends $300,000,000 every year in fares. Mr. Sprague's article is admirably illustrated with sketches and with portraits of his leading contemporaries in the same special field of work. It is understood that this notable article is one contribution in a series of an autobiographical nature, to which Mr. C. F. Brush has already contributed one on the arc lamp. When complete this series if maintained at its present high level of interest and value should be put into book form.

TAXES ON ELECTRICIY.—A special dispatch from St. John's, Newfoundland, of June 11 says: "Premier Bond, in the Legislature yesterday afternoon, announced plans for raising increased revenue. He said the Canadian Marconi Company had established three wireless stations in Newfoundland without authority, and the Colonial Government believed they were now doing commercial business with the Marconi stations at Cape Cod, Cape Breton, and passing steamers. Therefore the Government proposed to tax these stations $4,000 each if satisfied that such business was being done. The Premier also stated that it was not the intention of the Government to tax the Anglo-American Cable Company for more than five Atlantic cables at $4,000 each, as the extensions to the Canadian Continent were regarded as part of the same cables."

RADIUM AND NEW LIFE.—A special cable dispatch of June 24 to the New York *Evening Post* says: "The greatest interest has been excited by the discovery of Prof. John B. Burke, of the Cavendish laboratory, which may be summarized thus: After years of negative experimentation on the phosphorescence of cyanogen, which Pfluger declared to contain the element of life, Mr. Burke resolved to test it with radium, and placed it in the test tube with sterilized bouillon. After a couple of days cultures were obtained of atoms which subdivide on reaching a certain size. Placed upon fresh portions of sterilized bouillon, these growths continue to grow slightly, thus showing that the influence of the radium is only initiatory. Prof. Sims Woodhead pronounced them neither bacteria nor crystals; but they present many appearances of vitality and seem to indicate the possibility of spontaneous generation. Mr. Burke contends that the experiment is not in the least destructive of the Deistic conception of the universe. 'In fact, if it can be shown that dust and earth can produce life, on account of their radio-activity, it would only confirm the truth of Biblical teaching.' Leading men of science maintain an attitude of reserve as to the vitality of Professor Burke's radiobes."

PURIFICATION OF WATER.—Mr. R. Guenther, U. S. Consul-General at Frankfort, Germany, says: "The *Frankfort News* states that it is probable that electric purification of drinking water will soon be introduced into the home. This method, already used by a number of municipal waterworks, is based upon the germ-killing effects of ozone, which is cheaply engendered by electricity. If an electric discharge takes place between two glass tubes, one inside the other, whose surfaces facing each other are coated with metal, ozone is developed in the space between the tubes. Electricians have tried in recent years to simplify the means of electric ozone development for purifying water. The ideal apparatus would be one which every housekeeper could put up in the kitchen, and by utilizing the electric current of the common electric light wires purify every glass of drinking water. According to the *Frankfurter Umschau*, such an apparatus seems to have been successfully made by a French engineer, Mr. Otto. This apparatus is of very simple construction and takes up little space. It consists principally of a small, closed box, the metal cover of which is made conductory with the bottom. In the box is an ozone developer, an interrupter, and a tin tube. Through the later the ozone, which first has to pass through a cotton stopper to free it from dust and germs contained in the air, is conducted into the water and mixed therewith. If much ozone has been absorbed, the water becomes phosphorescent in the dark. The most important part of the apparatus is the "mixer," action of which can be interrupted at will. The apparatus is capable of purifying about 60 gallons of water an hour, and the cost per hour is about the same as that of an ordinary electric incandescent light."

MEXICAN 30,000-VOLT PLANT.—The electric lighting plant at Morelia, state of Michoacan, Mexico, has been purchased from the state by Messrs. Ibarralo, Gonzales y Ca, and will be known hereafter as the Sociedad Moreliana de Fuerzo Hidro-Electrica. The new company is now installing a plant about 24 miles from the state capital, utilizing a water power of 800-ft. head and capable of generating 1800 horse-power. The transmission will be at 30,000 volts, three-phase. The new plant will be put in operation about August 1.

STARTER FOR VAPOR LAMP.—In a patent issued June 20 to Mr. W. R. Whitney is disclosed a novel form of electrode of a vapor lamp combined with means for producing an arc in the vapor. The active material of the electrode is mercury, but in order that it may be rendered capable of being acted upon magnetically, a small amount of iron is added thereto. A carbon filament extends from the top electrode nearly into engagement with the bottom electrode of iron amalgam. An electromagnet serves for banking the fluid amalgam electrode until it comes into contact with the carbon filament. When current flows through the filament a switch, operated by the current, opens the circuit to the magnet coil, and the amalgam resumes its former level and an arc is started in the vapor. This arc extends instantly along the filament to the upper electrode.

ARTIFICIAL RESISTANCE.—It has been found in practice that when resistance rods are made of carbon dust with some binding substance, some of the rods, which are to all appearances identical with others, may differ in resistance by 75 per cent. or more. In a patent issued June 20 to Mr. W. R. Whitney, it is stated that the conductivity resides very largely in the surface coating of the rod. When this coating is removed the conductivity is largely reduced, and the resistances of the rods become almost uniform. The inventor proposes to remove the surface coatings of carbon dust by exposing the rod to an intense heat in the presence of air. When rods thus formed are provided with a moisture-proof coating, they become especially advantageous for use in lightning arresters, on account of their high resistance and because of the fact that they are not subject to permanent alteration of conductivity by heat.

TIME OF STARTING A STEAM TURBINE.—At the recent Scranton meeting of the American Society of Mechanical Engineers, Mr. A. S. Mann, of Schenectady, presented a paper giving the result of observations on the time required to start a Curtis steam turbine. The turbine is of 1500 kw. capacity, condensing, of course, and supplied from boilers which also supply steam for other purposes; upon starting up the turbine it is necessary, however, to pass from the condition of slow fires to forced fires. The time observed was that from sounding a whistle calling a scattered force to stations, to the time when the turbine was cut into circuit. Three or four pumps must be used in starting off each pair of turbines, and also an exciter driven by a small steam engine. The record book shows that of 43 calls for sudden starting up, 10 starts were made in 2½ minutes, 18 in three minutes and 15 in 3½ minutes. In a number of instances when all of the auxiliaries were in motion, the turbine was started and connected to line in from 45 seconds to 1½ minutes. Two starts in 45 seconds were made on the turbine when it had stood for 24 hours with the throttle valve shut, but with a slight leakage past the seat. After the throttle valve is off its seat it does not require more than 30 seconds to bring a turbine up to speed. The author states that to start a large steam engine from cold state requires from 12 to 15 minutes and from a hot state 5 minutes.

Electrical Engineers of the Times—XVI.

MR. F. F. FOWLE.

Frank Fuller Fowle was born November 29, 1877, at San Francisco, Cal. When three years of age, his family moved to Hancock, N. H., where he attended country schools until, at the age of eleven, he entered the Boston public schools. He graduated from the Grammar grade in 1893, and after spending two years in the Mechanic Arts High School, entered the Massachusetts Institute of Technology in 1895, from which he graduated in 1899 with the degree of Bachelor of Science in Electrical Engineering.

During the summer of 1898 Mr. Fowle had charge of an isolated electric light plant, and the following year entered the engineering department of the American Telephone & Telegraph Company in New York, under Mr. Frank A. Pickernell, engineer, as assistant electrician. He remained in this department four years, during which time he was engaged in work on transportation systems under the pioneer in this field, Mr. John A. Barrett. He made a special study of the question of joint occupancy of pole lines by telephone and electric light systems and devised a general system of transpositions to overcome inductive disturbance. He also took up laboratory work on common battery trunking systems and their design, the design of power plants for telephone exchanges and the preparation of specifications for the same, and was in charge of acceptance tests on generators, motors, motor-generators and rotary transformers.

Some months in 1901 were spent in assisting in a very elaborate investigation of transmission with the common battery system under service conditions, in five principal cities, in an analysis of traffic records and methods of handlng toll business, and in preparing several reports on printing telegraphy and multiplex manual telegraphy. The following year he was engaged for several months in connection with the application of Dr. Pupin's method of inductance loading of long aerial lines, the use of such lines for simultaneous telephony and telegraphy, both in cables and open wire lines, and in comparative tests of transmission over long loaded lines. In 1903 he entered the Railway Department of the same company as special agent, and engaged in introducing the system of compositing grounded telegraph circuits, known as the "railway composite." Later he took up the building of railway telephone lines and systems, acting in an advisory capacity on matters of design and construction, including the design of long lines and special equipment for use therewith, the preparation of specifications and estimates for construction, and work on telephone train dispatching systems and special uses of the telephone in the railway service.

F. F. FOWLE.

Mr. Fowle has been identified with the telephone development on several important railroad systems, including the New York Central & Hudson River Railroad, the Lake Shore & Michigan Southern Railway, the Baltimore & Ohio Railroad, the Chesapeake & Ohio Railway, the Pittsburg & Lake Erie Railroad, the Long Island Railroad, and the Lehigh Valley Railroad. In 1903 he read a paper before the New Orleans convention of the Railway Association of Telegraph Superintendents, on the "Transposition of Telephone Lines: Cross-Talk and Induction," which formed an important contribution to the subject and was reprinted in these columns and in several telephone journals. He has contributed articles to the technical press on "The Measurement of Distributed Leakage on Transmission Lines" and "An Alternating Current Relay for Low Frequencies," and presented a paper on "The Transposition of Electrical Conductors" at the October, 1904, meeting of the A. I. E. E., and another entitled "The Railway Telephone Service; Cost of Line Construction," at the Chattanooga, 1905, convention of the Association of Railway Telegraph Superintendents.

Mr. Fowle is a member of the American Institute of Electrical Engineers, the Railway Signal Association, the Association of Railway Telegraph Superintendents, the New York Telephone Society and the Technology Club of New York.

Transmission of Niagara Power to Toronto.—I.

Two lines of steel towers on a private right of way 75 miles long are to carry four circuits for the transmission of 40,000 horse-power at 60,000 volts from Niagara Falls to Toronto.

On this right of way the minimum standard width is 80 feet, the grade toward Toronto is not expected to exceed 15 feet per mile, and toward Niagara Falls 53 feet per mile, and the rate of curvature will not be more than 3½ degrees, or a radius of 1,637 feet. These figures for grade and curvature are especially important because a high-speed electric railway is to be operated with double tracks between the two rows of steel towers along the entire length of the line.

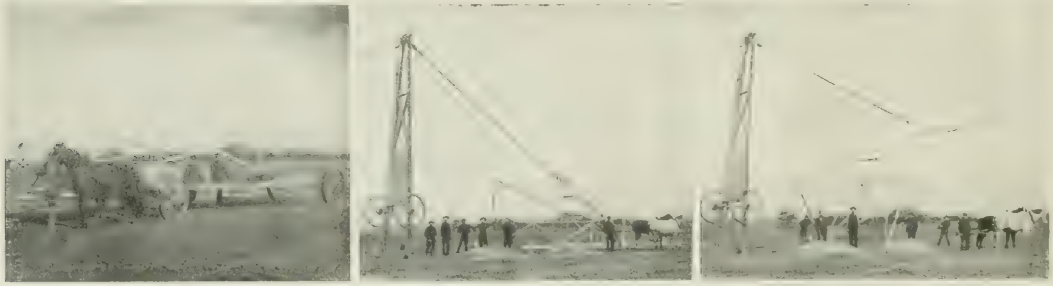
Between the two lines of towers the clear width of the right of way is 34 feet, the centers of the double tracks are 13 feet apart, and the distance from the center of each track to the sides of the nearer towers is also 13 feet. From the center of each tower to that of the right of way is 24 feet, and the two lines of towers thus have their centers 48 feet apart. At the ground line the width from outside to outside of the tower lines is 62 feet, but at the level of the crossarms the width is 67 feet 6 inches. At present one line of these towers with its two transmission circuits is nearly completed, and the other line of towers will be erected as soon as the demand for power makes it desirable.

On the straight portions of the line the steel towers are regularly erected 400 feet apart, but on curves the distances are less between towers, so that their total number is about 1,400 for each line. Standard curving along the line requires towers placed 50 feet apart, and a change in direction of not more than 10 degrees at each tower, except at the beginning and end of the curve where the change in direction is 3 degrees. When the change in direction of the line is not more than 6 degrees the corresponding spans allowed with each change are as follows:

Degrees change.	Feet of span.	Degrees change.	Feet of span.
½	300	3½	219
1	286	4	205
1½	273	4½	192
2	259	5	178
2½	246	5½	165
3	232	6	151

If the line follows a rising grade with a span of 200 feet the elevation of the first tower beyond the level may be 7 feet above the one preceding, the elevation of the second tower 14 feet, with 21 feet rise between the second and third tower, 28 feet between the third and fourth, and a line that follows an up grade with a span of 300 feet may rise 24 feet in the first span beyond the level, 48 feet in a distance of 400 feet between towers, the rise of the first span beyond the level may be as much as 56 feet, of the second 112 feet, of the third 168 feet, and so on.

At the same points along the line conditions require a span between towers of more than 400 feet, the regular distance for straight work. One example of this sort occurs at Twelve Mile Creek, where the stream has cut a wide, deep gorge in the Erie plateau. At this point the lines makes a span of 625 feet between towers. In the case of this long span, as in some others, it is not thought desirable to have the transmission circuits at either side of the electric railway, and the right of way is therefore widened so that the towers can be set at one side. For the crossing at Twelve Mile Creek the center line of the nearer line of towers is moved to a distance of 63 feet to one side of the center line of the electric railway, and the distance between the centers of the two lines of towers is reduced to 30 feet. To provide for this sharp offset a special form of tower is provided.



Figs. 1, 2 and 3.—Raising Towers on Niagara Transmission Line.

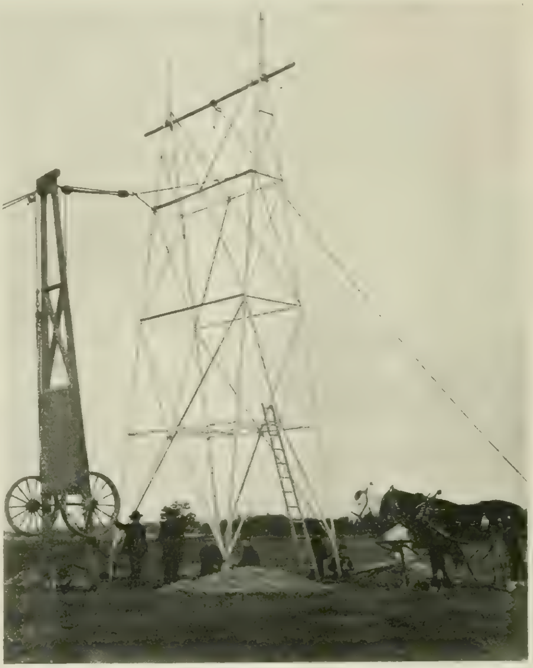


Fig. 4.—One of the Towers in Position.

The regular steel tower used in this transmission measures 46 feet in vertical height from its foot to the top of the lower insulators, and 51 feet 3 inches to the tops of the higher insulators. The lower six feet of this tower are embedded in the ground, so that the tops of the insulators measure about 40 feet and 45 feet 3 inches respectively above the earth. At the ground the tower measures 14 feet at right angles to the transmission line, and 12 feet parallel with it. The width of each tower at the top is 12 feet at right angles to the line, and the two sides having this width come together at points about 40 feet above the ground. Between the two L bars thus brought nearly together at each side of a tower a piece of extra heavy 3-inch steel pipe is bolted so as to stand in a vertical position. Each piece of this pipe is about 3½ feet long and carries a steel insulator pin at its upper end. The two pieces of pipe thus fixed on opposite sides of the top of a tower carry the two highest insulators. For the other four insulators of each tower, pins are fixed on a piece of standard 4-inch pipe that serves as a crossarm, and is bolted in a horizontal position between the two nearly rectangular sides of each tower, at a point two feet below the bolts that hold the vertical 3-inch pipes already named in position. Save for the two short vertical and one horizontal pipe, and the pins they support, each tower is made up of L-shaped angle bars bolted together. Each of the two nearly rectangular sides of a tower consists of two L bars at its two edges, three L bars for cross braces at right angles to the edges, and four diagonal braces also formed of L bars. The lower halves of the L bars at the edges of each side of a tower have sections of 3" x 3" x ¼", and the upper halves have sections of 3" x 3" x 3/16". This last named cross brace, and the other two cross braces have a common section of 2" x 1½" x ⅛". For the lower set of diagonal braces the common section is 2½" x 2" x ⅛", and the upper set has a section of 2" x 1½" x ⅛" in each member. At the level of the lowest cross braces the two rectangular sides of a tower are tied together by one member of 2" x 1½" x ⅛" of L section and at right angles to the sides, and by two diagonal braces of ⅝" round rod between the corners of the tower. On each of its two triangular sides a tower has four horizontal braces, and three sets of diagonal braces. The two upper horizontal braces are of 2" x 1½" x ⅛" L section, and the lowest is the same, but the remaining horizontal brace has a section of 2½" x 2" x ⅛". Bars of 2" x 1½" x ⅛" L section are used for the two upper sets of diagonal braces, and bars of 2½" x 2" x ⅛" for the lower set. In addition to the cross braces named, each triangular side of a tower near the top of the corner bars has two short cross pieces with the common L section of 3½" x 3½" x ⅝", one just above and the other just below the crossarm of 4-inch pipe to hold it in place. At the bottom of each of the four corner bars of a tower a foot is formed by riveting a piece of 3" x ¼" L section and 15 inches long at right angles to the corner bar. On one corner bar of each tower there are two rows of steel studs for steps, one row being located in each flange of the L section. On the same flange these steps are 2 feet apart, but taking both flanges they are only one foot apart. Every part of each steel tower is heavily galvanized.

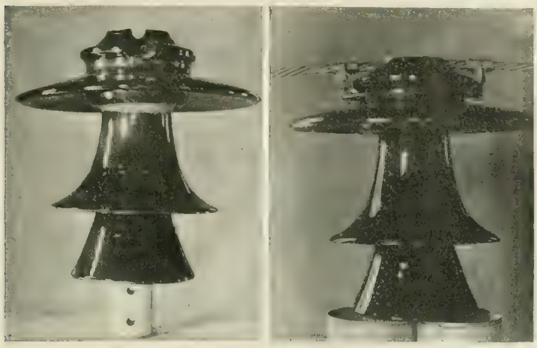


FIG. 5.—INSULATORS.

FIG. 6.—GENERAL VIEW ALONG NIAGARA TRANSMISSION LINE.

The labor of erecting these steel towers has been reduced to a low figure by the method employed, as shown in the accompanying illustration. Each tower is brought to the place where it is to stand with all of its parts assembled, save that the extensions of the legs that go into the ground are detached. These extension pieces are first fixed in the ground with their ends projecting to receive the legs of the tower. For hauling the towers a four-wheel wagon with a timber body about 30 feet long is used. When it is desired to raise a tower, two of the wheels with their axle are detached from the timber body of the wagon, and this body is then stood on end to serve as a sort of derrick. This derrick is guyed at its top on the side away from the tower, and a set of blocks and tackle is then connected to the top of the derrick and to the tower at a point about one-fourth of the distance down from its top. A rope from this set of blocks runs through a single block fixed to the base of the derrick and then to a team of horses. On driving these horses away from the derrick the steel tower is gradually raised on the two legs of one of its rectangular sides until it comes to a vertical position. The next operation is to bring the legs of the tower into contact with the extension pieces that are fixed in the earth, and then bolt them together.

Magnetic Non-Iron Alloys.

Prof. J. A. Flemings and Mr. R. A. Hadfield, in a recent Royal Society paper, give the latest results of their work of investigation of the magnetic qualities of some alloys not containing iron. The alloy experimented with was composed of manganese, 22.42 per cent; copper, 60.49 per cent; aluminum, 11.65 per cent; carbon, 1.5 per cent; silicon, 0.37 per cent; iron, 0.21 per cent. About 2 or 3 per cent of slag was intermingled, mostly consisting of manganese and silicon oxides, with slight traces of metals other than the above mentioned. The conclusions of the paper are as follows:

The above alloy exhibits magnetic properties which are identical with those of a feebly ferro-magnetic material.

The magnetization curve is of the same general form as that of a ferro-magnetic metal such as cast iron, and indicates that with a sufficient force a state of magnetic saturation would most probably be attained.

The alloy exhibits the phenomenon of magnetic hysteresis. It requires work to reverse the magnetization of the material and to carry it through a magnetic cycle.

The material has a maximum permeability of 28 to 30, which is not greatly inferior to that of the values reached for cobalt or a low grade of cast iron for small magnetic forces, and occupies a position intermediate between the permeability of the ferro-magnetic and the merely paramagnetic bodies, such as liquid oxygen and ferric chloride.

The material exhibits, therefore, the phenomenon of magnetic retentivity and coercivity. It is not merely magnetic, but can be permanently magnetized.

A further conclusion is that the magnetic properties of this alloy must be based on a certain similarity of molecular structure with the familiar ferro-magnetic metals. The hypothesis which best fits the facts of ferro-magnetism is that materials such as iron, nickel and cobalt, are composed of molecular groups which are permanently magnetic, and that the process of producing or changing the evident magnetization of a mass of these metals consists in arranging or disturbing the positions of these molecular magnets. Since, then, we have in this alloy an instance of fairly strong ferro-magnetism produced by an admixture of metals possessing in themselves separately no such property, it follows that ferro-magnetism *per se* is not a property of the chemical atom, but of certain molecular groupings. The importance of this fact cannot be easily overstated. It shows us that in spite of the fact that ferro magnetism has been hitherto regarded as the peculiar characteristic of certain chemical elements—iron, nickel and cobalt—it may, in fact, depend essentially on molecular grouping composed of a comparatively large number of molecules, and, hence, it may be possible to construct alloys which are as magnetic or even more magnetic than iron itself.

Commenting on the paper, our London contemporary, the *Electrician*, says that the discovery of the secret of the molecular grouping referred to would be of immense importance, as it will lay bare the whole mystery of magnetism, and might make possible the manufacture of a material even more magnetic than iron itself.

Electric Spark Recorder.

By F. W. Springer.

THE difficulty experienced in obtaining accurate records of the readings of current, voltage, watts, speed, etc., of railway motors, electric elevators and the like induced the writer to attempt the construction of a device which would record their instantaneous values. After considerable experimenting, the device, substantially as shown in Fig. 1, was constructed. This apparatus, which has been in use in various forms in the electrical laboratory at the University of Minnesota during the past six years, has proven very successful for the purpose for which it was intended. As it may be made up of a combination of instruments in common use in electrical laboratories, it is hoped that a description of it may be of interest to others who have occasion to obtain instantaneous records.

As shown in Fig. 1, two cylinders are mounted on the drum of an ordinary chronograph. Each cylinder is five and one-half inches long, and is insulated from the drum by fibre rings of a uniform thickness of one-fourth of an inch. The adjoining ends of the two "tin" cylinders are separated from each other by a space of three-eighths of an inch. It is sometimes convenient, however, to bring the ends of the cylinders together, making one cylinder, when current or voltage alone is recorded. The cylinders are roughened with coarse emery cloth and not lacquered or painted.

The covers being removed from a Weston direct-current portable voltmeter and from a separate shunt ammeter of similar type, the ends of the pointers of the instruments were fitted with light aluminum spark-points of such length that the covers could be replaced without interfering with the free movement of the pointers. Each spark-point was made by hammering a small aluminum wire to the thickness of the end of the pointer, and by trimming it to about one-sixteenth of an inch in width. This was split and set on the pointer, as shown in Fig. 2, and the top clipped off to the proper length. Two instruments were then placed under the two insulated cylinders, respectively, in such positions that when the pointers stood at one-fourth and three-fourths of the full scale reading, the spark-points would be directly under the axis of the cylinders and about one-sixteenth of an inch from the paper with which the cylinders were covered. The distance between the points and the paper is a maximum at zero, half scale and full scale readings. It is very desirable to have the gaps between the spark-points of the instruments and cylinders as small as possible and of the same length for all readings. For this reason a drum of large diameter gives best results.

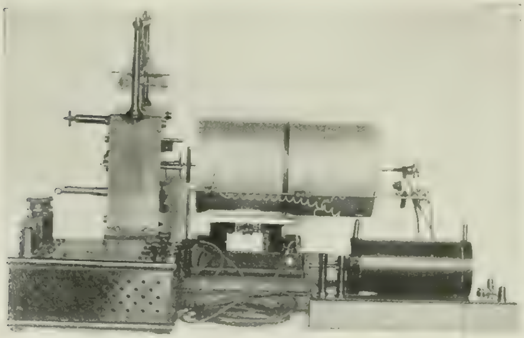


FIG. 1.—ASSEMBLY OF RECORDING APPARATUS.

An insulated spark-point is set on a rod in front of each cylinder within one-thirty-second of an inch of the paper. Two induction coils, such as vibrator jump spark coils for gas engines, are connected as shown in Figs. 2 and 3. One of the secondary terminals of one of the induction coils is connected to that binding post of the ammeter which is in immediate connection with the pointer of the instrument, and the other is attached to the spark-point on the rod at the side of the cylinder. Each discharge makes two holes in the paper, one opposite the spark-point of the instrument pointer which records the readings of the instrument, and the other opposite the fixed point. Two lines of holes are, therefore, made in the record paper; one more or less irregular, corresponds to the movements of the instrument pointer; the other, being straight, is used as a base line.

The second induction coil is similarly connected to the voltmeter, as shown in Fig. 2. When both instruments are used, it is essential that care be taken to put the ammeter on that side of the line with which the voltmeter pointer is in immediate connection, in order that there may be no difference of potential between the pointers of the ammeter and voltmeter, thus avoiding any possibility of a short circuit between the two instruments.

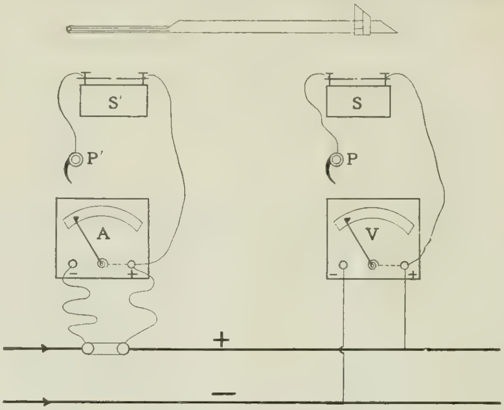


FIG. 2.—SPARK POINT AND ITS CONNECTION IN CIRCUIT.

The number of holes made by the sparks per inch of record paper depends upon the speed of the paper and the pointer and the construction and adjustment of the vibrator of the coil. In an extreme case the holes need never to be more than an eighth of an inch apart. With a slow-speed record and a fat spark, the paper will be burned so that the curves can easily be seen, otherwise they may be traced in pencil while holding the record between the observer and a strong light.

Due to the fact that the resistance of the spark is only a few ohms, so that there is only a comparatively small difference of potential between the cylinder and the pointer, the stream of sparks from the pointer does not affect the readings appreciably by static attraction between the drum and the pointer. The spark-points, *J J*, Fig. 3, are very essential. They should be set so that the gap will be a little greater than the sum of the two gaps through the record paper.

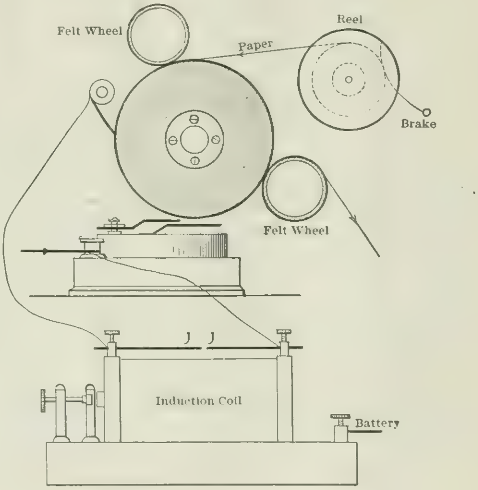


FIG. 3.—DIAGRAM OF RECORDING CIRCUITS.

Fig. 3 shows one arrangement of the apparatus as used for obtaining continuous records. The upper roller carries a long strip of ordinary white wrapping paper which is passed around a main cylinder, and under two felt-covered wooden wheels. The first felt wheel forces the paper down on little brads, which are soldered at intervals around the cylinder to prevent slipping.

A chronograph serves to regulate the speed of the paper, and a clock gearing attached to the other end of the main drum overcomes the friction of the drums and the brake. Where only one cylinder is used, as in acceleration and slow-record tests, the single recording drum may be mounted on pivots and operated by being properly geared to a good strong clock, and if necessary, the friction may be partly overcome by the use of a weight and cord or by a clock spring and gearing.

For various tests or electric cars, the drum may be so geared to the car axle that the speed of the paper varies directly with the car speed. In such cases it is necessary to use a "timer," as is also the case when it is impossible to adjust the chronograph or clock to regulate at a sufficiently constant speed. As a timer there is used an electro-magnet attached to the rod carrying the zero spark-points, or to a pencil in contact with the record paper, in such a way that a short line is made on the record paper when the magnet is energized. The magnet is operated by a dry cell whose circuit is closed by a device consisting of two clocks which closes the circuit every fifteen seconds. For work other than that on cars, the best timer consists of a heavy pendulum arranged to make contact with a drop of mercury at the middle of its swing, and of such length as to give the desired time interval.

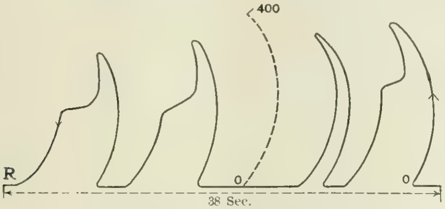


FIG. 4.—CURVES FOR ELEVATOR MOTORS.

Records of speed are taken in the same manner as those of voltage. A Remy magneto dynamo is geared or belted to the machine whose speed is to be recorded, and is connected to the low-voltage binding posts of the recording voltmeter, with such resistance in the circuit as will enable the speeds to be obtained from the voltmeter readings by using a simple reduction factor. Both the line-voltage and the speed may be taken with the same voltmeter by the use of a suitable double-throw switch.

The chronograph shown in Fig. 1 gives eighteen inches of record per revolution. A speed of one revolution per minute has proved very satisfactory for measuring the accelerating current of street-car motors, electric elevators and the like. One to three inches of record paper per minute will be found very satisfactory for continuous electric car tests.

The curves shown in Fig. 4 were taken on the machine shown in Fig. 1. The records were made on large size letter paper held on the cylinder by three or four rubber bands. They were taken from a test made in 1900 on the storage-battery and electric-elevators in the Hennepin County Court House in Minneapolis. The different curves indicate the runs between consecutive floors, except in the second curve at the right where the operator missed a floor, making it necessary to start up again.

The average value of any curve may be found by measuring the area of the curve with a planimeter and dividing this area by the length of the base line of the curve. This will give the height of a rectangle, having the same area and base line as the curve to be averaged. This height is the chord of the average reading as found by laying the chord on the scale arc with one end at zero.

The following statements concerning the accuracy of the records apply particularly to cases in which the recorder is used with Weston instruments. The stream of sparks, if continuous, has no effect on the reading of the instrument. The sparks do not always take the shortest path into the record paper. Drafts of air, caused to some extent by the heat of the sparks, and the air currents in the room, cause the sparks to jump about. This, however, introduces little difficulty, as the curve simply becomes wider and the middle points may be taken to obtain the true record. Drafts of air of sufficient strength to deflect the pointers may be guarded against by the use of a screen. The rectifier described below if used with the instrument need not introduce any perceptible error. The lag of the pointer will introduce no great errors with speeds of from one to twenty inches per minute. The lag must, however, be considered in interpreting high-speed records of transient currents, voltages, etc. In any case each instrument should be tested for pointed lag and curve distortion before attempting to interpret records. This may be done as follows:

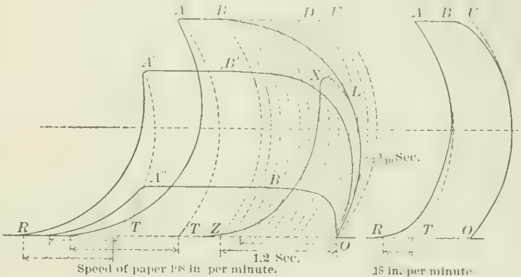


FIG. 5.—SPEED CURVES.

Connect the apparatus shown in Fig. 1 in series with a storage battery and a non-inductive resistance and make records by suddenly switching the current on and off with the recording cylinder standing still, running at the normal speed and also at a very high speed, as shown in Fig. 5. A similar test should be made on the voltmeter. The time and position lag and the curve distortion can then be easily determined. The corrections in curve shape in slow changes in current and voltage may be neglected, since the acceleration of the moving parts of the instrument, in such cases, takes place over a long time and hence is small. or in other words the difference between the controlling or spring force, and the actuating force is small and hence the traced curve and the true curve coincide.

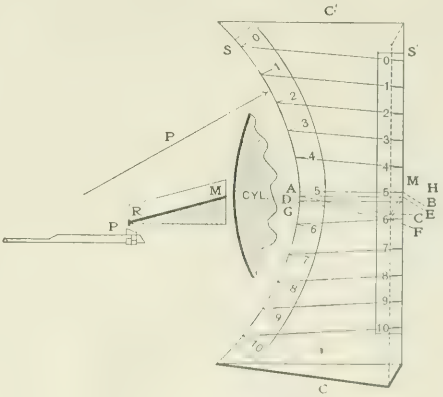


FIG. 6.—DETAILS OF SCALE RECTIFIER.

Curve distortion is due to pointer lag and to the fact that the pointer has a component of mition with or against that of the record paper. Pointer lag will be found least in instruments, which are just aperiodic, and whose moving parts have small inertia, air resistance and friction, and powerful actuating and controlling forces.

By interposing the device described below, the curve form may be modified to advantage in some cases. The records of the readings of any instrument, whether of uniform or non-uniform scale divisions may be rectified, i. e., made with straight ordinates, with scale divisions of uniform length. Also, the readings may be recorded as any power, root, multiple, or sub-multiple of the readings of the instrument. For example, the record may take the squared values of the instantaneous currents, enabling the average heating effects of a varying current to be obtained. This applies particularly to railway motor tests. Further, in case it is desirable to make records of several instruments on a narrow strip, all readings may be reduced in size, or in cases of only one record, the scale length may be increased.

The rectifier may be very easily constructed as follows: Make a block of dry wood, red fibre or hard rubber, substantially as shown in Fig. 6. The scale *S* has the same scale divisions and arc as that described by the spark point *P*. The scale *S* can be traced directly from the scale of the instrument and then pasted in position as shown.

Scale *S'* is made any length desired and divided into uniform spaces. These divisions are then numbered to correspond to the divisions on *S*.

Wind the block with double cotton-covered magnet wire of size about No. 28, beginning below zero and winding above the maximum reading, laying the wire so that each turn will connect points on the scales *S* and *S'* of the same scale value. The turns should be wound as closely as possible on the shorter scale. Thoroughly cover the top surface and the edge of *S* with several coats of thin shellac so that the wires will be firmly cemented to the block. Cut all the wires across the block on the under side, as at *C' C* and pull them straight out at *M*, and straight down at *R*. Carefully cut these off close to the block with shears or with a carpenter's chisel, as shown at *M* and *R*.

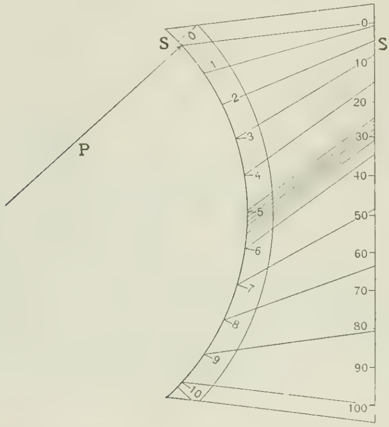


FIG. 7.—RECTIFIER FOR RECORDING SQUARED VALUES.

The sparks will pass from the pointer *P* through the wire *R M* nearest the pointer and into the recording cylinder as shown in Fig. 6.

Fig. 7 shows the method of winding to obtain squared values of instantaneous readings. The same general method would also apply to other powers, or multiples of the instrument readings.

Uranium a Radioactive Parent.

Recent researches of Rutherford and Soddy appear to demonstrate that uranium is the parent, mediate or immediate, of radium. Polonium descends from radium in the seventh generation, the intermediate links being emanations and other unstable products. Polonium finally becomes either bismuth or lead, and then remains in that condition for a period beyond human computation. The transformation of radium into lead takes some 40,000 years. Our English contemporary, the *Electrician*, in commenting on this, says that we may take it that our gold standard is safe for that period at least, unless somebody succeeds in controlling the transmutation by artificial means. But no agency hitherto discovered seems to affect the process of disintegration to the smallest extent.

Regulation and Efficiency of Transmission Lines.

By Harold Pender, Ph.D.

THE method usually employed in calculating the regulation and efficiency of transmission lines involves the use of a certain constant, which constant depends upon the size and distance apart of the several wires forming the transmission circuit, the frequency of the current, and the power factor of the load at the receiving end. A table giving the values of this constant for various size wires and frequencies was prepared several years ago by one of the large electrical manufacturing companies, and has been reprinted in numerous electrical engineering handbooks. The writer desires to call attention to a very considerable error in this table.

The table in question may be found on page 126 of Foster's "Electrical Engineer's Pocket Book," and the explanation of its use on pages 124 and 125. The constant is there designated by the letter *M*, and appears in the following formula (page 124):

$$\textit{Volts loss in line} = \frac{P \times E \times M}{100}. \qquad (1)$$

where *P* is per cent. of delivered power lost in transmission, and *E* is the potential difference between wires at receiving end.

From the above equation it is seen that *M* has a simple physical meaning, namely, it is the ratio of the per cent. volts lost in transmission to the per cent. power lost in transmission, expressed in terms of delivered volts and of delivered power.

An approximate formula for this quantity can be readily obtained. The formula derived will be shown to be correct to within less than 2 per cent. for any case likely to arise in practice.

Let n = the number of phases.
V = potential difference between adjacent wires at generating end.
E = potential difference between adjacent wires at receiving end.
W = watts delivered at receiving end.
I = current per wire.
r = resistance of each wire per unit length.
x = reactance of each wire per unit length.
L = length of each wire.
$\cos a$ = power factor of load at receiving end.
P = per cent. power lost in transmission, in terms of delivered power.
Q = per cent. volts lost in transmission, in terms of delivered volts.

$$M = \frac{Q}{P}.$$

Draw *C G* and *D B* perpendicular to *O A* produced.

Volts loss:

$$\frac{Q\,E}{100} = V - E. \qquad (2)$$

To a close approximation in any practical case,

$$V - E = A\,B \text{ (see diagram).} \qquad (3)$$

But $$A\,B = A\,C \cos a + C\,D \sin a. \qquad (4)$$

Now $$A\,C = 2 \sin \frac{\pi}{n}\, I \,.\, r \,.\, L = \text{resistance drop per phase,} \qquad (5)$$

$$C\,D = 2 \sin \frac{\pi}{n}\, I \,.\, x \,.\, L = \text{reactance drop per phase,} \qquad (6)$$

and $$I = \frac{2\,W \sin \frac{\pi}{n}}{n\,E \cos a} \qquad (7)$$

Hence, $$A\,B = \frac{4\,W\,L \sin^2 \frac{\pi}{n}}{n\,E}\,(r + x \tan a), \qquad (8)$$

and therefore

$$Q = 100\,\frac{4\,W\,L \sin^2 \frac{\pi}{n}}{n\,E^2}\,(r + x \tan a). \qquad (9)$$

Power loss:

$$\frac{P\ W}{100} = n \, . \, I^2 \, . \, r \, . \, L. \qquad (10)$$

Substituting the value of I from (7),

$$I^2 = 100 \frac{4\ W\ L\ r\ \sin^2 \frac{\pi}{n}}{n\ E^2 \cos^2 a}. \qquad (11)$$

From (9) and (11) we then have

$$M = \left(1 + \frac{x}{r} \tan a\right) \cos^2 a. \qquad (12)$$

Using this formula, the writer has computed the accompanying table, giving the values of M for all sizes of wire from No. 0000 to No. 10 B. & S. for power factors of 95, 90, 85 and 80 per cent., and for frequencies of 25, 40, 60 and 125 cycles per second, for a distance between wires of 18 in. For unity power factor $M = 1$. The values of M calculated for wires 18 in. apart can also be used for other distances met with in practice without the introduction of considerable error.

Values of $M = (1 + \frac{x}{r} \tan a) \cos^2 a$.

No. of wire B. & S. gauge.	Area of wire in 1000 C.M.	Reactance, ohms 1000 ft. 25° C.	Reactance, ohms per 1000 ft. 18" between wires	25 cycles. Per cent. Power Factor.				40 cycles. Per cent. Power Factor.				60 cycles. Per cent. Power Factor.				125 cycles Per cent. Power Factor.			
				95	90	85	80	95	90	85	80	95	90	85	80	95	90	85	80
0000	212	.0499	.176	1.17	1.16	1.12	1.06	1.32	1.36	1.36	1.32	1.53	1.64	1.67	1.66	2.21	2.54	2.72	2.76
000	168	.0628	.181	1.12	1.09	1.05	.99	1.24	1.26	1.24	1.19	1.41	1.49	1.50	1.47	1.97	2.22	2.34	2.37
00	133	.0794	.186	1.08	1.04	.99	.92	1.18	1.18	1.14	1.09	1.32	1.36	1.35	1.31	1.77	1.96	2.04	2.04
0	106	.0997	.190	1.05	1.00	.94	.87	1.13	1.11	1.06	1.01	1.24	1.26	1.24	1.19	1.61	1.74	1.80	1.79
1	83.5	.126	.194	1.02	.96	.90	.83	1.09	1.05	1.00	.94	1.18	1.17	1.14	1.08	1.47	1.57	1.59	1.56
2	66.6	.159	.198	1.00	.93	.86	.79	1.05	1.01	.95	.88	1.12	1.10	1.06	1.00	1.37	1.42	1.42	1.39
3	52.4	.202	.202	.98	.91	.84	.76	1.02	.97	.90	.83	1.08	1.05	.99	.93	1.27	1.30	1.28	1.24
4	41.6	.254	.206	.96	.89	.81	.74	1.00	.94	.86	.80	1.05	1.00	.94	.87	1.20	1.21	1.18	1.13
5	33.1	.319	.211	.95	.88	.80	.72	.98	.92	.84	.77	1.02	.97	.90	.83	1.15	1.13	1.09	1.03
6	26.2	.403	.215	.94	.86	.78	.70	.97	.90	.82	.74	1.00	.94	.87	.79	1.10	1.07	1.02	.96
7	20.7	.510	.219	.94	.85	.77	.69	.95	.88	.80	.72	.98	.91	.84	.76	1.06	1.02	.96	.90
8	16.6	.635	.224	.93	.85	.76	.68	.94	.87	.79	.71	.97	.89	.82	.74	1.03	.98	.92	.85
9	13.0	.813	.229	.92	.84	.76	.67	.94	.86	.77	.69	.95	.88	.80	.72	1.01	.95	.88	.81
10	10.4	1.01	.234	.92	.83	.75	.67	.93	.85	.76	.68	.94	.86	.79	.71	.99	.92	.85	.78

A comparison of this table with that given on page 126 in Foster's "Pocket Book" will make evident that the latter table has presumably been based upon an incorrect theory, for the error in it is anywhere from 5 to 50 per cent.

To determine to what extent the above formula is in error, due to the assumption that $V - E = A\,B$ (see diagram), an accurate determination may be made as follows:

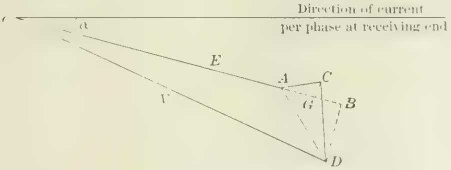


DIAGRAM OF COMPONENT ELECTROMOTIVE FORCES.

From the diagram,

$$V^2 = (E \cos a + A\,C)^2 + (E \sin a + C\,D)^2; \qquad (13)$$

substituting the values of $A\,C$ and $C\,D$ from equations (5), (6) and (7), and regrouping terms,

$$V^2 = E^2 + 2\ W\ L\ (r + x \tan a) + \frac{1}{E^2}\left(\frac{W\ L\ z}{\cos a}\right)^2. \qquad (14)$$

Whence,

$$V - E = \sqrt{E^2 + 2\ W\ L\ (r + x \tan a) + \frac{1}{E^2}\left(\frac{W\ L\ z}{\cos a}\right)^2} - E. \qquad (15)$$

This formula can hardly be said to possess the simplicity of the expression for the volts lost in terms of M, formula (1).

The two following special cases, in each of which is assumed a 10 per cent. volt loss in transmission, will serve to show that even for extreme conditions of power factor, size of wire and frequency, the formula above deduced for M is sufficiently accurate for all practical purposes. The errors that would result from the use of the old values of M are also given. These latter are so great that, for the conditions chosen, the old table of M is absolutely worthless.

Case 1.

3 phase system
25 cycles.
No. 10 wires, 18 in. between centers.
10,000 volts at receiving end.
500 kw. delivered.
80 per cent. power factor.
36.1 amp. per wire.
3.5 miles, length of line.
5.35 resistance of each wire per mile, at 25° C.
.308 reactance " " " "
5.36 impedance " " " "

Exact solution:

$$V - E = \sqrt{E^2 + 2\ W\ L\ (r + x \tan a) + \frac{1}{E^2}\left(\frac{W\ L\ z}{\cos a}\right)^2} - E = 992.$$

Power loss in line $= 3\,R\,I^2 = 72.9$ kw.
Per cent. power loss in line = 14.58.

Approximate solution, old value of M:

$$V - E = \frac{P \times E \times M}{100} = 1{,}458.$$

Per cent. error = 47.

Approximate solution, new value of M:

$$V - E = \frac{P \times E \times M}{100} = 977.$$

Per cent. error = 1.51.

Case 2.

3-phase system.
125 cycles.
No. 0000 wires, 18 in. between centers.
10,000 volts at receiving end.
2,000 kw delivered.
80 per cent. power factor.
144.4 amp. per wire.
4.4 miles, length of line.
.263 resistance of each wire per mile, at 25° C.
1.16 reactance of each wire " "
1.19 impedance of each wire " "

Exact solution:

$$V - E = 1{,}029.$$

Power loss in line = 72.6 kw.
Per cent. loss in line = 3.63.

Approximate solution, old value of M:

$$V - E = 1{,}268.$$

Per cent. error = 23.2.

Approximate solution, new value of M:

$$V - E = 1{,}002.$$

Per cent. error = 2.6.

On a Method of Potential Regulation Based on the Different Resistance Behavior of Carbon and Tantalum Lamps.

By A. E. Kennelly and S. E. Whiting.

THE marked difference between behavior of carbon and tantalum incandescent lamps at different voltages has suggested to us the possibility of employing this property for the operation of a relay capable of controlling, by its secondary actions, the voltage of a circuit.

It is well known that the resistance of a carbon filament incandescent lamp falls very markedly as the current through it increases. Thus, a 120-volt, 16-cp carbon lamp, which has a resistance of 600 ohms when cold, will have a resistance of about 300 ohms when at normal incandescent voltage. A 110-volt tantalum lamp, on the other hand,* which has a resistance of 50 ohms when cold, may have a resistance of 300 ohms when at normal incandescent voltage. In each case the most rapid change of resistance takes place in the initial stages of voltage and current application. Between half voltage and full voltage, the changes in resistance are relatively small. If, therefore, a Wheatstone bridge arrangement, *A B C D*, Fig. 1, be made up between a pair of mains, *M M*, with two branches, *r, r,* of similar resistance, the branch *B C*, with carbon filament incandescent lamps, and the branch *D C*, with tantalum filament incandescent lamps, a polarized relay or equivalent magnetic mechanism, *R*, can be made to respond to variations in the line voltage between the mains *M M*. All of the incandescent lamps will be operated at much below their normal voltage, and the resistance of the lamps will, therefore, be in a state sensitive to changes of voltage. If, for instance, a bridge balance is secured at a voltage $e = 115$ volts, then if the voltage should rise, say, to 116, the carbon filament branch of the bridge will diminish in resistance, while the tantalum filament branch will increase in resistance. This dissymmetry will destroy the balance and send a current through the relay from *D* to *B*, tending to throw the tongue of the relay against the contact stop, *c*. If, on the contrary, the main voltage should fall, the carbon resistance would increase and the tantalum resistance decrease, upsetting the balance in the opposite sense and sending a current through the relay from *B* to *D*. This current would tend to throw the tongue of the relay against the contact stop, *b*. Under these conditions the relay would be capable of operating apparatus through its local circuits in some of the various known ways for regulating the main voltage.

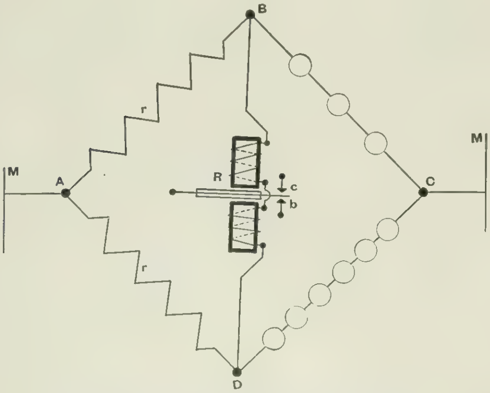


FIG. 1.—WHEATSTONE BRIDGE SENSITIVE TO VARIATIONS IN E.M.F.

The bridge connections of Fig. 1 are naturally capable of being modified in a variety of ways in order to attain the same result. Thus, either the carbon lamps or the tantalum lamps may be removed and replaced by an invariable resistance of metallic wire. This plan should be less sensitive, since the bridge would possess but a single resistance-varying arm. Again, all four arms of the bridge might be made of variable resistance, both *A D* and *B C* being occupied by carbon lamps, while both *A B* and *C D* would be occupied by tantalum lamps. This plan should be a more sensitive arrangement.

An alternative plan to the use of the Wheatstone bridge is offered by the use of a differentially wound polarized relay, as indicated in Fig. 2. *R* is a differential polarized relay. The circuit from the mains, *M M*, splits through the coils of this relay, passing on one side through the carbon filament lamps, *C C C*, and on the other side through the tantalum filament lamps, *T T T*. The lamps are so chosen, or the resistances of their respective paths so adjusted, that the two branch currents have equal strength at normal voltage between the mains, thus leaving the relay in balanced condition, i. e., with zero excitation. If now the main voltage should rise, the resistance of the carbon branch will diminish and that of the tantalum branch will increase, thereby upsetting the balance in favor of the carbon branch current, and urging the tongue of the relay against the stop, *c*. On the contrary, if the main voltage should fall, the differential balance would be upset in the opposite direction and the tongue of the relay urged against the opposite stop. This action of the relay might likewise be invoked to control the main voltage through mechanism actuated by local circuits from the relay.

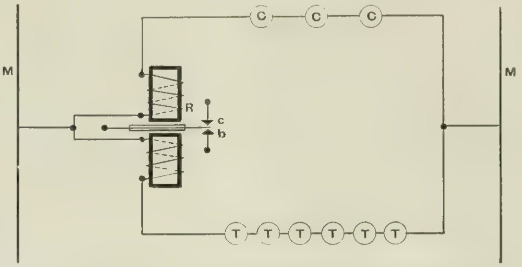


FIG. 2.—DIFFERENTIAL RELAY SYSTEM SENSITIVE TO VARIATIONS OF E.M.F.

In order to test the arrangement of Fig. 2, the authors employed a differential Western Union polarized relay, such as is used in the polar duplex system. The resistance of each of the two relay coils was approximately 423 ohms at the working temperature. The armature of the relay was a steel tube 0.379 in. (0.963 cm.) in diameter. The play of the tongue between the stops was 0.0015 in. (0.038 mm.) and the clearance or air-gap between the armature tube and the poles was 0.06 in. (1.5 mm.) on each side. Three carbon filament, 120-volt, 16-cp lamps were employed on one side at *C C C*, and six 110-volt, 25-hefner, tantalum filament lamps were employed on the other side at *T T T*. This arrangement secured a current strength of 84 milliamperes in each branch, or a differential balance, at the main voltage of 120.4 volts. The drop in each relay coil being 35.5 volts, the remainder, or 84.9 volts, was impressed upon each set of lamps, representing 28.3 volts per lamp in the carbon series, and 14.15 volts per lamp in the tantalum series. Under these conditions, the resistance offered by each carbon lamp averaged 336 ohms, and that offered by each tantalum lamp 168 ohms.

It was found that, under laboratory conditions, when the relay was carefully adjusted, an increase in main voltage of 0.6 volt (120.4 to 121 volts) would cause the relay to throw over its tongue in one direction, and a fall of 0.6 volt, or back again to 120.4 volts, would cause the relay to throw its tongue back against the original stop. Consequently the relay was found to be capable of operating continuously on a voltage variation of ½ of 1 per cent. The movement of the relay followed the change in voltage after a time lag of about one second. This time lag appeared to be of thermal origin and to be attributable to the action of the lamps.

It seems likely that with a relay specially designed for this work, a still greater degree of sensitiveness could be obtained.

The following is an outline of the engineering theory of the apparatus of Fig. 2:

Let e = the normal e.m.f. between the mains *M M* (volts).
r = the resistance of each relay coil (ohms).
r_c = the total resistance in the carbon lamps at normal balance (ohms).
r_t = the total resistance in the tantalum lamps at normal balance (ohms).
i_c = the current in the carbon lamps (amperes).
i_t = the current in the tantalum lamps (amperes).

---

*"Some Tests of Tantalum Lamps," by A. E. Kennelly and S. E. Whiting, ELECTRCAL WORLD AND ENGINEER, March 25, 1905.

R = the total resistance in each branch (ohms).

Then $R = r + r_c = r + r_t$ (at balance),

$i_c = i_t = i$ (at balance).

Then $e = i_c\,(r + r_c) = i_t\,(r + r_t)$.

When the balance is upset, let the differential current, $i_c \sim i_t = di$. Then

$$\left(\frac{\frac{di}{i}}{\frac{de}{e}}\right) = \frac{1}{1 + a\,i\left(\frac{\frac{dr_c}{di_c}}{r_c}\right)} - \frac{1}{1 + a\,i\left(\frac{\frac{dr_t}{di_t}}{r_t}\right)} \qquad (1)$$

where $a = \frac{r_c}{R} = \frac{r_t}{R}$.

This expression $\left(\frac{\frac{di}{i}}{\frac{de}{e}}\right)$ is the ratio between the differential current expressed as a fraction of the normal branch current and the change of voltage producing the disturbance (expressed as a fraction of the normal voltage). This ratio may be called the ratio of sensitiveness, since the more sensitive the arrangement of variable resistances, the greater will be this fraction. Under the conditions of the above-mentioned test, $r = 423$, $R = 1{,}431$, $a = 0.704$, $\frac{de}{e} = 0.005$, $i = 0.084$, the sensitiveness ratio was 0.38; so that for a change of voltage of 1 per cent, the differential current was upset by 0.38 per cent of the normal current (84 milliamperes); or 0.319 milliamperes, or for ½ of 1 per cent (0.6 volt) 0.16 milliampere. This agrees with direct measurement of the sensitiveness of the relay, which operated under the same adjustment with less than 0.2 milliampere.

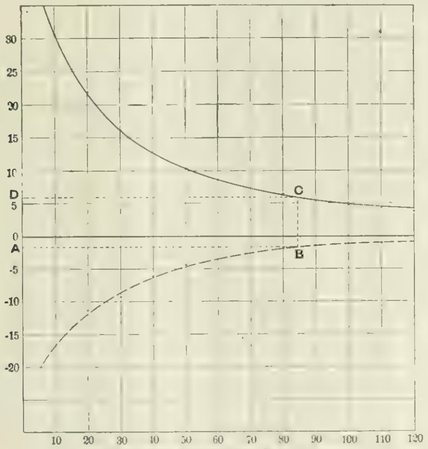


FIG. 3.—CURVES GIVING VALUES OF $\left(\frac{\frac{dr_t}{d_i}}{r_t}\right)$ AND $\left(\frac{\frac{dr_c}{di}}{r_c}\right)$ FOR THE LAMPS EMPLOYED IN THE TEST.

A first approximation to the equation (1) is given by the formula

$$\frac{\frac{di}{i}}{\frac{de}{e}} = a\,i\left\{\left(\frac{\frac{dr_t}{di_t}}{r_t}\right) - \left(\frac{\frac{dr_c}{di_c}}{r_c}\right)\right\} \qquad (2)$$

In this formula $\left(\frac{\frac{dr_t}{di_t}}{r_t}\right)$ is the proportional change in the tantalum resistance per ampere increase of current and $\left(\frac{\frac{dr_c}{di_c}}{r_c}\right)$ the corresponding proportional change of resistance per ampere for carbon. Fig. 3 gives the plot of these values from experimental observations on the lamps employed. The upper curve through C gives the value for the tantalum resistance and the lower or dotted curve through B that for the carbon resistance. Thus at 0.084 ampere, the value of this proportion is 6 for tantalum and —1.8 for carbon. That is the tantalum resistance, if it is kept on steadily rising in resistance for one ampere increase of current as fast as it does by observation for a very small increase of current, would add 600 per cent to its resistance. The length of the line $C\,B$ gives the value of the quantity within the large bracket in formula (2) and the area of the rectangle $A\,B\,C\,D$ gives the value

$$i\left\{\left(\frac{\frac{dr_t}{di_t}}{r_t}\right) - \left(\frac{\frac{dr_c}{di_c}}{r_c}\right)\right\}$$

so that it is desirable to employ such a balance in the branch circuits as will permit the area $A\,B\,C\,D$ enclosed between the current strength and the distance between the two curves to be a maximum. There is comparatively little difference between the areas thus enclosed, between the limits of current 25 milliamperes and 100 milliamperes, so that the sensibility ratio did not vary markedly between these limits.

It seems possible that iron wire filaments worked near the temperature of recalescence, like the ballast resistance of Nernst lamps, might be even more sensitive in resistance to current variations than tantalum, and might produce a still more sensitive regulator.

We are indebted to Messrs. T. F. Clark and M. C. Harrington, of the Western Union Co. for their courteous assistance in enabling us to secure the differential relay for the test.

A Method of Calculating the Core-Loss in Large Alternators.

By T. S. Allen.

In large fly-wheel engine type generators where it is impossible to accurately measure the core-loss and on which the manufacturer is compelled to guarantee rather high efficiencies, the necessity for a fairly accurate method of calculating core-loss is quite evident. With this point in view, the writer will endeavor to make clear a method of calculation which has been adopted by the Electrical Department of the Allis-Chalmers Company and which, in general, gives very satisfactory results.

The fact that it is impossible to accurately figure the core-loss in a generator means that it is also impossible to accurately figure the efficiency, but with the help of average results on previous machines and the careful measurements of losses in the iron used, a fairly close approximation to the core-loss may be attained, as shown by the following data which were taken on a number of 25-cycle and 60-cycle Bullock type alternators.

We will take for example the calculation of the core-loss in a small engine type generator, 200 k.w., 4,400 volts, 120 r.p.m., 3-phase, 60-cycles. It is first necessary to measure as accurately as possible the hysteresis and eddy-current loss in the iron used. This was done by taking from the finished armature punchings small transformer punchings 1½ inches wide by 5½ inches long, which were punched out with a special die. The method of selecting the iron for these punchings is as follows: The armature punchings were gone over while in stacks and a transformer punching taken out of every half inch of iron, thus giving a quantity of transformer iron containing practically the same characteristics as that in the armature. From these punchings a small transformer core was built up, outside dimensions 7 in. by 7 in., inside dimensions 4 in. by 4 in., and compressed to a depth of 3 in., thereby securing practically the same amount of iron per inch as in the armature. This core was carefully weighed and the section calculated from the weight was checked against the section calculated from the dimensions. On this core was wound a coil of 200 turns. In measuring the losses in this transformer core, the terminals of the coil were connected through a wattmeter to an alternating-current, 60-cycle circuit with a voltmeter across the line. By varying the volts supplied, a set of volt and watt readings was obtained from which it was possible to calculate the watts per pound at different densities. The results of this test are shown by the curve *A*, Fig. 1.

The core loss of the generator was very carefully measured in the following manner: A direct-current motor was belted to the rotor of the generator, which was driven at normal speed, and the input at the motor measured with and without the fields of the generator excited; the difference between these readings after the losses of the driving motor were subtracted, gave the core loss of the generator for that particular field excitation. By varying the field strength of the generator and taking readings of volts at generator terminals and input at motor terminals, a series of readings was obtained which were plotted in the form of a curve, as shown in Fig. 2. From this curve it is seen that the core loss at normal voltage 4,400 is 3½ kw.

From the average densities in the armature core and teeth at a voltage of 4,400, and the weight of steel in armature and teeth, it was possible to figure the core loss from the curve marked *A*, Fig. 1. At 4,400 volts, the density in the armature core is 30,000 lines per square inch, which corresponds to a loss of 2.4 watts per pound. The weight of iron in the armature core is 1,250 pounds, thus giving a loss in the core of .3 kw. The density in the teeth was obtained by taking the mean ordinate of that area subtended by the permeability curve between the densities in tooth roots and tips; in other words, this density is the average between the tooth root and tooth dip densities, taking into consideration the shape of the permeability curve between these two points; the average tooth density in this case was 95,000 lines per square inch, which corresponds to a loss of 2.2 watts per pound from curve *A*; the weight of iron in the armature teeth is 430 pounds, which gives a loss in the teeth of .95 kw. The total loss in core and teeth is 1¼ kw. Therefore, it is found that the actual measured core loss is 2.8 times greater than that calculated in this particular machine.

With the weight of iron in the armature core and teeth, and the corresponding core loss as calculated from curve *A*, it is possible to divide the measured core loss into two parts, one corresponding to the tooth loss, and one to the loss in the core. From these values, the watts per pound at the corresponding densities were figured, giving two points, one for the armature density and one for the tooth density. The values were figured for four different voltages (see Table I), thereby giving eight points which were plotted in the form of a curve (see curve marked *B*, Fig. 1).

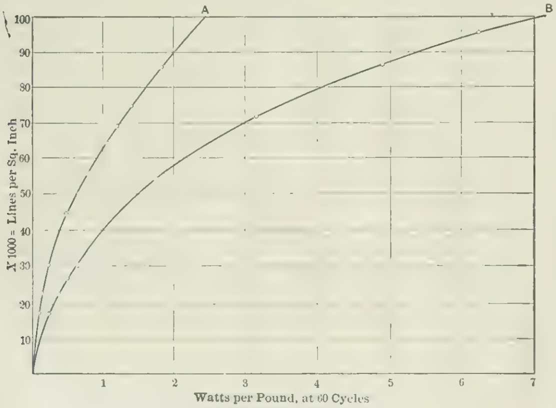


FIG. 1.—HYSTERESIS AND EDDY-CURRENT LOSSES. A: FROM TRANSFORMER TEST. B: FROM CORE-LOSS TEST.

A glance at the two curves in Fig. 1 will show at once the wide variation between the actual measured core loss and the core loss calculated from the transformer test.

Table II gives the results on eleven different 60-cycle machines worked up in the same manner as the preceding example. In the column marked "K" will be found the number by which the transformer core loss should be multiplied to obtain the actual core loss. The average K was found to be 2.906, or nearly 3. The variation is from 2.2 to 3.82. At first this variation may seem rather large, but on considering the number of variables upon which K depends, the reader will at once realize that very good results were obtained because, in order to have the same K in any two generators, it would be necessary to have the same pressure between armature punchings and the same amount of japan between punchings; in other words, the two armatures would have to be built up identically the same, and the same degree of accuracy would have to be maintained in the tests on both.

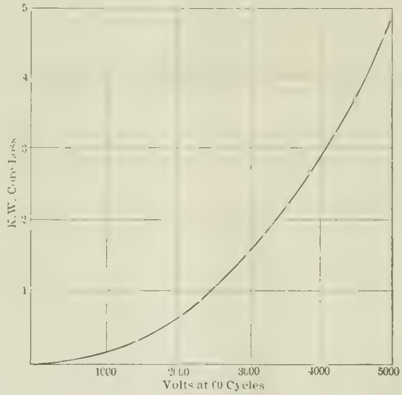


FIG. 2.—CORE LOSS CURVE, 200-KW, 4400-VOLT, 200-R.P.M., 3-PHASE, 60-CYCLE GENERATOR.

The wide difference between the transformer core loss and the actual core loss is largely due to the uneven distribution of the magnetic flux in the armature core and teeth, causing abnormally high densities in some sections and low densities in others; and, as the hysteresis and eddy-current losses are practically proportional to the square of the density, it will be seen that in parts of the magnetic circuit there will be very high losses. As it is impossible to calculate the variation in density, we are forced to use the average density which, of course, gives a much lower core loss. Another loss which is not taken into consideration in the transformer test is the hysteresis and eddy-current loss in the pole faces, although this loss would be very small in a well-designed machine.

TABLE I.

Volts at terminals of generator.	Densities		Weight, lbs.		From test					From t'sformer curve.				
					Watts, per lb.		K.W. loss.			Watts, per lb.		K.W. loss.		
	Arm. Core.	Arm. Teeth.	Core.	Teeth.	Core.	Teeth.	Core.	Teeth.	Total.	Core.	Teeth.	Core.	Teeth.	Total.
4400	30,000	95,000	1250	430	.67	6.2	.84	2.66	3.5	.24	2.2	.30	.95	1.25
4000	27,000	86,000	1250	430	.51	4.9	.64	2.11	2.75	.20	1.9	.25	.82	1.07
3300	22,200	71,000	1250	430	.40	3.13	.50	1.35	1.85	.16	1.27	.20	.54	.74
2500	17,000	54,000	1250	430	.25	1.72	.31	.74	1.05	.105	.72	.13	.31	.44

TABLE II.

Rating					Core loss K.W.		
K.W.	Volts.	R.P.M.	Phase.	Cycles.	Measured.	From Transformer	K.
200	4400	120	3	60	3.5	1.25	2.8
1000	2300	200	3	60	16.	4.19	3.82
750	6600	120	3	60	19.	5.84	3.26
5500	2300	300	3	60	74.	33.6	2.2
500	2300	600	3	60	10.	3.67	2.72
450	2400	150	3	60	14.	5.6	2.5
1500	2500	1800	2	60	21.5	6.9	3.11
125	240	277	2	60	1.9	.55	3.46
150	2300	120	3	60	3.5	1.25	2.8
800	2300	90	[illegible]	60	13.[illegible]	4.75	2.85

TABLE III.

Rating					Core loss K.W.		
K.W.	Volts.	R.P.M.	Phase.	Cycles.	Measured.	From Transformer	K.
800	375	125	3	25	9.7	3.67	2.64
800	480	125	3	25	10.5	3.87	2.74
750	2200	500	3	25	21.5	7.90	2.72
300	1100	167	2	25	4.0	1.63	2.45
1000	375	94	3	25	14.0	4.50	3.10
155	2300	500	3	25	2.8	1.053	2.65
950	2300	375	3	25	15.0	6.05	2.25

From the above data it is evident that the core loss of a generator, calculated from a transformer test on the iron used and at densities corresponding to normal voltage, gives in every case a value much lower than the actual. This value is found to be approximately one-third the actual value in 60-cycle generators.

In Table III are shown the results from seven 25-cycle generators. These data were taken in the same manner as those on the 60-cycle generators excepting the tests on the small transformers, which were made at 25 cycles. The average K in Table III is 2.65, which is slightly less than the average K from the 60-cycle machines, due to the smaller eddy-current loss at 25 cycles.

In conclusion, it may be quite interesting to compare the above method with the one used in calculating the core loss in the 5,000-kw generators installed in the Seventy-fourth Street (Manhattan) power station of the Interborough Rapid Transit Company, New York City, which was published in the *Electric Club Journal* of May, 1905. In this article it is stated that the losses in the generator were determined from a measurement of the losses in sample rings made from the material of which the armature was built up, the losses in the rings being measured at the working densities of the generators. It will be noticed that this method is practically the same as the one described above, which gave values about three-eighths as large as would be actually obtained in a core loss measurement on a 25-cycle generator. It would, therefore, appear from the above data that the Manhattan generators have a core loss somewhere in the neighborhood of 102½ kw instead of 38.69 kw, and an efficiency at full load of about 96.86 per cent instead of 98.39 per cent. Another point which would lead to the belief that the core loss as calculated was much too low is the fact that the rise in degrees centigrade on the armature iron was 13 per cent higher than the rise on any other part of the machine.

The Preservation of the Southern Appalachian Streams.

In his paper on this subject read at the recent Asheville A. I. E. E. meeting Mr. C. E. Waddell said that all large water-power developments in the South to-day are located on streams rising in the Appalachians, and therefore any influence that affects these rivers is of vital importance and far reaching in its consequences. A stream's value as a water power depends on the uniformity of its flow rather than on its quantity, and the regularity of flow is influenced by erosion of the hillsides and by floods.

The government gauging stations report an increasing irregularity in the streams of the Southern Appalachians, and investigations as to the cause leads to the conviction that it is on account of the removal of the forests. Originally these mountains were clothed to their summits with forests, but in the last few decades the lumbermen have made ruthless inroads, with deleterious consequences.

To form a clear conception of the nature of the influence of the forests it is necessary to consider the manner in which streams are formed and the methods by which they derive their supply. It must be noted that surface run-off is the cause of rapid fluctuations, while it is the perennial springs and underground drainage that furnish the permanent supply; therefore, regularity of flow is secured if run-off is diverted into storage. This is the part the forest performs. Its factors of conservation are the lower temperature, the shade, the capacity of the humus and the retarding of evaporation by protection from strong air currents.

Benefit is also derived from the mechanical action of the trees in breaking the fall of the raindrops, thereby protecting the soil, and to the obstruction offered by the roots to a rapid run-off of the precipitation. The roots further assist by increasing percolation through keeping the ground open and porous. The forest cover protects snowfall from rapid melting, and the snow in turn protects the earth from freezing, thereby keeping it open and susceptible to filtration when the snow does melt.

Evaporation is much more rapid from bare tracts than from wooded areas, and this is especially true of the mountains, as the greater the altitude the greater the effect in preventing evaporation.

In 1892 the first practical protection to forests in the United States was started on the Biltmore estate. The methods in vogue consist of mapping the tracts of timbered lands, making accurate surveys of the extent and character of the forests, noting trees that have reached maturity, and reforesting bare tracts. Conservative methods of lumbering are pursued, the trees being removed in a manner that will not destroy the younger growths, and plantings of seedlings take the place of matured trees. On steep declivities where the forests have been previously removed, and where erosion has ensued, the hills are first staked in belts at regular intervals of some four feet, and artificial obstructions such as rhododendron and kalnia roots are introduced, which result in the formation of a new soil. After sufficient time has elapsed to insure permanency and a desired richness the hillsides are planted with very small trees of a kind especially adapted to the locality. The results of these methods are today apparent in the condition of the brooks and streams. The deposit of sediment is materially less on streams not so protected, and the streams are not so turbid after heavy rains.

The French Broad River, with its tributaries above Asheville, drains the Biltmore estate, and the fact that statistics show the French Broad to vary less than any other stream in the South Atlantic States may be attributed to the protection the river receives in the manner just outlined.

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES. CHLORIDE ELECTROLYSIS.

A recent patent granted to M. Couleru refers to the electrolytic manufacture of chlorates and perchlorates with a valuable product at the cathode. The chlorates and perchlorates are produced in the usual way at the anode by electrolysis of a chloride solution, while the alkali formed at the cathode is neutralized by means of chloride of lead to form lead peroxide. If chloride of manganese is used instead of lead chloride, peroxide of manganese is produced as a by-product.

M. Yasuda patents mechanical details of construction of the cathode in order to remove the hydroxide which is formed by electrolysis from the sphere of electrolytic action. He uses a case of insulating material with a passage in which the cathode is disposed and through which the electrolyte enters the case adjacent to the electrode. The bubbles of hydrogen which are developed simultaneously with the formation of the hydroxide rise from the cathode within the insulating casing and carry the hydroxide upward. The case is constructed in such a way that the partially decomposed electrolyte passes on and is retained within the case out of contact with the electrolyte which is not decomposed, and is repeatedly resubmitted to electrolytic action within the case until the desired degree of decomposition is obtained.

A patent granted to C. W. Roepper and W. E. Harmon refers to improvements in the mercury cathode process. The object is to facilitate the formation of the hydroxide solution from the amalgam. Te inventors employ an iron transferring-wheel for effecting circulation of the mercury. It is mounted in the de-amalgamating compartment, dipping both below the water and amalgam. It is provided with buckets formed in the periphery and carrying the mercury.

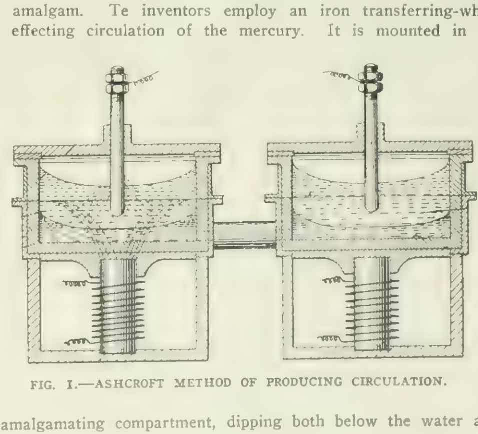


FIG. 1.—ASHCROFT METHOD OF PRODUCING CIRCULATION.

The above three patents refer to electrolysis of aqueous solutions of chlorides. If fused salt is electrolyzed with a fused lead cathode as in the Acker process (the fused lead cathode in this case being quite analogous to the mercury cathode in the Castner Kellner process) E. A. Ashcroft proposes to produce the necessary circulation of the fused lead by the method shown in Fig. 1. The illustration shows two vessels and the object is to provide for automatic circulation of the fused lead from one vessel to the other vessel through the connecting tube. For this purpose the vessels are constructed circularly, and one electrode in each vessel is suspended perpendicularly downwards from the top. The second electrode consists of the fused lead. Below the two vessels are placed the two cores of an electromagnet. The magnetic field produced by the electromagnet within the two vessels produces the required circulation, the necessary condition being that the lines of magnetic force cut the lines of electric current more or less at right angles and in a plane at right angles to the direction of the required motion. The magnetic lines of force and the electric lines of force are indicated by dotted lines in the left hand vessel of the figure.

ELECTROLYTIC DEPOSITION OF METALS.

Anson G. Betts, the indefatigable worker in the electrolytic refining of metals and best known by his lead refining process, has devised in recent years a complete scheme for treating electrolytic slimes. While his process is presumably applicable to the slimes of copper refiners, it was primarily devised in the interest of his lead process. It is well know that by his lead refining process Betts was able to produce a lead of excellent purity and quality, but in the meanwhile lead smelters had succeeded in producing by purely metallurgical processes lead of the same purity and at about the same cost. To make his electrolytic lead refining process superior to the metallurgical process, Betts had to devise a method of treatment of his slimes. Here he was placed before an entirely new problem and a very complicated and difficult one. If his method succeeds on a large scale, then the possibility of obtaining the considerable metallic values contained in the slimes will place his electrolytic process at an advantage over the metallurgical process, in which considerable losses are unavoidable. The complete scheme of Mr. Betts of treating the slime was described by him in an able article in the April issue of "Electrochemical and Metallurgical Industry." A patent has in the meanwhile been granted to him for one detail of the process, that is, the recovery of antimony from antimony trifluoride solutions.

Another patent recently granted to the same inventor refers to a process of extracting zinc from its ores. The zinc ore is roasted and lixiviated with sulphuric acid. The zinc sulphate solution is electrolized with a mercury cathode whereby the cathode becomes a zinc-mercury alloy, while the electrolyte is regenerated to sulphuric acid, suitable for further lixiviation. The mercury-zinc alloy is then used as anode in another cell with zinc chloride as electrolyte and zinc is deposted upon the cathode, while the amalgam is changed back into mercury, which is used again in the first cell above referred to.

F. A. Decker also precipitates zinc from a solution onto a cathode of mercury. A patent granted to him refers to details of the construction of the cathode. He uses a series of trays one above the other, containing mercury. In order to permit ready removal of mercury from the trays, each tray projects on either side through the walls of the vessel, while the opening is sealed by the mercury contained in the trays.

It has long been recognized that to get a good metallic deposit on the cathode with a high current density it is primarily necessary to prevent the electrolyte in proximity of the cathode from getting impoverished in the metallic ions to be deposited. For this purpose stirring and revolving electrodes have often been applied. H. C. Harrison and J. Day propose in a recent patent to use a highly polished cathode of circular cross-section, mounted vertically in the depositing vat and free to revolve about its own axis. To renew the layer of the electrolyte contiguous to the cathode they direct jets of electrolyte tangentially to the surface of the cathode.

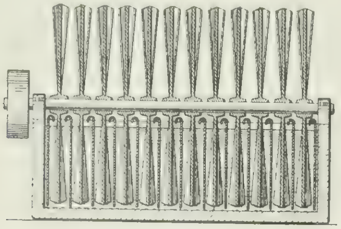


FIG. 2.—JOHNSON REVOLVING ANODE.

W. McA. Johnson obtains the same result in a neat way by a revolving anode of propeller construction, as shown in Fig. 2.

Apparatus for electroplating purposes are described in two patents granted to C. D. Pratt and Louis Schulte, respectively. Pratt's apparatus is especially adapted for plating the insides of ferrules, rings, slip nipples, etc., while Schulte's apparatus is designed for plating sheet metal, band-iron and wire.

MISCELLANEOUS ELECTROLYTIC PROCESSES.

The difficulty in using electrolysis for the production of organic compounds is due mainly to the variety of possible compounds which may be formed and which when once formed participate in the conduction of the current and are again oxidized or reduced; special precautions must, therefore, be taken to get only the one product which is desired. C. Ellis makes tartaric acid and its salts or its isomers and their salts from saccharine matter (grape sugar) by electrolytic oxidation. The gradual oxidation produces various monobasic and dibasic acids. When it proceeds, up to the point where tartaric acid is formed, it becomes necessary to prevent its further oxidation. This is accomplished by the conversion of the tartaric acid into an insoluble or slightly soluble product. For this purpose potassium carbonate or potassium acetate are added.

W. Hoopes patents a process for manufacturing ammonia in a double-fluid cell with carbon electrodes. The cathode compartment contains ammonium sulphate and the anode compartment a solution of common salt. The temperature of the process is 100° C. Ammonia is developed at the cathode with free hydrogen, from which it may be separated by passing through water. Chlorine is developed at the anode.

A. S. Ramage patents a method of treating spent sulphuric acid pickle liquor to recover the metal and regenerate the liquor. The pickle liquor containing ferrous sulphate and free sulphuric acid is saturated with sulphuric dioxide and then conducted through electrolytic vats containing lead anodes and iron cathodes. Pure iron is deposited on the cathodes, while free sulphuric acid accumulates in the electrolyte.

A method of keeping different liquors separate from each other in an electrolytic vat by making use of centrifugal action is patented by R. V. Heuser. The anodes and cathodes are concentric and perforated and the whole vat is revolved. The liquid of higher specific gravity tends to go to the outside.

STORAGE BATTERIES.

A. Meygret patents a protective sheath or envelope for holding the active material firmly in place. The plate or grid when complete with the active material, is placed in a bath consisting of castor oil, pyroxylin and flexible collodion. The coating thus obtained is of an elastic nature and is then rendered porous to permit the electrolyte to pass into the active material.

C. H. Whiting patents mechanical details of construction of a storage battery plate in which a plurality of strips are united with an end piece; the strips having the receiving surface for the active material run parallel with the outer side faces of the end piece of the grid.

A patent granted to Mr. T. A. Edison refers to the construction of his gas separator, the function of which is to separate mechanically entrained globules of the electrolyte from the escaping gases.

D. P. Perry patents a relief valve for storage batteries which permits ready access to the interior of the battery and which also permits the generated gases to escape freely and without danger of spilling of the electrolyte and without danger of dust ordirt entering the battery.

A patent granted to R. Macrea refers to a storage battery with a container in form of two porous cups, one within the other. The inner cup is filled with active material and the outer cup between its inner wall and the walls of the inner cup with an electrolyte. The outer cup is covered upon its exterior surface with active material.

PRIMARY BATTERIES.

A recent patent granted to F. M. Holmes refers to the use of a battery solution which "comprises the combination, with a suitable acid exciting fluid of a gum soluble in water."

Various mechanical details of construction of primary batteries are covered in patents recently granted to D. L. Winters, B. J. Blameuser and three patents of W. C. Banks.

New Telephone Patents.

NEW TELEPHONE REPEATER.

Again an attempt has been made at the repeater problem, this time by Mr. H. E. Shreeve, of Newton, Mass., who has returned toward first principles and has combined the receiver and microphone button. The patent is assigned to the American Telephone & Telegraph Company, which thus appears to recognize the possibility of a solution to the repeater problem.

In early attempts at this type of repeater, either two diaphragms have been provided, one for each element, or a single diaphragm common to both has been used. Mr. Shreeve, however, entirely omits any diaphragm as such, and permits the field of the receiving part to act directly upon the moving parts of the sending portion. To this end, as shown in Fig. 1, a section of a repeater which it is claimed has operated, an armature *f* has been attached to the front electrode of a granular button of the solid back type, i. e., with mica auxiliary diaphragm. The moving parts are made very light and free of inertia, that the distortion may be reduced to a minimum. In the figure, two windings are shown upon the receiving part. One of these is a magnetizing coil which supplies the fundamental field of force upon which the voice current effects are superimposed.

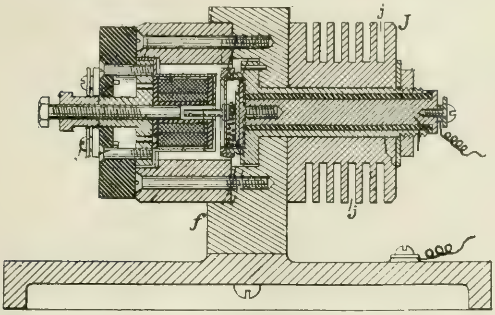


FIG. 1.—SHREEVE RELAY.

Another feature of this repeater is the metallic mass *J*, provided with grooves, *j*, and serving as a radiator for the heat liberated in the transmitter.

Mr. Shreeve has obtained a second patent, also signed to the Bell Company, bearing upon the art of repeating. This describes an induction or repeating coil designed for use with a repeater in connection with composited circuits. This coil is based upon the peculiar magnetizing effects of rapidly varying currents.

If two opposing windings be distributed over different parts of the same core and subjected to slowly varying or steady currents, the magnetizing effects will largely neutralize each other. If, however, the currents be rapidly varying the effect of the opposing windings is almost unnoticeable. With such a coil, therefore, the Morse "thump," a rounded current impulse is of no effect, while voice currents are of full effect. By connecting a repeater to a composited line through such a coil, the "thump" does not magnify. It will be interesting to know how fully the claims for this repeating system are realized in actual working.

NEW TRANSMITTERS.

A new transmitter has been patented by Mr. J. F. Fletcher, of San Antonio, Tex., which has been especially designed so that it cannot be accidentally injured by one unacquainted with its structure. With this end in view all permanent connection between the concealed moving parts and the removable parts of the casing have been avoided, and contact between the diaphragm and the microphone electrodes is obtained through an adjustable pin. This is adjusted so that the tension of the diaphragm keeps it in contact with the electrode stem.

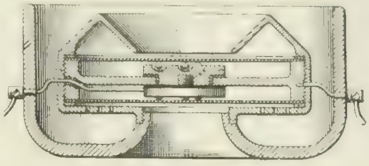


FIG. 2.—SNYDER TRANSMITTER.

Fig. 2 shows another transmitter of the multiple series contact type the features of which are self evident. The inventor is E. R. Snyder, of New York City.

LETTER TO THE EDITORS.

The Plunger Electromagnet.

To the Editors of Electrical World and Engineer:

Sirs:—I note the criticism of Mr. Charles L. Dawson in your issue of May 27, page 980, and in reply beg to say that while his point in the first paragraph is well taken, in that most large electric companies do their designing in c. g. s. units, the writer has found the English units much more useful in shop practice, owing to the fact that the pull, range and general dimensions of electromagnets are given by customers in English units.

Referring to the second paragraph, 10,000 ampere-turns per square inch of core are assumed merely for convenience, although as Mr. Dawson points out "The results of the tests reported—would seem to indicate that the flux in any magnetic core material at saturation is proportional to the cross-sectional area, and that the magnetomotive force to produce saturation varies directly with the length of the core, as ordinarily held." As a matter of fact, the reader can use his own judgment as to the proper magnetomotive force by referring to Fig. 1, page 881 (May 13).

I thank Mr. Dawson for his criticism.

New York, N. Y. Charles R. Underhill.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

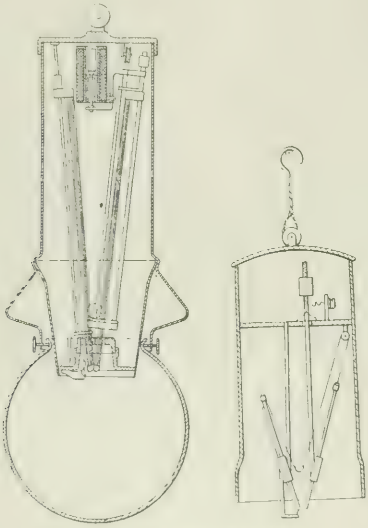
Single-Phase Commutator Motors.—Richter, Sumec, Pichelmayer, Niethammer, Eichberg.—Six communications on single-phase commutator motors. Richter considers Sumec's former exposition of the theory of the compensated series motor as extremely clear, and gives another proof of the result obtained by Sumec that the power factor of the compensated series motor is independent of the number of poles. It is impossible to improve the power factor of a series motor running at a certain speed by changing the number of poles. Sumec elaborates some points in his former article. Pichelmayer endeavors to show the error in the opinion of Lamme and Niethammer, who hold that it is possible to improve the power factor by increasing the number of poles. —*Zeit. f. Elek.* (Vienna), May 28.—Niethammer points out that there exists no essential difference of opinion concerning the theory. Only if the number of field conductors per pole is maintained constant with varying number of poles, the power factor is independent of the number of poles.—*Zeit. f. Elek.* (Vienna), June 4.—Eichberg criticises some special points in Sumec's article and Sumec replies to these cricitisms in *Zeit. f. Elek.* (Vienna), June 14.

Compensating Armature Reaction. Brown.—An abstract of a paper read before the Newcastle Section of the (Brit.) Inst. Elec. Eng., in which the author discussed the work of Deri and Ryan and the methods adopted by Brown, Boveri & Co., Sauter, Harle & & Co., and Lundell.—Lond. *Elec.*, May 26.

Design of Dynamos.—Frith.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng., giving a collection of labor-saving formulas for use in the design of dynamos.—Lond. *Elec. Rev.*, May 26.

LIGHTS AND LIGHTING.

New Arc Lamp.—ARENDT.—An illustrated description of the Beck lamp, which is essentially a flame arc lamp, the carbon being impregnated with light-emitting substances and producing a long arc. The construction of the lamp is shown in Fig. 1. The two carbons are arranged side by side in a slightly inclined position. One carbon (the left one in the illustration) is fixed, with respect to its longitudinal direction; the other, right hand carbon, being adjusted in position by means of the lever shown at the top. This lever is operated by means of an electromagnet, shown in the center at the top of the lamp. When no current flows the two carbons touch each other at their terminals at the bottom. When the circuit is closed the right hand carbon is deviated sideways (to the right hand) and removed from the left one (as a result of the action of the electromagnet) and the arc is started. The deviation of the right hand carbon is limited so that a constant distance between the two carbons is maintained. The electromagnet is entirely closed and contains only a few windings through which the main current flows. The lower terminals of the carbons are surrounded by a cast-iron reflector, the inside of which is of white enamel. The left carbon (for direct current, mostly the positive carbon) has not an exact circular cross-section, but is provided with a rib, which is shown at the left, and by means of which it rests on a support mounted at the bottom of the reflector. Above the lower support surface there is provided a small chamber surrounding the carbon rib and protecting it against the air. The purpose is to let the carbon burn off in such a way that a fine point always remains at the end of the rib. This fine point is the point on which the left carbon rests. It is stated that it burns off very uniformly and slowly, so that the carbon electrode is fed downwards very gradually and uniformly. The support on which the fine terminal point of the carbon rib rests remains relatively cold. The right hand carbon, which has a completely circular cross-section, is fed downward simultaneously with the left hand carbon by means of the mechanism shown in Fig. 2. The most economical current is stated to be 6 to 12 amperes for direct or alternating current for an e.m.f. at the terminals of 42 to 46 volts. Wedding has tested a direct-current lamp for 9.1 amperes at 44.2 volts, which gave without globe, 2469 hemispheric c.p., corresponding to a consumption of 0.163 watt per candle. The maximum of illumination, which is 3800 c.p., is perpendicularly below the lamp. Cored carbons are stated to be the best ones. For the 9-ampere lamp the diameter of the positive carbon is 8 mm. that of the negative carbon 7.5 mm. The length of the carbon is 330 mm. for the smallest type of lamp, which gives a carbon life of 8 hours. The lamps are built for carbon lengths up to 500 mm. For a carbon life up to 30 hours double lamps are used. Combinations of four lamps for giving 20,000 c. p. have also been built.—*Elek. Zeit,* June 8.



FIGS. 1 AND 2.—NEW ARC LAMP.

POWER.

Variable-Speed, Alternating Current Motors.—IONIDES.—A paper read before the Glasgow section of the (Brit.) Inst. Elec. Eng. on alternating-current motors in industrial service. For paper calendars the usual requirements are (1) the dead slow speed for threading in the paper; (2) minimum speed for calendering certain classes of paper; (3) top speed for calendering other classes of paper. These requirements can be met in the following manner with induction motors: There is a small auxiliary motor driving the main motor through a worm gear and free wheel clutch, so as to give the required slow speed for threading in. The main motor is wound and connected to a controller of the tramway type, so that the coils of the stator can be grouped to form eight poles, at which the medium speed would be obtained, or four poles, at which full speed would be obtained. In this particular apparatus the supply is at 25 periods per second, and consequently the speeds of the motor are 360 and 720 revs. per min., making the usual allowance for slip. The changing from dead slow to half speed and from half speed to full speed is obtained by means of tappings from a pair of auto-transformers and a number of notches on the controller, whereby a gradual increase in voltage is applied to the motor as the controller is moved from notch to notch. This insures an even acceleration, and prevents any tearing of the paper. It would have been equally feasible to have wound the motor with 12 and 8 poles, so as to give three-quarter and full-speed, or other combinations. The controller is placed remote from the motors for the convenience of the operator, and all movements are controlled by one handle. The whole apparatus is no more costly than direct-current apparatus to accomplish the same results would have been, and the operation is equally satisfactory. A modified form of this arrangement for paper calenders can be used to great advantage on other classes of work; for example, in the driving of air compressors or hydraulic pumps. In this arrangement the motor is wound for two speeds, i. e., tappings are brought out from the windings so that the coils may be grouped to give full speed and half-speed, or full speed and three-quarter speed, as the case may be, and connected to a double-throw switch, which when thrown in one direction will give the full speed, and in the other direction will give the half-speed. A still simpler form of this speed changing device can be used on squirrel-cage motors employed to drive machine tools and punching and shearing machines, where different speeds are required, and in this case the switch, which changes the grouping of the coils in the motor is simply operated by hand. As an example: A 10-h.p motor is used to drive a punching and shearing machine. For very heavy work the motor is required to operate at about 75 per cent of the speed at which lighter work could be done. To meet this requirement, the tappings for the grouping of the coils should be so arranged as to give three-quarters or full-speed. If half-speed and full-speed are required, the tappings could be arranged accordingly. The output of the motor is varied in direction proportion to the change in speed, i. e., a 100-hp motor at 480 revs. per min. will give 75 hp at 360 revs. per min. and 50 hp at 240 revs. per min.; but the efficiency at any of these speeds is as high as it is possible to obtain within a very small percentage. As the power required to drive most machinery varies directly as the speed at which it is driven, the output of the motor corresponds very nicely with what is required of it. These examples refer to those cases in which certain fixed speeds meet the requirements. If, however, it is necessary for the motor to have a speed variation of perhaps six or eight to one with the possibility of being able to run continuously, and with a high efficiency at any intermediate speed, the shunt-wound, direct-current motor operating on two or more voltages has heretofore been used. The author points out the advisability of the single-phase series motor and recommends the use of this motor controlled by an induction regulator, which is a boosting transformer placed in series with the motor. The regulator or transformer raises or lowers the voltage, depending on the relative position of the primary, which is moved in relation to the secondary by means of a worm-wheel gearing. Any voltage requiring from zero to full-line pressure can be applied to the motor, and consequently any required speed can be obtained. —Lond. *Elec.* May 26.

Electric Transmission and Distribution in New England.—An illustrated description of the two sub-stations of the Connecticut Railway & Lighting Company at Waterbury, Conn. Electric energy is supplied to these stations from the hydro-electric plant of the New Milford Power Company at Bull's Bridge, on the Housatonic River, in the town of Kent, Conn. The three-phase transmission lines from Bull's Bridge run to sub-station No. 1, which is located on the west bank of the Naugatuck River, on the outskirts of Waterbury. The lines carry three-phase, 60-cycle current at 33,500 volts, and this is delivered to the plant at Waterbury, over thirty miles distant, with a loss ranging from 4 to 7 per cent. The e.m.f. is stepped down in the sub-station to 2,300 volts for overhead transmission through the town of Waterbury to sub-station No. 2, which is situated in the center of the town. Current at a potential of 33,000 volts is also transmitted through sub-station No. 1, where switches are provided, to sub-stations at New Britain and Cheshire, thus giving a transmission circuit over 40 miles long, which is the longest in New England. Sub-station No. 1 is devoted almost entirely to railway and arc light work. The railway lines are supplied with a 600-volt direct current through rotary converter sets. The arc lights are supplied through tub transformers. Sub-station No. 2 is devoted entirely to commercial lighting work, which is fed from the Edison three-wire system, rotary converter sets in this station supplying the direct current. The article is profusely illustrated and the equipment of both stations is described in detail.—*Amer. Elec.*, June 1905.

Pumps.—An illustrated note on the installation of an electrically driven high-pressure turbine pump recently installed in a British colliery in place of a steam-driven pump. Also a note on the installation of motor driven centrifugal pumps for service on sewage disposal works.—Lond. *Elec.*, June 2.

Norwegian Power Plant.—THRUE.—An illustrated description of the water power development of the Gravfos Falls for transmission to the city of Drammen, a distance of 22 miles. There are at present 4,400 hp available. Three-phase currents are generated at 5000 volts and transformed up to 20,000 volts for transmission to the sub-station at the entrance of the city of Drammen. There the voltage is reduced to 4500 for distribution to a number of single transformers placed in different parts of the city. In these transformers the voltage is again reduced from 4500 to 220 to supply a low-voltage distribution network.—*Elek. Zeit.*, June 8.

Softening Water.—LECLAIR.—An abstract of a paper read before the Dublin section of the (Brit.) Inst. Elec. Eng. on softening water for steam raising. The author gives an interesting table showing the chief salts which cause temporary and permanent hardness and the treatment required for their removal, together with the reactions which take place.—Lond. *Elec. Rev.*, May 26.

Gas Engines.—RIEDLER.—The first part of an illustrated serial on large German gas engines.—*Iron Age*, June 22.

TRACTION.

Single-Phase Traction in Italy and Safety Devices.—KERBABER.—An illustrated article on the Roma-Civita Castellana line, on which the single-phase system of the Westinghouse Company will be adopted. Many stiff gradients are met with, including one of 1 in 14 for about half a mile. The power station will be at Ponte Milvio, 2.5 miles from Rome, and will be equipped with 300-hp steam turbines, driving 600-volt, single-phase alternators. The line between Rome and Ponte Milvio will be operated at 550 volts, the remaining section at 6,000 volts, the frequency being 25 cycles per sec. Between Rome and Ponte Milvio, where a pressure of 550 volts is used, there are two No. 00 trolley wires of copper of high conductivity. From Ponte Milvio to Civita Castellana there will be used only one No. 0 trolley wire. In order to render a pressure of 6,000 volts permissible on a public road, it is necessary to employ such a system that, should the trolley wire break down at any point of the line, the current will be cut off at the same moment at the power station. Furthermore, the current must also be cut off in the case of a short-circuit on the line, or of a current flowing in excess of the limits of safety. Fig. 3 is a diagram showing the system adopted. The apparatus includes an automatic oil circuit-breaker *S*, with its coil *C*; two electromagnets *M* and *N*; and two transformers, *T* and *R*. When the line is in its normal working condition, the current supplied to it goes through the electro-magnet *M*, but is not strong enough for operating the latter, which, therefore, remains always open. On the other hand, the transformers *T* and *R* have their primaries always connected on 6,000 volts, so that at the terminals of their secondaries there is a certain constant pressure. Furthermore, the secondary of *T* is always connected with the terminals of the electromagnet *N*, and keeps its armature in the "open" position. Suppose, first, that a short circuit happens on the line; then the electromagnet *M*, which is in series with the trolley wire, carrying a current stronger than the normal value, draws up the core and closes the circuit through the secondary of the transformer *T* and the coil *C*, thus opening the circuit breaker. Suppose now that the trolley wire or the pilot wire breaks down at a certain point of the line. In this case, as the trolley wire and the pilot wire are in series, no current will go through the primary of the transformer *T*; therefore the pressure at the terminals of its secondary becomes zero, and no current can go through the coil of the electromagnet *N*. The core of the latter comes down, closes the circuit through the coil *C* and the secondary of the transformer *R*, and consequently trips the circuit-breaker. One of the difficulties of the system described in its application at the turn-outs, because if the two wires run in parallel, it is impossible to avoid danger, due to the breakage of one of them. It has been proposed, however, to use the arrangement shown in Fig. 4; by this means the safety of the system is maintained, but the construction of this part of the line requires much care and intelligent supervision. The line in question will have no feeders at all, a No. 0 copper wire being sufficient for the whole length with the high pressure used; every three miles there will be placed section insulators which consist of a neutral wire fixed to two or more poles, to which are fixed also the two ends of the live trolley wire. At the point, however, where the change of voltage has to be effected, the neutral wire has a length of about 40 yds., and there is a special switch which can connect this wire with one or other of the two voltages, but never both at the same time. This switch is erected just at the front of the power station, and one of the station attendants will be entrusted with its operation.—Lond *Elec. Rev.*, June 2.

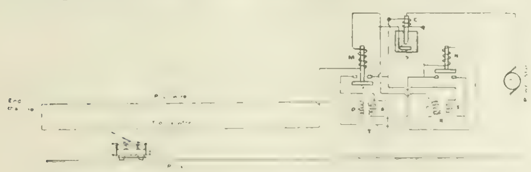


FIG. 3.—SINGLE-PHASE TRACTION.

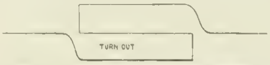


FIG. 4.—SINGLE-PHASE TRACTION.

Hot Air in New York Subway.—An editorial discussion of the cause of the high temperature in the New York subway. It is pointed out that practically all the electrical energy which is consumed in the subway for lighting and traction purposes is changed into heat. With the exception of the force used in overcoming inertia, the power of the motors is expended in overcoming friction, or in other words, is converted into heat. Moreover, in the last analysis, even the force used to overcome the inertia of the trains is converted into heat, for when the brakes are set to retard the train the heat developed at the surfaces of contact between the brake shoes and the tires is equivalent to the electric energy originally expended in overcoming inertia. Some data on temperature measurements are given, showing that the subway air is at present from 4 to 6 degrees hotter than the surface air above. A calculation is given showing that sufficient electrical energy is changed into heat in the subway in order to heat the whole of the subway 200 times a day to a temperature six degrees higher than the outside temperature. If this volume of air is to be supplied the subway air must change 200 times in 24 hours, or practically once every 7 minutes. There are more than 30 stations in the 10 miles, with an average of nearly 4 entrances and exits to each station, or 120 openings for ventilation, of which half, or 60, may be assumed as intakes for the outside air. If these intakes average 70 square feet in cross-section, the air will need to pass through them at a velocity of about 10 miles an hour to change the subway air 200 times in 24 hours, or once in 7 minutes. It appears that in reality the subway air is changed far more frequently than is necessary for perfect sanitary requirements, even allowing 3,000 cu. ft. per hour per person. The problem of ventilation of the subway, then, is not a problem of sanitation, but a problem of keeping the subway temperature down to reasonable limit.—*Eng'ing News,* June 15.

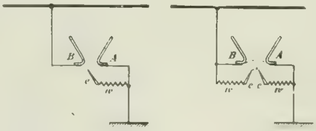
Steel Wheels.—Fowler.—A comparison of the cost, life and other characteristics of cast iron and steel wheels. The author concludes that the adoption of the steel wheel in street railway work should be both rapid and extensive.—*St. R'y. Jour.,* June 17.

India.—An illustrated article on the conversion of the Calcutta tramway system from horse traction to electric traction. The equipment is modern and is specially adapted to the peculiarity of tropical and local conditions.—*St. R'y. Jour.,* June 3.

Single-Phase Locomotive.—Storer.—An illustrated description of the 135-ton, single-phase locomotive exhibited by the Westinghouse Elec. & Mfg. Co. at the recent International Railway Congress.—*Elec. Journal,* June.

Installations, Systems and Appliances.

Lightning Arresters.—Dina.—A long article, illustrated by diagrams describing the various arrangements by which it is possible to obtain a suitable length of air-gap at relatively low voltages, say at a few thousand volts. The most suitable length of air-gap is said to be three to four millimetres. All attempts at lengthening the air-gap by giving special forms to the electrodes, for instance by using very sharp edges, have proven unsuccessful, because after numerous discharges the sharp edges are destroyed. Other inventors have introduced an artificial air-gap which starts the discharge. Either the heat effect or the ionizing effect of the ultraviolet light of the discharge starts a discharge through the main air-gap. One construction is shown in Fig. 5, in which *Be* is the auxiliary air-gap and *BA* is the main air-gap. A modification is shown in Fig. 6, in which there are really three successive discharges. First between *ee,* then between *B* and *e* and finally the main discharge from *B* to *A.* Further modifications of this scheme are possible by using successive auxiliary air-gaps like *ee,* one below the other and with decreasing lengths of the gap so that the lowest and shortest air-gap is first acted upon, which starts the discharge through the next one, and so on. The disadvantage of these methods is that the auxiliary air-gap must have a short length and is liable to be changed in time; moreover the wind may blow the discharge from the main gap to the auxiliary air-gap and it may remain where there are not special devices to extinguish the arc quickly. Another principle is that of Elihu Thomson (U. S. patent 495,858). The author then describes the Siemens-Shuckert lightning arrester, which is shown in Fig. 7. The scheme is to use a special circuit in which high frequency oscillations are produced. *W* is the damping resistance and *B A* the main air-gap. *C* C_1 are condensers, *F* is an auxiliary air-gap, *P* the primary and *S* the secondary of a Tesla transformer. When the voltage at the plates of the condenser *C* (which is practically equal to the voltage between line and earth) reaches the value to which the air-gap *F* is adjusted, the condenser *C* discharges partly through the circuit *C F* C_1 *P,* i. e., it transfers a part of its charge to the other condenser, C_1 high frequency currents being produced. This discharge depends in no way on the methods by which condenser *C* has been charged (that is, on the causes of the excessive rise of voltage in the line). The oscillating currents in the primary *P* produce a high e.m.f. in the secondary *S* of the Tesla transformer, so that now a higher voltage exists between *B* and *A* and the discharge from *B* to *A* is started. This higher e.m.f. is without any danger to the line. The main advantage is that there is no direct effect from the auxiliary air gap *F* on the main discharge gap *BA.* It is, therefore, possible to enclose *F* in a suitable tube and place it at some distance from the main discharge. The apparatus is called a "lightning arrester relay." It is built with an air-gap *BA* of 4 mm. for about 3000 volts effective current and with a gap of 3 mm. for about 2000 volts.—*Elek. Zeit.,* May 25.



FIGS. 5 AND 6.—LIGHTNING ARRESTERS.

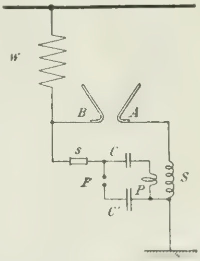


FIG. 7.—LIGHTNING ARRESTER.

Static Disturbances in Transformers.—Kintner.—An article in which the author first explains, with the aid of diagrams, the causes of the static disturbances sometimes observed on the low-tension side of a transformer with a high ratio of transformation. To prevent serious trouble, a discharge spark gap may be connected between the middle point of the low tension side of the transformer to be protected and the ground. When single transformers are worked in groups for polyphase transformations, the discharge gaps must be properly connected to the group. A series of diagrams is given, showing the connections for various polyphase systems. Only one spark gap is used in all groups save that of the two-phase independent circuit, which is in reality two independent single-phase circuits. The gap should be attached to the neutral point of the group when possible, and under all conditions it should be attached as near to that point as possible. No spark gap discharges should be used on transformers supplying a rotary converter that has one leg of the direct-current circuit connected to ground.—*Elec. Jour.,* June.

Installations.—A great many special problems concerning details of installations and wiring have been discussed in the form of questions and answers during the past four years in the journal; an alphabetical index of the different problems dealt with is now given in *Elek. Zeit.,* May 25.

Regulations.— A reprint of the revised regulations of the British Board of Trade for local authority undertakings in the provinces of Great Britain.—Lond. *Elec.,* May 19.

Safety Regulations.—Weber.—A report of the Committee of the German Association of Electrical Engineers for considering safety regulations.—*Elek. Zeit.,* June 1.

Wires, Wiring and Conduits.

Insulating Materials.—A table giving various properties of the most important insulating materials. The properties dealt with are average perforation voltage for an alternating current at 50 periods, inflammability, specific weight, method of treating, machining, and other details. Fifty different samples of 15 different materials are dealt with.—*Elek. Anz.,* May 25.

Drum Carriage.—An illustrated description of a new carriage for cable drums, designed for the purpose of lessening the labor of loading and unloading.—Lond. *Elec.,* June 2.

Electrophysics and Magnetism.

Production of Radium from Uranium.—Soddy.—An account of experiments in which he found that a quantity of uranium, originally practically free from radium, after being kept for a certain time in a closed bottle, showed the characteristic properties of the radium emanation. A certain amount of uranium had, therefore, been changed into radium, but the rate of this production was lower than should have been expected, if the radium atom resulted directly by the change of the uranium X atom. He gives reasons why we should expect that as polonium and radium are to be regarded as products of uranium, the other radio-active elements, especially actinium, present in pitchblende, probably had a similar origin and may, in fact, be the missing intermediate forms. One disintegration series is probably from uranium to radium to polonium to lead (or bismuth).—*Phil. Mag.,* June.

Metallic Resistance at High Frequencies.—Brocca and Turchini.—An account of experiments in which the authors tested Kelvin's formula for the alternating-current resistance of wires for frequencies of several million per second by means of simultaneous thermal and electrodynamic measurements. They find that in non-magnetic metals, like copper and platinum, the deviations from the calculated values are slight for frequencies well under a million, but they exceed the errors of observation and follow a perfectly definite law. The variable $x = \delta \surd 4x\overline{cwu}$, by which Lord Kelvin calculated the ratio of the resistances, gives values which are too high or too low according to the frequency. For $x = 8$, the formula holds strictly. In the case of iron, the formula fails entirely, the current density being of paramount influence. The heating is much less than that which would correspond to its ordinary permeability below saturation.. The permeability to be inserted in the formula for x above, necessary to justify the values obtained, would be about 100. German silver also shows a distinct effect of the current intensity. When the current increases from an effective strength of 1 ampere to 1.4 ampere, the resistance of a German silver wire 0.59 mm. thick diminishes 5 per cent.—Lond. *Elec.*, May 26; from *Comptes Rendus*, May 8.

Flow of Electricity in Metals Under Changes of Pressure.—THWING.—An abstract of an Amer. Phys. Soc. paper, giving an account of experiments on the flow of electricity in metals under changes of pressure. A bar of metal, *A*, is connected by a fine wire, *a*, of the same metal to one pair of quadrants of a sensitive electrometer. *A* is enclosed in a straw jacket and heated to 100°, while *a* is at the temperature of the room. When *A* is heated the electrometer is charged negatively. When *A* is cooled the electrometer is charged positively. If *A* is enclosed in a stout tube of steel, insulated in oil, and hydrostatic pressure applied, the charge obtained is positive, and for pressures of 10-20 atmospheres is in the case of some metals as much as 0.1 volt.—*Phys. Review*, June.

ELECTROCHEMISTRY AND BATTERIES.

Electric Furnace in the Iron and Steel Industries.—BORCHERS.—A review of the present condition of the manufacture of iron and steel in the electric furnace. The author gives an outline of the more important electric furnace procsses which have been devised or introduced into practice. He concludes that the experiments which so far have been made and which have given real results, were made by experimenters who were able electrical engineers, electrochmists and furnace designers, yet were more or less unacquainted with the iron and steel industries, at least when they began their experiments. He thinks the time has not yet come to say exactly what may be accomplished with the electric furnace in this field. But the time is now ripe for experienced iron and steel men to take up the problem.—*Stahl und Eisen*, June 1.

Filter Presses.—HATSCHEK.—An illustrated article on the materials for the construction of filter presses for use with various solutions. He deals especially with iron, gun metal and wooden presses and the use of various materials for the fittings, etc. The use of hard-rubber liners and cocks is mentioned. The author concludes that there is practically no substance requiring to be filtered on a commercial scale for which a suitable filter press cannot be made.—*Electrochem. and Met. Ind.*, June.

Magnetic Separator.—An illustrated article on the Buchanan magnetic separator.—*Iron Age*, June 22.

Refractories.—JOHNSON.—A communication pointing out the importance of selecting the proper refractory materials for metallurgical furnaces and the problems which are involved in different cases.—*Electrochem. and Met. Ind.*, June.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Bolometer for the Absolute Measurement of Radiation.—CALLENDAR.—An abstract of a (Brit.) Phys. Soc. paper. The electric compensation method in which the heat received by radiation on a metallic strip is determined by measuring the electric current required to produce the same rise of temperature in the strip, is the most satisfactory and accurate method for absolute measurement. Two methods have been used for this purpose: The thermo-electric method and the bolometric method of Kurlbaum, in which the rise of temperature produced by the radiation or by the electric current is measured by the increase of resistance of the metallic strip itself. The author points out the advantages of the latter method and describes some improvements which he has introduced.—Lond. *Elec.*, May 26.

Inductance Standards in Varying Temperatures.—TAYLOR.—An abstract of an Amer. Phys. Soc. paper. The standard variable inductance examined was of the familiar Aryton-Perry type, consisting of two coils wound on portions of concentric spherical mahogany frames. It was thought that temperature variations might produce unequal expansions in different portions of the wooden frames and so alter the configuration of the coils as to produce an appreciable difference between inductance values when used at different temperatures. The results were in all cases practically negative. At least it is safe to say that for the standard tested, as probably for others of the same type, the variation of inductance with temperature is less han 1-40,000 per degree centigrade.—*Phys. Review*, June.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Transmission of Photographs.—WILL.—An illustrated article on Korn's electric method for transmitting photographs. At the transmitting and receiving station two drums are revolving synchronously. At the transmitting station there is used a hollow glass drum on which the photograph to be transmitted is rolled off in the form of a transparent film. The receiving station has a sensitive film rolled on a hard-rubber drum. A thin light ray passes through the film on the transmitting station and drops on a selenium cell, which is combined with a storage battery, the transmitting line and apparatus of the receiving station to one circuit. According to the picture on the film, more or less light passes through it so that the resistance of the selenium cell is accordingly diminished to a greater or less extent. The current passing through the line varies correspondingly so that at the needle of a galvanometer in the receiving station changes its position accordingly. By this means more or less resistance is inserted in the local circuit of a Geissler tube, so that the tube emits more or less light. A fine ray of light emitted from the tube falls on the film of the drum of the receiving station and blackens the same more or less and in accordance with the degree of blackness of the corresponding part of the film on the transmitting station. Since both drums revolve synchronously and are simultaneously displaced in a longitudinal direction (like a phonograph record), the picture of the transmitting station is reproduced in form of a helical line on the film of the receiving station. Several transmitted and received pictures are reproduced, and it appears that the similarity in each case is quite satisfactory. It is stated that in general the received picture makes the person appear younger since little wrinkles are not reproduced. The more characteristic lines in the face are clearly shown. If the drums make one revolution in 12 seconds, pictures of a size of 12 by 18 cm. are transmitted in 12 to 24 minutes.—*Elek. Anz.*, June 4 and 8.

Wireless Telegraphy.—DUDDELL AND TAYLOR.—The first part of an illustrated paper read before the (Brit.) Inst. Elec. Eng. The authors endeavored to get quantitive data; they measured the effective value of the current in the receiving air wire and determined as far as possible how this current depends on the arrangement of transmitting and receiving apparatus and the distance between them. The paper is to be concluded.—Lond. *Elec.*, June 2.

BOOK REVIEW.

AMERICAN STREET RAILWAY INVESTMENTS. (The Electric Traction Red Book.) Twelfth Annual Volume. 415 pages, with maps. New York: McGraw Publishing Company. Price, $5.

We are glad to welcome the latest issue of this admirable and valuable publication, so long a standard work of reference in its field. The new edition contains 415 pages of statistical matter or 53 pages more than the edition of 1904. This increase has been due partly to the addition of reports from new roads, and also to the fact that many roads have furnished a statement of earnings for the first time this year. Among the new features in the manual this year is an increase in the index. Heretofore only the names of the companies reported have been included in the index, but this year it has been enlarged to include the names of all underlying companies which have bonds outstanding, even though the company may not at this time have any separate corporate existence. This enables investors to refer readily to the report of the company which now operates the road of any former company.

The introduction to the book contains a summary of the gross receipts for the last two years of the principal companies reporting. As there have been many consolidations during 1904, this table is not an exact index of the growth of the business, as the figures in a number of cases represent receipts for a larger amount of trackage. Nevertheless the increase is such a steady one as to indicate a substantial gain in street railway earnings for the past year. It is interesting to note that 43 companies showed gross income of $198,644,802; 30 companies showed $21,483,088; 144 companies showed $31,783,234; 106 companies showed $7,661,972, and 82 companies showed $3,138,982. It will thus be seen that 405 companies reported earnings above $272,000,000, from which it would be a conservative inference that the street railways in the United States—from 1,200 to 1,500 all told—have the splendid income of $300,000,000 based on an average fare per passenger of less than 5 cents, in return for which they give a service without parallel in the world for speed, distance covered, comfort and convenience, all due to electricity.

Test of Reeves Vertical Cross-Compound Engine.

Professors R. C. Carpenter and H. Diedrich, of Cornell University, give in a recent report the data of a test of a Reeves vertical cross-compound engine. The engine itself is the vertical cross-compound type controlled by Rites shaft governor. There is no receiver, the steam from one end of the high pressure cylinder entering the corresponding end of the low pressure cylinder. The engine was run both condensing and non-condensing. In the latter case the dimensions were 12 inches and 20 inches by 14 inches; when run condensing, a liner was put in reducing the diameter of the high pressure cylinder to 10½ inches.

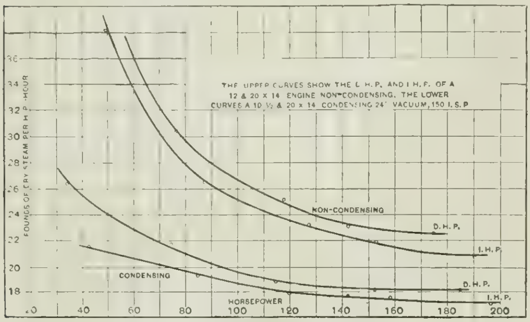


FIG. I.—HORSE-POWER CURVES.

The accompanying curves give the data of the test. In the report two points are noted about these curves. The cut-off even at high loads does not seem to be late enough to cause any marked rise in the steam consumption at overloads; in most cases little or no rise could be determined. The curves show good economy over wide range of load, the efficiency falling off but slightly on overloads.

Belted-Type Rotating Field Alternator.

A line of belted type, self-contained, rotating field, alternating-current generators, such as shown in the illustrations, has recently been placed on the market by the Westinghouse Electric and Mfg. Company. The machines are built for single, two and three-phase circuits, in sizes from 30 to 200 kw. The single phase generators are manufactured for 220, 440, 1100 and 2200 volt circuits at 7200 alternations, and besides these the polyphase machines are wound for 6600 volts and both 3000 and 7200 alternations. In this type of generator the armature is stationary, a construction which facilitates the insulation of its windings, and provides that the field current instead of the armature current pass through the brushes and collector rings. Alternators of this type are, therefore, especially adapted to high voltages or large current output.

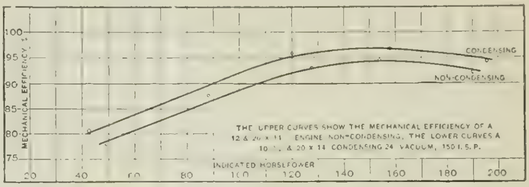
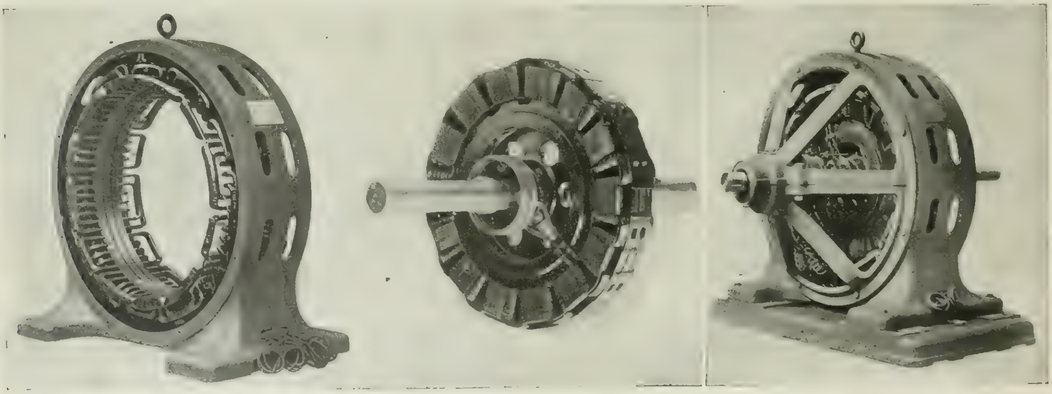


FIG. 2.—EFFICIENCY CURVES, REEVES ENGINE.

The frame of the stationary armature is cast in one piece with slots machined on the inside for holding the punchings which receive the windings; these are composed of wire, strap or bars, depending on the size and voltage of the generator. Open slots are employed in machines up to 75 kw. with coils held in place by hard fiber wedges. In the larger machines partially closed slots are used. Horizontally split brackets, which carry the bearings, are bolted to this cast iron frame. All generators have bed plates with large foundation areas and suitable belt tighteners, and may also be arranged for direct connection to an engine or water wheel.

The fields of the smaller generators are of cast steel with pole caps of the same material. The poles of larger sizes are laminated and keyed or dovetailed to a cast iron spider. The field coils are composed of square wire so wound as to expose the maximum surface. In the generators having laminated poles heavy brass wedges, which hold the field coils in place, retard any shifting of the field between the poles, and thus practically eliminate pumping between the generator and any rotary converters or synchronous motors which may be connected in the system and insure satisfactory parallel operation of two or more generators. A large shaft insures cool running of the bearings, and the absence of any distortion which might result from the pull of the belt.



Figs. 1, 2 and 3.—Rotating-Field Alternator.

Every means has been utilized for the rapid dissipation of heat from all parts of the machines. Open spaces in the laminated field register with those in the armature, and during operation air is drawn in through the field spider and forced out through the stationary core and windings, thus insuring low operating temperature. Excellent regulation is obtained by properly proportioning the armature and field windings in preference to saturating the magnetic field.

The single-phase generators have compensating field windings supplied with rectified alternating current. A commutator on the shaft adjacent to the collector rings, has its brushes connected to the secondary of a series transformer in the armature circuit and its segments to the self-exciting field coils. The compensating winding is so designed that the generator can be adjusted for a practically constant voltage from no load to full load, or for an increase in voltage.

◆

Recording Voltmeter for Both Direct and Alternating-Current Circuits.

Since it accurately, automatically and continuously furnishes a written record of the slightest variation of the voltage, the recording voltmeter has proven itself to be of great value, and is an indispensable part of a modern electric plant. With the recording voltmeters previously used it had been necessary to furnish each instrument with entirely different current coils, according as it was to be employed upon alternating or direct-current circuits. In many electric plants both alternating and direct current are produced, and it is desirable that the same voltmeter be capable of being used equally well for recording either kind of current.

The novel feature and improvements in the new voltmeter illustrated in Figs. 1 and 2 are: First, it is equally applicable to both alternating and direct circuit; second, it requires only one-third as much current to operate as that necessary for the older design for alternating currents; third, it is more sensitive to very slight variations of voltage; fourth, the chart graduations are nearly uniform on both sides of the working range; fifth, the portable form of the instrument in its carrying case is only half the size and weight that was formerly required.

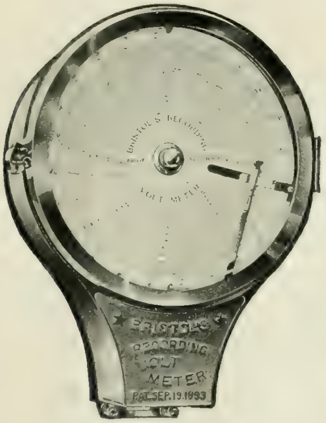


FIG. 1.—STANDARD SWITCHBOARD METER.

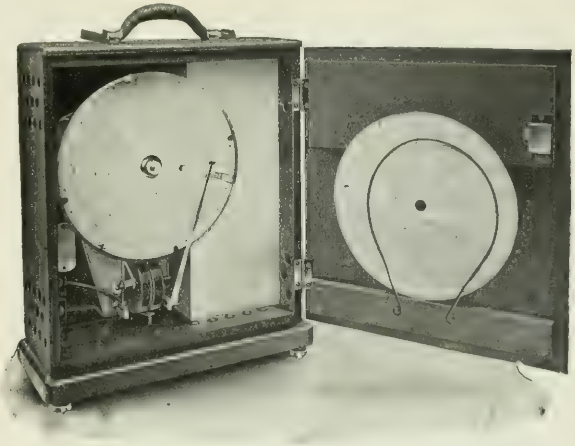


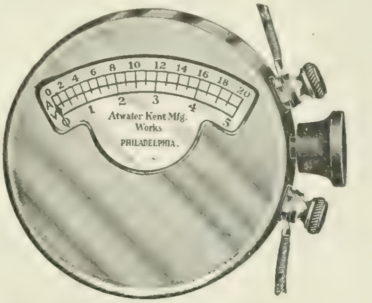
FIG. 2.—PORTABLE METER.

The solenoids shown in Fig. 2 are connected so that when current is passing through them in series the movable solenoid will be repelled from, instead of being attracted toward, the stationary one. The movable solenoid is mounted on a frictionless knife-edge multiplying device, which transmits its motion to the pen arm, carried by the knife-edge blade. This simple multiplying device permits the solenoids to be located very near each other, and consequently the magnetic field of force is uniform throughout the motion of the solenoid resulting in the desirable scale divisions of the chart.

By making the constructions of the solenoids so that there is repulsion instead of attraction, the mutual inductance between them is neutralized, thus making the same instrument suitable for recording either alternating or direct current. The instrument is independent of the rate of alternations and is compensated for changes of atmospheric temperature. This new type of recording voltmeter is manufactured by the Bristol Company, Waterbury, Conn.

A Pocket Size Ammeter.

The Atwater Kent Manufacturing Works, 112 North Sixth Street, Philadelphia, manufactures the new automatic volt-ammeter shown in the accompanying illustration. This ammeter is pocket size, and a hand-sewed leather case is furnished with each instrument. It is particularly adapted to automobiles and other kinds of work where an absolutely correct instrument of small size and not too high voltage is required. Another type recently brought out includes the use of a dash-pot, making the instrument dead beat, and the doing away with one of the two leads used in the old style. No change is made in the connection to the battery for the two readings, as that in amperes is obtained by simply pressing the button.



AMMETER.

◆

Shaw Non-Arcing Lightning Arresters.

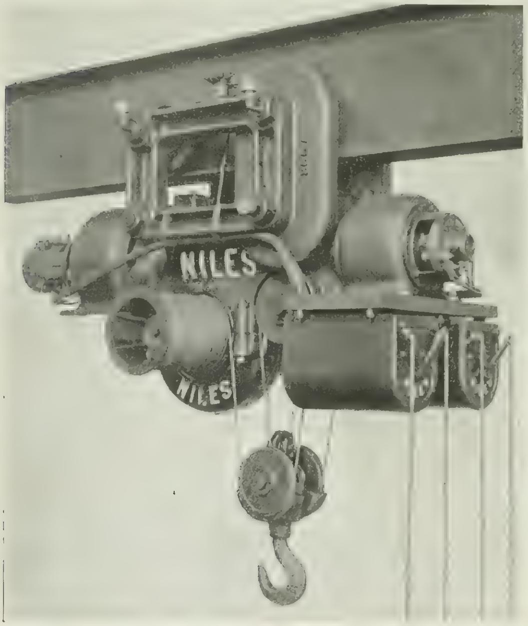
The Lord Electric Company, Boston, which now owns and manufactures the Shaw system of non-arcing lightning arresters and static dischargers, after a special study of all the factors involved in the design of this class of instruments, has introduced important improvements intended to make them most efficient in action, and the parts interchangeable. In the construction of the improved Shaw non-arcing lightning arrester two metal caps are used, each having circular serrated edges. These caps are supported by metal brackets and they in turn support a hollow insulating tube on which are placed alternately mica washers and carbonized rings. These rings are of specially prepared high resistance carbonized material. In both the low and high-potential types this composition is formed into oval rings, affording a large surface of discharge area, and when placed in series with mica rings to supplement the air gap the resistance surface of the mica acts as a discharge plate and materially assists in presenting a continuous surface to the abnormal or static discharge. At the same time this combination of resistances will not permit an arc to form or a dynamic current to precede or follow it. This high resistance feature and the peculiar shape of the rings afford one of the many advantages possessed by this form of arrester.

The supporting brackets are secured to the insulating base, which is raised from the bottom of the steel box in which it is enclosed, allowing the free circulation of air and preventing the formation of an arc between the box and instrument. As a further precaution the box is treated with a special insulating enamel.

The box itself is made of heavy pressed steel with a cover of the same material, held in place with winged screws. The openings in the sides of the box for circuit wires are provided with special insulating bushings, the whole making a compact and durable instrument of neat appearance, the several parts being so proportioned and distributed as to make the combined instrument convenient to handle, place and connect. All of the parts are readily accessible for inspection and test at all times.

New Niles Electric Traveling Hoist.

The new Niles electric traveling hoist shown herewith is designed for hard, continuous service, and, as may be seen in the illustration, is of compact design, being self-contained in a heavy cast-iron frame to which the motors are attached end-on. The power is transmitted directly from the armature shaft to the drum shaft through a train of worm and worm wheel gears. The traversing mechanism is also driven through one train of worm and worm-wheel gears, similar to the hoisting mechanism, except that, when the trolley is arranged to run on a single I-beam, a double set of transmission gears is used. All the mechanism is enclosed in oil and dust-proof casings, and is absolutely noiseless in operation. In addition to the braking effect obtained by the use of the worm and worm wheel, a powerful electric brake is attached to the hoist motor.



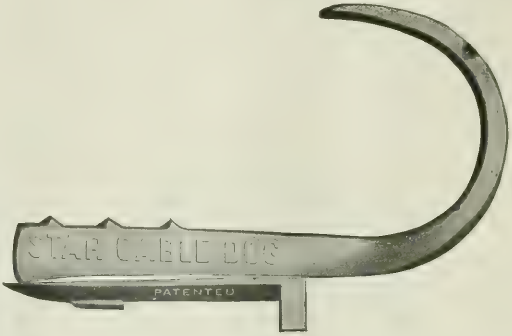
TRAVELING HOIST.

These hoists when mounted on a traveling bridge may be used as small capacity cranes. When used as cranes, the hoists are arranged to run between the two I-beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge, and operated by cords from the floor, or in an operator's cage attached to the bridge.

The Niles hoists are built in capacities of ¾ to 6 tons and are usually arranged to run on an I-beam track. They will run on straight and curved tracks, and are generally provided with a separate motor for traversing; but if desired hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The increased service of the electric traverse, however, much more than compensates for the slight additional cost.

Star Cable Dog.

To meet the demand for some means for fastening cables to side walls by appliances which, although serving to hold the cables securely in place, may readily be removed when desired, there has been developed the cable dog shown in the accompanying illustration. The dog is made of galvanized malleable iron in two wedge-shaped pieces. Its form is such that when inserted a positive expansion occurs on the inner end. A hole is drilled just large enough to insert the shank and then the wedge part is hammered in. Pressure with a hammer or chisel will loosen the wedge, thus releasing the hold, and allowing its easy removal, and the dog is ready for use elsewhere when desired. The "Star" cable dog is manufactured by the Star Expansion Bolt Company, 147 Cedar Street, New York.



CABLE DOG.

Exhibits at the National Interstate Telephone Convention.

The telephone convention held at Chicago, June 20 to 22, brought out by far the largest and best exhibits of telephone apparatus yet displayed at a national convention. All past differences having been settled by the consolidation of the Interstate and National Associations the manufacturers responded heartily to the invitation to support the convention by making exhibits and in other ways.

The American Steel & Wire Company occupied two rooms, one of which was entirely taken up with a huge pyramid made up of coils of all kinds of wire used in telephone construction.

Ewing-Merkle Electric Company, which is now getting extensively into the telephone business and has appointed L. G. Le Bourveau manager of its telephone department, exhibited a number of its "Everbest" specialties, and the "Everbest" magazine was found everywhere around the convention hall A new receiver and the Mason lightning arrester were among the new things shown. This company is the agent for the Sumter Telephone Manufacturing Company, of Sumter, S. C., and also handles miscellaneous telephone construction material along with electrical supplies.

The International Telephone Mfg. Co. made a small exhibit, which served to bring out the excellent mechanical details of its receivers, transmitters and switchboard apparatus. President Shafer, First Vice-President McCormick, and F. L. Middleton, manager of the sales department, were in attendance, as well as several other representatives.

The Addressograph Company had exhibit quarters, which showed addressing machines of much interest to those in the clerical departments of telephone companies.

The Nicholas Telephone Selector Co., of Rochester, N. Y., exhibited a system whereby central office can call any one of a number of parties on the same line. The Nicholas lightning arrester was also shown.

The Miller Anchor Company, Norwalk, Ohio, occupied half of a parlor with exhibits of anchors and augers for setting anchors.

The Fibre Conduit Company, Orangeburg, N. Y., showed lengths of its impregnated fibre conduit both before and after treatment with compound, and distributed some interesting data relative to underground conduit construction of this kind.

The T. & A. Selective Call Company, Geneseo, Ill., showed a selective attachment and central relay for use on old telephones by which any party on a rural line can call another without calling central, and can also call central without calling any other party.

The Automatic Electric Company, of Chicago, showed its standard automatic exchange apparatus with some slight improvements. It also showed a four-party line system for use on the automatic exchange. This system has selective ringing and is non-interfering.

Frank B. Cook, Chicago, made an extensive exhibit of protective devices and terminal heads. A multiple distribution box, which is sealed so as to do away with the necessity of pot heads, was one of the newest features.

Morgan & Wright, Chicago, had an exhibit of insulated tape, in charge of E. S. Hilton.

The Dean Electric Company, Elyria, Ohio, showed a fine line of switchboards, which testified to the large amount of engineering talent in the company. These switchboards include many excellent details which space does not permit to be described here.

M. B. Austin & Co., Chicago, had as the great feature of their exhibit the Meinema selective ringing lockout system shown as applied to an eight-party line. The exhibit was in charge of Mr. Meinema, the inventor.

The Electric Appliance Company, of Chicago, had its telephone department well represented by an exhibit in charge of H. M. Remington and S. A. Densmore. President Low was also a frequent visitor to the convention.

The Monarch Electric & Wire Company, Chicago, made an exhibit of wire and telephone construction material.

The Central Telephone & Electric Company, St. Louis, which handles everything in the way of telephone apparatus and supplies, made a representative exhibit.

The Illinois Electric Company, Chicago, showed a large number of constructive specialties which it handles, including the Davis protective devices.

The Western Telephone Mfg. Co., Chicago, showed magneto call switchboards with improved drops and plugs and also a new non-interfering party line calling system.

The Century Telephone Construction Co., Buffalo, gave special prominence to its four-party selective system for local or common battery exchange work. This works by throwing positive or negative direct current on the side of the line desired. Another special feature of the exhibit was the platinum electrode transmitter. The exhibit was a large and representative one.

The Sterling Electric Company, Lafayette, Ind., chartered the whole of the writing-room of the Auditorium Hotel, in which it set up a number of switchboards and apparatus in working order. The switchboard exhibit consisted of one section of a 3,000-line multiple board going to Green Bay, Wisconsin; one section of a 100-line lamp signal board going to Seymour, Ind., a private branch exchange board going to a South American bank, and a chief operator's desk going to Depere, Wis. A four-party line system was shown with selective ringing.

The North Electric Company, Cleveland, Ohio, made a good-sized exhibit of telephones, switchboards and accessories, supplemented with photographs of recent work.

The Malthaner Electric Mfg. Co., of Minneapolis, attracted considerable attention with its telephone ringing apparatus, which, with five cells of dry battery, will ring as many telephones bridged across the line as are ever likely to be put on one rural circuit. This remarkably high efficiency is secured partly by a skilfull design of the induction coil and pole changing apparatus, and partly by the fact that the mechanical motion of the pole changer is stopped whenever there is no ringing to be done. In other words, the pole changer operates only during a ring; hence no energy is necessary to keep a vibrator in motion at unnecessary times.

The Denio General Electric Company, Rochester, N. Y., was able to show telephone exchange men how they could add to the popularity of telephone service by means of a new fire alarm, which can be connected to any subscriber's circuit and is available as a fire alarm at any moment. A fire alarm message by this system is transmitted directly to fire headquarters. It involves no modifications of existing telephone circuits and does not interfere with telephone service except at the instant an alarm is being sent in. It can be used in connection with a thermostat system to indicate the presence of fire in a building.

The Stromberg-Carlson Telephone Mfg. Co. was, as usual, represented by a very large exhibit occupying several rooms on the parlor floor of the hotel. This exhibit was very complete, including the company's most representative apparatus, both in telephone instruments and switchboards. The instruments for mines and interurban electric railways have been like the other instruments of the company, brought to a high state of perfection. The company's factory being easily accessible from the hotel, excellent opportunity was offered to visit the factory and see the even more complete lines of apparatus there available as well as the processes of manufacture.

The American Electric Telephone Company, besides occupying several parlors near the convention hall, had a sample of its switchboard work in the Auditorium lobby. Invitations were everywhere prominent for the delegates to visit the company's new factory located at Englewood, State and Sixty-fourth Streets, Chicago. The company recently moved from the down-town west side manufacturing district to this location, which is much better suited to a modern factory, in which light, air and shipping facilities are important considerations.

The Swedish-American Telephone Company, as usual, occupied a prominent place just off the main parlor of the Auditorium Hotel, where abundant room was available to exhibit this company's telephone switchboards and accessories as well as to receive visitors.

The Monarch Telephone Mfg. Co. occupied two parlors with exhibits of its new switchboard apparatus and also a full line of instruments. E. E. Yaxley, general manager, and a large corps of traveling representatives, were in attendance.

The Moon Manufacturing Company, in its exhibit of terminal and protective devices, made a specialty of the Moon self-soldering terminal heads.

The Adjustaphone for conveniently supporting desk telephones was exhibited by the Chicago Writing Machine Company.

The Chicago Telephone Supply Company made an extensive exhibit.

The Burdick Sign Company made an exhibit of signs for advertising purposes, which is an indication of the increasing interest of telephone exchange managers in advertising.

The Haller Machine Works, Chicago, had an electric sign in a prominent place in one of the halls in connection with a flasher, to remind delegates that this was a good way of advertising.

The Eureka Electric Company, Chicago, made an exhibit of telephones and accessories.

The Ackerman-Boland Telephone Company made a neat display.

George Conover, manufacturer's agent, Chicago, was in attendance and had headquarters and an exhibit.

The Gray Telephone Pay Station Company exhibited its well-known coin-in-the-slot devices for telephone use.

The Skelley telephone holder was on exhibition.

The Farr Telephone Company, Chicago, exhibited telephones and accessories.

The Baird Telephone Pay Station Company was prominently represented by an exhibit.

The Williams Telephone & Supply Company showed its various telephone products.

Raber & Watson were among the exhibitors.

The American Electrical Supply Company, which has recently entered the field, occupied a parlor, where, to quote one of its officers, it was engaged in getting acquainted and showing a few of the specialties it handles.

The National Carbon Company had an exhibit of granular carbon, also carbons for batteries and protectors.

The Fisk-Newhall Telephone Mfg. Co. was among the exhibitors.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Seasonable weather has had a decidedly beneficial effect upon business in general. Agricultural products are feeling the influence of the favorable weather and are in better condition. Western wheat harvesting is now well under way, while late planted corn and cotton are rapidly recovering lost ground. These are the most important commercial influences at this season of the year, jobbers' advance orders being largely dependent upon local conditions at the interior, and manufacturers gauging their activity by the outlook for fall and winter distribution. It is noticeable that moderate midsummer transactions are not productive of price concessions to stimulate forward business, owing to a general sentiment of confidence in the future. In the leading manufacturing industries there is less idle machinery than is customary at this time of inventories, especially at plants making textile fabrics, despite the fact that prices of raw materials are somewhat inflated. Normal midsummer quiet in the iron and steel industry is occasioning no anxiety, conditions being much better than they were at this time last year, and confidence is expressed in the tonnage of orders that will appear next month, while it is expected that full production will be required after Aug. 1. *Bradstreet's* reports 157 failures during the week, against 175 for the previous week and 215 for the corresponding week of 1904. The Middle States had 41, New England 27, Southern 30, Western 28, Northwestern 10, Pacific 20 and Territories 1. Domestic consumers of copper continue to buy small quantities of the metal as their needs warrant, and this continued hand to mouth buying is undoubtedly responsible for the firm undertone to the market. The quotations are nominally unchanged at 15c. for prompt shipments of both Lake and electrolytic and 14¾c. for casting grades.

CANADIAN WHITE COMPANY.—The announcement is made of the incorporation in Canada of the Canadian White Company, Limited, to carry on a general contracting and engineering business on lines similar to J. G. White & Co., Incorporated, of New York; J. G. White & Co., Limited, London, England, and the Waring-White Company, London, England. The letters patent of the incorporation were granted the latter part of May, and the organization of the company is now practically completed. The Canadian White Company, Limited, will carry on a general contracting and engineering business and will undertake civil, mechanical, electrical, hydraulic and building work. It will be fully equipped to handle large construction contracts for steam or electric railways, and will be prepared to design, build, equip and operate electric lighting plants and power installations, gas works, water supply, sewage systems, piers, docks, harbor works, office buildings, apartment houses, hotels, etc. The contracting and engineering departments of J. G. White & Co., Incorporated, of New York, will at all times be at the service of the Canadian company, and the company will further have the benefit of the experience of J. G. White & Co., Limited, London, England, and the Waring-White Building Company, London, England. This insures the Canadian company, from its inception, the benefits and advantages to be derived from a very long and successful experience in the contracting and engineering business. The Canadian company has upon its board as stockholders strong representative business men well known throughout Canada. The general manager of the company will be a prominent civil engineer with large experience in railway construction, etc., and who has held executive positions. Mr. H. P. Douglas, formerly vice-president and general manager of the Canadian Otis Elevator Company, Limited, is treasurer of the company. Mr. H. C. Hitch has been secured as superintendent of building construction. Mr. Hitch has been for several years connected with the Thompson-Starrett Company, of New York, as superintendent. Recently he has had full charge of the erection, for the Thompson-Starrett Company, of the Union Bank Building, at Winnipeg. This is one of the largest and most important buildings in Canada, and the record made by Mr. Hitch in connection with this and previous work, insures the efficient handling of the building department. This company will make a feature of building construction, this work being carried out along the lines of the Waring-White Building Company, Limited, of London, which has on hand at the present time contracts aggregating several millions of dollars. The company has an authorized capital of $1,000,000, of which $500,000 is common stock and $500,000 is 6 per cent cumulative preferred stock, preferred as to assets, as well as dividends. After both kinds of stock have received dividends at the rate of 6 per cent per annum, the preferred stock is entitled to share further with the common stock in any dividends declared up to a maximum of 10 per cent per annum, above which the common stock is entitled to any residue.

CINCINNATI NORTHERN TRACTION COMPANY.—The Westinghouse Electric & Manufacturing Company has just closed a contract for the equipment of the main generating station and four rotary converter substations of the Cincinnati Northern Traction Company. The power house will be located at Hamilton, Ohio, and the original installation will be of 5,000 kilowatts capacity, with provisions for ultimately increasing it to 10,000 kilowatts. In the generating station will be located three 1500-kw, and one 500-kw, three-phase, rotating-field, enclosed turbo-type generators, and three 300-kw rotary converters. Current will be generated at 375 volts, thus avoiding the necessity of lowering transformers for the main station rotaries. The outgoing lines will then be equipped with raising transformers having a ratio of 375-33,000 volts. Each generator will be driven by a Westinghouse-Parsons steam-turbine and excited by a direct-current generator attached to the end of the turbine shaft, from which its power will be derived. Each sub-station will contain a 300-kw rotary converter supplied by three 33,000-375-olt step down transformers. All transformers are of the oil insulated, self-cooling type. Besides the above, the contract includes all necessary switchboards and protective devices for the control and protection of apparatus in the power house and rotary stations.

WESTINGHOUSE TURBINES FOR BROOKLYN TRACTION.—The Brooklyn Heights Railroad Company has recently closed contracts with the Westinghouse Companies, Pittsburg, Pa., for two 7,500-kw turbine type generating units for extending their present power house equipment in Brooklyn. These units will be the largest generating units of the turbine type in the world. With the guaranteed overload capacity of 50 per cent above rating, the turbines will thus be capable of developing 16,000 brake horse-power and about 10,500 brake horse-power on normal load. The turbines will operate on dry steam at 175 pounds pressure and a vacuum of about 28 inches. Three-phase, 25-cycle current will be generated directly at 11,000 volts for distribution to the line. It is of interest in this connection that the second and third largest turbine generating units in the world are also of the Parsons type, the former built abroad and the latter by the Westinghouse Companies at Pittsburg. The Brooklyn Heights contract is especially significant from the fact that the company had already contracted about a year ago for a Westinghouse-Parsons turbine unit of the largest capacity then built—5,500 kw. The building of the new machines will mark an important step in the development of power station apparatus.

WESTINGHOUSE ORDERS.—Ten Westinghouse electric locomotives have been ordered for use on the Metropolitan Railway of London, England, of 1,200-hp capacity each, to operate 120-ton trains at an average speed of thirty-six miles an hour. They will be equipped with four motors of 300-hp capacity each. A feature of the engines will be that, owing to the terminal facilities being somewhat restricted, it has beeen determined to adopt motors of a smaller size than usual, equipped with forced ventilation, so as to keep down the length of the locomotives to convenient limits for handling. The Japanese engineering and contracting firm of Takata & Company has received contracts for vertical, single acting, simple and compound engines, from the Akabane, Kure, Tokio and Yokoska arsenals, the Kiushiu and Nippon railways, the Fukagawa and Tokio electric light companies, the Furukawa Western Bureau, the Tokio Imperial University, the Yokohama Electric Wire Works and the Tokio Water Works, aggregating in all about 8,000-hp. All this apparatus will be of Westinghouse construction.

ELECTRO-HYDRAULIC PLANT FOR JAPAN.—Takata & Company, 10 Wall Street, New York, have placed an order for an electro-hydraulic plant for the Kanazawa Electric Light Company, Kanazawa, Japan. It will consist of a Westinghouse 120-kw, rotating armature alternator, 2,200 volts, 60-cycles, three-phase, to be direct coupled to a 22-inch, high-pressure, horizontal Victor turbine made by the Platt Iron Works, Dayton, Ohio. The turbine is to be capable of developing 230 actual horse power at the shaft, under a working head of 190 feet, running at 720 r.p.m. Some of the power of this wheel will be used in operating other apparatus in addition to the 120-kw generator. To furnish excitation a 2-kw machine will be driven from the generator shaft. To control the above alternator and exciter, there will be a standard Westinghouse white marble switchboard equipped with Westinghouse instruments. For governing a Lombard type "Q" 8 x 16 governor has been ordered. The complete plant will be shipped overland by way of the Pacific coast, and it is hoped to get the complete plant in Japan by the first part of October.

STANLEY WATTMETERS.—The Stanley Instrument Company announces that it has changed the design of its well known Model H, rotating, jewel-bearing wattmeter, whereby its efficiency is improved, and at the same time the instrument placed in conformity with the suggestion contained in the opinion of U. S. Circuit Court of Appeals, which decided that the former type infringed the Tesla split-phase patents. The Court stated: "If the device stopped with a 'metallic rotating body,' and some method other than a counting machine operated by it was used for determining the number of revolutions, we might not be able to charge the respondent with infringing. We might then well apply the proposition of the respondent that a mere meter is in a different art from a motor; but, as it does not stop there, we must look further." The Stanley Company states that, under the advice of counsel, and conforming to this suggestion of the Court, it is manufacturing wattmeters in which the train mechanism, or "counting machine," will not be operated by the disc or "metallic rotating body," but by a totally independent mechanism. The "counting machine,"—the train or registering mechanism—will be operated or driven by a spring which will relieve and prevent the "metallic rotating body," the disc, from operating or driving the train, thereby complying in the minutest particular with the suggestion of the Court expressed in the following language: "Therefore, as it may well be that, if the counting mechanism was of a kind not operated by the 'metallic rotating body,' we should not be compelled to find infringement." It is stated that not only will the "metallic rotating body" (the disc) not operate the "counting mechanism" or the registering train, but error in the meter due to train friction will be removed; consequently, in the new wattmeters with registering train operated independently of the disc, besides the advantages of the rotated jewel bearing, the spring-supported pivot, the absence of vibration effects, mechanical or electrical, the adaptability for any frequency from 40 to 140 cycles, and the ease and simplicity of installation, calibration and adjustment, is included also the entire absence of error due to train friction.

STEAM TURBINE EQUIPMENTS FOR RAILWAY SERVICE.—An important contract for a 10,000-hp power house equipment has just been awarded to the Westinghouse Companies, Pittsburg, Pa., by the Fort Wayne & Wabash Valley Traction Company, of Fort Wayne, Ind. The entire electrical equipment, comprising both three-phase and two-phase apparatus, the former for railway and the latter for lighting service, will be built by the Westinghouse Electric & Manufacturing Company, and the steam turbines by the Westinghouse Machine Company. The principal apparatus covered by the contract comprises two 1,500-kw and one 400-kw turbo-generator units, delivering 375 volts, three-phase, 25-cycle currents to rotary converters; two 1,500 and one 500-kw turbo units, delivering 2,300 volts, two-phase, 60-cycle currents to step-up transformers for the lighting system. Four rotary converters; seven 375-kw, fifteen 75-kw, six 100-kw, and three 150-kw, oil-insulated, self-cooling transformers; four switchboards for 125, 550, 600 and 2,300 volts. Low equivalent lightning arresters, choke coils and disconnecting machines are included in the equipment. The steam turbine equipment is to be of the standard Westinghouse-Parsons type, operating under 150 pounds steam pressure, a moderate vacuum and with dry saturated steam. Many distinctive features will be embodied in the arrangement of the new power house now building. The Fort Wayne & Wabash Valley Traction Company controls all the city lines in Fort Wayne and La Fayette, Ind.; the Logansport Street Railway Company and the Logansport, Rochester & Northern Traction Company in Logansport; the Fort Wayne & Southwestern Traction property from Fort Wayne to Wabash; the Wabash River Traction Company and the Wabash-Logansport Traction Company, operating from Wabash to Logansport, and the electric lighting plant in Fort Wayne. Contracts have also been closed with the Westinghouse Companies by the Grand Rapids-Muskegon Water, Power & Electric Company, of Grand Rapids, Mich., for two 1,500-kw three-phase, 6,600-volt turbo-generator outfits with two 20-kw, engine-type exciters. The voltage will be raised for transmission by three 1,000-kw, oil-insulated, water-cooled transformers and finally lowered for distribution by three transformers of the same size and type. The apparatus will be controlled from a 660 and a 6,600 volt switchboard.

WATER POWER IN MAINE.—Plans have been developed at Bangor, Me., for the purchase and development of the Bodwell Water Power Company, as a nucleus upon which will be developed a company with a capital of a million dollars for the purpose of selling electricity in Penobscot valley and the surrounding country. An immense power plant will be built at Milford, across from Oldtown. It is expected that construction of concrete dams will commence immediately. W. C. Johnson, expert consulting engineer of Niagara Falls; A. B. Leach, of the big banking house of Farson, Leach & Company, of New York; Mr. Olmstead, of New York, and Mr. Mesleck, of Chicago, have recently visited Milford with Carl P. Dennett, of Pear & Dennett, who conceived the idea of the formation of such a company.

LARGE WATER VALVE.—The Pratt & Cady Company, of Hartford, Conn., has completed the manufacture of probably the largest valve ever built. It was constructed for the Niagara Construction Company and will be used to regulate the flow of water through the sluiceway at Niagara Falls before it reaches one of the big turbine wheels at the electric plant. The valve weighs 126,000 pounds. Its length is 26 feet, its width is 11 feet and its height is 7 feet 6 inches. The diameter of the opening is 9 feet. The mechanism stood well all the tests that were applied to it, and an order has been given for another valve of the same dimensions.

ELECTRICITY FOR A FORT.—Bids have been opened at Portland, Me., in the office of Captain A. W. Yates, quartermaster U. S. army, for the construction of barracks at Fort Williams and for an electric lighting and power system at Fort McKinley. The bids were complete and were as follows: For an electric lighting and power distributing system at Fort McKinley, Malcolm W. Hill Company, Boston, $14,441; Edwin C. Lewis, Boston, $12,998; Joseph W. Roman & Company, New York City, $16,730. Electrical wiring, York & Boothby, Portland, $195. G. H. & E. E. Lowell, South Portland, $267.

POWER DEVELOPMENT IN MEXICO.—The syndicate of London capitalists which composes the Encinillas Mines, Ltd., is arranging to establish a large electric power plant a Santa Rosalia, Mex. It is proposed to dam the Conchos River and generate electrical energy. Captain C. O. Greenwall, representing the Encinillas Mines, Ltd., says that a separate company will be organized to carry out the electrical project. It is proposed to not only supply Santa Rosalia with lights and power, but to also build transmission lines to other towns in that part of the state.

CHIHUAHUA TRANSMISSION.—Colonel W. C. Greene, of New York, who recently obtained a concession from the Mexican Government for the establishment of a large electric power and transmission plant in the western part of the state of Chihuahua, is now in Mexico for the purpose of directing the inauguration of the work on the industrial enterprise. The power plant will be located on the Aros River near Guaynopa. The electric power will be transmitted to a number of mining camps of that part of Mexico.

MEXICAN ELECTRICAL PROJECTS.—Senor Miguel Rubio Ocampo, owner of the electric plant at Zitacuaro, state of Michoacan, Mexico, proposes to install a lighting plant in Maravatio, in the same state. A concession has been granted for an electric railway and lighting plant in La Piedad Cabadas, Michoacan. A telephone line will be built from Chucandiro to the state capital. Senor Teodoro Garduno, manager of the State of Mexico Bank, is installing a hydro-electric plant in Tacambro.

ORDERS FOR FINISHED STEEL.—The Philadelphia Rapid Transit Co. has signed a contract for 24,000 tons of fabricated steel for the elevated structure in Philadelphia. John Claflin has placed an order for 3,000 tons of steel for his new 34th street store, in New York. The American Bridge Co. secured both orders, making the total placed with that company within the last few days approximately 40,000 tons.

LARGE SOUTH AMERICAN CONTRACT.—Bryant Brothers, of New York City, have been awarded a contract by the Peruvian government, it is stated, for building a complete railway system at Iquitos and the construction of one of the largest electric lighting and heating plants in South America. This is in addition to a contract for a telephone system in the same city at a cost of about $1,000,000.

ELECTRIC LIGHT EQUIPMENT WANTED.—Messrs. Mahan & Thompson, Cherryvale, Kan., are contemplating the installation of a small electric light and power plant at this place. They are in competition with natural gas, and want to get a first-class plant as reasonably as possible. They want prices on dynamos, boilers, engines, construction material, supplies, etc., for a 500 to 1,000-light plant.

CATALOGUES WANTED.—The Hewitt Electric Company, a new firm, has opened a store at 55 Webster Street, North Tonawanda, N. Y., to do a general electric construction and supply business. The firm desires catalogues and price lists of electrical supplies, fixtures and novelties

MEXICAN POWER PLANT.—H. G. Harvey will establish a large electric power plant on the Aros River, near Tomosachic, in the Guerrero district, state of Chihuahua, Mexico. A large waterfall will be utilized for the purpose of generating electrical energy.

THE LOS ANGELES RAILWAY COMPANY recently called for bids for three 1,000-kw motor-generator sets.

AMERICAN DRILLS ABROAD.—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has recently returned from Europe where he spent six weeks in the interest of the company. He brought with him orders for 3,400 tools for shipment from America, representing a value of over $300,000. Mr. Duntley states that the trip was the most successful he has ever experienced, and, owing to the growing demand for pneumatic tools in England and on the Continent, it was found necessary to extend the organization of the foreign business. In order to accomplish this, the factory and business of E. G. Eckstein, Berlin, Germany, and that of the Lencke Company, St. Petersburg, Russia, were purchased, and will be operated for the purpose of meeting these requirements in the continental countries. Pneumatic tools are rapidly being introduced in shipbuilding and other industries in Russia, Austria, Germany, Italy, France, etc., and a largely increased demand for the various devices is anticipated. The line of electric drills exhibited and demonstrated was extremely successful, and large orders received therefor. Owing to the fact that all European countries are well equipped with electricity, the electric drill is destined to rival the air drill in time and opens up a field which heretofore could not be solicited. The profits earned through the extension of the foreign business will accrue to the benefit of the Chicago company. The English courts on May 17 rendered the final adjudication of the patent litigation instituted by the English company, which decision sustained all of the company's claims, 52 in number, covering pneumatic hammers, thus leaving the English company in a particularly strong position with reference to its patents. Its plant, located at Fraserburgh, Scotland, is now in full operation. The American business, according to President Duntley, shows a very satisfactory increase in volume, and all factories, both American and foreign, are operating overtime. The month of May was the largest month in the history of the company.

THE COPPER SITUATION.—The *Copper Gossip* of the National Conduit & Cable Company remarks as follows under date of June 21: "The market for copper has displayed a very steady undertone during the past three weeks, and this seems to be the natural result of the extremely heavy movement into buyers' hands. Demand is making an excellent showing alongside of production, and the large rate of world consumption has proved a constant source of strength to the situation for the last six months. The mining companies are producing more copper than last year, but they are also exporting more than ever before. On no other conditions could present values be long maintained. Home and foreign buyers covered a large proportion of their requirements last month, and consequently current business does not equal the heavy transactions in May. Consumers and exporters, however, have placed fair-sized orders for delivery between now and August, and both local and European interests continue to replenish their stocks to a moderate extent as opportunity offers. Quotations continue at 15 cents for electrolytic wire bars, and on this basis there seems to be no ground for complaint as long as supply and demand remain as well balanced as at present. Of course a very decided change in these factors would be more than likely to have its effect, one way or the other, on the selling price. Production is large, and at some of the more important points there is a marked increase in the quantity turned out. But demand is following close on the heels of output, and reliable reports indicate that stocks have undergone a decrease. With the statistical position so favorable to firmness, the danger of serious fluctuations is minimized."

FRENCH WESTINGHOUSE CONTRACT.—Single-phase railway work is being pushed in Europe. The French Westinghouse Company has received a contract for the installation of its single-phase railway system on the Bergama, Valle Brembana Railway, Italy. This is the second single-phase railway contract secured by this company in that country, the first being the Rome-Civita-Castellana Railway. The length of the line is 30 kilometers, and it will be operated by five 30-ton locomotives, equipped with four 75-hp single-phase motors, with multiple unit control, and pneumatically operated bow trolleys. The gage of the track will be 1.44 m. The power station will be about 1 km. out of Valle Brembana, and will be equipped with three single-phase, 500-kw alternators, running at a speed of 500 r.p.m. There are to be no transforming substations, and the line will be fed at the initial pressure direct from the power house.

UNITED STATES' FOREIGN COMMERCE.—The foreign mercantile commerce of the United States during the fiscal year which is now nearly ended will be the largest on record in the history of the country. For the twelve months ending May 31 the total trade was larger than in any corresponding twelve months, and when the figures are made up for June, it is altogether likely that the totals will show that for the twelve months ending June there was an unprecedented total of commerce. During the twelve months ending May the total imports and exports of merchandise amounted to nearly $2,600,000,000. During the eleven months ending May the total of exports and imports was $2,425,000,000 against $2,376,000,000 in the corresponding eleven months of the preceding year. Other figures are cited on our editorial page.

ENLARGING SOUTH NORWALK PLANT.—The Board of Electrical Commissioners, of South Norwalk, Conn., has awarded to the Fort Wayne Electric Works the contract for the electrical equipment for the enlargement of the city electric light plant. The contract for the power equipment was awarded to the American Diesel Engine Company for $16,000. The price of the electrical equipment, as awarded to the Fort Wayne Electric Works, is $3,700. The distribution system will also be enlarged. The entire work will be executed under the personal direction of the three electrical commissioners, Messrs. Joseph A. Volk, Col. Leslie Smith and Charles N. Smith, with general superintendent A. E. Winchester as their supervising engineer in charge. The engine and generator will be direct-connected.

ELECTRICAL INSTALLATION CONTRACT.—The contract for the complete electrical installation for the new 19-story annex to the Frick Building, Pittsburg, Pa., has been let by the architects, D. H. Burnham & Co., to the Iron City Engineering Co., Pittsburg, Pa. This company has also secured the contract for the electric wiring in the 12-story office building for Col. Henry Schmulbach, Wheeling, W. Va.; also the electric wiring for the crusher and brick plant of the Bessemer Limestone Co., Bessemer, Pa. It is at present installing the conduit and wiring systems in the Home of the Good Shepherd, Pittsburg, Pa., and the B. & O. passenger station, at Youngstown, O.

ENLARGING LYNN WORKS.—The General Electric Company will build a number of new buildings at the river works plant on Saugus River, Lynn, and plans have been completed for three. They will be constructed of brick and steel, two will be 120 by 200 feet, and the third 80 by 200 feet and 35 feet high. A large portion of the sides and roof will be of glass. The company further contemplates the erection of a group of dwellings for workmen on land owned by the concern near the Saugus River factories.

BIG CRANK SHAFTS.—The Bethlehem Steel Company is at work on three crank shafts which will weigh 86,000 pounds each when finished. They are turned out of solid steel ingots 25x4x4 ft. and are intended for three Snow gas engines, which are to drive 4000-kw Crocker-Wheeler alternators, the largest gas-engine-driven generators ever built, ordered by the California Gas & Electric Corporation, details for which have already been given in these pages.

BIDS FOR NAVY SUPPLIES.—Bids will be received July 18 at the Bureau of Supplies and Accounts, Washington, for furnishing at the navy yards, at Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., and Washington, D. C., a quantity of naval supplies as follows: Incandescent lamps, motors, motor drive, electrical supplies, wire cable, etc. H. T. B. Harris, Paymaster-General, U. S. N., is the official interested.

X-RAY FOR ARMY.—Six portable X-ray machines, costing $6,000, are to be purchased by the United States Government for use in army hospitals and in the field where bases shall be established. The machines will weigh 1,350 pounds each, and will be operated by gasoline.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a general advance in prices on the New York Stock Exchange, attended with a corresponding degree of activity and strength. The electric and traction stocks shared in the general improvement, and some of the principal issues closed the week with good gains to their credit. The tendency just now is upward, all things pointing in that direction. Metropolitan Street Railway closed at 124½, ex. div., this being a net advance of 3¼ points. Interborough Rapid Transit was quiet, closing at 202½, a net gain of ¼-point. Brooklyn Rapid Transit was active and advanced 3⅞ points net, closing at 67¾. Philadelphia Rapid Transit, which is now dealt in on the New York Stock Exchange, advanced 1 point during the week, the closing price being 115. Among the electric stocks, Allis-Chalmers preferred lost a fracton in closing at 51, while Westinghouse made a net gain of 1 point, closing at 169. The last quotation of General Electric was 174½, ex. div. Western Union made a net gain of ⅝-point, closing at 94. The curb market was generally quiet during the week and did not share in the activity of the Stock Exchange to any extent. Following are the closing quotations of June 27:

NEW YORK

	June 20	June 27		June 20	June 27
Allis-Chalmers Co.	14½	13⅛	Electric Vehicle pfd.	21	20½
Allis-Chalmers Co. pfd.	55	50⅞	General Electric	174½	175
American Tel. & Cable	93	90	Hudson River Tel.	..	..
American Tel. & Tel.	142	142	Interborough Rap. Tran.	202	201
American Dist. Tel.	32	29½	Metropolitan St. Ry.	125⅜	124¼
Brooklyn Rapid Transit.	66	68⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	35	28	Western Union Tel.	94¼	93¾
Electric Boat pfd.	80	75	Westinghouse com.	167¾	166
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..
Electric Vehicle	17	16			

BOSTON

	June 20	June 27		June 20	June 27
American Tel. & Tel	142⅛	142½	Western Tel. & Tel. pfd.	..	100
Cumberland Telephone	119½	119	Mexican Telephone	1½	1¼
Edison Elec. Illum.	*245	244	New England Telephone.	140	*139
General Electric	175	174¾	Mass. Elec. Ry.	19⅜	18½
Western Tel. & Tel.	19½	18¾	Mass. Elec. Ry. pfd	62½	61½

PHILADELPHIA

	June 20	June 27		June 20	June 27
American Railways	52	50½	Phila. Traction	..	100
Elec. Storage Battery	80	78	Phila. Electric	8⅜	8⅝
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	27¼	27⅛
Elec. Co. of America	11⅞	11½			

CHICAGO

	June 20	June 27		June 20	June 27
Central Union Tel.	..	..	National Carbon pfd.	120	117
Chicago Edison	..	..	Metropolitan Elev. com.	25	23⅞
Chicago City Ry.	*190		Union Traction.	..	..
Chicago Tel. Co	..	..	Union Traction pfd.	..	..
National Carbon	63	65			

* Asked.

NORTH AMERICAN REPORT.—At the annual meeting of the stockholders of the North American Company the directors whose terms expired were re-elected. The report of the company for the year ended December 31, 1904, is issued. The income account and the general balance sheets were published in April last. President Wetmore gives a long detailed statement of the operations of the company which is of interest to the shareholder. He calls attention to the fact that, as regards income account, the North American Company has not yet received dividends from two of its important investments, the surplus earnings, otherwise applicable thereto, having been devoted to construction work not yet completed. Referring to the increase of capital stock authorized on March 16, 1905 (130,000 shares), the report states that 71,045 shares were sold at par for cash, 55,310 shares were issued at par directly in part payment for shares of the Union Electric Light & Power Company and the Laclede Gas Light Company, and 3,645 shares remained unissued at the date of the annual report (June 21, 1905). Of the cash received from the sales of stock, after paying the loans appearing in the balance sheet of December 31, 1904, and completing payment for the interests acquired with the new stock, a balance of approximately $2,500,000 remained applicable to the future uses of the company, thus placing it in possession of sufficient cash working capital. The North American Company reports for fiscal year ended December 31:

RECEIPTS.

Interest received and accrued	$44,835
Dividends received	777,153
Other profits	147,878
Total	$909,866

DISBURSEMENTS.

Salaries, legal expenses, net rentals, etc.	$73,719
Taxes	4,605
Total	78,324
Excess receipts	891,532
Net increase in value of assets as readjusted Dec. 31 last	891,532
Total undivided profits	1,592,661
Previous profits	1,231,544
Total profits	2,824,202
Premium on 2,000 shares of stock issued during year	8,375
Total	$2,832,578
Dividends paid and accrued	840,834
Surplus	$1,991,745

This compares with a surplus reported previously to fiscal year ended May 31, 1904, of $739.33.

issued further issues can be made only to the extent of 75 per cent of the new construction completed. The remaining 25 per cent of the cost of new construction, in the past, has come out of the earnings and from the sale of stock to the Chicago Edison Company, which holds, through trustees, all of the stock of the Commonwealth Company.

ANALYSIS OF GENERAL ELECTRIC.—Curtis & Sederquist, of Boston, have issued the forty-third number of their series of letters, "Studies in Investment Values." It is devoted to General Electric. It is shown that gross earnings have increased in the last five years from $22,379,463 to $39,231,328. The floor space and the factories have increased from 2,000,000 to 4,100,000 feet. The number of employees has increased from 11,000 to 18,000. Although there has been a large gain in gross earnings, yet in the last two years operating expenses and cost of material have so much increased that net earnings have fallen off about $2,000,000, explained by the increased price of copper, expenditures in developing steam turbines, higher labor, lower selling prices during the business and financial depression of 1903 and 1904. The stock earned [illegible] per cent in the fiscal year ending June 1, 1905, against 22.4 in 1904 and 28.9 in 1903. These earnings are based upon an increased capitalization after a stock dividend of 66 per cent in 1902. It is shown that the company has a net working capital of $50,444,000, or $104 a share, on the outstanding stock. The factory plants are carried upon the books at $7,500,000. It is figured that their actual value is at least $20,000,000, or $41 a share on the stock. It is shown that in the last twelve years $17,000,000 in cash has been added to the value of the plants, of which $13,500,000 has been written off. Dividends have been paid regularly at the rate of 8 per cent. per annum on the stock since 1901. This in addition to the 66 per cent dividend declared in 1902.

MEXICAN LIGHT & POWER.—The Mexican Light & Power Company, at its Montreal meeting, gave authority to issue $6,000,000 of new bonds at 90, the purpose being to pay for the two Mexican light companies recently acquired. The amount necessary to liquidate this indebtedness will be $5,400,000 gold. The San Ildefonso Company, one of the corporations acquired, has a capital stock of $3,500,000 Mexican and a bond issue of 5,000,000 francs. The other corporation purchased was owned by Anthony Gibbs, Sons & Company, bankers, of London, and has a capital of £500,000. A holding company will take care of the two corporations purchased. It will be known as the Mexican Electric Light Company, Ltd. The Mexican Light & Power Company will own all the stock of the new corporation.

DIVIDENDS.—The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent., payable July 7. Electric Storage Battery directors have declared the regular quarterly dividends of 1¼ per cent on both the common and preferred stocks, payable July 1. Directors of the Westinghouse Electric & Manufacturing Co. have declared the regular quarterly dividend of 2½ per cent. on the preferred and assenting and non-assenting stocks, payable July 10. The Washington Water Power Company has declared the regular quarterly dividend of 1½ per cent, payable July 1. A semi-annual dividend of $3 per share has been declared, payable July 10, on the preferred stock of the El Paso Electric Company.

CENTRAL & SOUTH AMERICAN TELEGRAPH.—The quarterly report of the Central & South American Telegraph Company shows traffic receipts of $300,000, an increase of $26,500 over the corresponding period a year ago. Operating expenses show a slight increase. After deducting the dividend there was a surplus for the quarter of $86,616, an increase of $27,300. The total surplus now stands at $1,195,708.

PHILADELPHIA BELL TELEPHONE.—The directors of the Bell Telephone Company, of Philadelphia, have decided to issue an additional $2,000,000 (40,000 shares) of stock to the stockholders of the company at par. The stockholders will have the right to subscribe for one share for every seven shares held at present. The subscription will open on July 5 and the right to subscribe will expire on August 1, 1905. This will make the capital of the company $16,000,000. It has no bonded debt.

MEXICAN TELEGRAPH.—The Mexican Telegraph Company reports traffic receipts for the quarter ended June 30 of $135,000, an increase of $16,500 over the same period a year ago. Operating expenses were larger by $4,000, leaving a balance of $108,000. There was a surplus after allowing for the dividend of $73,685, an increase of $7,300. The total surplus now stands at $1,845,239.

DETROIT EDISON BONDS.—Perry, Coffin & Burr, of Boston, and other firms are offering $300,000 of the Detroit Edison Co. first mortgage 5 per cent gold bonds, due 1933. The company expects earnings in 1905 to approximate $825,000 gross and $400,000 net. The business is growing rapidly.

UNITED STATES STEEL.—The United States Steel Corporation's net earnings for the first half of the calendar year—estimating April, May and June—will be at least 65 per cent. greater than for the first half of 1904; 13½ per cent. less than for the first half of 1903 and 18¾ per cent. less than for the first half of 1902.

LEHIGH VALLEY REORGANIZATION.—The property and franchises of the Lehigh Valley Traction Company have been sold at Allentown, Pa., under an order of the court for $2,000,000, the purchasers being William F. Harrity, George H. Frazier and Harry C. Trexler, comprising the reorganization committee.

TWIN CITY STOCK.—The Twin City Rapid Transit Company has applied to the New York Stock Exchange to list $1,000,000 additional common stock.

OHIO TRACTION COMPANY.—The Ohio Traction Company, with a capital of $20,000,000, half preferred and half common, has listed its securities on the Cincinnati Stock Exchange.

INTERNATIONAL PUMP.—The International Steam Pump Company has applied to the stock exchange to list $1,000,000 additional [illegible] debenture 6 per cent bonds of 1913.

General News of the Week

The Telephone.

DENVER, COL.—The Union Pacific is planning to install the new telephone system for the handling of trains, which was experimented with two years ago and is now in operation over small sections of the line. The system will be constructed over the entire road.

STAMFORD, CONN.—The American Telegraph & Telephone Company has presented a petition to the City Council for the laying of a conduit through the main street of the city.

HARTFORD, CONN.—Telephone service will be cheaper in Hartford, New Haven and Bridgeport on and after the first of January next, in Waterbury after July 1, 1905, and in other cities after October 1, 1905, according to the reduced rate schedule of the Southern New England Telephone Company given out by President Morris F. Tyler. The changes which affect Connecticut's three cities are as follows: The single-line business service will be reduced from $100 to $84; the party line business service will be reduced from $72 to $60; the party line residence service will be reduced from $36 to $30; a new service for $36 will be given, having but two residences on a circuit, with what is known as "selective calling," so that the bell will ring only when the party is wanted. New measured service rates will be introduced as follows: On party lines: 400 calls for $25 instead of 380 as at present, extra calls 4 cents; 800 calls for $36, extra calls 4 cents; 1,200 calls for $42, extra calls 3 cents; on single circuit, 1,000 calls for $50, instead of 760 calls, as at present, extra calls 4 cents; 1,500 calls for $60, extra calls 3½ cents. Unless expressly limited to residences, all measured service rates are offered for business and residences alike. In Danbury, Meriden, Middletown, New Britain, New London, Norwich, South Norwalk and Stamford, substantial reductions on all kinds of service go into effect October 1, 1905.

TWIN FALLS, IDAHO.—The People's Telephone Company, which was recently organized here, has applied to the City Council for a franchise.

BOISE, IDAHO.—The Idaho Independent Telephone Company has purchased a lot upon which it is proposed to erect a modern building for the central office.

HARVARD, ILL.—The Chicago Telephone Company has purchased the country lines of the Harvard Telephone Company.

MONMOUTH, ILL.—The Galesburg Union Telephone Company will in the near future build in Galesburg a fine exchange building costing $10,000.

ABINGDON, ILL.—A franchise has been granted to the Mutual Union Telephone Company, of Abingdon, to build a telephone system between Abingdon and St. Augustine.

MONROE, ILL.—The Killbuck Telephone Company, of Monroe, has been incorporated with a capital stock of $1500. The incorporators are: A. Thompson, E. A. Foster and G. A. Sauber.

ODIN, ILL.—The Odin & Sandoval Township Telephone Company has been incorporated with a capital stock of $600. The incorporators are A. J. McClelland, George Ross and R. R. Glines.

HACKBERRY, ILL.—The Hackberry Mutual Telephone Company was incorporated June 19 with a capital stock of $1200. The incorporators are William McMeese, James E. McKittrick and J. B. Tripp.

WATSEKA, ILL.—The Board of Supervisors has granted a franchise for a new telephone line to be constructed on the Hoopeston road. The company is called the Southern Limited Telephone Company. The officers are: President, T. J. Downey; secretary, Frank A. Pruitt; treasurer, George Lockhart; manager, Jno. S. Lockhart.

TERRE HAUTE, IND.—The Central Union Telephone Company will ask the City Council for permission to install a conduit system in Terre Haute. It will offer the city the right to use one duct in each conduit for police and fire alarm telegraph.

LOGANSPORT, IND.—A district meeting of the chief operators of the Central Union telephone exchanges of the first district of Indiana was held in this city last week for the purpose of conferring with E. J. Roche, of South Bend, service inspector for the district. Arrangements were also made for the annual outing of the operators, which will be held at Lake Maxinkukee. The chief topic discussed was: "How Best to Improve the Various Toll Lines."

FORT WAYNE, IND.—Representatives of the Independent Telephone Companies of the northeastern part of the State held a meeting in this city last week and discussed a plan of invasion for the lost territory, the acquiring of franchises, etc. The matter was left in the hands of a committee headed by Mr. W. L. Moelling, of this city. Judge R. D. Taylor was present and rendered an opinion to the effect that the contracts affecting the toll-line service which the independents had with the United Telephone Company are good and enforcable. The committee will have a meeting at the close of the Chicago convention.

CEDAR RAPIDS, IOWA.—A new exchange is to be installed by the Walker Telephone Company.

SOMERS, IOWA.—The Somers Telephone Company has been incorporated with $5,000 capital.

MUSCATINE, IOWA.—Articles of incorporation have been filed by the Massena Independent Telephone Company of this city with a capital of $10,000. George J. Austey and others are the incorporators.

WATERLOO, IOWA.—Articles of incorporation have been filed with the Secretary of State by the Corn Belt Telephone Company with the principal office at Waterloo. The capital is $300,000. A. T. Averill is president, C. W. Chapman, vice-president; S. S. Lichty, secretary, and W. P. Frech, treasurer.

HAZLETON, KAN.—The Barber Telephone Company is constructing a telephone system which will commence operation with two boards of 100 drops each. The same company intends to build lines to Medicine Lodge and Kiowa this fall. C. F. Ware, Crisfield, Kan., is secretary.

GRAND RAPIDS, MICH.—The Wood County Mutual Telephone Company has been formed with a capital of $10,000.

ALPENA, MICH.—The Alpena Mutual Telephone Company has leased for five years all telephone property belonging to the Michigan State Company in this locality, including suburban lines, cables, etc. The Mutual company will complete lines to Spruce, Hubbard Lake and other towns.

INTERNATIONAL FALLS, MINN.—The International Telephone Company has been formed; capital $50,000. The incorporators are E. W. Backus, W. F. Brooks and others.

RICE, MINN.—Residents of this place will install telephone connections with the long distance lines of the St. Cloud exchange. The local company will be known as the Apollo Telephone Company.

INDEPENDENCE, MO.—The Independence Home Telephone Company has increased its capital stock from $30,000 to $60,000.

ST. LOUIS, MO.—St. Louis is to enlarge its municipal telephone plant, which, it is claimed, will effect a large saving to the city. The city rents 170 telephones used in the City Hall and other institutions.

CLINTON, MO.—Stockholders of the Mutual United Telephone Company, of Clinton, have elected the following directors and officers for the ensuing year: W. F. Hall, president; G. W. Schweer, of Windsor, vice president; Dr. S. T. Neill, business manager; Geo. R. Lingle, secretary and treasurer.

ST. LOUIS, MO.—The Suburban Telephone Co., recently organized and operating in St. Louis County from Clayton, has been purchased by a syndicate formed by the Mississippi Valley Trust Co. The concern will be reorganized and conducted as an independent company. Plans of the syndicate include raising the capital stock from $100,000 to $500,000. The system which operates within a radius of about five or six miles of Clayton, will extend its lines so as to take in the entire county. New equipment will be added to the plant and improvements will be made in all departments. The intention is to equip the system so as to give an up-to-date service and reach residents in all parts of St. Louis County. The deal was closed June 20 through James D. Housman, the original promoter and a large stockholder of the company. The purchasing company includes several of the large stockholders of the Kinloch Telephone Co., and several of those of the Suburban Co. There is a working agreement between the Suburban and the Kinloch companies. This, it is said, will be continued, though the county company will be independent.

HAMMONTON, N. J.—The Hammonton Telephone & Telegraph Company has been incorporated with a capital of $125,000. The incorporators are Andrew J. Rider, Samuel Anderson and others.

FREEHOLD, N. J.—George H. Atkinson, as trustee, sold at public vendue all the rights, title and interest in the Red Bank Telephone Company and the Freehold Telephone & Telegraph Company. The Red Bank plant was purchased by Henry C. McLean, of Red Bank, for $2,550. The Freehold Telephone & Telegraph Company plant was purchased by George W. Eggert, of Perth Amboy, for $1,550.

NEW YORK, N. Y.—The West Lakeside Telephone Company of this city has been organized with a capital of $15,000. The incorporators are Charles Long, William Lockwood and others.

NEW YORK, N. Y.—The Rock Rift, Cannonsville & Granton Telephone Company has been organized with a capital of $260. The incorporators are D. C. Gregory, L. H. Owjes and others.

ALBANY, N. Y.—The Lake Champlain Telephone & Telegraph Company has been incorporated to operate from Eagle Bridge through Rensselaer, Washington and Essex counties, New York State and Bennington, Rutland and Addison Counties, Vermont. The capital stock is $250,000. The directors are Henry E. Hawley, Albany; F. W. Story, Boston; O. O. Dennis, Whitehall; E. D. Raymond, Fairhaven, Vt.

AMSTERDAM, N. Y.—There is a telephone rate war on in Amsterdam between the Hudson River Telephone Company and the Automatic, an independent company. The monthly rates have already been cut down by the Automatic Company to a trifle over $1 a month. The Bell people are offering to install telephones for six months free. Both companies have canvassers at work in the city and the suburban towns, and in the latter places rates have been cut to $1.25 a month where the Bell people have been charging $4.50. The Bell company is now meeting the cut rate.

WAYNESFIELD, OHIO.—The Auglaize Telephone Company has increased its capital stock from $15,000 to $25,000.

YOUNGSTOWN, OHIO.—The Union Works of the Carnegie Steel Company have just had installed an entirely new telephone exchange system.

MORGANSVILLE, OHIO.—The Morganville Telephone Company has been organized with a capital of $5,000. The incorporators are Morgansville men.

ROCK CREEK, OHIO.—The Citizens' Telephone Company has been formed by C. W. Harrington, R. W. Covell, C. E. Andrews, G. H. Ray, E. K. Mills. Capital, $4,000.

SNYDER, OKLA.—The Snyder Telephone Company, of Snyder, filed letters of incorporation June 5. The incorporators are J. Helen, J. H. Carmack, Fred Switzer and J. V. McClintic. The capital is $5,000.

MT. STERLING, OHIO.—The Home Telephone Company has been organized here. The capital stock of the new concern is $15,000. The incorporators are: W. H. Alkire, N. A. Riggin, G. M. Fisher, H. L. Cook, T. S. Alkire and T. P. Sylvan.

TOLEDO, OHIO.—A syndicate of Toledo capitalists has purchased a one-third interest in the Cuyahoga Telephone Company, of Cleveland, Ohio. Messrs. Brailey, Bell and Secor are members of the syndicate and are well-known in the independent telephone field.

PHILADELPHIA, PA.—The business of the Philadelphia Bell Telephone Company has increased very rapidly in the last year and a half. On January 1, 1904, the stations in service numbered 67,268. The gain for the year was 15,229, so that the number of stations in use on January 1, 1905, was 82,497. On June 1, 1905, the number of stations in service stood at 94,533, making a gain for the last five months of 12,036 and placing the system at a very high point as regards numbers compared with other systems the world over.

SALT LAKE CITY, UTAH.—The Independent Telephone Company is constructing a line to Fort Douglas.

COALVILLE, UTAH.—The County Commissioners have granted a franchise to the Utah Independent Telephone Company.

SALT LAKE CITY, UTAH.—The Independent Telephone Companies of this city and Los Angeles are completing arrangements for the construction of a line to connecte the two cities.

SPOKANE, WASH.—An effort is being made to effect the consolidation of all the independent telephone companies in Washington and other Pacific Coast States. Attorney A. L. Black, of Bellingham, represents a number of the independent telephone interests in the proposed incorporation.

RICHLAND CENTER, WIS.—The Independent Consolidated Company is in the hands of a receiver.

Electric Light and Power.

ENSLEY, ALA.—The Mayor and Board of Aldermen have authorized the lighting committee to investigate the question of constructing an electric light plant, procure plans and specifications and report back to Council July 6.

JACKSON, ALA.—The lighting plant at this place, which was only completed December 15, 1904, already requires extension. It is proposed to add an overshot waterwheel. Geo. P. Brockman is electrical engineer and superintendent.

LOYALTON, CAL.—The Loyalton Electric Light Company is extending its service to Beckwith, 17 miles from here, across the Sierra Valley. The town of Beckwith will be lighted by electricity in the near future.

SOUTH NORWALK, CONN.—On June 15 the Board of Electrical Commissioners awarded contracts for an enlargement of the city electrical station. The proposal of the Diesel Engine Company for a gas engine was accepted, the amount involved being $16,000. The contract for electrical equipment was awarded to the Fort Wayne Electric Works.

WYOMING, DEL.—Alex. Daly, representing Philadelphia capitalists, has presented to the citizens of Wyoming and Camden, Del., a proposition to install a water and light plant to supply both towns.

COVINGTON, GA.—It has been decided by the City Council to rebuild at once the electric lighting plant which was recently demolished by a boiler explosion.

GRANITE CITY, ILL.—This city is in need of a good up-to-date electrical plant for street and commercial lighting. The place has a population of about 8000, and is growing rapidly. Mr. Alvin Morefield can give information to any one interested.

QUINCY, ILL.—The Quincy Gas & Electric Company has changed its name to Quincy Gas, Electric & Heating Company. The number of directors has been increased from five to seven, and the capital stock increased from $600,000 to $2,000,000.

HARRISBURG, ILL.—John W. Shaw has been appointed receiver for the Harrisburg Water, Light & Power Company by Judge W. N. Butler, upon application of the American Trust & Savings Bank of Chicago, to which the property of the company was transferred in trust recently. The plant has been doing a good business, but has fallen behind with its interest payments and other obligations.

GREENFIELD, IND.—The Water and Light Commissioners are in the market for a 350-hp. engine and two new boilers for the electric light plant.

GREENFIELD, IND.—Municipal ownership has not proven a success in this city. The corporation owns and operates the water-works and electric light plants. Over $17,000 is now required for making repairs and improvements at the electric light plant, but the city has no money to do it and is in debt up to the constitutional limit. An expert examined the plant and reports that a new 350-hp. engine and two new boilers were necessary, and the cost would be $17,500. A sale of the plant is advocated.

FORT DODGE, IA.—The City Council has appointed a committee to investigate the construction of a gas and electric light plant, to be owned and operated by the city.

CRESTON, IA.—A franchise for an electric light plant has been granted to a new company, of which J. C. Sullivan is president and J. W. Reynolds secretary. The company is now arranging to purchase equipment for a plant to cost about $40,000.

CAMPBELLSVILLE, KY.—J. L. Atkinson, Pres. Campbellsville Lighting Company, says bids for constructing an electric light plant, to cost $4000, will be received about Aug. 15 by the Campbellsville Lighting Company. B. S. Kincort, Lebanon, Ky., is the engineer.

SHREVEPORT, LA.—Mayor Querbes and the lighting committee have recommended that Council enter into a contract with the Shreveport Gas, Electric Light & Power Company for lighting the city for a period of 6 years.

NEW ORLEANS, LA.—The Algiers Railway & Lighting Company is to construct a power plant at a cost of $[illegible],000.

WATERVILLE, ME.—At a meeting of the stockholders of the Kennebec Water Power Company, the following officers were elected: President, Charles A. Dean; treasurer, W. H. K. Abbott; clerk, A. M. Kennison.

GLENDALE, MASS.—The Monument Mills Company, of Housatonic, is making plans to develop the water power at Glendale. Barnes & Farnham, of Pittsfield, are making surveys.

BALTIMORE, MD.—At the annual meeting of the stockholders of the Mount Washington Electric Light & Power Company, the following officials were elected for the ensuing year: President and general manager, Thomas W. Offut; vice-president, Alten S. Miller; secretary and treasurer, Harry J. McIntyre; directors, Thomas W. Oftut, Alten S. Miller, S. Davies Warfield, Walter R. Townsend and Richard A. Bevan. The company is expending about $100,000 for the power house and new machinery, and will have the new plant in operation by Sept. 1.

HOLYOKE, MASS.—Plans have been completed for the new power plant of the Holyoke Water Power Company, on the west bank of Connecticut River. They call for the construction of a new canal, from which water will be conveyed to a 7000-hp power plant.

MISSOULA, MONT.—Missoula Light & Water Company will enlarge and improve its plant at an estimated expenditure of $30,000.

LIVINGSTON, MONT.—An electric power plant, to cost about $60,000, will be established here shortly by Lewiston capitalists. John L. Bright is at the head of the project.

MISSOULA, MONT.—The Missoula Light & Water Company has ordered from the Westinghouse Machine Company a 500-kw, three-phase, 60-cycle, 2200-volt Westinghouse-Parsons steam turbine. Other contracts for motor-driven exciter sets, switchboard material and surface condensing outfit have also been placed, the whole aggregating about $30,000.

OMAHA, NEB.—An ordinance is before the Council providing for laying of electric wires underground within the district bounded by P street, 23d Street, on east, Q street on south, and 26th street on west.

NEWARK, N. J.—The new owners of the New Light, Heat & Power Company will take charge July 1. This plant was recently sold to Messrs. Rigby, Mandeville and Mathews by the Gas & Electric Development Company, of Philadelphia, Pa. Extensive improvements are contemplated.

ANDOVER, N. Y.—The Andover Electric Power & Light Company, of Andover, has been incorporated with a capital of $10,000, by R. A. Stout, A. B. Richardson and J. H. Backus, all of Andover.

YOUNGSTOWN, OHIO.—All bids opened on June 19, for constructing an electric light plant for the water-works pumping station, has been rejected, and new bids will be received July 15.

NEW BREMEN, OHIO.—The village of New Bremen has instituted ouster proceedings against the New Bremen Electric Light Company, claiming that the company has no legal right to the use of the streets and alleys of the town, inasmuch as the original ordinance granting the franchise did not contain the words "heirs, successors and assigns." The franchise expired two months ago. The town wants to buy the plant.

TOLEDO, OHIO.—The May statement of Toledo Railways & Light showed an increase in gross of 8.3 per cent and an increase in net of 12.7 per cent. Earnings have been running considerably ahead of last year so far this fiscal year, so that for the four months ending May 31 there has been an increase of 8.18 per cent. in gross earnings and an increase of 17½ per cent in net, while the surplus after charges has increased 55½ per cent.

CAMBRIDGE SPRINGS, PA.—The Cambridge Springs Electric Light Company has been incorporated with a capital of $20,000, by A. H. Matteson, Chas. W. Jones and others, all of Cambridge Springs.

TAMAQUA, PA.—The Tamaqua Heat, Light & Power Company has purchased a site for a new plant

MONTROSE, S. D.—Donohue & Williams, of Montrose, write that their electric plant is about completed, but they desire electric fixture catalogues.

MURFREESBORO, TENN.—The City Council has granted the City Gas & Electric Light Company a franchise and a 10-year contract.

LAFOLLETTE, TENN.—The Lafollette Water, Light & Telephone Company has been organized with a capital of $150,000. The directors are: W. C. Knight, St. Louis, Mo.; F. A. Joss, Indianapolis, Ind., and T. C. Whalen, of Indianapolis, Ind.

DENTON, TEX.—The city has purchased the plant of the Denton Water, Light & Power Company, and will take possession on July 1.

JOHNSON, VA.—There has been talk of installing the electric plant at Ithiel Falls and it is understood that the town has purchased the water power of Rev. I. T. Johnson, and that the plant is to be established there.

TOLUCA, MEX.—The Toluca Electric Light & Power Company will establish an electric power plant at Temascaltepec, on the Rio Verde. It is proposed to develop about 3000 hp, which will be transmitted to the towns of that region. R. J. M. Danley is general manager and chief engineer, with headquarters at Toluca.

FORT WILLIAM, ONT.—Extensive power development at Fort William, Ont., is contemplated by a company having a capital of $2,[illegible]. The name assumed is the Kakabeka Power Company. The incorporators are: H. S. Holt, president of the Montreal Light, Heat & Power Company; Chas. R. Hosmer, director of the Canadian Pacific Railway; F. W. Thompson, manager of the Ogilvie Flour Mills Company, W. Norton and F. H. Phippen, of Montreal.

The Electric Railway.

LOS ANGELES, CAL.—The Los Angeles Pacific Railroad Company is reported to have purchased a site for a new power house and sub-station here.

LOS ANGELES, CAL.—Surveyors are at work running the lines for an electric railway from San Bernardino to the summit of the mountains, directly north of that city, a distance of about [illegible] miles.

INDIANAPOLIS, IND.—Hundreds of families of this city have gone out camping for the summer. Eagle Creek, Sugar Creek, Flat Rock, Blue River, White River, Jewett Lake and Spring Lake are lined with campers because each are crossed or touched at convenient places by interurban lines. It is estimated that between 1,000 and 2,000 people wi'l live in camps this summer, the men going back and forth on the interurban lines.

BOSTON, MASS.—The Massachusetts Electric Company is sending over its extensive system of nearly 900 miles a model car bearing a great poster which reads "Boston & Northern and Old Colony Street Railway advertising car." This car is heavily laden with interesting literature which gives descriptions of the seashore resorts, places of historic interest and rural scenery to be reached by the system. This car has already run through the principal cities and towns on the system and over 500,000 booklets have been placed in the hands of the people.

ST. JOHN, N. B.—The annual statement of the St. John street railway shows that the net profit, during the past year, after providing for the interest on the bonds and all other charges, is $52,034, out of which two half yearly dividends have been declared, amounting to $44,626, leaving a balance of $7,407.

ALBANY, N. Y.—The Buffalo, Lockport & Rochester Railway Company, a consolidation of the Albion Electric Railway, the Albion & Rochester Railway and the Albion & Lockport Railway, has been incorporated with a capital stock of $590,000. The directors are F. B. Griffith, Jr., Charles B. Hill, Buffalo; Lorenzo Burrows, George B. Church, Albion; R. A. Adams, Rochester.

NEWARK, N. J.—Thomas N. McCarter, president of the Public Service Corporation, has announced that his corporation has determined on the construction and operation, through the agency of a subsidiary company, shortly to be formed, of a modern high-speed electric road from this city to New York. Thirty minutes from the center of Newark to the business part of New York City is promised.

ALLENTOWN, PA.—The franchise and properties of the Lehigh Valley Traction Company were sold in foreclosure here a few days ago. The price paid was $2,000,000, the purchaser being William F. Harrity, acting for the reorganization committee.

BLOOMSBURG, PA.—The contract for the grading and general construction of the New Millville-Bloomsburg trolley line has been awarded to Thomas H. Reagan & Company, of Philadelphia. F. W. Darlington will be superintendent of construction.

JEANNETTE, PA.—Officials of the Jeannette-West Newton trolley line have signed a contract with the New England Construction Company to build the road. The line will be about 14 miles long, and will run through Adamsburg, Edna, Madison and Herminie. In Jeannette it will connect with the Pittsburg-Greensburg line.

NEW CASTLE, PA.—A new interurban trolley line direct from this city to Sharon may be one of the first results of the coming merger of the Pennsylvania & Mahoning Valley and the New Castle & Sharon Companies. A direct line, it is said, will be built to Sharon by way of the Shenango Valley through Pulaski, West Middlesex and Wheatland.

WAYNESBORO, PA.—The Winchester & Washington City Railway Company has purchased from the estate of former Governor Lowndes, Cumberland, and David Sloan, of Lonaconing, their water power on the Shenandoah river, 4 miles southeast of Charlestown, for $10,000. The company has an engineer on the premises, who is making surveys. The power will be developed. It is stated that the company will build a trolley line from Harper's Ferry to Winchester by way of Charlestown and Berryville. A line is also to be built from Berryville to Bluemont, Va., and probably from that point to Washington. The water power is said to be capable of developing 2,000 hp. Winchester, Berryville and Philadelphia men are the promoters. N. Wilson Davis, Harrisonburg, has been elected the resident engineer.

MANITOWOC, WIS.—The Fox River Railway Company, of which Isaac Smith, of New York, is consulting engineer, has had its survey for location completed. The line as surveyed is 65 miles long.

KINGSTON, ONT.—The civic authorities of the city of Kingston, Ont., have given the bondholders of the electric street railway notice that the street railway generators, in the city's electric power house, must be removed before July 1, as the space now occupied by these generators is required for the extension of the lighting system. This means that the city has no intention of further supplying power to the street railway, and it also means that there will be no cars operated in the city during the summer at least, as a power plant could not be erected in less than three months.

OTTAWA, ONT.—In the railway committee of the Canadian Senate, the Ottawa Electrical Company's bill to increase its capital and providing authority to amalgamate with other existing electric companies, was passed on June 14. When this bill was before the Commons, the city of Ottawa objected to the company being allowed to establish a monopoly in the electric lighting business of the Canadian capital. Since then, however, the city has bought out the Consumers' Electric Company, the plant of which is to be owned and operated by the city as a means of ensuring competition to the public. The Ottawa Electric Company has held out a sop to the city by offering the municipality a seat on the company's board of directors, and that after a six per cent dividend has been declared, all surplus earnings shall be devoted to the reduction of the rates.

New Industrial Companies.

THE CRESCENT ELECTRICAL & MANUFACTURING COMPANY, of Valparaiso, Ind, has been incorporated with a capital stock of $20,000. The directors are James H. McGill, Harry W. Harrold and Leslie R. Skinner.

THE CHARLES A. THOMPSON COMPANY, of New York, N. Y., has been incorporated to manufacture electrical machinery, etc., with a capital stock of $25,000. The incorporators are Charles A. Thompson, Brooklyn; Rudolph Miehling, New York; James Shaw, Brooklyn.

THE SCOTT ARC LAMP COMPANY, of Portland, Me., has been organized for the purpose of manufacturing arc and incandescent lamps, and for other purposes, with a capital stock of $1,000,000. The officers are: President, H. E. Mason, Portland; treasurer, James J. Hernan, Portland.

THE AITON MACHINE COMPANY has been incorporated under the laws of New Jersey for the manufacture and sale of machinery covered by Mr. Thos. A. Aiton's patents for all classes of wire insulation, cabling and rubber machinery, and is now established in connection with Marine Engine & Machine Company, at Harrison, N. J. The factory facilities provide for prompt execution of the largest as well as the smallest orders. The company has a large foundry with capacity and modern facilities for producing high-grade castings up to the largest sizes, and an ample railroad siding and wharf on tide water insure prompt and economical shipments. The officials of the Aiton Machine Company are as follows: Mr. Gardiner C. Sims, president; Mr. Thos. A. Aiton, vice-president; Mr. Arthur S. Beves, secretary and treasurer. Mr. Aiton's business was formerly conducted in conjunction with the Chase Machine Company, Cleveland, Ohio.

Legal.

NEGLIGENT TELEPHONE CONSTRUCTION.—The Kansas City, Mo., Court of Appeals, in the suit of Smith vs. Miss. & Kan. Telephone Company, affirming a decision for the plaintiff, holds that: 1. The proximate cause of plaintiff's injury was the negligence of defendant telephone company in setting a guy pole for the purpose of bracing another pole loaded with telephone wires and keeping them from contact with electric light wires carrying a high voltage of electricity. 2. Where an electric lineman was injured by the negligence of a telephone company in setting a guy pole, defendant was not relieved from liability because of the fact that the defectiveness of the construction only manifested itself after a severe but not unprecedented storm, defendant being bound to make its construction sufficient to stand storms of ordinary or normal severity. 3. Where the parting of electric primary wires carrying a heavy voltage was the direct result of defendant's negligence and plaintiff, a lineman, was violently shocked and injured, because of such negligence, while at work on a telephone pole, it was no defence that some other person negligently wrapped the ends of the broken wires around the pole, and thereby facilitated the forming of a short circuit on the pole on which plaintiff was working. 4. Where an electric lineman, while working on a telephone pole, treated an electric light wire as charged, and the closing of the circuit by his body coming in contact with the wire was purely accidental and caused by slipping of his foot, he was not guilty of contributory negligence in failing to test the light wire, or in failing to wear rubber gloves, it appearing that there was no danger in handling live wires when the body was not in a position to connect them with other charged wires or with the ground.

Obituary.

MR. JAMES GAMBLE.—Mr. James Gamble, formerly Oakland (Cal.) manager of the Western Union Telegraph Company, died recently at Santa Barbara, where he had gone for his health. He is survived by two daughters, Mrs. Walter Ellis and Miss Mary Gamble, and three sons, James, Jr., Fritz and Leland. The latter was formerly a well-known Coast newspaper writer, but in recent years has been connected with Eastern mining journals.

MR. T. C. WALES, JR.—We regret to note that Mr. Thomas C. Wales, Jr., chief engineer of the New England Telephone & Telegraph Company, died this week at the Boothby Hospital, Boston. He was brought from Rutland, Vt., last Saturday, to be operated on for appendicitis, and did not successfully stand the shock. The operation was performed at the hospital by Dr. William M. Conant and Dr. Ernest D. Burden, and it was found after the operation that Mr. Wales could not live so advanced was the trouble, yet everything possible was done to save him. Mr. Wales was a son-in-law of R. H. White. When he was stricken in Rutland Mrs. Wales was summoned, and it was decided to bring him to Boston to be operated on. A special train was secured and the trip to Boston was made in record-breaking time. Mr. Wales's body was taken to his home at Chestnut Hill, Newton.

W. W. DONALDSON.—We regret the death of Mr. William W. Donaldson, which occurred at Elk Ridge, Md., on June 12. Mr. Donaldson was born June 16, 1863, at Baltimore, and received his primary education at George Carey's School, which he left at the age of 18 to enter Princeton. He remained at Princeton one year and a half, and left to take up special courses in chemistry and physics in Baltimore. He entered on storage battery work in February, 1884, and was connected in turn with the Storage Battery Company, of Baltimore, the Eastern Electric Company, and the Donaldson-Macree Storage Battery Company, of which latter he was president for three years, being a co-inventor with Mr. Macree of the type of battery manufactured by this company. In 1899 he became the engineer of the Automobile Manufacturing Company of Baltimore, and in 1901 accepted the position of electrical engineer with the Gould Storage Battery Company of New York, which he occupied at the time of his death.

Personal.

MR. F. C. TIDHAM, of Dallas, Tex., has been appointed general manager of the Oklahoma City Gas & Electric Company.

MR. W. VON PHUL has resigned as general superintendent of the electrical division of the Cincinnati Gas & Electric Co.

WM. STEWART WILDER will be general manager, as well as vice-president of the Northern Westchester Lighting Company, with offices at Ossining.

PROF. CHAS. P. MATTHEWS has been elected as head of the department of electrical engineering at Purdue University, to succeed Prof. W. E. Goldsborough.

MR. T. K. JACKSON, recently connected with gas and electric interests of Oklahoma City, Okla., has joined the forces of the Byllesby Engineering Company, of Chicago.

MR. J. H. WHITE, formerly superintendent of the Alton, Ill., Gas & Electric Company, has been made general manager of the Winona, Minn., Railway & Light Company.

MR. ALEX. H. KIRKWOOD, cashier of the Cleveland Telephone Company, has been elected treasurer of that company to fill the vacancy created by the death of J. P. McKinstry.

MR. JOHN P. HOLLAND, inventor of the submarine boat, and a lecturer on applied mechanics at Manhattan College, has received from that college the honorary degree of Master of Science.

DR. ALBERTO PIRELLI, of Milan, Italy, who was one of the visiting electrical engineers last year, expects to be again in this country during July, on behalf of the well-known Italian cable manufacturing firm of which he is a member.

MR. WALTER K. GANONG has received the appointment of acting professor in the department of electrical engineering at the University of Maine. Mr. Howard D. Carpenter will fill the vacancy in the department caused by Prof. Ganong's promotion.

MR. J. H. EVANS has been appointed secretary of the Kings County Electric Light & Power Company and of the Brooklyn Edison Company, to succeed Mr. W. W. Freeman. Mr. Evans has been auditor of the Edison Company since 1902.

MR. W. F. WELLS, the efficient superintendent of the big Waterside station of the New York Edison Company, and formerly with the Brooklyn Edison Company, now returns to the latter corporation, having been made its general superintendent during the present week.

MR. G. E. SKOG, who was connected with the Westinghouse Elec. & Mfg. Company for a number of years, and left for Europe a few months ago, has accepted the position of Superintendent of Construction with the Allmanna Svenska Electric Company, the largest electrical company of Scandinavia. Mr. Skog has headquarters in Westeras, Sweden.

MR. WYNNE MEREDITH, of Cory, Allen & Meredith, San Francisco, has gone to Chicago on a business trip. He recently completed the engineering of the Vancouver Power Company's electric power transmission plant on Burrard Inlet, B. C. A 13,000-ft. tunnel through solid rock and a 2800-ft. span across an inlet are among the special features of this 16-mile, 20,000-volt transmission.

MR. N. F. BRADY, treasurer of the New York Edison Company, finding that several old fire horses after doing good service were to be sold cheap for more hard work or for delicatessen, has gathered them in at the sale and given them positions on one of the farms up the State, where they will now literally live in clover. This is a generous plan that might well be developed and persisted in.

MR. P. TORCHIO, a biographical sketch of whom appeared recently in our series devoted to electrical engineers, has now been made chief electrical engineer of the New York Edison Company, a promotion well deserved by conspicuous merit and ability. Mr. and Mrs. Torchio are sailing this week for their native land, Italy, and will spend two or three months there, more particularly in the north and the vicinity of Milan.

MR. DELANCEY RANKINE.—It is announced that Mr. DeLancey Rankine has been made third vice-president of the Niagara Falls Power Company and its allied companies, to succeed the late Mr. George W. Davenport. For seven years past Mr. Rankine has been secretary and treasurer of the Cataract Power & Conduit Company, Buffalo, and secretary-treasurer and general manager of the Tonawanda Power Company and of the Suburban Power Company.

MR. W. W. FREEMAN, secretary and treasurer of the Brooklyn Edison Company, has been promoted as vice-president and general manager, in the place of the late Mr. E. A. Leslie, and has assumed the new duties. He assumes similar duties with the Kings County Electric Light & Power Company. Mr. Freeman has had a steady and rapid rise in the Edison Company, which he entered as a stenographer when it was organized in 1889. He also takes Mr. Leslie's place as a director and treasurer of the Testing Laboratories of this city.

MR. EUGENE LENTILHON, C. E., for the past several years a contracting engineer in New York City, has become associated with J. G. White & Company, and is now on his way to Chili on a mission covering the investigation of a number of important engineering projects. Mr. Lentilhon is a graduate of the Sheffield Scientific School, Yale University, and, for several years following his graduation, was in the service of the Dock Department in New York City. His most important work in this direction was his supervision as assistant engineer of improvements and repairs on the North River from the Battery to 14th St. In 1897 Mr. Lentilhon resigned from the Dock Department to engage in business as a contracting engineer. Among the principal contracts completed by him were the construction of the Hudson Park, New York City; the erection of two buildings at the New York Navy Yard; the removal of the reservoir from the site on Fifth Ave., between 40th and 42d Sts., New York City, and the building of the foundations for the New York Public Library.

MR. G. R. WADSWORTH, who has recently joined the staff of J. G. White & Company as assistant to the construction manager, was born in 1875, and in 1898 graduated from the Massachusetts Institute of Technology in civil engineering. He entered the employ of the New York Central Railroad at Albany, being assigned to the office of division engineer, in which he worked in various capacities, ultimately being appointed assistant engineer. In 1901 he was transferred to the general offices in New York on special work under the engineer of track. Shortly afterwards he was made resident engineer of the middle district at Albany in charge of construction work. In 1902 Mr. Wadsworth was appointed designing engineer of the company, with headquarters at the Grand Central Station. Here he had the supervision of plans and estimates for bridge masonry, culverts, piers, bulkheads and yard and shop layouts. In 1903, he was placed on the New York Terminal improvement as assistant engineer, having charge of the construction of the "Port Morris Branch Depression" in the Bronx, the "Marble Hill Cut-off" in Upper Manhattan and general improvements in four-tracking. Early in 1905 Mr. Wadsworth was appointed resident engineer of the Hudson district, in charge of contract work connected with the terminal improvements from Mott Haven to Croton. Since graduation Mr. Wadsworth has been continuously in the employ of the New York Central, and his rapid promotion has given him an unusually wide experience for a man of his age.

MR. HAROLD ULMER WALLACE has resigned as chief engineer of the Illinois Central Railroad to accept the position of third vice-president with J. G. White & Company, Inc. Mr. Wallace was born in 1872 and graduated from the Chicago Manual Training School in 1892, after which he took a special course in civil engineering at Purdue University. He entered the service of the Illinois Central R. R. in 1894 as assistant engineer, and had charge of the construction work and of new concrete and masonry work. In 1896 he was appointed resident engineer of the Lake Front improvement work at Chicago, which was completed in eight months and cost $1,000,000. This work included the depression and reconstruction of twenty miles of main line and yard track; the building of a masonry retaining wall, one mile long, and of a sea wall, 8,000 feet long; the placing of 2,000,000 yards of filling; and the erection of an underground station and three street viaducts. From 1896 to 1900 he was roadmaster of the Chicago Terminals and the Louisville Division. During the two years of his assignment to the Louisville Division, its main line was entirely reconstructed. From 1900 to 1902 he was superintendent of the Freeport & Louisville Division. Since 1902 Mr. Wallace has been chief engineer of the Illinois Central Railroad, and has had charge of the maintenance of way, bridges and buildings and reconstruction work, including the building and rebuilding of yards, double tracking and grade reductions. He has also directed the construction of elevators and wharves at New Orleans and a ten-story office building at Chicago. Mr. Wallace will direct the management of the construction department of the J. G. White Company, from the main offices of the company, 43 Exchange Place, New York.

◆

Trade Publications.

ICE CONDENSER PIPES. The Chicago Pneumatic Tool Company has given out some interesting and valuable data as to best methods of sealing condenser pipes in refrigeration plants by the aid of pneumatic hammers.

FAN MOTORS.—Booklet 41-F of the F. Bissell Company, Toledo, Ohio, is devoted to fan motors. Desk and bracket types are illustrated and described and tables of data given covering a large range of these summer conveniences.

IGNITION STORAGE BATTERIES.—The Storage Battery Supply Company, 239 East 27th Street, New York, in a circular describes the "Reliance" and "Reliable" storage batteries for the ignition circuits of gasoline automobiles, motor boats, etc. The two types are handsomely illustrated in colors.

NATIONAL BATTERY COMPANY, of Buffalo, N. Y., is calling the special attention of automobilists to its "National" sparker storage battery outfits for the ignition of the explosive mixture in gasolene motors. A leaflet gives full particulars of the sparkers as put up in either wood or metal cases, with two cells or three cells.

WESTINGHOUSE TURBINES.—Owing to derogatory reports in the newspapers as to steam turbine performance, the Westinghouse Machine Company has issued a very striking list of 70 large Westinghouse turbines in successful use in this country, to which any one interested can have access for information as to their economical results.

THE AITON MACHINE COMPANY has just issued its Bulletin No. 7 showing a No. 7 wire stranding machine, also Bulletin No. 18, showing cable reel winding gear, and would be pleased to furnish any one who would be interested in this type of machinery with copies of the bulletins which it has on file at its offices, 126 Liberty St., New York.

THE SUNBEAM INCANDESCENT LAMP COMPANY has just issued a new bulletin describing and exploiting its complete line of Sunbeam Reflector lamps. These lamps are furnished in 6, 28 and 36 c.p. in all voltages. This bulletin is ready for distribution and a copy will be sent to any one interested upon request either to the above company or to the Western Electric Company. The latter company and its branch houses carry a large stock of Sunbeam lamps, embracing the entire line.

WESTINGHOUSE IN PORTLAND.—The Westinghouse Electric & Mfg. Company has issued in connection with the Lewis & Clark Exposition at Portland, Ore., a very handsome pamphlet with decorated cover, showing Mount Rainier in the background and with two supporters—one an Indian with bow and waving a torch; the other being a figure of peace and progress with a palm branch and the arc light. The contents of the 32 illustrated pages are chiefly a description of the leading Westinghouse products. A complete list is given at the end of the various Westinghouse Companies all over the world.

OIL ENGINES.—The De La Vergne Machine Company, 138th street, New York, has issued an attractive folder devoted to the Hornsby-Akroyd oil engines. It is stated that the amount of fuel per h.p.-hour developed by these engines is about one-eighth of a gallon of kerosene, which may cost from one-half to one cent. These engines are of the single and twin cylinder type, for station work, and are supplied in the portable and semi-portable types for use in running electric generators, refrigerating machines, air compressors and other machinery employed in mining, construction work, on the farm and in the factory.

CABLE POTHEADS.—In a folder recently issued, the Central Electric Company, 207 Jackson Boulevard, Chicago, describes the Candee cable potheads, which are stated to be water and moisture proof and thus capable of preventing the destructive attacks of moisture upon paper-insulated cables. The conductors extending from one end of the pothead or plug are insulated with "Okonite," those from the other end are cotton-covered, and are sealed in a lead sleeve to protect them from dampness. The sleeve is subsequently removed and used for making a permanent joint between the pothead and the lead covering of the cable.

TOOL-ROOM GRINDING.—The Cincinnati Machine Company, Cincinnati, Ohio, has recently issued a well-illustrated "Treatise on Tool-Room Grinding and Grinding Machines," which contains considerable valuable information on the subject of cutter and tool grinding. Part 1 is devoted to the No. 1 cutter and tool grinder, while part 2 is devoted to the No. 2 grinder, which is a machine of new form. This latter machine is a complete universal grinder, and has a range for cutter and tool grinding from the smallest cutters up to face mills 24 in. in diameter. The numerous illustrations show exactly how to handle the work, and the descriptions in connection with them give data on cutter grinding, no matter what machine is used.

SMALL CAPACITY STORAGE BATTERY.—The Electric Storage Battery Company, Philadelphia, has issued Bulletin No. 92, descriptive of its two-plate type chloride accumulator which has been developed to meet the demand for a storage cell of small capacity, occuping a minimum amount of space and of a form readily installed. The positive plate of one cell and the magnetic plate of the adjacent cell are burned to one connecting strap, and the pair is supported by the edges of the two adjacent containing jars. The use of bolt connectors between cells is thus unnecessary; there is no contact to corrode or nuts to loosen, and installation is simplified. Bulletin No. 95 of the same company describes the application of "chloride accumulators" to lighting and power plants as exemplified in the installation at the Youngstown, Ohio, works of the Carnegie Steel Company.

News of the Trade.

REMOVAL.—The Chicago office of the Ball & Wood Company has been removed from the Marquette Building to 401 Fisher Building.

WILLARD STORAGE BATTERY PLANT DESTROYED.—The plant of the Willard Storage Battery Company, Cleveland, O., was destroyed by fire on the morning of June 26.

THE FORT WAYNE ELECTRIC WORKS on June 16 was awarded a contract for the electrical equipment of an extension to the municpal lighting plant of South Norwalk, Conn.

D. M. STEWARD MFG. COMPANY, of Chattanooga, Tenn., has opened a permanent office at 47 Murray Street, New York City, for direct shipment of its lava specialties in this section.

THE DIESEL ENGINE COMPANY on June 16 was awarded a contract for an oil engine to be used in the extension of the municipal electric plant of South Norwalk, Conn. The total amount of the award was $16,000.

THE CRANE COMPANY, Chicago, has moved its general offices and sales departments to its new office building at 519 South Canal St. A branch of the city sales department will be continued at the old address, 10 North Jefferson St., where the company has maintained its general offices since 1864.

E. B. MEYROWITZ, New York, manufacturer of the Vetter current tap, reports business as exceedingly good at present for this ingenious device. This demand is caused, no doubt, by the advent of the fan season. By means of this tap an electric light circuit can be tapped for the operation of a fan motor.

THE COOK POTTERY COMPANY, Trenton, N. J., well known in the porcelain field, has recently gone into the manufacture of electrical porcelain and is making a specialty of tubes. This company states that a guarantee stands behind all its products, and points to the fact of its being established in 1876, having, therefore, an experience of nearly thirty years.

THE STAR PORCELAIN COMPANY, of Trenton, N. J., has found it necessary, owing to its rapidly growing business, to enlarge its extensive plant, and has recently erected an additional building of three stories, and measuring 141 x 30 ft. This new building will be used principally for the manufacture of porcelain tubes, a line which this company has gone into, in addition to its various other porcelain specialties.

MR. CHARLES T. JAEGER, of the Jaeger Miniature Lamp Manufacturing Company, New York, informs us that this company has joined the Association of Licensed Manufacturers of Incandescent Lamps. Mr. Jaeger further states that a provision has been made whereby his customers will be protected on all contracts placed with the Jaeger Miniature Lamp Manufacturing Company at contract prices on or before March 31 last.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., had an attractive exhibit at the recent convention of the National Electric Light Association at Denver. It showed several types and sizes of its new Sangamo direct-current wattmeter, which is an improved form of mercury motor-meter. Several of the meters were shown in operation. One of the most interesting features of the display was a shunt of 800 amperes capacity, together with a properly calibrated meter, the combination being suitable for recording total energy, instead of a specially constructed meter being required. The company was represented by Mr. W. W. Low, president of the Electric Appliance Company, of Chicago, who has been for several years the general selling agent for the Sangamo Company. Mr. R. C. Lamphier, superintendent of the Sangamo Electric Company, was also present.

HARVEY HUBBELL, Bridgeport, Conn., manufacturer of machinery, tools and electrical specialties, has incorporated his business, retaining the personal name. It will be a close corporation, and, for all purposes, business will continue as in the past under Mr. Hubbell's management. The object in incorporating was to establish a permanent institution, and also to enable the building up of a stronger business. The present three lines of manufactured goods, machinery, machine screws and electrical specialties, will be continued. The main office will remain at Bridgeport, Conn., with a branch office at 299 Broadway, New York City, under the care of Mr. H. W. Bliven, who is general sales manager. The firm is represented by Thos. C. Grier Company, 128 W. Jackson Boulevard, Chicago, and by The John R. Cole Co., 658 Mission Street, San Francisco, Cal., who carry stock in both places.

THE TEA TRAY COMPANY, of Newark, N. J., maker of incandescent street fixtures, hoods, shades and reflectors, announces the opening of a sales room at its factory, where it shows its well-known Martin specialties. This is the most complete line of incandescent street fixtures, hoods, shades and reflectors on the market, and embraces more than three hundred different articles, including incandescent street fixtures for high-tension circuits, copper hoods with porcelain enameled deflectors (the "don't-rust-out" kind) and hoods and fixtures suitable for all situations and voltages, together with a full assortment of tin shades, porcelain enameled steel shades and mirror reflectors. The Tea Tray Company is the pioneer maker of these goods and its product is standard in quality. Its extensive factory is fully equipped to make special shades and reflectors, as well as regular goods, and it solicits correspondence. Its catalogue No. 15 describes fully these specialties and should be in the hands of every central station manager, contractor and user. The Tea Tray Company's factory is located at Mulberry and Murray Street, Newark, and is quickly reached by the Pennslvania R. R., South street station, Newark.

CORY, MEREDITH & ALLEN.—The engineering firm of Cory,, Meredith & Allen has recently removed its offices to the Union Trust Building, San Francisco, Cal. The firm engages in expert examinations, advisory reports and construction supervision. The personnel consists of Professor C. L. Cory, the Dean of the College of Mechanics of the University of California, in Berkeley, which college embraces all of the courses in steam, hydraulic and electrical engineering. Mr. Wynne Meredith has been a well-known engineer on the Pacific Coast for the past ten years, and Mr. W. H. Allen has had charge of a number of the electrical power installations on the Pacific Coast during the past five years. The 20,000-hp. plant of the Vancouver Power Company, at Vancouver, B. C., has just been finally completed, the point of particular interest in this plant being the tunnel through the mountains, the length of the tunnel being 13,000 ft. and the section 9 ft. square. The work upon this tunnel has been carried on continuously during the past two years. Upon the examination and report made by the firm this plant was financed, and later it became the consulting engineers, having in charge all the plans and specifications and later supervised the entire work of construction. The plant of the Washoe Power & Development Company, at Reno, Nevada, a 2500-hp. installation, has also just been put in operation. All the engineering work, including the supervision of construction, was done by the firm, which was also consulting engineer for the plant of the Britannica Copper Syndicate at Vancouver Island, also recently completed, which is of interest because of the exceedingly high head, 1935 ft. The steam-driven transmission plant for the Tonopah Mining Company, of Nevada, which is being installed complete by Messrs. C. C. Moore & Co., engineers, of this city, should be completed by September. The firm has had charge of the electric end of this installation, acting as consulting engineers in connection with the general contractors.

W. C. STERLING & SON COMPANY.—The old cedar pole and tie firm of Michigan, W. C. Sterling & Son, which has been doing business in cedar products for a quarter of a century, has incorporated with W. C. Sterling president; W. P. Sterling, vice-president, and W. C. Sterling, Jr., secretary-treasurer. The new company is called the W. C. Sterling & Son Company, and is enlarging its operations and handling cedar on a much larger scale. For a number of years this company has made a gradual and healthy gain in the cedar business and is one of the largest wholesale producers in the country. Twenty-five years ago Commodore W. C. Sterling started out producing small lots of telephone and telegraph poles from the Michigan forests. He took small contracts with the Western Union Telegraph Company, and later extended his business by taking larger contracts and furnishing telephone companies in Michigan and nearby States. He has grown up with the modern electrical business and has furnished poles and ties to nearly every State in the Union east of the Rocky Mountains. Assuming only seventy thousand poles per year that this firm has handled as an average, it means 1,750,000 poles, or with thirty-five poles to the mile, would furnish a pole line 50,000 miles in length, reaching twice around the world. Enough ties have been sold in the last ten years to build over 1,500 miles of railroad, and fence posts enough to fence in thousands of acres of land. There will always be a demand for cedar poles and ties, as there is no wood that can take its place. Cedar poles and ties will outlast any other wood and Michigan cedar is worth at least 25 per cent more than Idaho cedar, Southern cedar, chestnut or cypress. The W. C. Sterling & Son Company has some very large contracts this year with electric and steam railroads for ties. They have purchased all the Maltby Cedar Company stock at Riverhouge, Pinconning and other points in Michigan, and of other cedar firms of Michigan. Their large sorting yard in Bay City is to be enlarged and they are now taking their river drives out of the water.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary, S. S. Stadtler, 39 S. 10th St., Philadelphia.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next convention, Philadelphia, last week in September, 1905.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electrical Association of North Dakota. Secretary, S. J. Fuller, Larimore, N. D.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y.

Electrical Trades Society (Member National Electrical Trades Association.) Secretary, Franz Neilson, 81 Wall Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, D. Davis, Litchfield, Ill.

Independent Telephone Association of the United States of America. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Erie, Pa., Aug. 29, 30 and 31, 1905.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Electrical Association. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

National Electrical Trades Association. Secretary, Frederick P. Vose, 1343 Marquette Building, Chicago.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, J. E. Davidson, Port Huron, Mich.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Boston, July 19, 1905.

National Electric Light Association. Secretary, Dudley Farrand, Newark, N. J.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Albany, N. Y., June 16, 1905.

Ohio Independent Telephone Association. Secretary, E. E. Knox, Portsmouth, O.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Hotel Victory, Put-in-Bay Island, Aug. 16, 17, and 18, 1905.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio.

Pacific Coast Electric Transmission Association. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

Southwestern Electrical and Gas Association. Secretary, C. W. Hobson.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, W. W. Cole, Elmira, N. Y.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Virginia Street Railway & Electric Association. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

792,594.—COMBINED CABLE AND WIRE SUPPORTING CLIP. William J. Hiss, Jr., New York, N. Y. App. filed Jan. 27, 1905. Comprises a sheet metal clip having a curved hook to engage a usual form of lead sheathed telephone cable, and an eye for supporting insulated wires, all against a wall or fence.

792,597. ELECTROLYTIC CELL; John F. Kelly, Pittsfield, Mass. App. filed Sept. 9, 1904. (See page 23.)

792,601. SANITARY ATTACHMENT FOR SPEAKING TUBES OR TELEPHONE MOUTHPIECES; Walter S. Little, Lynn, Mass. App. filed Mar. 3, 1905. Comprises a thin diaphragm supported in a light metal casing so as to form an attachment which can be ordinarily carried in the pocket and applied to any telephone transmitter.

792,607. MEANS FOR ATTACHING POLE PIECES; James F. Mclroy, Albany, N. Y. App. filed Mar. 30, 1905. Designed for the attachment of laminated pole pieces to the usual annular yokes of cast iron. Comprises T-shaped hooks with screw-threaded ends for the engagement of a clamping nut.

792,611. BATTERY-GRID; Henry C. Porter, Waukegan, Ill. App. filed Aug. 19, 1904.

792,612. BATTERY-PLATE SEPARATOR; Henry C. Porter, Waukegan, Ill. App. filed Aug. 19, 1904.

792,613. BATTERY-GRID; Henry C. Porter, Waukegan, Ill. App. filed Aug. 19, 1904.

792,634. TROLLEY HEAD FOR ELECTRIC TRAM CARS; Samuel R. Thompson, Liverpool, England. App. filed Jan. 17, 1905. A lubricating cup contains a heavy grease and a spring-pressed piston is effective to slowly force the grease against the periphery of the trolley wheel.

792,637. ELECTROMEDICAL APPLIANCE; Paul Wenigman, Chicago, Ill. App. filed Nov. 2, 1904. A body belt is provided with a pair of batteries, of which the attaching clips form the terminals, and constitute electrodes to apply the electricity to the body.

792,638. ARTIFICIAL RESISTANCE; Willis R. Whitney, Boston, Mass. App. filed Nov. 16, 1901. (See Current News and Notes.)

732,639. VAPOR ELECTRIC APPARATUS; Willis R. Whitney, Boston, Mass. App. filed Dec. 19, 1903. (See Current News and Notes.)

792,658. MOTOR STARTER; Albert J. Horton, White Plains, N. Y. App. filed Nov. 2, 1904. A mortor starter in which field resistance cannot be cut out until all the resistance has been taken out of the armature circuit. Comprises two arms which are moved together in one direction, but one of which is retained at a certain position of its movement by an electro-magnet until proper conditions arrive for the resistance to be cut out of the field circuit.

792,672. STATION INDICATOR; James H. Shepherd, Denver, Col. App. filed Aug. 22, 1903. A trolley car is provided with a tablet having the names of the stations thereon, and glow lamps in circuits closed by a sliding contact manipulated by the conductor indicate the stations successively.

792,684. ELECTRIC MOTOR; Thomas S. Watson, Milwaukee, Wis. App. filed Mar. 21, 1905. A device to relieve an electric motor of its load at starting. A magnetic clutch is energized when the motor arrives at full speed by circuit controlled from the regulator arm.

792,689. CIRCUIT CLOSER FOR TROLLEY SIGNALS. Harold E. Bradley, Warwick, R. I. App. filed Oct. 19, 1904. A trolley actuated switch in which a tappet thrown by the trolley wheel sets a dash-pot controlled apparatus in operation which closes a circuit for an interval of time great enough to insure the operation of any auxiliary mechanism.

792,691. TELEPHONY; Edward A. Buell, DeKalb, Ill. App. filed May 9, 1904.

792,692. ELECTROMAGNETIC MECHANISM; Edward A. Buell, DeKalb, Ill. App. filed Aug. 9, 1904.

792,693. TELEPHONY; Edward A. Buell, DeKalb, Ill. App. filed Oct. 25, 1904.

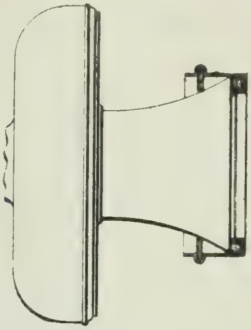
792,734. AUTOMATIC ELECTRIC SWITCH; Herman A. Schultz, Berkeley, Cal. App. filed Jan. 3, 1905. Apparatus for pumping out cellars, wells, etc., in which a float rising above a certain point snaps a switch which starts the motor pump which continues in operation until the float has fallen below another predetermined point.

792,738. ELECTRIC CIGAR OR LAMP LIGHTER; Frank W. Smith and William H. Smith, New York, N. Y. App. filed Jan. 9, 1905. A jug-shaped receptacle contains an electrical ignition system, and an inflammable fluid, and the stopper of the jug has a wick which is ignited by the electric ignition devices when withdrawn from the jug.

792,739. COMMUTATOR BRUSH; Charles W. Speirs, Battersea, England. App. filed Nov. 7, 1904. A plumbago brush in which the plumbago is ground up with gelatine and subjected to an enormous pressure in a lateral direction so as to expel the air longitudinally and arrange the grain in the direction of the brush.

792,741. ELECTRIC RAILWAY SWITCH; Thomas B. Stewart, William H. Turner and Rowland E. Dixon, Leeds, England. App. filed Nov. 26, 1904. A track switch has an insulated trolley section through which current may or may not be taken by the car to operate the switch in the usual way. A supplemental tappet is provided on a branch line to restore the switch point to its normal position.

792,751. ELECTROSTATIC APPARATUS; Lucien I. Blake, Lawrence, Kan. App. filed June 9, 1904. A gas-producing system supplies a continuous current of an insulating gas to the interior of a static machine. Dry air is employed in the structure set forth, but patentee states that other gases may be used.



792,601.—Sanitary Attachment for Speaking Tubes or Telephone Mouthpieces.

792,762. DYNAMO ELECTRIC MACHINE; Gano S. Dunn, East Orange, N. J. App. filed Oct. 24, 1904. Relates to details of the casing of a generator by which the commutator is wholly enclosed and protected, at the same time permitting a rotary adjustment of the brushes.

792,776. MAGNETIC SEPARATOR; Elwin C. Kavanaugh, Holyoke, Mass. App. filed Apr. 15, 1904. The revolving drum which contains the electromagnets for attracting the ore particles to the surface of the drum is normally filled with oil by a special pipe connection in order to absolutely exclude water therefrom.

792,783. MANUFACTURE OF PRUSSIC ACID; Wilhelm Muthmann, Munich, Germany. App. filed Oct. 17, 1903. (See page 23.)

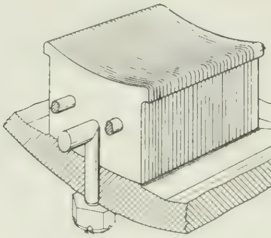
792,787. ELECTRIC UNLOADER FOR AIR COMPRESSORS; William Prellwitz, Easton, Pa. App. filed Nov. 20, 1903. A device to relieve the motor of its starting load. For this purpose an auxiliary valve is used, which is controlled by an electro-magnet, which is energized as soon as the starting arm arrives at a predetermined position.

792,7[illegible]. ELECTRIC LAUNDRY IRON; Earl H. Richardson, Ontario, Cal. App. filed Jan. 25, 1904. Relates mainly to the feature of construction by which a plate of asbestos is clamped between the handle section of the iron and the face thereof in order to insulate the heat of the iron from the handle.

792,843. GALVANOMETER; Edwin F. Northrup, Philadelphia, Pa. App. filed Apr. 1, 1905. A D'Arsonval galvamometer which is mounted on a supporting vertical board which can be attached to a solid wall by a couple of screw-eyes. The telescope is on a protecting rod which can be detachably secured to said supporting board.

792,845. ELECTRICAL SWITCH; Hubert Pfirmann, Frankfort-on-the-Main, Germany. App. filed Aug. 20, 1902. Has a rocking switch and rotary mechanism for driving the same. A locking device is provided to temporarily detain the switch, which can be released at certain times by the drving mechanism, whereupon it is quickly thrown by a spring.

792,855. ELECTRIC SYSTEM; Axel L. Sjoberg, Union Hill, N. J. App. filed Sept. 23, 1904. A rotary switch is provided at a distributing point to direct the current into different sub-stations. The rotary switch is stepped around to different positions by a ratchet wheel controlled through a magnet and an operating circuit.



792,607.—Means for Attaching Pole Pieces.

792,860.—ELECTROMAGGNET SWITCH; August Sundh and David L. Lindquist, Yonkers, N. Y. App. filed Oct. 27, 1904. Is adapted to be operated by alternating currents, and comprises a magnet having a pole piece formed to enter a socket in its armature. The armature has a switch-closing contact which also forms a spring abutment and insures against chattering.

792,860.—ELECTROMAGNET SWITCH; August Sundh and David L. Lindquist, Yonkers, N. Y. App. filed Oct. 27, 1904. Relates to modifications of the above, in which the alternating current magnet is formed with curved pole faces so as to act upon a concentric rotary armature or core to close the switch. Chattering is avoided since there is no fixed abutment for any of the parts.

792,875. BLOCK SIGNALING MECHANISM; Charles P. Bass, Portland, Ore. App. filed Mar. 7, 1904. At the entrance to each block section a switch arm is placed which may be operated by any passing car. The successive cars step around a ratchet wheel and display an additional semaphore signal until a maximum number of cars are within the block. When the cars leave the block the ratchet wheel is successively stepped backward until all the semaphores again come to safety position.

792,892. SYSTEM AND MEANS FOR LAYING ELECTRICAL WIRES IN CONDUITS. Guy M. Gest, Cincinnati, O. App. filed Feb. 14, 1903. A support for naked wires within the usual tile telephone conduits. The wires are threaded through insulating blocks which are spaced along at regular intervals. The plates are designed to have no angular turning movement, and also to shed the moisture which condenses upon their surfaces.

792,900. RAILWAY SIGNALING; Ernest C. Irving, Westminster, England. App. filed Mar. 14, 1903. A semi-automatic railroad system in which special devices are thrown into action when a switchman, on account of light traffic conditions, sets everything to safety and leaves the cabin. Under these circumstances a pneumatic control system is thrown into action which operates automatically.

792,903. TROLLEY STAND; Frank N. Kelsey, New Haven, Conn. App. filed Apr. 14, 1905. The trolley pole is held against the wire by a flexible spring-pressed connection at a point on its length. Supplemental springs are provided to compensate for the change in tension due to angular variations in the position of the pole.

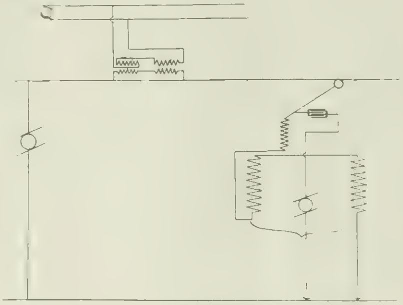
792,922. APPARATUS FOR CONTROLLING TRAFFIC ON RAILWAYS; Thomas H. Patenall, Wilkinsburg, Pa. App. filed Oct. 27, 1904. Relates to an improvement in "staff systems" and has means whereby the insertion of the staff within the controller synchronizes all of the instruments and permits another staff being withdrawn from either instrument or from the controller itself. When a staff has been removed from any of such instruments another staff cannot be removed from any of the other instruments.

792,927. TELEPHONE-TRANSMITTER; De Elbert A. Reynolds, New York, N. Y. App. filed Feb. 25, 1905.

792,959. CLAMP FOR TROLLEY WIRES; Cris C. Bakewell, Kaylor, Pa. App. filed Mar. 31, 1905. A hanger has a fixed and a pivoted jaw which can be forced together to clamp the trolley wire by means of a screw in the fixed jaw.

792,963. RAILROAD SIGNAL; Albert M. Bullard, Somerville, Mass. App. filed May 8, 1903. Has means by which danger signals of different sorts are produced by direct currents, or by an open circuit, but safety signals can only be received within the locomotive cab by an alternating current which causes lamps to flash periodically and thus indicate the safety signal.

792,985. SAFETY DEVICE FOR TROLLEY POLES OF ELECTRIC CARS; Daniel R. W. Hardman, Liverpool, England. App. filed Mar. 14, 1905. A retrieving device for trolley poles in which the trolley current normally energizes a magnet which controls a detent for the rewinding spring. Should the trolley leave the wire the magnet is de-energized and the spring drum rendered effective to wind up the trolley cord and lower the pole.



793,033.—Electric Circuit.

793,004. EYE-MASSAGE MACHINE; Frank H. May, Birmingham, Ala. App. filed Apr. 8, 1905. Contains a diaphragm adapted to fit against the eye and a magnetic vibrator for imparting a movement to said diaphragm. Electrodes are provided for passing a current through the eye at the same time.

793,033. ELECTRIC CIRCUIT; Isidor Kitsee, Philadelphia, Pa. App. filed filed Oct. 16, 1903. An alternating current is impressed upon a circuit in which a direct current is normally flowing, and the receiving apparatus at the other end contains two branches, one having inductive resistance and the other capacity, so that only certain instruments respond to certain characteristics of the current flowing.

793,035. ELECTRIC METER; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 17, 1902. An electric motor is operated by a high resistance shunt circuit across the mains. The speed of the motor is controlled by a mercury brake which is applied more or less in proportion to the current flowing. The motor is connected to the usual registering means.

793,036. ELECTRIC CLOCK; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 17, 1902. A self-winding clock in which a weighted arm acts directly upon the escapement wheel. When the arm falls to a certain position, a magnet js automatically energized which raises the arm.

793,037. ELECTRIC TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 4, 1905. A code adapted for submarine telegraphy in which a dash comprises two impulses of opposite polarity and a dot, a single impulse.

793,039. PROCESS OF TREATING THE METAL MIXTURES PRODUCED AS A BY-PRODUCT IN ELECTROLYTIC METAL-REFINING; Anson Gardner Betts, Troy, N. Y. App. filed May 20, 1904. (See page 24.)

12,364. AUTOMATIC NON-INTERFERING REPEATER FOR FIRE-ALARM CIRCUITS; William H. Kirnan, Bayonne, N. J. App. filed May 4, 1904. Means are provided whereby two signals are received at the same time on one or more of the street magnets, whereupon all of such street magnets will operate in unison. As soon as any one receives a signal in advance of the others it will be "disabled" and the last one receiving the signal will continue to operate until its entire signal has been received.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, JULY 8, 1905. No. 2.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................................1139 Monadnock Block
PHILADELPHIA OFFICE..............................929 Chestnut Street
CLEVELAND OFFICE ....402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico......................Per year, $3.00
Foreign Countries, within the Postal Union.................................$6.00
Great Britain and Ireland......................................25 shillings
Germany ....25 marks
France ....31 francs
Single copies ....10 cents

Remittances for foreign subscriptions may be made through our European office. In requesting your address changed give OLD as well as new address.

Copyright, 1904, by McGRAW PUBLISHING Co.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **378,500.**

NEW YORK, SATURDAY, JULY 8, 1905.

CONTENTS.

Editorial 45
Proposed Municipal Lighting Plant for New York City.................. 48
Problems in Water Power Operation.................................... 49
The Ward Leonard Railway System in Switzerland....................... 50
Bell Monopoly in Frankfort, Ind...................................... 50
Meeting of Independent Contractors................................... 50
The Burden of Municipal Indebtedness................................. 51
The American Society for Testing Materials........................... 51
Electrical Engineers of the Times XVII.—Mr. Walter F. Wells.......... 53
Transmission of Power from Niagara to Toronto. II. (Concluded.)...... 54
Single-Phase Induction Regulator. By B. G. Bergman................... 56
The Supply of Electric Power in London. By A. Britton................ 59
Stone Wireless Telegraph System 61
New Telephone Patents 63
Discussions of A. I. E. E. Asheville Meeting......................... 64
Recent Electrochemical Developments 66
LETTER TO THE EDITORS:
Double Trolleys in Cuba.. 66
Digest of Current Electrical Literature.............................. 67
Book Reviews 71
Direct-Current Engine-Driven Generators 71
Doing the Work of the Institute. By Morris Brown 66
Electric Power on the Mesaba Range 73
The New Metallized Carbon Filament Lamp.............................. 73
Electric Switch for Railways 74
New Allis-Chalmers Shops 74
Chain Blocks 75
Increasing Boiler Capacity 75
Tachometers 75
Industrial and Financial Intelligence................................ 76
General News of the Week 78

DOUBLE TROLLEYS.

The double overhead trolley is still to be found in a few places in the United States, but its utility in the art is insignificant. The difficulties attendant on its use are popularly supposed to outweigh the advantages. Cincinnati is the most conspicuous American instance of its use, and there one of the best known street railway managers is said to have remarked that he would gladly give $100,000 if he could be permitted to dispense with it and adopt track return instead. Under these circumstances peculiar interest is given to the announcement that a large contract has just been placed in this country for the equipment of not less than 125 miles of trackage in and around Havana, Cuba, all of which is to employ the double trolley method. The reasons for this are not given, though some can be imagined. The line voltage will be the normal 600, and direct current is to be used. Probably a good deal of the territory covered is low and swampy, but as a general thing track return and single overhead contact have been found adequate to meet the conditions in most tropical regions.

◆

UNIFIED CURRENT SUPPLY IN LONDON.

A very interesting summary is given in our present issue by a well-informed London correspondent, of the steps that have been taken to unify the supply of current and electric power in that vast region known as London. The subject has many important aspects and these are carefully brought out. While there is natural, and in some instances reasonably grounded opposition to the proposed legislation rendering the plan feasible, it does seem that on the whole and broadly considered, the creation of the centralized generating plants would be a public boon. We have heard it stated that within the given area there are something like sixty authorities empowered to do business and several of them are in business. We have not seen the testimony given before the parliamentary committee, but it is safe to say that it reveals a sad absence of uniformity in practice, and a heterogeneity of plant and method that can only make for high cost of current and an absence of convenience to the consumer.

◆

SINGLE PHASE TRACTION.

The rapid stride that single-phase traction has made in technical and public estimation is furnished by a timely article in the *Electric Club Journal* for July from the pen of Mr. Charles F. Scott. The author refers back to the Great Barrington Institute meeting of three years ago, and then shows how swift has been the march of thought and events in the brief interval, laying emphasis on the fact that the compensated type of motor is that which apparently has won out. He sums up the existing status and conditions in three points on which he believes electrical engineers to be in the main in substantial agreement, viz.: That the use of single-phase alternating-current is essential for heavy and long distance railway work; that a single-phase motor and a single-phase system fulfilling the requirements is now available; and that the series compensated single phase motor is the one best adapted to meet the demands of the case. If this be true, some very important and vital developments in steam railroad conversion or supersession ought soon to follow. The recent Institute discussion at Asheville, however, showed that all the three-phase advocates are not yet dead or silenced.

Method of Measuring High Electrical Pressures.

A paper by Prof. S. M. Kintner on this subject presented at the recent Asheville A. I. E. E. convention discusses the various devices that have been employed for measuring alternating e.m.f's of 10 kilovolts or more. High pressures are steadily extending their applications, and are leading the way to yet higher pressures. It becomes of great importance to be able to measure these pressures conveniently and accurately. The most convenient method of measurement, without resorting to a multiplier, is the spark-gap method, although it is not direct reading, and the device temporarily disables itself at the instant when the measurement is made. Moreover, the method is subject to much uncertainty at high pressures; owing to the electrostatic influence of neighboring conductors, to the presence of ionized air due to continued electrification, as well as to the presence of other influences not yet defined. The method advocated in the paper is that of the oil electrometer. An ingenious form of static voltmeter is described, working in oil, through an angular range of about 80 degrees. The moving system consists of a pair of parallel metallic cylinders closed at their ends by hemispheres. These swing around a central axis between a pair of curved stationary metallic sectors to which the potential difference is connected for measurement. The use of oil instead of air enables a much greater electrostatic flux density to be safely carried within the apparatus than would be otherwise possible to allow.

An objection to this type of apparatus is that it has no simple law of operation from which the scale can be computed after a single point has been established in experimental calibration. It is necessary to calibrate the entire length of the scale experimentally. The apparatus described reads up to 35 kilovolts, square-root-of-mean-square. Another weak point of this type of apparatus, in connection with alternating-current pressures, is that its readings do not depend immediately upon the maximum voltage, but depend upon the average square of the voltage. In practical work it is the maximum voltage which ought to count. The advantage of the needle-point spark-gap is that it depends upon the maximum voltage for its indications, and does not seem to be affected by the wave shape on each side of the maximum. Of course, if the wave of testing e.m.f. could be depended upon to be sinusoidal, this objection would vanish. In practice, however, it is very difficult to secure a simple sinusoidal source of e.m.f. for such testing, and even in cases where it is obtained it is by no means safe to assume that after stepping the pressure up through transformers, the charging current at high pressure will leave the e.m.f. wave sinusoidal. On the contrary, the charging current seems to distort the voltage wave considerably. While, therefore, oil electrometers may find a distinct sphere of usefulness in electrical measurement of high pressures, there is a demand for a different type of apparatus that will conveniently and reliably measure maximum voltages from 10 kilovolts upwards.

The New Carbon Filament.

Mr. John W. Howell's announcement before the Institute regarding the production of a new carbon filament for incandescent lamps, printed in our issue of June 24, has been received with a good deal of interest. It has rather important bearings both theoretically and practically. On the former side we are hardly inclined to agree with the author in his interesting hypothesis that we may be dealing here with a new allotropic modification of carbon. It is undoubtedly true that the carbon of the "metallized" filament differs radically from the usual forms of carbon, but the changes and the condition under which they are produced scarcely suggest such a change as amounts to a new physical modification. To begin with, the metallized filament is the result of heating at atmospheric pressure to a temperature very much in excess of anything hitherto employed in preparing filaments. The result is a great reduction of the specific resistance, large increase of density, and a change in the temperature coefficient from negative to positive. The evidence is very strong that in the process there is a driving off of the volatile impurities in the filament and the consolidation of the remaining carbon. The most singular feature of the matter is the great difference of the result from anything to be reached by raising the filament to incandescence by passing a current through it in vacuo. The application of extreme heat from the outside and in air produces an effect of its own for some reason not at once apparent. It is possible that there may be removal by oxidation of some of the volatilized or gaseous impurities which might in vacuo be occluded in the filament as it cooled.

The change appears to be the production of an exceedingly pure form of graphite carbon rather than the evolution of a new allotropic modification. The changes are exactly what might be expected of a purified product. Carbon is ordinarily rather impure, carrying both ash and gaseous impurities; and it also seems to possess the power of occlusion to a notable extent. Its homologues, boron and silicon, are likewise extremely difficult to rid of impurities, and have only very recently become fairly well known in a somewhat pure state. All three have the power of forming enormously stable compounds only decomposable at truly tremendous temperatures; and the new filament seems to bear a similar relation to the old one that the silicon of the electric furnace does to this historic product at the hands of the early experimenters. From the commercial side of the matter it is surely advantageous to have a filament that will stand higher temperatures than heretofore advisable and that, from its positive temperature coefficient, will be less severely affected by small changes of voltage. How far beyond present commercial practice the "metallized" filament will carry us is somewhat uncertain. It would seem to be a little more expensive and difficult to prepare than the old form, and may require very careful sorting to secure uniformity. The lowering of the specific resistance, too, is by no means an unmixed blessing, for it implies a longer and slenderer filament to produce a lamp of moderate candle-power for the usual voltages. To stow away an extra length of slender filament in a standard bulb is not altogether convenient, particularly if the filament is worked at a temperature high enough to impair its elasticity.

These, however, are practical difficulties that in the long run mean simply a little extra cost, and this can well be endured in order to secure a good increase of efficiency. The claim at present made for the new lamp is a life of 500 hours with an initial consumption of 2.5 watts per candle and 20 per cent decrease during the life just named. In other words, the new lamp is heralded to give the same useful life as the ordinary 3.1-watt incandescent with an initial consumption of 2.5 watts per candle. Six-tenths of a watt per candle is a very considerable gain in cost of power. For a 16-cp lamp it would mean a saving of five kilowatt-hours during the life of the lamp, worth at average prices, say, 50 cents. The value of this gain to the consumer depends, of course, upon the extra cost of the lamp, regarding which there is as yet no definite announcement as to standard price. With the tantalum, osmium and zirconium lamps in the game, to say nothing of the Nernst for larger powers, it is, however, safe to say that the consumer will get a fair share of the gain, although doubtless some of the lighting companies will give it up with protestations. But in the long run any increase of efficiency works to the benefit of the business.

In commending Mr. Howell's paper highly, we trust he will not be offended if we take the liberty of criticising the form in which his curves are given. To give temperatures in percentages of the pressure at which a certain filament of unknown dimensions and properties work at 3.1 watts per candle-power may probably be convenient in view of the method used in making the tests, but it robs the curves of much of their value. In fact the paper, interesting as it is, is in a form as well suited for presentation before the National Electric Light Association, whose interests it affects most deeply, as before the American Institute of Electrical Engineers. The facts given are extremely important, but they are not so fully correlated as to give the engineer a clear view of the situation. In spite of this it is clear that a material advance has been made in filament construction, and that carbon has been given a new degree of usefulness. We hope that ere long full reports of tests of the new lamp will be made available by Mr. Howell, whose personal research and results are, it is understood, largely represented in this notable advance in lighting art

THE REPORT OF THE LIGHTNING RESEARCH COMMITTEE.

The Lightning Rod Conference of Great Britain published twenty-three years ago, a notable report containing a code of rules for the erection of lightning rods. This report attracted widespread attention at the time. The gist of these rules was that buildings should be protected by copper strip conductors well grounded at the bottom and sharply pointed near the top. The rules remained standard practice for a number of years. In fact they are closely followed in numerous building specifications at the present time. There can be hardly any doubt that the application of the rules has saved many a building from injury by lightning. On the other hand, many buildings equipped with lightning rods according to those rules were struck by lightning and injured more or less severely. These occurrences shook the faith of architects in the protective security of lightning rods. If a case of injury to a rodded building was brought to an electrical man for explanation, he was likely to say that the ground connection of the rods must have been bad. In some cases, however, it was ascertained that the ineffectual rods had good ground connection. Then the electrical man would probably say that if the lightning rods on the injured building were intact and made good ground, the injury was proof that there should have been more of them. The rods were insufficient in number. This would probably be a safe statement in view of the event. But the trouble has always been that no one could tell for certain whether he had a sufficient number of lightning rods on his building until after it had been struck. Then the knowledge might be too late.

In view of the dissatisfaction with lightning rods, "The Royal Institute of British Architects and the Surveyors' Institution" appointed in 1901 a new committee to take up the subject of lightning protection, and several well-known scientists and engineers were put on the committee. A circular letter of inquiry was issued and observations upon lightning injuries to buildings were accumulated. The report, which is a most interesting document, states that in the three years—1901-1904—the number of cases of injury to buildings by lightning reported in Great Britain exceed 500. Of these 115 cases have been reported in detail, of which 40 were to buildings equipped with lightning rods and supposed to have been adequately protected. Thirty-four of these failures of rods to protect buildings are detailed in the report. Of the tabulated 34 cases, 15 are churches, 2 are lighthouses, 4 are tall chimneys, and the rest are miscellaneous structures. In four cases gaspipes were damaged and gas was ignited, thus initiating fire. In one case a tall mill chimney was overthrown. In many of the remaining cases the damage must have been serious. In nine cases the ground connection is reported as defective. In most instances the condition of the ground connection is not reported. Only in three instances is the ground connection positively stated to have been good. In the case of the destroyed chimney it is believed that although there was a lightning rod outside the chimney, of which the condition is not known, the flash passed inside the chimney and broke out at the base with such violence as to cause the structure to collapse. Another important observation was on the chimney of the East London pumping station at Sunbury. Here stood a 36-in. steel standpipe thoroughly grounded at the base, and reaching almost to the top of the chimney. The flash is reported to have followed the hot air escaping from the side of the chimney and then to have toured the standpipe lower down. The case is cited as proof that a flash will strike a column of hot air in preference to the top of a large steel standpipe.

As the result of the investigation, and of experimental researches conducted since the lightning rod conference report of 1882, the whole theory of lightning protection has been modified. The old idea was to erect perpendicular conductors from good ground to the top of the building. If there are several high points on the building erect a perpendicular to each. It was supposed that a vertical rod exercised a protecting range of influence for a radial distance equal to its own height. These notions are abandoned. It is now supposed that lightning flashes are of two distinct characters, or, as described in the report, there are A flashes and B flashes. The vertical conductor is all right for the A flash, but for the B flash it may be of no use. There is thus always the comforting reflection left open to the owner of a lightning-struck rodded building that he suffered from a B flash. In brief, an A flash is a direct or main discharge between cloud and ground, while a B flash is a side discharge between one cloud and ground precipitated as the immediate consequence of a main flash between two opposed clouds. The only complete protection against a B flash is to construct a bird cage of metal around the building and to ground the bird cage. This is almost precisely the construction followed in a modern skyscraper or tall office building, except that occasionally the steel structure is not very thoroughly grounded. It is noticed in the report that these tall steel structures appear to be immune. Those who work inside modern tall office buildings during thunder storms ought to lay this consolation to their souls: that they are rendered as nearly immune to lightning as modern science can devise. A flashes and B flashes may jump about and envelop them, but persons who are well inside the metal birdcage, may consider themselves safe.

As a consequence of the revision in theory, the recommendations of the report depart markedly from those of the 1882 report. It is no longer recommended to gild, platinize or electroplate the points near the top of a rod. The earlier report had emphasized these "tipping" suggestions. The later report restores iron conductors to confidence. Iron is preferred to copper, except on the score of permanence. But for the wasting away by oxidation, an iron rod would be greatly preferred to copper because of its larger inductance. In the old days the inductance of iron was held in horror. Finally, the new recommendations of the report are that two rods should be provided to each tower or prominent high part of a building, one rod on each side of the building. Horizontal conductors should interconnect all vertical rods at the roof ridge level, and also at the ground level. This works in the direction of the bird cage theory. All large masses of metal, in or on the building, should be grounded as directly as possible. Gaspipes should be kept away from lightning conductors. Steel pipe grounds are recommended, terminating below in packed charcoal and kept moist by rain flow above. There can be no doubt that the new report is a great improvement over the earlier one, and property owners all over the world owe thanks to the committee for its labors. All nations have taxes and lightning damages in common

Proposed Municipal Lighting Plant for New York City.

The technical commission on electric lighting for the City of New York, consisting of Dr. Cary T. Hutchinson, Nelson P. Lewis and Prof. George F. Sever, has submitted to the Board of Estimate and Apportionment a report giving the cost of construction and operation of a city electric plant to supply all of the city lighting by electricity for streets, parks and public buildings.

The report deals in great detail with the problem and claims that with the proposed equipment each arc lamp for which the city is now paying $146 per year can be operated at an annual cost of $64.07, and that at 5.5 cents per kw-hour the city can obtain incandescent service which now costs 10 cents per kw-hour. The estimated cost of complete plant for Manhattan and the Bronx is $7,567,000, which appears as a total cost per arc lamp of $352 and per kilowatt of connected load of incandescent lamps of $153.

The city owns a plot of ground bounded by Avenue A, Ninetieth and Ninety-first Streets and the East River, and it is proposed that the central station be located upon this plot. It is understood, however, that a large sum would be required for the necessary land. The power house, views of which are given in Figs. 1 and 2, will comprise a boiler room, a turbine room, with switchboard galleries, and two wings for office purposes. Each office wing is to be approximately 50 ft. deep by 53 ft. wide. The boiler room is to be 88 ft. wide by about 260 ft. long. The turbine room is to be 103 ft. 5 in. wide and the same length as the boiler room. The building is to be constructed of reinforced concrete and masonry.

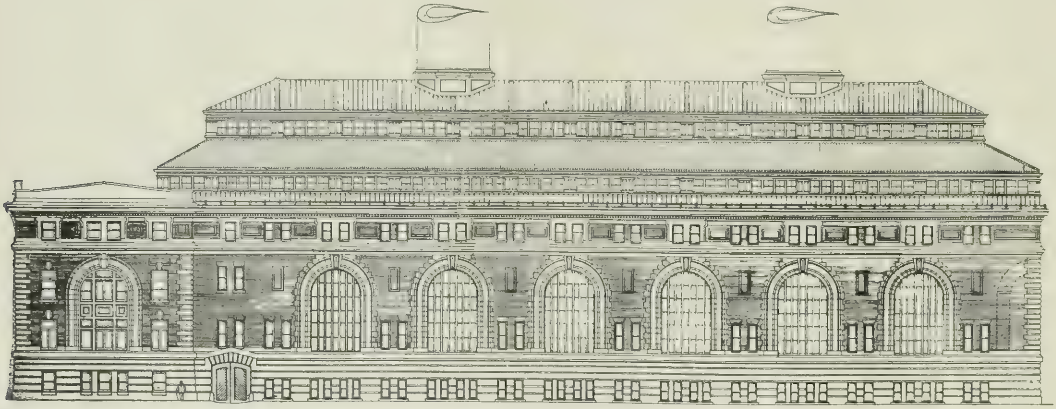


FIG. 1.—SIDE ELEVATION OF POWER HOUSE.

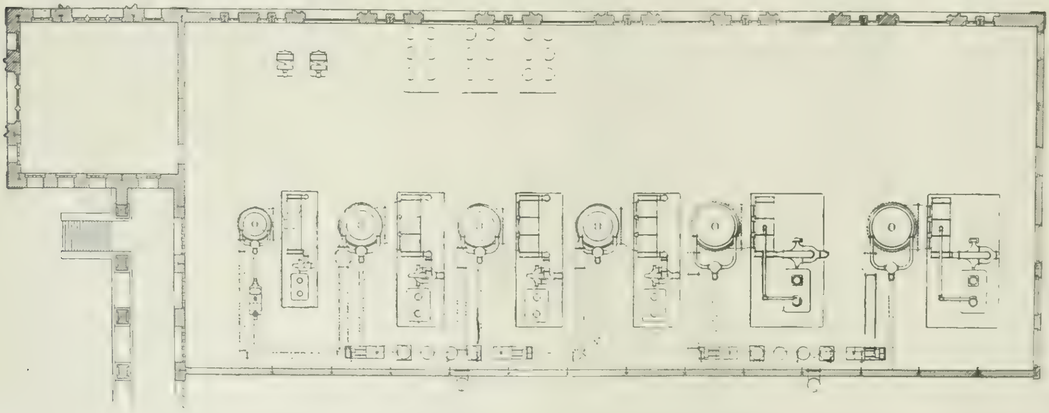


FIG. 3.—PART PLAN OF POWER HOUSE, WITH VERTICAL TURBINES.

The specifications call for two 5,000-kw turbo-generator units, three 3,000-kw turbo-generator units, and one 1,000-kw turbo-generator unit, together with one turbine or engine-driven exciter of at least 200 kw capacity for exciting purposes. In Figs. 3 and 4 are shown the arrangement of the units with vertical turbines. The arrangement with horizontal turbines is indicated in Fig. 5. The exciter is to be wound for 125 volts direct current, while the other generators are to be wound for three-phase, 60-cycle current a 11,000 volts working e.m.f. between terminals.

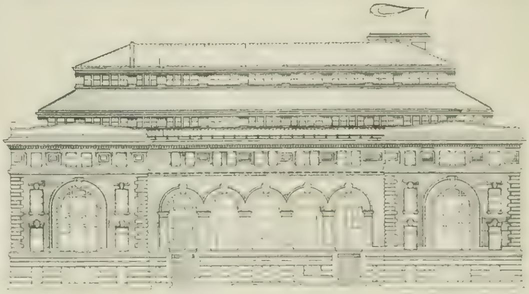


FIG. 2.—FRONT ELEVATION OF POWER HOUSE.

A sectional view of the boiler house is given in Fig. 5. The specifications call for inclined water-tube boilers designed for a working steam pressure of 200 pounds per square inch. These are to be fitted with mechanical stokers for burning either soft or hard coal. The equipment is to include 24 boilers each of approximately 6,000 sq. ft. of actual water-heating surface, excluding the superheaters. On the basis of 10 sq. ft. of water-heating surface for one boiler horse-power, each boiler will be rated at 600 hp. The superheaters will raise the temperature of the steam 150° F. above the temperature of saturated steam at 200 pounds pressure. Storage is to be provided in the yard for more than 20,000 tons of coal, in addition to the storage in the bunkers over the boilers. It is estimated that the total storage capacity will contain sufficient coal to run the plant for six months.

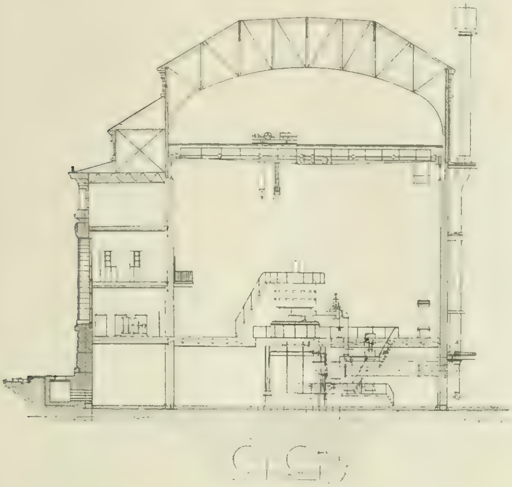


FIG. 4.—PART CROSS-SECTION OF POWER HOUSE, WITH VERTICAL TURBINES.

The power will be delivered to nine sub-stations in Manhattan and five in the Bronx, by means of cables run underground in ducts, at 11,000 volts. At the sub-station, part of the power will be transformed for 7.5 amp. constant-current arc lamps, and the balance will be transformed to 2,200 volts constant pressure for secondary distribution. This latter power will be transformed to 230 volts for delivery to single-phase, three-wire branch circuits in the buildings. In order to eliminate the drop of e.m.f. in the feeders from the central station, pressure regulators will be installed in each sub-station. No provision whatever is made in the estimates for a storage battery plant as a safeguard against breakdown or accident in the generating plant.

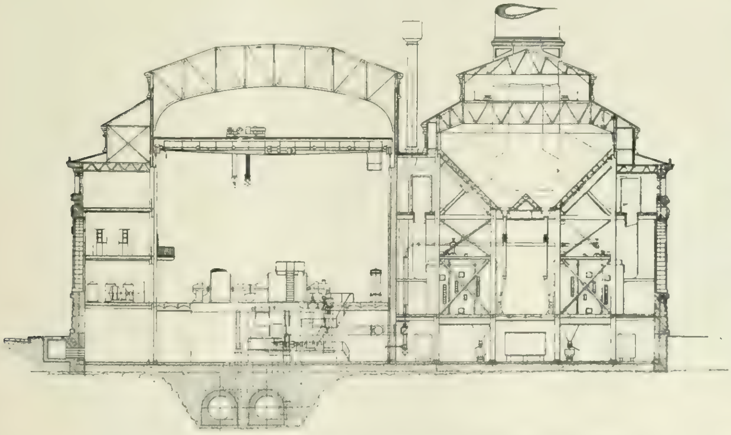


FIG. 5.—CROSS-SECTION OF POWER HOUSE, WITH HORIZONTAL TURBINES.

Problems in Water-Power Operation.

The "Question Box" of the N. E. L. A. contains 17 queries, with answers, under the head of "Water Wheels, Water Power," etc. To the query "Is there any remedy for anchor ice?" seven answers are given. Two of the answers recommend a large quiet basin above the wheels, which will be permanently frozen over during the winter; one answer supplements this remedy with the recommendation that by using some boom logs in the still bay the water will freeze over earlier than otherwise. In one plant, wheels have been kept free of slush and anchor ice during the spring break up by putting brush in the canal, which catches the ice and allows a fair flow of water to come through; the water is kept as high as possible during this period in order to throw the ice over a waste weir. In one case anchor ice and slush is deflected from the head race by means of three parallel sheer booms. In this plant when the gates show that they are going to stick, a jet of steam from a 1¼-in. pipe under 30 pounds pressure discharges into the water about 2 ft. above the wheel casing directly over the gates; the steam not only prevents the ice from sticking, but helps the water to cut it off after it has formed a thick coating. One remedy recommended for anchor ice is the placing of heavy iron bars for the intake at an angle so that the ice will slide down the bars to the spillway. Another recommendation is to draw across the current a wire netting 3 or 4 ft. in width stapled on a light wooden boom to float it. One or two sets of such booms will, it is stated, gather the floating anchor ice and leave a chance for the water to pass underneath. In answer to a question as to a method for preventing slush ice from forming on water wheels, it is recommended to keep the turbine wheels well housed and to keep them in motion.

A question that might have been excluded is as follows: "I have a 75-ft. head of water and want to develop a maximum of 150 hp, but will use from 40 to 50 hp most of the time. What is the best size of wheels?" Four answers recommended two wheels of 75 hp each. Three answers are given to the question, "What is the general efficiency of a water power plant at low head?" One of these is 80 per cent efficiency under any head not less than 4 ft.; another 75 to 80 per cent, and a third 50 to 60 per cent. In reply to a query as to the heads most suitable for turbines and for impulse wheels, one answer gives 18 to 20 ft. as a limit for the former, and another that impulse wheels are suitable for all heads, but especially those above 200 ft. One seeker for information wants to know how to measure water power heads, and is favored with five replies. Of six answers to a question asking what per cent of variation of speed can be reasonably expected in practice on water wheels driving a railway load and equipped with a standard governor, three give 2 per cent, two give 3 per cent and one from 5 to 6 per cent. In reply to a query as to the best lubricant for wooden water wheel bearings, one recommends graphite plugs, another graphite mixed with tallow, two state that no lubricant is needed, and one is of the opinion that "lignum vitæ contains enough oil to lubricate itself." In reply to a question asking the percentage of power loss in a beveled gear on a vertical water wheel it is stated that the loss will be 8 to 12 per cent if everything is in good operating condition.

Six questions in reply to a query as to whether there is any objection to making the power house a part of the dam, the head being 20 ft., are unqualifiedly in favor of doing so; the seventh reply offers the objections that there is a possibility of the breast wall leaking; that the method does not permit of the water being readily cut off from the fore without a cofferdam, and "Where the tail water rises very high there is possibility of the water getting into the wheels."

As to whether it is profitable to belt or gear a 200-kw generator to a water wheel where there is plenty of floor space, the five replies given favor belting. In reply to a question as to whether it is good engineering to erect four or more water wheels on one horizontal shaft in order to get speed under low heads for direct connection to the generators, the three replies state that this plan is satisfactory As to the safest means of preventing bursting of the penstock when the water wheel gates are suddenly closed, four answers recommend a standpipe; two prefer relief valves, and one a standpipe on heads under 50 ft., or a relief valve in the penstock for larger heads.

◆

The Ward Leonard Railway System in Switzerland.

As is well known, the Ward Leonard Electric Railway System has been in experimental operation in Switzerland for some time, and we are enabled to give below some data of tests made by the Oerlikon Company, which has the system under trial. The accompanying illustrations show a locomotive which is designed for 400 hp at the rim of the drivers, or 295 kw. For some time the locomotive has been hauling trains varying from 125 to 255 tons. In the case of a train of 200 tons—the locomotive weighing in addition 42 tons—a speed was attained of 18 miles (30 kilometers) an hour on an .8 per cent grade. The energy supplied to the low pressure terminals of the step-up transformers of the power house was at the rate of 300 kw during this run. On a level track this train was brought up to 30 kilometers per hour in 75 seconds, and in no case was there any trace of sparking at the commutators. The starting of the locomotive is stated to be exceedingly smooth and no peaks are produced on the load diagram. The regulation of torque and speed is extremely satisfactory and the electric braking is so simple and efficient that it is always used in preference to braking with the compressed air outfit.

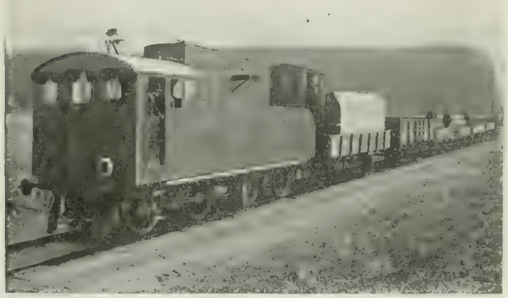


FIG. 1.—ELECTRIC LOCOMOTIVE ON SWISS RAILROAD.

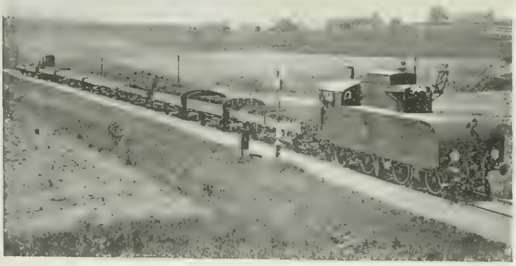


FIG. 2.—ELECTRIC LOCOMOTIVE ON SWISS RAILROAD.

As the speed with this system can be varied without sacrifice of efficiency from the lowest and the highest speed, it is claimed to possess a decided advantage over the single-phase type. With the latter type good efficiency can only be obtained by the addition of some double-speed reducing gear, which would result in the locomotive becoming heavy and awkward in design and of reduced efficiency. In the case of slow-speed locomotives, the motor-generator of the Ward Leonard type is claimed to be the best solution for heavy freight traffic for a large starting capacity, as a small expenditure of power at starting is more important than a quick acceleration.

A number of records have been taken of various tests of the locomotive, of which the following is one:

The trolley voltage used was 15,000; weight of locomotive, 45 tons; weight of cars, 200 tons; total, 245 metric tons (265 English tons); speed, 27 kilometers per hour (16.8 miles per hour); grade, 0.8 per cent (42.2 ft. per mile). The curvature of the line was very slight.

The work done at the rim of the drivers was at the rate of 216 kilowatts, the 15,000-volt circuit being supplied at the rate of 310 kilowatts. The total electrical and mechanical efficiency was approximately 70 per cent. The load factor on this run was 73 per cent of full load. Under this load the efficiency will be approximately as follows: Motors, gears and connecting rods, 86 per cent; motor-generator, 85 per cent; locomotive step-down transformer, 98.5 per cent; the exciter and air pump consumed 2 per cent of the energy and the line loss was 0.5 per cent. These data give a combined efficiency of 69.5 per cent. The watt-hours per metric ton-kilometer were 47. This corresponds to 68.2 watt-hours per ton mile on a grade of 42.2 ft. to the mile, and about 23.7 watt-hours per ton mile on the level

◆

Bell Monopoly in Frankfort, Ind.

The Bell Telephone Company has again secured the monopoly on the telephone business in Frankfort, Ind., by purchasing the plant of the Central Energy Telephone Company, for a consideration of $115,000. The Bell people say that there will be no advance in rates, although the Bell franchise is unrestricted. The Bell Company maintained a small exchange in Frankfort, while the Central Energy people have 1,300 subscribers, and one of the finest plants in the state, costing about $125,000. Eli Marvin was the principal stockholder of the Central Energy Company and gave as an excuse for selling that his company had been severely crippled by the Bell Company buying up a number of the independent plants in the state, and that its toll service was at the mercy of the Bell Company.

There is a bitter feeling against the men of the Central Energy Company who have sold the plant to the Bell Company, and the citizens as well as independent telephone men in the state say the excuse is frivolous and inconsistent with a statement recently published in its new directory setting forth that its toll line service reached more than three to one subscriber of the Bell toll line service. The Indianapolis Long Distance Company has a long time contract with the Central Energy Company and Secretary H. B. Sales says that the contract will be enforced to the letter. There is considerable speculation concerning the policy of the Bell Company in buying up independent plants

◆

Meeting of Independent Contractors.

The Independent Electrical Contractors' Association of Greater New York has planned its first annual outing to take place July 8, 1905. The members of the association, with invited guests, will leave the Battery at 1 p.m. and proceed to Pleasure Bay, where at West's Pavilion a clambake and general jollification will be held. The organization was formed last January. The purposes are: First, protection of the public against improper and dangerous installations and against all arbitrary combinations, which might tend to unfairly increase the cost of installations. Its further purpose is to protect its own members against injurious or unfair treatment of any kind, and to nullify any effort that might be made to injure the electrical industry, or bring it into disrepute by artificially raising or attempting to raise the cost of material. The third purpose is to promote mutual acquaintance. The members have so far progressed in their object that, in addition to the membership, they have received decided benefit in prices as well as in mutual respect, good will and understanding.

The initiation fee and annual dues have been kept low in order that all persons engaged in the electrical construction business in Greater New York may be encouraged to join the ranks.

Mr. F. W. Cohn, No. 52 Lexington Avenue, Manhattan, is secretary of the Independent Electrical Contractors' Association of Greater New York, and Mr. F. G. Schafer, of Brooklyn, is treasurer.

◆

The Burden of Municipal Indebtedness.

According to the annuals of the American Academy of Political and Social Science, the bonded debt of American cities is already about $1,000,000,000, or nearly the sum of the present interest bearing national debt. Greater New York represents a net funded debt of $401,000,000, after deducting $157,000,000 more for the redemption of its debt in the sinking fund. Nearly one-half of the debt of Greater New York represents bonds issued for interest bearing enterprises such as water supply purposes, docks and wharves and rapid transit construction, the amount invested in water works being $76,746,000, for docks and wharves $56,228,000 and for rapid transit construction $43,616,000. Next to New York comes Boston with $60,000,000 of bonded debt, exclusive of sinking fund deposits; Baltimore and New Orleans, $24,000,000; Cincinnati, $31,000,000; Cleveland, $19,000,000; Pittsburg and Washington City, $14,000,000 each; Milwaukee, $7,000,000; Duluth, $5,250,000, and Seattle, $4,500,000. Interest on the bulk of the bonded debt of American cities does not exceed 3½ per cent, and the greater part of the bonded debt of Greater New York bears only 3 per cent interest.

Among the items of municipal indebtedness are the investments in public utilities. Boston has outstanding water works aggregating $8,226,000; Baltimore, $8,627,500; New Orleans has a bonded debt of $12,000,000 to pay for its water works and drainage system. Of the net debt of $13,500,000 incurred by the city of Providence, $4,250,000 is for water works, making a little less than one-third of the whole. Of the aggregate bonded debt of Duluth, $2,206,000 are water and light bonds, while the water works plant of Seattle has been acquired at an expense of $1,050,000.

◆

American Society for Testing Materials.

The eighth annual meeting of the American Society for Testing Materials was held at Atlantic City on Thursday, Friday and Saturday of last week. The proceedings of the organization, which confines its attention to the properties of engineering materials, testing and the standardization of specifications, were marked by two important actions. The first relates to the Society's affiliation with the International Association for Testing Materials. In the past it has been very difficult to obtain any acknowledgment of remittances and communications sent to the latter organization, and for several years practically nothing has been done by it that anybody can ascertain. Its conventions have been repeatedly postponed, and as the American Society has been contributing a considerable annual sum for which it has received nothing whatever except an occasional circular of no value, it was decided to send out a letter ballot on the advisability of continuing the present relations. It is not at all unlikely that they will be severed, and that about 200 American testing engineers will join the International Association independently. The American Society will retain its membership as a single unit in the International Association and will probably contribute at least $100 annually to its funds.

The second important innovation related to the disposition of committee reports. A main feature of its work is the preparation by committees of standard specifications for engineering material. On each committee there is an equal representation of manufacturers and consumers, and the specifications are, therefore, pretty certain to be fair to all interests, as general specifications. There is a natural tendency, however, to introduce into them the special requirements for the highest grade of material, for which an extra price is demanded. In the convention last week such a spirit was shown with respect to steel rails, when a very animated debate arose over an attempt to adopt for such material the requirements of trunk roads for the rails for their main lines. It was finally decided that the time of the convention could not be devoted advantageously to further discussion of such an important subject, and it was referred back to the committee on rail specifications with instructions to adopt such a specification as it thought just and then send it out to the entire membership of the Society for letter ballot. This course enables the convention to avoid giving a snap judgment on such a very important matter, and at the same time permits a reasonable amount of time for airing divergent opinions. It was followed with several subjects and is a precedent that will doubtless prove most useful in securing full consideration of controverted topics.

The reports and papers covered not only the whole range of engineering materials but also certain aspects of engineering education. The only matters of special electrical interest that were brought up were an informal report from the committee on the magnetic testing of iron and steel and a paper by Mr. R. D. De Wolf on specifications for cotton tapes for electrical purposes.

◆

CURRENT NEWS AND NOTES.

CURIE AND THE ACADEMY.—Prof. Curie, of radium fame, is a candidate for the vacancy in the Academy of Science of France, caused by the death of M. Potier.

THE GENTLE WAYS OF CARACAS.—The municipal government having sued the Caracas Gas & Electric Company, Venezuela, for breach of contract, the company replied by serving notice on the government that it would not light the city after July 5. Consequently the government took possession of the entire plant of the company and will continue lighting the city.

TROLLEYS STOPPED BY HEAT.—That horse car traffic should be interfered with by hot weather is a familiar fact. The following cable dispatch from Berlin of June 30 shows that heat may also stop trolley systems: "A hot wave struck Berlin to-day, the temperature in the streets rising to 107. There were several cases of sunstroke, and horses died from the effects of the heat. Street railway traffic was interrupted at certain points in the city, where the underground trolley system is in use. The heat was so intense that the rails expanded and horses had to be pressed into service to haul the cars."

SERIES DISTRIBUTING SYSTEM.—On June 27, 1905, Mr. C. M. Green was granted a patent for a system of electrical distribution on an application filed November 3, 1897, relating to the use of lamps in series from a constant-potential alternating current system. The improvement consists in providing means for increasing the number of lamps in series without increasing the potential at any point between the mains or between the mains and earth. The inventor introduces into the series circuit at some point a boosting potential, which is sufficient to carry the additional load. The result is quite similar in effect to installing an additional parallel circuit of lamps in series.

NEW YORK SUBURBAN TRACTION.—There are many indications that the electric railway developments in the vicinity of New York are expected to do a great deal for suburban real estate. The extensive land purchases made the past week in Queens Borough have attracted the attention of real estate men in Long Island City, and various surmises have been made as to what it means. A straw showing the way the wind is blowing was the filing of a mortgage for $208,000, given to A. J. Cassatt, president of the Pennsylvania Railroad; Henry Tatnall, treasurer, and N. Parker Shortridge, chairman of the Finance Committee of the Board of Directors and Trustees of the sinking fund of the Long Island Railroad, on 145 acres of farm land north of Forrest Park, in Newtown. This land is traversed by the main line of the railroad and the Rockaway Beach Division, which form a junction on the property. The money has been advanced by the Pennsylvania Railroad sinking fund, and the tracts will in time be taken hold of by the company for the development of a residential section. The latest purchases, with the 500 to 600 acres previously obtained by a syndicate allied to the railroad company, will be used for suburban development. The same syndicate is developing a tract of twelve square miles east of Jamaica, and extending as far as Floral Park, on the main line of the railroad, including the high ridge of hills known as the backbone of Long Island.

COOLING DEVICE FOR MERCURY-VAPOR LAMPS.—In order to prevent an excessive rise in temperature of the containing vessel of mercury-vapor lamps, Mr. Richard Küch, according to a patent issued June 27, would surround the vessel with metallic mantles provided with ribbed plates which present large surfaces to the circulating air, so that the electrodes are sufficiently cooled and the pressure of the vapor within the lamp does not exceed a certain pre-determined limit

THE TECHNOLEXICON.—Up to the present about 2,700,000 word cards have been completed for the Technolexicon, which, it will be recalled, is a universal technical dictionary in English, French and German, being compiled under the auspices of the Society of German Engineers. The work was commenced in 1901, and its collaborators number about 2,000 firms and individuals in Germany and abroad. Besides the above cards, sources of information on file, but not yet taken in hand, will provide some hundreds of thousands additional cards. The editor-in-chief is Dr. Hubert Jansen, 49 Dorotheenstrasse, Berlin N. W. 7, who will be glad to supply further information concerning the Technolexicon.

TESLA ON WIRELESS.—In a letter to the New York *World* Mr. Tesla repeats his previous statements as to results obtained or possible with electrical waves in transmission of power and intelligence. He asserts that others have used his ideas and devices and says: "I may add that any expert, not a blacksmith or woodchopper in electrical experiments whose cheeks are covered with horn-back alligator skin, and who is thus enabled to make use of my patented devices without my permission and public acknowledgment, can easily enough girdle the world with wireless messages, and in Smardis's fashion achieve fame and distinction, cheap and unprofitable. With these marvelous appliances an engineer possessed of a knowledge and skill not greater than my own could throw this planet out of its orbit."

MR. EDISON AND X-RAYS.—In a recent interview, Mr. Edison made an interesting statement as to the effect on himself of work with Röntgen rays. After recalling the fatal effects on his assistants, the Dally brothers, he said: "Radium is a mighty dangerous substance to experiment with, as I found out to my cost. I am even now suffering from the effects of it. It damaged one of my eyes seriously and has also caused me great trouble with my stomach. My wife became so exercised over my condition as a result of studying it that I promised her to quit for a while at least. Its effect on me was the most mysterious thing that I ever had occur. I found after a time that my eyesight was beginning to trouble me. That was the first symptom. I noticed that whenever I walked along the street and tried to read a sign a little distance away I would see double. After a while I found that every time I attempted to read it gave me a severe headache. This set me to worrying quite a bit, as before I always had remarkably good eyesight. Mrs. Edison insisted that I was getting old and needed spectacles. Well, she might have been right about both statements. Anyway, I went to an oculist and had him examine my eyes. They stumped him. He puzzled over the case for a long time and finally confessed to me that he did not know what was the matter. He said it was the most remarkable eye case that he ever had come across. One eye, he said, was perfectly normal and all right, and the other about a foot out of focus."

OZONIZING WATER.—Dr. Rivas, assistant bacteriologist of the water department of Philadelphia, has made at the instigation of a private company, a report on the method of purifying water by ozone. He says: "Water taken from the city mains has been subjected to the process of ozonization, with the result that the removal of bacteria has been 90-100 per cent. Working at different rates of water and one and the same amount of ozone, i. e., of electrical energy, I found on an average 5 bacteria per c c. At the maximum rate of 35,000 gallons an hour, the maximum number of bacteria was 12. These experiments confirm those of other people abroad who have been working on the same lines. A second series of experiments was made in order to note the effect of ozone on strained river water. The Schuylkill River, at the place where the plant is situated, carries up to 2,500,000 bacteria per c.c., as a rule somewhere about 1,500,000. Passed through a straining tank, this number is reduced to a few hundred thousand, viz., from 200,000 to 500,000, and after ozonization we obtained as low as 5 when operating at a low rate (5,000 gallons per hour), and 38-55 at the rate of 10,000 gallons an hour. Nobody else has ever attempted to ozonize such foul water. We tried to ozonize raw river water carrying 1,100,000 bacteria per c.c. and brought this number down to 460 and 740 and 1,500 at different rates of operation."

THE FATHER OF RADIOBES.—With regard to the experimenter in "radiobes," the London correspondent of the New York *Tribune* says: "John Butler Burke has suddenly become the most talked of man of science in the United Kingdom. An Irishman by birth, he took his degree at Trinity College, and displayed peculiar aptitude for research work in science. Prof. Fitzgerald, in Dublin, was the first educator to excite his enthusiasm for investigations of this kind. They worked together for a short period, until Mr. Burke, who was only 20 when he received his first degree, accepted an invitation to become lecturer at Mason's College, Birmingham. Those associated with him were greatly impressed with his scientific ardor and inventiveness in suggesting methods of investigation, and did everything in their power to introduce him to men of science and to enlarge his facilities for work. He was offered a fellowship at Owens College, Manchester, where Prof. Schuster was his colleague and friend, and it was not long before he was engaged in research work at Cambridge, where the Cavendish Laboratory offered the best equipment in the country for physical and chemical investigations. He reached Cambridge by way of the Irish and provincial universities before the ardor of youth had left him, and during the past three years he has been convincing Lord Kelvin, Prof. Thomson and other masters of science that he has original genius for profound investigations of the most advanced nature. Outside the narrow circle of students employed in research work, he has been known as a popular lecturer on radium; but now that he professes his ability to prove that spontaneous generation is possible, and that by means of radium cultures the aspects of vitality can be produced in sterilized bouillon, he has taken the world by surprise and suggested a new and astounding explanation of the origin of life. As the modest experimenter himself explains his discoveries, he has been working for ten years on a problem which has fascinated and baffled investigators and thinkers for generations. This is spontaneous generation."

TUITION AT CARNEGIE SCHOOLS.—A special dispatch from Pittsburg of July 1 says: "Director Arthur A. Hamerschlag, of the Carnegie Technological Schools, being erected here, gave out to-day the first intimation of requirements of students, their tuition rates, etc. The circular made public this evening is filled with surprises, one of which is the small amount of tuition which will be charged at the school of applied science, the department which will be first opened next October, and of which the announcement is made. The tuition will be but $20 a year for residents of Pittsburg and $30 a year for those outside of Pittsburg. The small tuition comes as a genuine surprise, as it had been circulated that the tuition would be up in the hundreds yearly in this $10,000,000 school. Director Hamerschlag in his circular calls attention to the opening of the school of applied science, which will have courses for day students and also for night students. In part he says: "The school of applied science provides courses of instruction in those studies which are essential to a technical education. The elements in the curriculum are mathematics, physics, chemistry, drawing and shop work. Three-year day courses in the school of applied science are offered to students desiring to pursue studies preparing them for service in any one of the following vocations: Architectural, civil, electrical engineering, foundry, mechanical or railway practice. All students, irrespective of the course they may select prior to entrance, must pursue the same studies during the first year; the course of instruction being designed to give a broad fundamental knowledge of the principles underlying the applied sciences. Specialized instruction leading to a specified vocation will be offered only to those students who, in the first year, give satisfactory evidence of their capacity to pursue the more advanced studies outlined in the second and third years of the curriculum." Students must be at least 16 years and pass satisfactory examinations in at least three of the following subjects: English—ability to express thought in clear, concise and accurate English; mathematics—arithmetic and algebra as far as quadratics; science—elementary physics or chemistry; drawing—plane geometry or mechanical drawing. Examinations will be held in Pittsburg on October 14."

TELEGRAPHY IN KOREA.—A recent bulletin of the Department of Commerce and Labor gives in full the text of the agreement between the governments of Japan and Korea, whereby the postal, telegraphic and railway systems of Korea are transferred to the control of the Japanese government.

CONDENSER LIGHTNING ARRESTER.—A patent issued June 27 to Mr. T. J. Johnston disclosed a lightning arrester system involving the use of a condenser. The inventor proposes to use a number of substantial cylinders, of a good conducting metal, insulated from each other and having their surfaces brought into proximity without contact, so as to form a series of spark-gaps extending from one line to the other. The central cylinder is connected to ground through a suitable high resistance. In shunt to the series of gaps is placed a condenser, the purpose of which is stated to be to deflect the current from the arc between the spark-gaps in order to render the arc unstable and, to a certain extent, self-interrupting.

MUNICIPAL OWNERSHIP AT LEEDS.—U. S. Consul Hamm sends the following to the Department of Commerce and Labor: "The accounts of the electric department of the Leeds corporation for the financial year ended March 25, 1905, have just been made public. The gross profit amounts to $280,260, against $227,685 in the financial year 1904, but after allowing for interest and redemption there is a surplus of only $1,410, as compared with $17,150 surplus in 1904. The receipts from sales for lighting have increased from $334,075 to $367,985, and the receipts for power from $44,535 to $54,095. No explanation is given as to why the interest and redemption fund was so much larger in 1904-5 than in 1903-4, reducing the net profits to a nominal figure, notwithstanding the fact that the gross profits were over $33,000 larger." It would appear that virtually the plant is running behind.

AMERICAN FLEET AT CHERBOURG.—The American squadron, consisting of the armored cruiser Brooklyn (flagship) and the protected cruisers *Chattanooga, Tacoma* and *Galveston,* which were detached from the North Atlantic fleet and placed under the command of Rear Admiral Sigsbee to escort to the United States the remains of Admiral John Paul Jones, arrived at Cherbourg on June 30, where the remains will be embarked. The *Brooklyn* communicated by wireless telegraphy with the Hamburg-American Line steamer *Deutschland,* eastward bound, and with the American Line steamer *New York,* westward bound. Under the management of the Bureau of Equipment, interesting experiments were made in wireless telegraphy, various types of receivers being installed on board the *Brooklyn.* A message from Cape Cod was received 1,040 miles at sea, although the weather conditions were not favorable.

GERMAN ELECTRICAL GOODS AND TREATIES.—The Association for Protecting the Interests of German Electro-Technics, at its annual meeting May 2, 1905, at Berlin, adopted a resolution as follows: This association notes the results obtained in our new commercial treaties with Switzerland, Italy, Servia and Roumania, which lead us to presume that the exportation of German electrical products thither will maintain its volume as heretofore. The association, however, deplores the very considerable tariff increases made by Austria-Hungary, and the prohibitive character of the most important tariff schedules of Russia, in whose markets German dynamos, electric motors and cables will henceforth have no sales. The total German exportation to Russia will be diminished by one-third. The association urgently requests the German Federal and State authorities to use all efforts for making up for this diminished exportation by getting better terms in the treaties to be negotiated. It is to be borne in mind that during late years numerous and extensive electrical manufactories have been established in various countries, and these, working under more favorable conditions, have either made it very difficult for us to compete with them or threaten to tie us up altogether in the near future." According to this, remarks U. S. Consul General Guenther, the future offers opportunity for American electrical enterprise in many European countries where hitherto the Germans have dominated. The manufacturers of the United States have decidedly superior advantages in many ways over German manufacturers, but can only make them available abroad by personal effort and business tact

Electrical Engineers of the Times.—XVII.

WALTER F. WELLS.

Walter Farrington Wells was born in Rahway, N. J., January 10, 1870. He attended the public and high schools of that town, the Pingry Preparatory School at Elizabeth, and in 1887 after a course in the Newark Business College took a position as stenographer with the Callander Insulating & Waterproofing Company of New York, and later with the Pullman Palace Car Company in its Jersey City office. Having decided to take up the electrical profession, he prepared for entrance to Rutgers College, in which he matriculated September, 1890. There he followed a special course in electrical engineering, higher mathematics, chemistry, etc., with the class of 1892.

In August of the same year he became connected with the Edison Electric Illuminating Company, of Brooklyn, occupying successively positions as draughtsman, foreman and assistant electrician, and in June, 1894, was made electrical superintendent. In addition to the regular operating and construction work on the Edison low-tension system, his duties at that time included the installation of the 2,400-volt polyphase system and remodeling the old series arc system on a modern basis. In April, 1897, he accepted the position of assistant general manager of the Manhattan Electric Light Company, with full charge of the technical departments. This position he held until in 1900 the company was merged with the New York Edison Company, when he became one of the district superintendents of the operating department of the latter company. In June, 1899, he was appointed superintendent of the Mt. Morris Electric Light Company and continued to act as such for about a year. In 1898 when the Edison Company made its first installation of rotary converters, transformers, etc., for 6,600-volt transmission, the direction of the work was assigned to Mr. Wells. He also co-operated in the preparation of the plans and superintended the installation of the electrical plant at the Waterside station of the company at 38th Street and East River. Upon the completion in October, 1901, of this station, which is to-day the largest electric light plant in the world, Mr Wells was appointed superintendent in general charge of the operation of the station.

WALTER F. WELLS.

Upon the recent death of Mr. F. A. Leslie, vice-president and general manager of the Edison Electric Illuminating Company of Brooklyn, the position of general superintendent was created and Mr. Wells appointed to discharge its duties. This office will have supervision over all the operating and construction departments of the Brooklyn company.

Mr. Wells has contributed several papers on subjects connected with the operation of large power plants to the Transactions of the Association of Edison Illuminating Companies and to the National Electric Light Association. He has also taken part in the discussions and has shown a ready and remarkably strong grasp of the problems arising in connection with the newer development of the central station art. He is an associate member of the American Institute of Electrical Engineers.

Transmission of Power from Niagara to Toronto.—II.

(Concluded.)

THE tops of the three pins that carry the insulators for each three-phase circuit are at the corners of an equilateral triangle (Fig. 7), each of whose sides measures six feet. The six steel insulator pins used on each tower are exactly alike, and each is swaged from extra heavy pipe. Each finished pin is 2⅜ in. in diameter for a length of 3¼ in., and then tapers uniformly to a diameter of 1⅛ in. at the top through a length of 11½ in This gives the pin a total length of 14¾ in. In the larger part there are two 9-16 in. holes from side to side, and within two inches of the top there are three circular grooves each 3-16-in. wide and 1-16-in. deep. Forged steel sockets of two types are employed to attach the steel pins with the pipes. Each socket is made in halves, and these halves are secured to both the pipes and the pins by through bolts. Like all other parts of the towers these steel pins and sockets are heavily galvanized. On each of the four corner bars of a tower the lower six feet of its length is secured to the upper part by bolts. This lower six feet of each corner bar is embedded in the earth, and the construction just named makes it easy to replace the bars in the earth when corrosion makes it necessary.

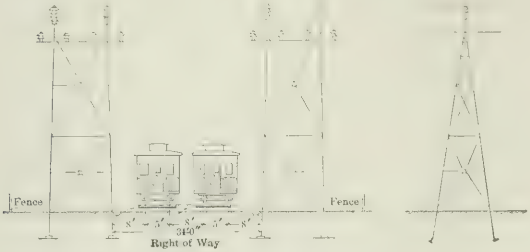


FIG. 7.—STEEL TOWER FOR TRANSMISSION LINE.

Footings for each tower were provided by digging four nearly square holes with their sides at approximately 45 degrees with the direction of the transmission line, and the shortest side of each hole at least two feet long. Centers of these holes are 14 ft. 3 in. apart, in a direction at right angles to the line, and 13 ft. 9 in. apart, parallel with the line. In hard pan each one of the holes was filled to within 2 ft. 6 in. of the top with stones, after the leg of the tower was in position, and then the remainder of the hole was filled with cement grouting mixed four to one.

At the bottom of each hole in marsh land a wooden footing 3 ft.x 6 in.x24 in. was laid flat beneath the leg of the tower, and then the hole was filled to within 2½ ft. of the surface with the excavated material. Next above this filling comes a galvanized iron gutter pipe, 4 in. in diameter, and filled with cement about the leg of the tower for a length of two feet. Outside of this pipe the hole is made rounding full of cement grouting.

At some points along the transmission line exceptionally high towers are necessary, a notable instance being found at the crossing over the Welland Canal, where the lowest part of each span must be not less than 150 feet above the water. For this crossing two towers 135 ft. high above ground are used, as seen in Fig. 8.

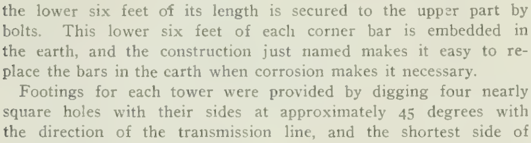


FIG. 8.—TRANSMISSION LINE AT WELLAND CANAL.

Each of these towers is designed to carry all four of the three-phase power circuits that are eventually to be erected between Niagara Falls and Toronto. For this purpose there was used a special design of tower with a width of about 48 ft. at right angles to the direction of the line below the top truss, and a width of about 68.5 ft. at that truss where the two lower conductors of each circuit are attached.

With all spans longer than 400 ft. a tower of heavier construction than the standard type is used, and this tower provides three insulators for the support of each conductor. A tower of this type that supports the lowest conductors about 40 ft. above the ground level has its corner bars made up of 4-in.x4-in.x⅜-in. and 4-in.x4-in.x5-16-in. L sections, has three cross-arms of extra heavy 4-in. pipe, and a 6-in. vertical standard pipe to support each group of three insulators for the highest conductor of each circuit. Each of the lower conductors of a circuit on this tower is supported by an insulator on each of the three parallel cross-arms. On some of these towers, for long spans, the two outside insulators for the support of each conductor are set a little lower than the insulator between them.

Angle towers, used where the line makes a large change in direction at a single point, have three legs on each rectangular side, a width of 20 ft. on each of these sides for some distance above the ground, and a width 27 ft. 2 in. at the top. In these towers the two legs on the triangular side that is in compression are each made up of four 3-in.x3-in.x¼-in. L sections, joined by 1½-in.x ¼-in. lattices and rivets. Towers of this sort are used near the Toronto terminal station, where the line changes 35 degrees at a single point, and near the crossing of Twelve Mile Creek, where the angular change of the line on a tower is 45 degrees. Close to each terminal station and division house the transmission line is supported by terminal towers. These towers differ from the others in that each carries insulators for only three conductors, and these insulators are all at the same level. Each terminal tower has nine insulators, arranged in three parallel rows of three each for the conductors of a single circuit, and each conductor thus has its strain distributed between three pins. All three wires of a circuit are held 40 feet above the ground by a terminal tower, and pass to their entries in the wall of a station at the same level. As these terminal towers must resist the end strain of the line they are made extra heavy, the four legs each being made up of 4-in.x4-inx 5-16-in. and 4-in.x4-in.x⅜-in. L sections. For the three cross-arms on one of these towers three pieces of 4-in. pipe, each 15 ft. 9 in. long, are secured at its top with their parallel center lines 30 in. apart in the same plane. Each of these pipes carries three insulator pins with their centres 7 ft. 4½ in. apart. On the bottom of each leg of a terminal tower there is a foot, formed by riveting on bent plates, that measures 15 and 18 in., respectively, on its two longer sides. Each foot of this tower is set in a block of concrete 5 feet square that extends from 3.5 ft. to 7.5 ft. below the ground level.

Insulators for the transmission line, which are illustrated in Fig. 5, are of brown, glazed porcelain, made in three parts, and cemented together. The three parts consist of three petticoats or thimbles, each of which slips over or into one of the others, so that there are three outside surfaces and three interior or protected surfaces between the top of an insulator and its pin.

From top to bottom the height of each insulator is 14 in., and this is also the diameter of the highest and largest petticoat. The next or middle petticoat has a maximum diameter of 10 in., and the lowest petticoat one of 8 in. Cement holds the lowest petticoat of the insulator on one of the steel pins previously described, and in this position the edge of the lowest petticoat is about 2½ in. from the steel support. At the top of each insulator the transmission conductor is secured, and the shortest distance from this conductor to any of the steel parts through the air is about 17 in.

From the step-up transformer house at Niagara Falls to the terminal station at Toronto, a distance of 75 miles, each three-phase, 60,000-volt, 25-cycle circuit on the steel towers is made up of three hard-drawn copper cables with a cross section of 190,000 circular mils each, and is designed to deliver 10,000 electric horsepower. Six equal strands of copper make up each cable, and this wire has been specially drawn with an elastic limit of more than 35,000 pounds, and a tensile strength of over 55,000 pounds per square inch. This cable is made in uniform lengths of 3,000 ft., and these lengths are joined by twisting their ends together in copper sleeves, and no solder is used. No insulation is used on these cables

Instead of a tie wire a novel combination of clamps is employed to secure the copper cable on each insulator. This clamp is made up of two separate clamps that grasp the cable at opposite sides of each insulator, and of two half circles of hard-drawn copper wire of 0.187 in. diameter. Each half circle of this wire joins one-half of each of the opposite clamps, and fits about the neck of the insulator just below its head. Two bronze castings, one of which has a bolt extension that passes through the other, and a nut, make up each separate clamp. When the combined clamp is to be applied as quickly as a tie wire, is very strong, and does not cut side are separated by removing the nut that holds them together, the half circles are brought around the neck of the insulator and each of the side clamps is then tightened on to the cable by turning the nut that draws its halves together. This complete clamp can be applied as quickly as a tie wire, is very strong and does not cut into the cable.

Each of the regular steel towers is designed to withstand safely a side strain of 10,000 pounds at the insulators, or an average of 1,666 pounds per cable. With the 190,000 mil cable coated to a depth of ½-in. with ice and exposed to a wind blowing 100 miles per hour, the estimated strains on each steel pin for different spans and angular changes in the direction of the line are given in the accompanying table:

POUNDS STRAIN ON PINS, ½-IN. SLEET, 100 MILES WIND.

Span Feet.	Degrees and minutes 0	0.30	1	1.30	2	2.30	3	3.30	4	4.30	5	5.30	6
0	0	35	69	104	138	173	207	242	276	311	345	380	414
100	256	291	325	360	394	429	463	498	532	567	601	636	670
200	512	547	581	616	650	685	719	754	788	823	857	892	926
300	768	803	837	872	906	941	975	1010	1044	1079	1113	1148	1182
400	1024	1059	1093	1128	1162	1197	1231	1266	1300	1335	1369	1404	1438
500	1280	1315	1349	1384	1418	1453	1487	1522	1556	1591	1625	1660	1694
600	1536	1571	1605	1640	1674	1709	1743	1778	1812	1847	1881	1916	1950
700	1792	1827	1861	1896	1930	1965	1999	2034	2068	2103	2137	2172	2206
800	2048	2083	2117	2152	2186	2221	2255	2290	2324	2359	2393	2428	2462
900	2304	2339	2373	2408	2442	2477	2511	2546	2580	2615	2649	2684	2718
1000	2560	2595	2629	2664	2698	2733	2767	2802	2836	2871	2905	2940	2974

The copper cables were so strung as to have a minimum distance from the ground of 25 ft. at the lowest points of the spans. In order to do this the standard steel towers that hold the lower cables 40 feet above the ground level at the insulators are spaced at varying distances apart, according to the nature of the ground between them. At each tower the upper cable of each circuit is 5 ft. 3 in. higher than the two lower cables, and this distance between the elevations of the upper and the lower cables is maintained whatever the amount of sag at the center of each span. If there is a depression between two standard towers on a straight portion of the line the sag in the center of a span 400 ft. long may be as much as 18 ft. Where a rise and fall in the ground between towers makes it necessary to limit the sag to 14 ft. in order to keep the lowest cables 25 ft. above the highest point of earth, the length of span is limited to 350 ft. If the rise and fall of ground level between towers allows a sag of only 11 ft. with the lowest cable 25 ft. above the earth, the length of span with 40-ft. towers is reduced to 300 ft., and if for a like reason the sag is limited to 8 ft. the span may only be 250 ft.

At each terminal tower, where the cables are secured before they pass into a terminal station, the three insulators for each cable are in a straight line with their centers 30 in. apart. When a line cable reaches the first insulator of the three to which it is to be attached on one of these towers it is passed around the neck of this insulator and then secured on itself by means of two clamps that are tightened with bolts and nuts. See Fig. 9. The cable thus secured turns up and back over the tops of its three insulators and goes to the terminal station. Around the neck of the insulator to which the line cable has been secured in the way just outlined a short detached length of the regular copper cable with the parts of a turnbuckle at each end is passed, and this same piece of cable also passes around the neck of the next insulator in the series of three. By joining the ends of the turnbuckle and tightening it, a part of the strain of the line cable in question is transferred from the first to the second insulator of its series. In the same way a part of the strain of this same line cable is transferred from the second insulator of the series to the third or one nearest to the terminal station.

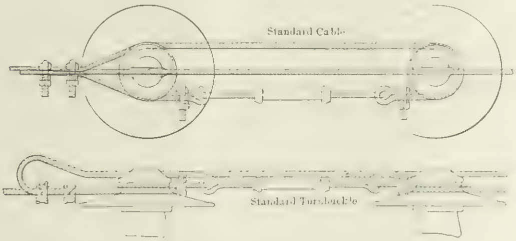


FIG. 9.—TAKE-UP ARRANGEMENT ON TERMINAL TOWER.

From its insulators on a terminal tower each line cable passes to an insulator at the same level on a steel bracket outside of the terminal station. After leaving this insulator on the bracket the line cable turns up and goes through a bushing set in the bottom of a metal box or hood that is fixed on the outside of the terminal station above the steel bracket, as shown in Fig. 10. Having reached the inside of this metal hood the line cable makes another right-angle turn and goes through the center of a 40-in. by 30-in. opening in the brick wall of the terminal station. At the center of this square opening the line cable is supported by one of the porcelain insulators regularly used outside. The hood just mentioned is made of expanded metal covered with cement.

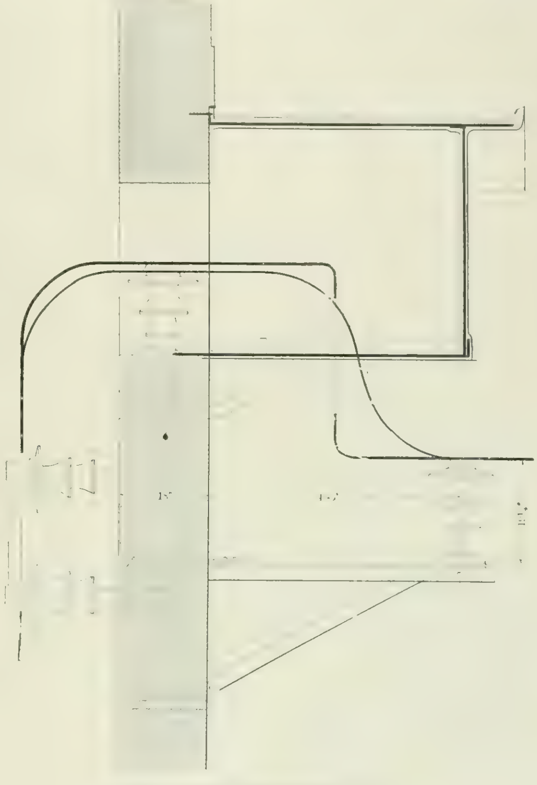


FIG. 10.—CABLE ENTERING BUILDING.

From the line cable to the steel socket of the pin on the bracket the shortest distance through the air is about 17 in., and this is also the distance from the cable to the metal hood. Between the line cable and the brick wall outside of the metal hood the distance is about 25 in. At the upper outside edge of the hood there is a gutter that prevents the dripping of water on to the insulators and line cables below. Of the two insulating bushings through which a line cable passes to enter the metal hood the inner one has an outside diameter of 3 in. and a length of 24 in., and the outer one a diameter of 1½ in. and a length of 12 in. The three rectangular openings in the brick wall of the terminal station for the entry of the line cables of each 60,000-volt circuit are at the same level, and have their centers 7 ft. 4½ in. apart. From the nearest opening of one circuit to the nearest opening of another circuit in the wall of the Toronto terminal station the distance between centers is 20 ft.

At one or more points on the transmission line there is a division house through which the circuits pass. The object of this division house is to make easy the connection of any circuit between the house and Niagara Falls with any circuit between the house and

Toronto. This is done by means of two sets of three-phase busbars to each of which either circuit may be connected by switches. The scheme of connections is shown in Fig. 11. Each division house includes a pair of duplicate brick buildings joined by a gallery for busbar connections. Into each of these duplicate buildings two of the three-phase circuits pass. Each of these buildings, exclusive of the gallery for busbar connections, measures 58 ft. at right angles to the direction of the transmission line, and 34 ft. parallel therewith, outside, and is 48.5 ft. high. Structural materials in the building are brick, stone, steel and concrete. On each of the longer sides of this division house, and with their centers 12 ft. from it, there are two of the 40 ft. steel terminal towers previously described.

The present portion of the complete division house provides for two of the three-phase circuits, and when the other two circuits are erected the remainder of the division house will be built. For this remainder the brick building will be exactly like the one just named, and the two buildings will be connected by a busbar gallery of steel and masonry 34 ft. long. In this gallery there will be sectional switches by which each of the six busbars in the two three-phase sets can be divided.

Each line cable entering at one side of the division house connects through one knife switch with a bank of lightning arresters, and through another knife switch with one pole of a three-phase oil switch. From this same pole of the oil switch a cable runs to the corresponding pole of another oil switch that connects through a knife switch with a line cable that enters on the opposite side of the division house from the cable first named. In this way each line cable may have its connection completed in the division house through two knife switches and two oil switches, without coming into contact with the busbars. When each transmission circuit passes directly through the division house in this way the busbars are entirely out of use. If it is desired to connect that part of a circuit between Niagara Falls and the division house with the part of another circuit between the division house and Toronto, this can be done by joining the two parts of circuits to the same set of busbars through knife switches. By means of such knife switches any cable between two poles of different oil switches in the division house can be connected to one busbar of either of the two three-phase sets.

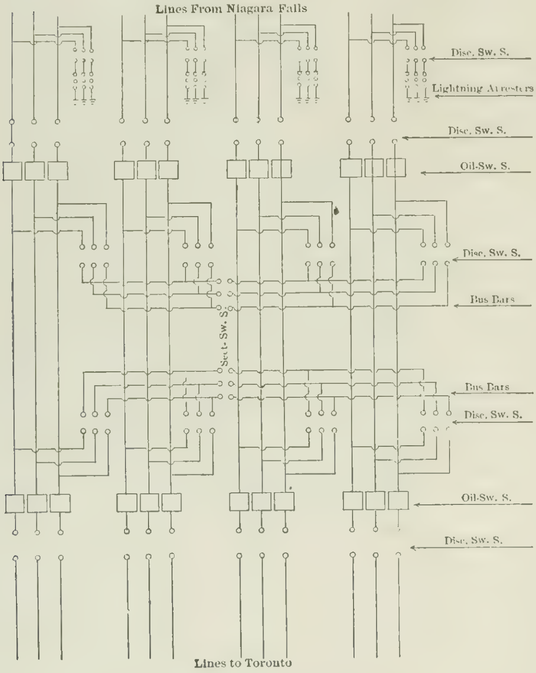


FIG. 11.—CIRCUITS AT DIVISION HOUSE.

On the inside the division house has two rooms in the first story, formed by a 13-in. brick wall at right angles to the direction of the line, and each of these rooms contains one set of busbar compartments. Besides the busbars one of these rooms also contains the lightning arresters. In the upper story of the house the two groups of oil switches stand on a steel and concrete floor.

The Toronto & Niagara Power Company, which is making this first really long transmission of electric energy from Niagara Falls, has for its president Col. H. M. Pellatt, and first vice-president and general manager Mr. Frederic Nicholls. Dr. F. S. Pearson is chief consulting engineer for the company, and Mr. Robert C. Brown is chief electrical engineer. The facts here presented have been collected through the personal kindness of Mr. Nicholls and Mr. Brown.

◆

Single-Phase Induction Regulator.

By B. G. Bergman.

THE single-phase induction regulator is simply a transformer having one coil movable, so that the amount of flux through secondary winding can be varied. The result will be a corresponding change in the voltage induced in the coil.

The regulator is connected to an autotransformer, as shown in Figs. 1 and 2. Therefore, the secondary voltage can be added to or subtracted from the constant volts supplied by the autotransformer, and consequently the desired volt-regulation can be obtained at the motor terminals.

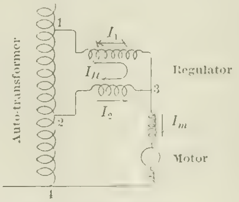


FIG. 1.—REGULATOR IN "OFF" POSITION.

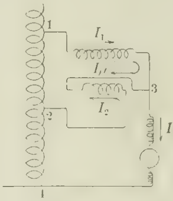


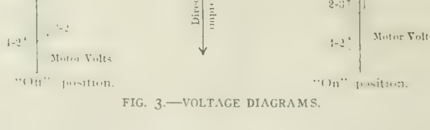
FIG. 2.—REGULATOR IN "ON" POSITION.

The appearance of the induction regulator is similar to that of an induction motor. The design is very similar also. It is to be noted that the primary winding is arranged on the rotary part—this being advantageous for several reasons. There is on the revolving part a short-circuited winding displaced 90 degrees from the primary. The purpose of this winding is to neutralize the self-induction of the secondary, as will be explained later.

The advantage of the induction regulation in addition to the possibility of a perfectly smooth voltage variation without any breaking or closing of the circuit is the avoidance of the heavy losses, which necessarily occur with the regular resistance control used with direct-current equipments.

Losses, although comparatively small, will, of course, take place in the regulator, and as the distribution and variation of these might be of interest, they are also considered.

In Fig. 3 are shown, corresponding to Figs. 1 and 2, the different voltages in their relation to each other, of the whole combination auto-transformer, induction regulator and motor. In these diagrams are not shown the ohmic and self-inductive e.m.f's which have been neglected to avoid complications. These e.m.f's are comparatively small.



"Off" position. "On" position.

FIG. 3.—VOLTAGE DIAGRAMS.

Complete voltage diagrams are given in Figs. 4 and 6.

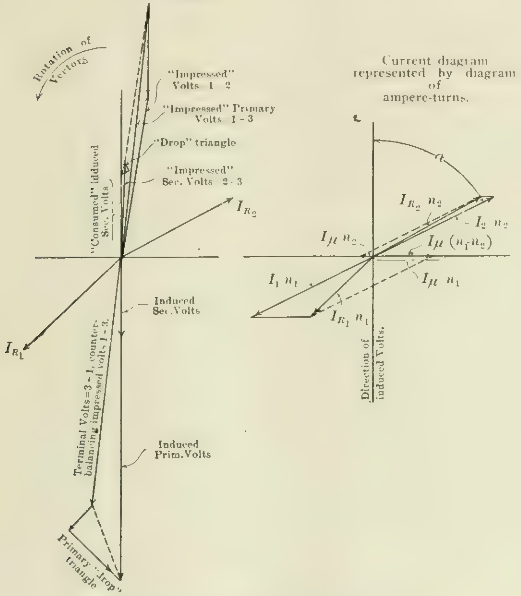
It is evident that the primary of the regulator—having a greater number of turns than the secondary—is always effective in producing magnetization, independently of whether the regulator is "boosting up" or "bucking down." The secondary, on the other hand, is effective for magnetization only in the "boosting up" position.

This is evident from the diagrams of Figs. 1 and 2. The voltage between the points 1 and 2 is always approximately constant and has to be counterbalanced by the total volts induced by the flux in the regulator. This flux is produced in the "off" position by the magnetizing current (approximately the current at no load) in the primary turns minus the secondary turns, while in the "on" position the primary turns plus the secondary turns are effective.

From the above it is seen that the magnetizing current must be larger in the "off" than in the "on" position. The reasons are that in "off" position there are fewer effective turns, the flux is larger, and, therefore, the saturation is higher than in the "on" position.

Higher flux through the iron means necessarily increased iron loss. The heating of the regulator from this source is actually considerably larger in "off" than in "on" position.

The ampere-turns, produced by the load, in the two parts of the regulator must always neutralize each other. This means that the currents, due to the load, must flow in opposite directions in the two windings. (See the diagram of Figs. 1 and 2.)



FIGS. 4 AND 5.—REGULATOR IN "OFF" POSITION.

Hence, when the regulator is in the "off" position, the current from the regulator through the motors must necessarily produce a current in the primary, flowing in direction towards the transformer. This current comes through the secondary and is "circulating" in the transformer and regulator. Hence the total current in the secondary is the motor current plus the "circulating" current. From this, it is evident, that the "circulating" current must have a value such that its magnetizing effect in the primary winding neutralizes the magnetizing effect of the sum of the motor current and itself in the secondary winding.

The above stated facts can be expressed in equations as—

$$I_1 = \frac{n_2}{n_1 - n_2} I_m \tag{1}$$

$$I_2 = I_m + I_1$$

$$\therefore \quad I_2 = \frac{n_1}{n_1 - n_2} I_m \tag{2}$$

where I_μ = magnetizing current,
I_m = motor current,
I_1 = primary current, due to the load;
I_2 = secondary current,
n_1 = primary turns,
n_2 = secondary turns.

On the other hand, when the regulator is in the "on" position, the motor current comes from both the secondary and the primary winding. Therefore,

$$I_1 = \frac{n_2}{n_1 + n_2} I_m \tag{3}$$

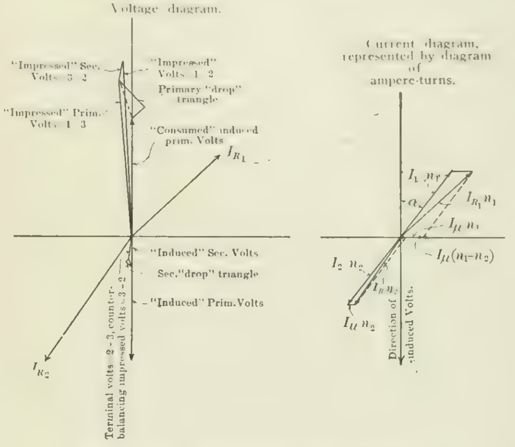
and

$$I_2 = \frac{n_1}{n_1 + n_2} I_m \tag{4}$$

From equations (1), (2), (3) and (4) it is evident that both the primary and secondary load currents are larger in the "off" than in the "on" positions for the same motor current.

As shown above, the magnetizing current also is larger in the "off" than in the "on" position of the regulator.

The summation of the load and magnetizing currents has to be made geometrically, and below are shown the general diagrams for the regulator at "off" and "on" position, by referring to which the general equations for the currents can easily be found. For the "off" position, refering to Figs. 4 and 5, the equations are:


Voltage diagram.
"Impressed" Sec. Volts 3 2
"Impressed" Volts 1 2
Primary "drop" triangle
"Impressed" Prim. Volts 1 3
"Consumed" induced prim. Volts
I_{R_1}
"Induced" Sec. Volts
Sec. "drop" triangle
"Induced" Prim. Volts
I_{R_2}
Terminal volts 2 - 3, counter-balancing impressed volts 3 - 2
Current diagram, represented by diagram of ampere-turns.
$I_1 n_1$
a
$I_{R_1} n_1$
$I_\mu n_1$
$I_\mu (n_1 - n_2)$
$I_2 n_2$
$I_R n_2$
$I_\mu n_2$
Direction of induced Volts.

FIGS. 6 AND 7.—REGULATOR IN "ON" POSITION.

$$\overline{n_1 I_{R_1}}^2 = \overline{I_1 n_1}^2 + \overline{I_\mu n_1}^2 - 2 I_1 I_\mu \, (n_1)^2 \cos (90 - a)$$

$$I_{R_1} = \sqrt{I_1^2 + I_\mu^2 - 2 I_1 I_\mu \sin a} \tag{5}$$

$$\overline{n_2 I_{R_2}}^2 = \overline{I_2 n_2}^2 + \overline{I_\mu n_2}^2 - 2 I_2 I_\mu \, (n_2)^2 \cos (90 - a)$$

$$I_{R_2} = \sqrt{I_2^2 + I_\mu^2 - 2 I_2 I_\mu \sin a} \tag{6}$$

a is approximately the angle of lag of the current in the motor. Regarding other quantities, see previous equations.

For the "on" position, referring to Figs. 6 and 7, the equations are:

$$\overline{n_1 I_{R_1}}^2 = \overline{I_1 n_1}^2 + \overline{I_\mu n_1}^2 - 2 I_1 I_\mu \, (n_1)^2 \cos (90 + a)$$

$$I_{R_1} = \sqrt{I_1^2 + I_\mu^2 + 2 I_1 I_\mu \sin a} \tag{7}$$

$$\overline{n_2 I_{R_2}}^2 = \overline{I_2 n_2}^2 + \overline{I_\mu n_2}^2 - 2 I_1 I_\mu \, (n_2)^2 \cos (90 - a)$$

$$I_{R_2} = \sqrt{I_2^2 + I_\mu^2 - 2 I_1 I_\mu \sin a} \tag{8}$$

a is approximately the angle of lag of the current in the motor.

Referring to equations (1), (2), (3) and (4), the last equations, (5), (6), (7) and (8) can also be written for "off" position:

$$I_{R_1} = \sqrt{\left(\frac{n_2}{n_1 - n_2} I_m\right)^2 + I_\mu^2 - 2\left(\frac{n_2}{n_1 - n_2} I_m\right) I_\mu \sin a} \tag{9}$$

$$I_{R_2} = \sqrt{\left(\frac{n_1}{n_1 - n_2} I_m\right)^2 + I_\mu^2 - 2\left(\frac{n_1}{n_1 - n_2} I_m\right) I_\mu \sin a} \tag{10}$$

For "on" position:

$$I_{R_1} = \sqrt{\left(\frac{n_2}{n_1 + n_2} I_m\right)^2 + I_\mu^2 + 2\left(\frac{n_2}{n_1 + n_2} I_m\right) I_\mu \sin a} \quad (11)$$

$$I_{R_2} = \sqrt{\left(\frac{n_1}{n_1 + n_2} I_m\right)^2 + I_\mu^2 - 2\left(\frac{n_1}{n_1 + n_2} I_m\right) I_\mu \sin a} \quad (12)$$

A comparison of these equations shows that the resultant current in the secondary will in general be larger in "off" than in "on" position. This is also the case with the primary resultant current at heavy load, i. e., when I_μ is very small in comparison with I_m. If the ratio $\frac{n_1}{n_2}$ is small, the difference between the currents at "off" and "on" position will be especially great.

In case of a non-nnductive load the resultant currents will in both windings always be larger at "off" than at "on" position of the regulator.

For getting a somewhat clearer idea about the values of the currents in relation to each other at "off" and "on" position, and about the influence of the magnetizing current, some data, approximately corresponding to practice, might be used in the equations developed above.

Assume a regulator of 40 kw capacity, ratio $\frac{n_1}{n_2} = 9$; maximum "boosting up" volts = 50 = secondary volts; primary volts = $9 \times 50 = 450$; primary full load current $= \frac{40,000}{450} = 89$ amperes.

The magnetizing current at "on" position can be assumed to be 20 per cent of the full load primary current.

$\therefore\ I = 17.8$ amps. = approximately 18 amps.

The magnetizing current at "off" position is, therefore, approximately (assuming a constant permeability):

$$I_{\mu \text{ "off"}} = \left(\frac{10}{8}\right)^2 I_{\mu \text{ "on"}} = 28 \text{ amps.}$$

Assume a motor load of 1,400 amps. At starting the power factor is very low—about 15 per cent. Hence in the equations for "off" position, $\sin a$ is practically equal to 1. Thus:

$$I_{R_1} = \frac{1}{9-1} 1,400 - 28 = 147 \text{ amps.}$$

$$I_{R_2} = \frac{9}{9-1} 1,400 - 28 = 1,547 \text{ amps.}$$

When "full on" position is reached the power factor has generally a value between .60 and .80. At a load of 1,400 amps. the power factor may be assumed to be .80. Hence,

$$I_{R_1} = \sqrt{\left(\frac{1}{10} 1,400\right)^2 + (18)^2 + 2 \times \frac{1}{10} \times 1,400 \times 18 \times .60}$$
$$= 151 \text{ amps.}$$

$$I_{R_2} = \sqrt{\left(\frac{9}{10} 1,400\right)^2 + (18)^2 - 2 \times \frac{9}{10} \times 1,400 \times 18 \times .60}$$
$$= 1,250 \text{ amps.}$$

At a motor load of 1,800 amps. the results are, for "off" position:

$$I_{R_1} = 197 \text{ amps.}$$

$$I_{R_2} = 1,997 \text{ amps.}$$

For "on" position, assuming the power factor to be .70:

$$I_R = 193 \text{ amps.}$$

$$I_{R_2} = 1,610 \text{ amps.}$$

The motor load being 2,200 amps., the resultant currents are, at "off" position:

$$I_{R_1} = 247 \text{ amps.}$$

$$I_{R_2} = 2,447 \text{ amps.}$$

And at "on" position, with a power factor of .60:

$$I_{R_1} = 234 \text{ amps.}$$

$$I_{R_2} = 1,967 \text{ amps.}$$

From the above given examples it is clear that at heavy load the currents through the regulator are largest in "off" position, which is also the case with the magnetization, as stated above.

Therefore, it can be said, that at heavy load, when starting, the heating is worse at "off" than at "on" position in all parts of the regulator. The same is the case also at lighter load, if the power factor is very high—as when running at great speed. Generally, the losses in the iron and in the secondary copper are larger in "off" than in "on" position.

As is shown before, the ratio $\frac{n_1}{n_2}$ has a great influence on the distribution and the values of the currents in the regulator.

Two cases might be considered. One in which the effective ratio $\frac{n_1}{n_2}$ is varied, although the actual number of primary and secondary turns, remains unchanged, and another in which the ratio $\frac{n_1}{n_2}$ is varied by changing the design of the regulator.

In the first case, when the regulator is turning, the magnetic axes of the windings get deviated from each other, the total useful flux in the regulator does not go through the secondary winding, but only a part of it: The result is a change in the induced secondary voltage, just as though n_2 were varied.

As in the deviated positions, however, only a part of the magnetizing effect of the secondary can be neutralized by the primary ampereturns, there should be produced by the other part a flux, which at 90 degrees deviation would be due to the whole magnetizing effect of the secondary turns and the total motor current. Hence, the result would be a considerable self-inductive drop in the secondary and consequently a very low power factor.

For avoiding this effect the regulator is provided with short-circuited windings, displaced 90 degrees from the primary. It is evident that in these turns will be set up currents which will almost entirely neutralize the effect of these secondary ampereturns, which are not counterbalanced by the primary ampere-turns. These short-circuited turns will be seats for additional losses, which can be kept low only by making the resistance as low as possible. At a deviation of 90° these losses will evidently obtain a maximum, which will show up as a hump on the loss-curve.

According to the above developed equations it is clear that a reduction of n_2 means on the "off" side a decrease, and on the "on" side an increase of heating for the same motor current.

The second case, where the design of the regulator is changed, is of interest in several respects. Suppose that the regulator to be used must "boost up" at "full on" a certain number of volts, and that its secondary winding has to be connected to a certain tap on an auto-transformer. It is evident that with increasing ratio $\frac{n_1}{n_2}$ the voltage across the primary must be raised. Further, at any certain motor current, the current in the secondary will increase with $\frac{n_1}{n_2}$; hence, there will be needed a larger regulator. But at "off" position the current and, consequently, the losses in the regulator, will decrease with increasing $\frac{n_1}{n_2}$, and very considerably, when the ratio $\frac{n_1}{n_2}$ is low.

With increasing $\frac{n_1}{n_2}$ the regulator must be larger, but the auto-transformer can be made correspondingly smaller. This is clear, as the high-voltage terminal to the regulator will be moved to points of higher voltage. Increasing the size of the regulator and correspondingly decreasing the size of the auto-transformer means, however, at "on" positions poorer efficiency of the system, as the regulator necessarily is a less efficient apparatus than the auto-transformer. At "off" position, on the other hand, the efficiency will be better according to what is shown above.

The ratio $\frac{n_1}{n_2}$ will also greatly affect the range of volts between "pull off" and "pull on" positions. The voltage range is

$$n_2 \epsilon + n_2 \frac{n_1 + n_2}{n_1 - n_2} \epsilon = \frac{2 n_1}{n_1 - n_2} n_2 \epsilon,$$

where ϵ = volts per turn in the regulator at "full on" position.

From this equation it is evident that for $n_1 = n_2$ the voltage range is theoretically infinite (practically it is, of course, greatly depending upon the ohmic and self-inductive drop), and for $n = \infty$, the range is two times the maximum "boosting up" voltage.

Hence, the main advantages and disadvantages of an increasing of the ratio $\frac{n_1}{n_2}$ are, briefly, as follows:

Advantages:

At "off" position less liability to overheating and better efficiency. The larger part of the motor current will be secured through the good stationary contact of the secondary. The moving contact device for the primary will require smaller dimensions.

Disadvantages:

With the higher voltage more insulation necessary and increased liability to trouble. At "on" position poorer efficiency of the system. At "off" position less "bucking down," hence less range of voltages for the motor control, the same range to be obtained only by a sacrifice of the efficiency.

Therefore, regarding the choice of the ratio $\frac{n_1}{n_2}$, it seems advantageous for a service with long runs to have a relatively low ratio, $\frac{n_1}{n_2}$, giving good efficiency of "on" position, which in that case is by far the most important. On the other hand, for a service with frequent starting, a higher ratio, $\frac{n_1}{n_2}$, seems preferable as giving good efficiency for the whole starting period.

In this connection might be mentioned the advantage of connecting the primary of the regulator to that terminal of the secondary which is next to the motors, instead of to the terminal nearest to the auto-transformer. With the same "boosting up" volts and the same motor load, the advantages are the same as with an auto transformer in comparison with a regular transformer, i. e., less weight, less losses, better efficiency, less drop and better power factor. Also, as shown above, the range of volts is generally considerably larger, it being in the other case only twice the "boosting up" volts.

Finally, it might be noted that the field for the induction regulator is apparently limited to heavy locomotives as for freight service, because practice has shown that for motor cars a far more efficient and sufficiently smooth speed control can be obtained simply by direct switching to a few taps on the auto-transformer.

◆

Electrolytic Production of Fine Wire.

In the *Comptes Rendus* H. Abraham reports that he has succeeded in preparing very fine and uniform wires by the partial decomposition of a wire in an electrolytic tank. The diameter of the wire is controlled by measuring its resistance, and for this purpose it is attached to metallic rods at both ends. It hangs in the liquid, which does not touch the rods. The solution must be very dilute, and the action slow. The resistance is concentrated in the immediate neighborhood of the wire. The author uses distilled water containing a few thousandths of its weight of copper sulphate for copper wires, or silver nitrate for silver wires. The current employed is about 10 milliamperes per square centimeter of surface of the wire. It must be reduced as the wire becomes thinner. This current intensity allows time for the products of electrolysis to diffuse through the electrolyte. The resistance then keeps highest at the thinnest portions of the wire, and thus regulates the process of solution. The breaking stress of the wire is inversely proportional to its resistance.

The Supply of Electric Power to London.

BY A. BRITTON.

WHATEVER the year 1905 may produce in the matter of electrical legislation in England, it will long be remembered on account of the magnitude of the proposals for the distribution of power by electricity which were submitted to Parliament. Electrical engineers in the United States appear to be so well accustomed to the erection of immense power stations that they may not be concerned to hear of a proposal to build a station which will produce some 80,000 hp when in full working; but to those who are concerned with electricity in England, this is an event of no mean importance.

That the distribution of power by electricity "in bulk" in England is advantageous to the community was clearly recognized in 1900. For the benefit of American readers of the ELECTRICAL WORLD AND ENGINEER it may be mentioned that all great schemes which involve the acquisition of power to purchase land compulsorily and to practice any kind of monopoly, are submitted to committees of both houses of Parliament, and must be sanctioned by an act of Parliament before they can become law. At the hearing before the committees every scheme is fully gone into, and evidence for and against it is heard on oath. In 1900 four important bills for the distribution of power came before a committee of the House of Commons presided over by Sir James Kitson. These were the County of Durham Electric Power Supply, the Tyneside Electric Power, the Lancashire Electric Power, and the South Wales Electrical Power distribution. The bills were all opposed by local authorities, many of whom were authorized distributors of electrical energy used mainly for lighting purposes. After much evidence had been given the following announcement was made: "The chairman said he wished to state on behalf of the committee that the value of electrical energy as a means of distributing power had been amply demonstrated, and its importance to industries in this country admitted. The committee felt that it was to the public advantage to facilitate measures which would insure a general supply of electrical power to all consumers who might seek to avail themselves of the economy and efficiency offered in the service of these sources of the application of the power. The committee, therefore, did not require the constant repetition of scientific evidence to prove that which had already been proved to their satisfaction." As the result of their deliberations the committee declared the principle upon which they were ready to pass these power bills; and the principles underlying all the power bills above mentioned which have been passed in recent years were thus enunciated by the chairman of the committee above mentioned.

1. The company to be authorized to supply electrical energy for power purposes anywhere within the area of supply, subject to the consent of the local authority in certain cases as set out below.

2. The company to have no general lighting powers, i. e., distribution to ordinary consumers within the area, except in pursuance of a provisional order obtained in the ordinary way.

3. Where a local authority is now authorized to supply electricity within the area their consent is to be required for the supply of electricity by the company, the Board of Trade to be empowered to override the refusal of the local authority to give consent, if the local authority is not prepared to provide the requisite supply on reasonable terms within a reasonable time.

4. Any local authority which hereafter acquires statutory powers for supplying electricity within the area to have in ordinary cases the option of taking over the company's supply in its local area on terms to be laid down by the provisional order or act by which the statutory powers are given.

5. A company having statutory powers to be in the same position as a local authority now having statutory powers; a company to whom powers are hereafter granted to be placed in the same position as a local authority to whom statutory powers are hereafter granted.

Engineers were not slow to realize that the system of power distribution from large central generating stations was capable of extension, and in the present year a proposal has been made for the supply of electricity on a vast scale to London. Having regard to the large area which the promoters of this undertaking who are known as the Administrative County of London & District Electric Power Company hope to control, and to the magnitude of the supply which they hope to furnish, it may be of interest to American engineers to draw attention to some of the clauses in the bill which are designed to make proper allowance for vested interests and undermine opposition. At the time of writing (June 16, 1905) the bill has already been sanctioned by the House of Lords Committee, and there is every reason to think that it will eventually meet with the approval of both houses of Parliament and become law before the close of the present session.

Before dealing with the clauses of the bill and in order to appreciate the difficulties which it is designed to overcome, it is necessary to remember that the County of London is divided up into a number of administrative districts in many of which the local authorities have at present a monopoly of the supply of electricity. In other districts the supply is in the hands of private companies, acting, of course, under statutory authority. It would be possible, but it would not be equitable, for Parliament to step in and allow a new company to deprive these authorities and companies of all their existing powers and profits, and the new company has been compelled to bring forward proposals which will make due allowance for these vested interests.

The following economic facts go a long way toward showing that there is room for improvement and sufficient scope for the development of a large organization. Many of the existing stations are on inconvenient sites, such as Regent Street, Bond Street and Kensington, to which there are no facilities for the cheap transport of coal, and where it is impossible to obtain a supply of water for condensing purposes. The average capacity of the present stations in London is under 4,000 hp, while the capital outlay upon these stations amounts to about £1,000,000 per annum. It has been shown that no less than 93 per cent of the revenue of these bodies is derived from the supply of electricity for lighting purposes, while supply for power is often given at or below cost price. In other cases the price—2d per unit—for power is too high to admit of its being freely used by manufacturers. It has also been proved that the total amount of power supplied by the existing authorities and companies is only 4 per cent of the total power requirements of the district, 16,172 hp being supplied out of a total of 456,000 hp which is at present used in London in the course of the year. Finally, it may be mentioned that the average price of electric current in London at the present time, according to the latest returns of the Board of Trade, amounts to 3.57d (6½ cents) per unit, while the total cost of production amounts to slightly over 2d (4 cents) per unit.

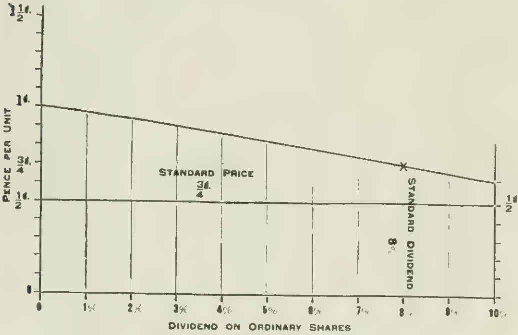


DIAGRAM SHOWING RELATION BETWEEN AVERAGE PRICE PER UNIT OBTAINED AND DIVIDEND PAYABLE. (IF AVERAGE PRICE OBTAINED EXCEED 1.05D PER UNIT, NO DIVIDEND IS PAYABLE.)

The main object of the new scheme is to obtain power for the purpose of enabling a supply "in bulk" to be given to the existing authorities, who will have the option of continuing to distribute it to individual light and power users. No powers are sought for giving a supply direct to the small private user, provided the authorized distributor (i. e., the existing local authority or company) is willing to do so; but the usual clause is inserted which, in the event of the distributor not being willing to retail sufficiently cheaply, authorizes the Board of Trade to allow the individual user to obtain a supply for power (but not for light) direct from the power company; this, of course, insures that the consumer shall share in the reduced cost of production, and has the further advantage that under it the distributor can be relied on to push business energetically.

The maximum prices authorized by the bill are said to be lower than those obtainable in any other great city in the world. There is a sliding scale based upon the number of hours of daily use, running as low as 6/10 of a penny per unit. The standard price upon which the sliding scale is based is ¾d per unit, and these prices are subject to periodical revision by the Board of Trade. Powers are also sought for supplying apparatus on the hire system, which many local authorities are debarred from doing by the Local Government Board owing to the speculative nature of this work. It forms, however, an important feature in the business of a power company.

We are now in a position to understand some of the clauses which are to be inserted in the bill. By clause 49 the powers of the company for the supply of energy are to be subject to the following provisions:

1. Energy shall be supplied under this act only (*a*) for supply to authorized undertakers; and (*b*) for providing power to any person.

2. The energy supplied to authorized undertakers may be used by them for lighting or other purposes and the energy supplied to any person for power may be used by such person for lighting any premises on any part of which the power is utilized, but save as aforesaid the company shall not supply energy for lighting purposes. Provided that where energy is supplied to any person for power within the area of supply of any authorized distributors the energy used by such person for such lighting purposes shall not in any year except with the consent in writing of the authorized distributors exceed twenty per centum of the total amount of energy supplied to such person and save as aforesaid the company shall not supply energy for lighting purposes.

3. Energy shall not be supplied under this act by the company (except to authorized undertakers or to the proprietors or trustees of any railway, tramway or water works or of any dock, canal or navigation lawfuly entitled to use energy or to any government department) in any area being at the passing of this act the area of supply of any authorized distributors except with the consent of those distributors, but that consent shall not be unreasonably withheld. If any question arises whether that consent is unreasonably withheld that question shall be determined by the Board of Trade. The consent shall be deemed to be unreasonably withheld if the authorized distributors are not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time and in considering what are reasonable terms and what is a reasonable time the Board of Trade shall have regard to all the circumstances of the case, including among other things the terms upon which and the time within which the company are willing and in a position to give the supply and the fact (if such be the case) that the undertaking of the authorized distributor is liable to be purchased under the principal acts.

By S. 50 (2) in dispensing with any consent the Board of Trade may, if they think fit, impose upon the company such terms and conditions as the board may think necessary for the protection of such distributor and for affording a supply of energy under this act throughout such area and such terms and conditions may at any time be enforced by such distributor in any court of competent jurisdiction, and by S. 50 (4) where the Board of Trade has dispensed with the consent of such distributor the company shall, in respect of the supply of energy for providing power to any person within such area, be subject to the same obligations to afford a supply of energy as the authorized distributors therein, and the board may compel the company to lay all necessary cables.

By Clause 59 the clear profits of the undertaking to be paid as dividend must not exceed 8 per cent on the paid-up capital; but if in any year the average price for energy is less than three farthings per unit the dividend which the company is authorized to pay in that year may be increased in the ratio of one-quarter per centum in respect of every one and a quarter per centum by which the average price charged by the company has been below the standard price. A smaller dividend must be paid if the average price per unit is above the standard price of three farthings, and the company, in a year of plenty, may make good any deficiency in any previous dividends which have fallen below the standard rate of dividend. A further clause provides that at any time after ten years from the passing of the act the Board of Trade may revise the maximum prices contained in the second schedule to the act.

The relation between the standard price and standard dividend can be readily understood by reference to the following table:

The maximum charges to be made for current are as follows:

SECTION 1.

1. The charge to be made by the company to any consumer shall not, in respect of the total units supplied, exceed the rate of one penny and one-half penny per unit.

2. The company shall, if required by the consumer, make such charge by way of a fixed sum per quarter annum not exceeding one pound per quarter per kilowatt of the maximum power required to be supplied, and in addition a sum not exceeding one-half penny per unit for all units supplied to such consumer.

SECTION 2.

Where the company charges any consumer by the electrical quantity contained in the supply given to him, the company shall be entitled to charge him according to the rates set forth in Section 1 of this schedule, the amount of energy supplied to him being taken to be the product of such electrical quantity and the declared pressure of the consumer's terminals; that is to say, such a constant pressure at those terminals as may be declared by the company under any regulations made under this act.

SECTION 3.

Such price shall include:

(*A*) In the case of an authorized undertaker the cost of transforming and converting by the company on the premises of such undertaker three-phase current to such pressure and description of current as such undertaker may reasonably require; and

(*B*) In the case of any person other than an authorized undertaker the cost of transforming by the company three-phase current to such pressure as the Board of Trade may approve as the standard pressure of supply.

We may conclude by giving an outline of the scheme by which the administrative company hopes to fulfil its obligations. They propose to erect three generating stations on the banks of the Thames, at Greenwich, West Ham, and Fulham. Each station will be equipped with turbines of a larger size than any hitherto built. Some idea of how far the principle of concentration is carried may be obtained by contrasting the capacity of one of the proposed stations—90,000 kw—with the average capacity of the existing stations, which is 2,920 kw. The estimated cost of the new station shows a considerable saving over the average cost of the present stations. Here are the figures for one station in detail, which were given in evidence before the House of Lords Committee:

CAPITAL EXPENDITURE.

Land	£40,000
Condensing, conduits, sidings, quays and main foundations	77,000
Iron buildings, chimneys, boilers, piping, auxiliaries and coal handling plant	330,000
Generating plant	195,000
Switch gear and sundries	50,000
Engineering, supervision and contingencies, 10 per cent on all expenditure except land	65,200
Total capital expenditure	£757,200

This represents an expenditure per kilowatt of £8 4s, while the average corresponding figure for existing stations is £51. These figures were shown to be based on *actual tenders*. Economy in capital cost is accompanied by economy in working. Here are the estimates of works costs per Board of Trade unit of electricity generated at the new 90,000-kw station, which are the same except for coal (which is higher) as those to-day being obtained at the Tyneside Company's station at Carville:

Wages	0.0225d
Coal	0.11d
Water, oil, etc	0.0045d
Repairs	0.017d
	0.154d.

This total has to be compared with the 1.1d per unit which is the corresponding average for the existing companies. The saving is due to the fact that coal can be obtained cheaply, wages are kept low by the use of automatic coal-handling plant, stokers, and so on, while the use of large turbines bespeaks economy.

The new company requires a capital of £5,000,000. Should this be insufficient, the names of those connected with the scheme which include Messrs. Baring Bros., are guarantee enough that the sinews of war will not be lacking. Among the names are several associated with the successful Tyneside Power enterprise, which is the best illustration of the benefits of concentration. We may also mention Lord Armstrong, Sir Andrew Noble, Sir Thomas Richardson, Dr. Spence Watson, J. H. Armstrong, James Falconer, J. H. B. Noble, Francis Priestman, Douglas Vickers, P. Wigham Richardson, A. F. Yarrow, Sir George Gibb and J. T. Merz, in addition to a great number of leading London manufacturers, while 250 others have petitioned Parliament in favor of the bill.

◆

Stone Wireless Telegraph System.

The general features of the Stone wireless telegraph system are familiar to our readers through numerous references to the work of the inventor and to the patents granted to him, and detail information concerning the system was given in these columns on October 24, 1903, and September 3, 1904. It is believed, however, that a further description covering the later developments, and dealing especially with the practical features of the apparatus employed, will prove of interest.

As is well known, the distinguishing characteristic of the system is its selectivity. The aim has been to produce sufficiently powerful transmitting apparatus capable of developing simple harmonic electromagnetic waves of a definite frequency, and to devise sufficiently sensitive receiving apparatus to be responsive only to electromagnetic waves of the proper frequency, and to be immune from disturbances of any other frequency. These results are obtained with the aid of resonant circuits. The transmitting circuits are so disposed that the product of the henries and farads in each component circuit corresponds to the desired frequency of vibration according to the familiar law: $f = \frac{1}{2\pi} \frac{1}{\sqrt{LC}}$, while the component circuits at the receiving station are similarly disposed. The particular features of interest reside in the methods pursued for securing the applicability of the above stated law.

A diagram of both the transmitting and the receiving circuits of a station in service is shown in Fig. 1. There are installed ten vertical conductors, each consisting of a cylindrical copper wire. By means of the double-throw switch shown in the diagram, all ten are used as transmitting antenna, while only the outer two are employed with the receiving devices. The change from the one number to the other is dictated by the different requirements of the transmitting and of receiving devices as to the electrostatic and electromagnetic constants of the vertical oscillator.

When the double-throw switch is placed in the right-hand position, the ten vertical wires and the transmitting devices are in circuit. It will be noted that the antenna is in electrical contact with the earth through the secondary of the high-frequency transformers. The capacity of the elevated conductor and the inductance of the secondary coil of the transformer are given values such that their product corresponds to the frequency of electric wave which it is desired to transmit. By varying the active length of the secondary coil, the circuit can be adjusted to any chosen frequency. The primary of the high-frequency transformer is given a current of the proper frequency on account of the condenser, which is placed in series with it across the spark-gap, the initial source of energy being a commercial 5-kw, 60-cycle, 150-volt, alternating-current generator, the e.m.f. of which is stepped up to the potential required to discharge across the air-gap by means of a transformer built after the style of the ordinary induction coil. The condenser referred to above and the primary of the high-frequency transformer are given the proper constants to insure that the current surging through them and across the spark-gap will have the definite frequency corresponding to that of the antenna circuit. The value of this frequency may be changed at will by altering the active length of the primary coil by simply revolving the bobbin to any position desired. (See Fig. 2.)

It has been determined theoretically and verified experimentally that the production of simple harmonic waves of definite frequency without the presence of modifying superposed ripples can best be obtained when the primary (spark gap) circuit and the secondary (antenna) circuit, each separately considered, are adjusted for the desired frequency and the two circuits, though placed so as to be inductively related, are so far separated that their mutual induction modifies but slightly the self induction of each coil.

It will be recalled that the rate of decay of amplitude of vibration in a simple oscillating circuit is largely dependent upon the resistance of the connections, and, in fact, that the current ceases to be oscillatory in character if the resistance is greater than a certain critical value. It is evident, therefore, that for maximum persistence of oscillations the resistance should be kept reasonably small. It is worthy of note that magnetic hysteresis in any core material and dielectric hysteresis of the condenser produce upon the oscillator a damping effect quite similar to that of resistance, and that the cyclic change in the constants of the core and the dielectric may result in the superposition of ripples upon the fundamental electric wave. It is evident, therefore, that the high-frequency transformer must be entirely free from iron, and that much care must be exercised in the construction of the condenser.

A dielectric possessing excellent qualities with reference to hysteresis is found in air. The insulating strength of air alone, however, is far from satisfactory for the condenser at the transmitting station. In building a condenser for a certain capacity at a given voltage, the area of the surface required is an inverse function of the distance separating the plates, which distance is limited by the insulating strength of the dielectric for the operating voltage. It is found that the low insulating strength of air requires such a separation between the plates that at its low specific inductive capacity an enormous area is required for obtaining the capacity demanded for the transmitting condenser. In the early experiments the condensers were rendered fairly compact by inserting a sheet of glass between the plates of the air condenser, not for the purpose of increasing the specific inductive capacity of the medium between the plates, but in order to supply somewhat of insulating strength and to allow the plates to be brought closer together. The condenser thus produced is shown in Fig. 3. It has proved admirably adapted for the purpose intended, but, although very considerably smaller than a pure air condenser of the same capacity, it occupies too much space for commercial service. A satisfactory dielectric for a compact condenser has been found in a mixture of beeswax and resin, of which the insulating strength and specific inductive capacity are high and the dielectric hysteresis is small.

In order to minimize the noise from the discharges across the spark-gap, the gap is completely enclosed in a sound-proof case (see Fig. 2) and is subjected to a forced circulation of air by means of a small motor-driven fan, indicated in Fig. 1.

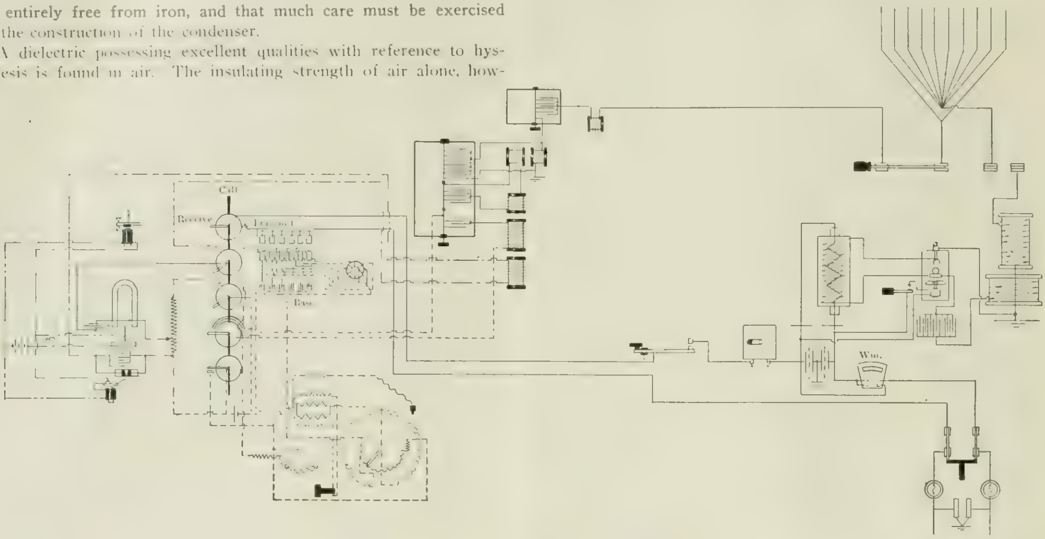


FIG. 1.—DIAGRAM OF TRANSMITTER AND RECEIVER CIRCUITS.

As stated previously, the initial source of energy is a commercial 60-cycle alternator. A view of the power equipment of a transmitting station is shown in Fig. 4. It is interesting in this connection to note the precautions taken to prevent the rupturing of the insulation of the generator by abnormal disturbances. For this purpose there is connected across the terminals of the alternator a condenser of such a capacity that it takes only a small amount of current at the normal frequency of the generator, but will allow to pass readily a very large amount of current at the exceedingly high frequency of any abnormal oscillatory disturbance. The central plate of this condenser is connected to earth, and large capacity protective fuses are connected in its main circuits. As an additional protective device there is placed across the primary of the step-up transformer a spark-gap adjusted to a discharge voltage very much in excess of the e.m.f. of the generator. In the primary circuit there is placed a rheostat for varying the current, and a Morse key switch for interrupting the circuit for the purpose of sending the signals.

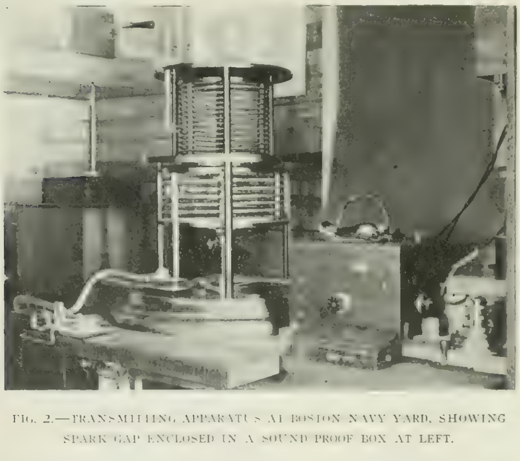


FIG. 2.—TRANSMITTING APPARATUS AT BOSTON NAVY YARD, SHOWING SPARK GAP ENCLOSED IN A SOUND PROOF BOX AT LEFT.

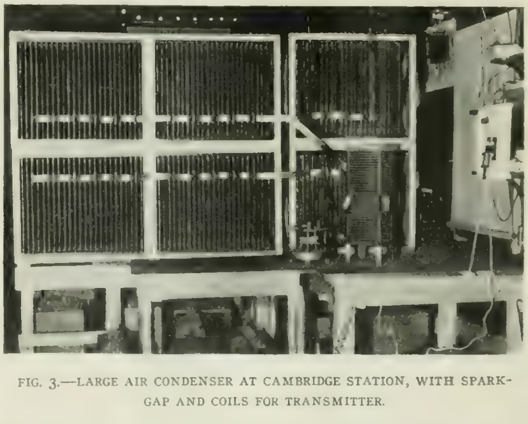


FIG. 3.—LARGE AIR CONDENSER AT CAMBRIDGE STATION, WITH SPARK-GAP AND COILS FOR TRANSMITTER.

The receiving circuits consist of three parts, each of which is individually so adjusted that its fundamental frequency is equal accurately to that to which the station is intended to respond. The three circuits may be designated as the vertical oscillator circuit, the "weeding-out" circuit and the local receiver circuit.

The connections of the vertical oscillator circuit are shown in Fig. 1. In series with the two vertical wires are connected a condenser and an induction coil, the circuit to the earth being completed through a local closed circuit comprising a separate condenser and inductance coil. This latter branch circuit is not individually resonant to the frequency to which the station is intended to respond, but it is so adjusted that when combined, as shown, with the other component parts of the vertical oscillator circuit, the latter is responsive to the desired frequency.

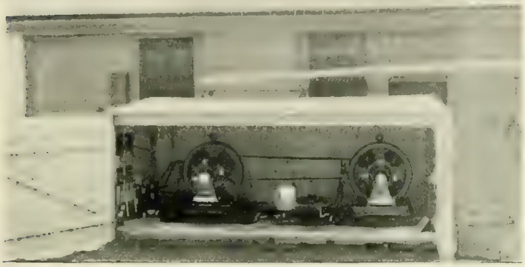


FIG. 4.—MOTOR-DRIVEN ALTERNATOR, BOSTON NAVY YARD, SHOWING PROTECTING CONDENSER.

The receiver circuit, which is adjusted accurately, to be responsive to the desired station frequency, is energized inductively from a portion of the "weeding-out" circuit, which receives its energy inductively from the local closed portion of the vertical oscillator circuit. While both the vertical oscillator circuit and the receiver circuit would respond most energetically to persistent trains of waves of the desired frequency, and would respond but feebly to waves of other frequencies, it has been found that only by the use of the intermediate "weeding-out" circuit is it possible to eliminate satisfactorily the effects of the waves of undesired frequencies. The "weeding-out" circuit has within it no apparatus to decrease its selectivity, and, separately considered, it responds to an extremely limited range of frequency and is effective in eliminating from the receiver circuit all but an inappreciable portion of all waves whose frequencies do not fall within this range.

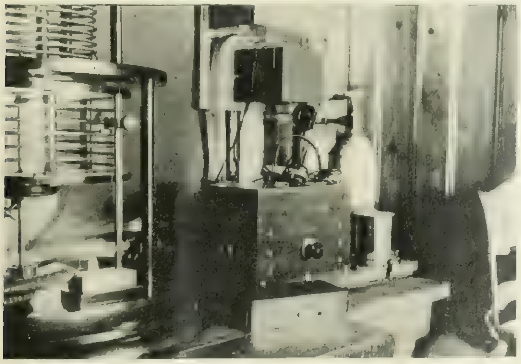


FIG. 5.—RECEIVING APPARATUS AND PORTION OF TRANSMITTING APPARATUS AT BOSTON NAVY YARD.

It is evident that the amount of energy which reaches the receiving station is exceedingly small, and that numerous precautions must be taken that it be not dissipated unnecessarily. For this reason the condensers are insulated with air, and the induction coils are so constructed as to eliminate all hysteresis and eddy currents. Experiments have shown that coils built upon wooden cores change in performance from day to day, due doubtless to the presence of a variable loss from eddy currents in the partially conducting material of the core as more or less moisture is absorbed from the air. All coils used in the Stone system are wound upon ebonite frames, and those used with the receiving devices are completely enclosed in a moisture-proof case. The tuning of the separate circuits at the receiving station is accomplished by adjusting the capacities of the various condensers. Large changes in capacity are made by inserting or removing plates, while the finer adjustments are made by exposing more or less area of positive to negative plates.

As a wave detector, the ordinary filing tube coherer is sometimes used. A sensitive relay, whose actuating elements resemble those of the Weston direct-current instruments, serves to indicate when the resistance of the coherer has been reduced by the electrical oscillations. The main difficulty with the coherer resides in the limit to the speed of receiving the signals by a device which requires the use of relays and mechanical tappers to restore it to its initial condition after each signal impulse. A more satisfactory detector has been found in the self-restoring bolometer. This device consists of a platinum wire of microscopic diameter dipped into a capillary tube filled with mercury. The characteristic property of the bolometer is that its apparent resistance is varied to an enormous degree when subjected to the effect of the oscillatory electric waves. The bolometer is used in conjunction with a battery and a sensitive telephone receiver, the latter serving for detecting the signals. (See Fig. 5.) The adjustments of the bolometer are made by means of a micrometer screw, the object being to maintain the resistance of the platinum wire at the lowest possible value consistent with the operation of the telephone receiver. This detector has been found admirably adapted for use with the selective wireless telegraph system, on account of its sensitiveness, the regularity in its response and its self-restoring quality.

After exhaustive theoretical and experimental investigation as to the nature of the electrical disturbances to be produced at the transmitting station and to be detected at the receiving station, and as to the character of the earthing devices required for most efficient operation, the earlier embedded conducting earth plates have been discarded, and there has been substituted therefor a wire netting which completely surrounds the aerial wire at its ground end.

Although with earlier equipments some variation was found in the performance of the system with changes in the condition of the weather, with the apparatus as now in use the operation is unaffected by any atmospheric changes.

New Telephone Patents.

SERVICE METER.

The central office service meter has now been in successful operation for some time, and while this is a satisfactory type of device from the exchange manager's standpoint, it is not always so from the subscriber's standpoint. The latter feels safer when the meter is upon his own premises where he can see it work. Messrs. J. L. McQuarrie and F. R. McBerty, of Chicago, have recently patented a service meter to fulfill this latter requirement.

The operation depends upon a slow acting relay, whose armature takes considerable time to complete its travel. Thus when a plug is inserted to answer a call, the slow acting relay during the period of action allows an abnormal circuit to exist. This abnormal circuit allows a current of polarity the reverse of normal to be momentarily sent out on the line, and this impulse causes the count of the meter. If for any reason the call is not completed then the operator may put a special current upon the key so as to cancel the count. The patent for this device has been assigned to the Western Electric Company.

NEW STYLE DROP.

Mr. L. F. Rose, of Washington, Iowa, has invented a very sensitive form of drop, in which the parts to be carried by the moving armature are as small as possible and the friction of the parts is reduced to a minimum. The shutter of the drop is mounted upon a counter-balanced frame and when released it falls before a window in the plate.

COMBINED TRANSMITTER AND RECEIVER.

A transmitter and receiver combined into a single piece of apparatus has been brought out by K. Hödlinger, of Austria. Ringing is to be effected by a push button, and this is so designed that with two stationary legs it forms a tripod support for the instrument.

RECEIVER EAR PIECE.

A receiver cap has been patented by P. C. Green, of Philadelphia, in which the usual sound channel at the center has been replaced by an ear plug designed to fit into the orifice of the ear.

Discussions at A. I. E. E. Asheville Meeting.

In our issue for June 24 we printed a very full telegraphic report of the proceedings at the Asheville general meeting of the American Institute of Electrical Engineers, which we supplement below by a fuller report of some of the more interesting discussions.

HIGH-POTENTIAL SURGES.

In discussing the paper of Dr. Steinmetz on "High-Potential Surges in Electrical Distribution Systems of Great Magnitude," Mr. H. G. Stott stated that it had been observed that static ground protectors invariably indicated the presence of a ground on one phase before a short circuit became evident in a feeder. In order that the proper feeder may be cut out before the current burns the insulation of the neighboring phases, there have been installed resistances of a rated capacity of 1,000 amperes for two minutes and a resistance of six ohms. These are used on the star voltage of 6,300 so as to make certain that the oil switches at both ends will open. This system will be put in use immediately. Mr. Percy H. Thomas stated that the high-potential rises could in numerous cases be prevented by grounding the neutral of the three-phase system, because such connection will cause the circuit to open when any cable becomes grounded. In a large transmission plant there should never be used single-pole opening devices, especially on the generator end of the system. If one leg of a high-tension system is cut off, all three should be opened simultaneously. In commenting upon this suggestion, Dr. Steinmetz remarked that he also had formerly been of the opinion that fuses are not permissible in high-voltage transmission systems. In the last few years, however, tests made in the fuses in cutting off branch lines of moderate power from a large power system have indicated that there is practically no rise in voltage. The fuses apparently did not cause instantaneous rupture. It seems, therefore, that the question of fuses for branch lines, in distinction to main lines, may profitably be reconsidered. Whether or not the very elaborate and expensive automatic oil switches which are necessary for the main lines are desirable for the branch lines is worthy of more extended consideration.

HIGH-PRESSURE MEASUREMENTS.

In the discussion of Prof. S. M. Kintner's paper on "Methods of High-Pressure Measurement," Dr. Steinmetz stated that he had always been prejudiced against the electrostatic voltmeters, possibly because of some very disastrous experience with early forms of such instruments, which were liable to 25 per cent error without giving any indication thereof, and therefore he had always preferred the method of measurement by step-down transformers, which cannot well be wrong. It is extremely gratifying to learn that there has now been developed an instrument which promises to be reliable. For high-voltage testing the spark-gap, however, is the ultimate court of appeal. If the static voltmeter or a step-down transformer equipment fails to agree with the spark-gap, the spark-gap is correct, and not the others. When all of the devices indicate accurately the disagreement in results is to be attributed to the fact that the e.m.f. differs from a sine wave. The voltmeter shows the effective value of the wave, but the spark-gap indicates the maximum corresponding to the stress in the dielectric, and the purpose of the high-potential test is to expose the dielectric to a definite stress. It has been shown conclusively in some recent investigations with a 500.000-volt transformer for testing purposes that the needle points of the spark must be unshielded for a distance much greater than the actual striking distance. Due to the burning out of a coil on the transformer, the tests have not as yet been completed, but it has been found that up to 300,000 volts the curve of the striking distance, whether between squares or between needle points, becomes a straight line. The striking distance can be calculated on the assumption that the arc has a definite disruptive strain; that it breaks down and becomes conductive by a brush discharge as soon as the potential gradient exceeds a definite value, which value may obviously be a function more or less of the temperature. It is the intention to bring out these facts in a paper before the Institute.

THREE-PHASE TRACTION

The papers by Mr. F. N. Waterman and by Mr. C. de Muralt were similar in that both advocated the use of three-phase motors for heavy electric traction. After Dr. Sheldon had read a communication from Mr. W. W. Smith criticising the use of polyphase motors, the discussion of Mr. Waterman's paper was continued by Dr. Steinmetz, who stated that the paper shows what the three-phase motor can be made to do when designed properly, and where the constants of the system are chosen, not according to existing practice, but as the best values for the problem under consideration. He said that the efficiency of 96 per cent as assumed for the induction motor seemed extremely high; in fact, much higher than he had been able to obtain in any apparatus of this character which he had designed. The most serious handicap of the three phase system lies in the unavoidable complications in the trolley circuits where switching must be done. In order to obtain a three-phase motor practically as good as the corresponding direct-current machine, it has been necessary to lower the frequency to 14 cycles per second and to reduce the air-gaps to .079 in. It would be possible to adopt so low a frequency only by sweeping away all that exists and reconstructing old systems. There is not much hope of replacing the city trolley service by any alternating system, whether three-phase or single-phase, because for city service the direct current is entirely satisfactory and no self-respecting city would ever permit doubling the already installed overhead network of trolley wires, as would be necessary with the three-phase system. Furthermore, the troubles from electrolysis which are formidable now and very difficult to guard against, will be intensified vastly by changing to a low-frequency alternating system, because electrolysis exists also with low frequency currents; but the methods which are meeting with fair success in guarding against electrolysis in the direct-current systems fail with the low-frequency, alternating-current systems. This is another problem which still waits for solution.

Mr. C. O. Mailloux stated that while it is theoretically true that a part of the energy can be recovered with a constant-speed system, yet the same result can be obtained better by some other system of recuperating energy. It would be more practical to run the cars at lower speeds and to make up lost time by coasting on down grades, under which conditions all the energy is being given to the cars without transformation losses. The action is purely kinetic. For satisfactory long-distance work, the trolley potential must be 10,000 to 15,000 volts, and for this service it is out of the question to use more than one line conductor.

Mr. C. de Muralt replied to the criticism concerning the necessity for more than one supply conductor by stating that there are now several three-phase systems in operation, and no difficulty has been met with. Switch yards have not presented great difficulties. The Valtellina line has switch yards more complicated than any in this country. In regard to the suggestion concerning the use of extremely high voltages, it seems preferable to use lower voltages which will allow of proper insulation and which will yet prevent the current from being excessive In most cases this can be done.

Mr. Waterman mentioned the scheme used by Ganz & Co. to eliminate the effect of the variation in size on the driving wheels of three-phase locomotives. The several driving wheels are joined by side bars. There is used with the equipment a control box by which resistance can be inserted permanently in the secondary of any of the three-phase motors which may be found to be taking an abnormal current with a tendency to overheat.

In further discussion of Mr. Muralt's paper, Dr. Steinmetz called attention to the fact that while it is possible to design a motor with an overload capacity 10 times the rated load, the power factor and efficiency at the rated load must be low. The condition is evidently that of a motor operating at one-tenth of the maximum output. As to the return of energy, it is to be remembered that such result can be accomplished with direct-current motors, but experience has shown that the complications incident to the devices are such that the energy saved does not warrant it. When the return is made with three-phase motors in concatenation, the motors heat up and the efficiency is low.

In closing the discussion of his own paper Mr. Muralt remarked that, leaving out subordinate advantages of the three-phase equipment, the principal one is that the motor has no commutator, the compensating disadvantage being that it requires two overhead wires. If one compares the cost of repairs to the commutator with the slight cost of repairs to the second line he will surely appreciate that the advantages are in favor of the three phase system.

THE COMMUTATION OF DIRECT-CURRENT MACHINES.

Both the paper by Mr Thornburn Reid and that by Mr. Sebastian Sentius dealt with the subject of sparking in direct current machines. Mr. G. S. Dunn stated that Mr. Reid's paper is extremely valuable in giving a theory to account for sparking, which appears to be the best thus far suggested, although it does not explain all of the facts connected therewith. The theory that the blackening of the commutator is due to the volatilization of copper has confirmation in the fact that when there is a very delicate layer of copper deposited on the under side of the brush this layer may be completely removed from a brush and deposited on a brush of the other polarity if, in the case of a generator, the machine be shut down and started in the reverse direction. The layer of copper changes from one brush to the other when the current changes its direction, which fact implies that the action is electrolytic and could take place only when the copper is volatilized. In commenting on the paper by Mr. Sentius, Mr. Dunn remarked that while he agreed to the general method by which the author arrived at the limitations placed upon the sizes of direct-current machines, he could not accept the actual value specified. Machines in satisfactory operation are much larger than the sizes stated by Mr. Sentius. The general fact that there is a limiting size for direct-current machines, particularly in the lower voltages, ought, however, to be better known than it is. Manufacturers are constantly receiving inquiries for generators several times larger than it is possible to construct.

THE DESIGN OF INDUCTION MOTORS.

Mr. W. L. Waters, in commenting upon Prof. C. A. Adams' paper on induction motors, remarked that in actual practice the air-gap is quite variable in machines of exactly the same design, so that, independent of the accuracy of the calculations, one must expect a variation of 10 per cent between high and low values from a series of similar machines. Taking everything into account, a good designer can approximate the results as accurately as they can be calculated. Complicated methods of calculating the leakage reactance and the exciting current are not suitable for practical work. The author stated that, while in machines of the same design the air-gaps may vary appreciably from the mean value and the exciting currents will vary correspondingly, it is desirable to be able to make calculations which fit the average air-gaps as nearly as possible. The leakage reactance in the design of a machine is often of greater importance than is the power factor. This is especially true with squirrel-cage motors, which must be started with a compensator at a reduced voltage. With a large leakage reactance the starting torque is low, and it is desirable to employ such methods of construction as will reduce this reactance.

NEW CARBON FILAMENT LAMP.

The principal interest in the discussion which followed the reading by Mr. John W. Howell of his paper on "A New Carbon Filament" centered in the replies of the author to questions as to the practical operating features of the lamp. Mr. H. N. Potter inquired concerning the length of the new filament as compared with that of the ordinary lamp, and asked what effect age would have upon the filament. Mr. Howell stated that the length of the filament is determined by the resistance and the radiating characteristics. On account of the fact that the efficiency of the lamp will be increased, the new type of lamp will be considerably shorter than the old. The general operating characteristics and the chemical data have been omitted from the paper intentionally. They would be very incomplete if given and are, therefore, reserved for some future time. As to the change of candle-power with time, it may be stated that it is very slightly different from the corresponding characteristic of the ordinary lamp, except as to duration. At the same specific consumption it takes probably four times as long to get the same deterioration, but apart from this fact the characteristics are not materially different. In answering a question of President Lieb, Mr. Howell said that there is every indication that lamps having a specific consumption of 2.5 watts per candle are by no means the most efficient that the process of treating as described in the paper is capable of producing.

A NEW INDUCTION ALTERNATOR.

The discussion on Mr. William Stanley's paper was opened by Dr. Steinmetz, who explained in great detail the reactions by considering the machine as a frequency converter. The alternator is an induction machine containing primary windings connected with an impressed e.m.f. of low frequency and the secondary winding connected to an external load circuit. The relations are those of a transformer in which the primary and secondary are movable with regard to each other; that is, it is a general alternating-current transformer. In reply to the question of Prof. Morgan Brooks as to the operation of the machine as a motor, Mr. Stanley stated that it would run as an ordinary synchronous motor.

DEVELOPMENTS OF THE ONTARIO POWER COMPANY.

Mr. G. S. Dunn called attention to the permanent and solid character of the constructions that Mr. P. H. Nunn described in his paper, The equipment seems to have been installed for all time. An interesting question arises as to the possible withdrawal of the water from the falls. It is estimated that 24 per cent of the water is now used for power purposes, and it is evident that this amount will be increased. Another source of danger appears in the probable tapping of the Great Lakes at Chicago. The outlet of the Great Lakes used to be at Chicago and the divide there is only about 15 ft. higher. Recently in order to obtain a pure water supply there has been taken from the lakes about 8 per cent of the water that formerly went over Niagara and the Chicago people are contemplating more. A great inducement to carry out these schemes is found in the fact that the water already diverted is furnishing 40,000 hp, and the power idea is quite attractive. The problem in this respect is quite broad and extends beyond the limits of New York State. It is, indeed, an international problem.

Prof. W. E. Goldsborough outlined the possibility of a wall being constructed in such a position as to deflect somewhat more than one-half of the water of the Niagara River over toward the American side. Such a wall might cause the two power plants which are situated farther down the stream on the Canadian side to be left without any available source of water.

Mr. H. G. Stott stated that probably the cost of keeping ice from the power plants at Niagara equals the entire operating expenses per year. Since the plant described represents the most up-to-date hydraulic installation, the provisions for taking care of the ice are of great interest. It is to be noted, however, that only experience will serve to determine the effectiveness of the methods employed.

Mr. P. H. Thomas pointed out that the installation described by Mr. Nunn when compared with older plants serves to indicate the trend of developments. The most striking feature resides in the separation into units and the isolation of auxiliaries into compartments, so that at no point in the system is all of the power brought to one spot where a large short-circuit, or something similar, might shut down the whole plant.

In commenting on the points brought forward in the discussion, Mr. Nunn stated the engineers at Niagara Falls were not worried on account of the water question, because they have a great deal of confidence in the good faith of the governments. While at the present time 20 per cent of the water has been ceded to different companies, less than half of that amount is being utilized. The effect of any wall built from the head of Goat Island would not be serious on the Canadian plants, for the reason that the trend of the river is directly toward the intake of those plants.

WATER POWERS IN THE SOUTH.

In opening the discussion of the paper of Dr. Perrine on "Water Powers of the Southeastern Appalachian Region," Mr. Pope remarked that there are numerous water powers available at many points throughout this region, but there is at present a market for only a limited amount of the power. This condition necessitates the development of industries to utilize the powers. It would seem that a suitable market for the power developed along the various streams is to be found in the railroads which follow the streams. It appears to be poor economy to transmit the power electrically over long distances and then haul in coal for use at the point from which the power is transmitted. One of the greatest objections now raised against travel by rail in the South is based upon the smoke nuisance where the steam locomotive is used. It is evident that the use of electricity would remove this objection. It might be argued that there is not enough power along each route to operate the railroad at all seasons of the year. While this objection would hold with regard to the total service of the railroad, there might be sufficient power to operate the passenger trains, and the reserve of locomotives for the freight service could be used for the passenger trains when the power was not sufficient for that purpose. In this connection it is well to note that it is common practice in mills supplied with power from water falls to install a reserve steam plant It appears, therefore, that the steam locomotives would serve admirably as reserves when railroads are operated by electricity

In compliance with the request of President Lieb, Mr. Weaver, president of the Weaver Power Company, of Asheville, pointed out the financial features of water power development in the South. The equable climatic conditions in the neighborhood of Asheville are conducive to the spinning of fine yarns such as are used for insulating purposes. This fact is of importance, because no apparatus has yet been devised for rendering an unsuitable atmosphere proper for the production of fine yarns. There are numerous advantages which accentuate this particular locality for cotton manufacturing on a large scale. Labor troubles are unknown, the walking delegate and the labor agitator being despised by the citizens. The water powers themselves are characterized by uniformity of fall, freedom from freshets and freedom from anchor ice.

Recent Electrochemical Developments.

ELECTRIC FURNACE INVENTION.

A batch of nine patents was recently granted to Edgar F. Price, all relating to electric furnace processes. One patent refers to a modification of an electric furnace, formerly patented by Alfred H. Cowles, and described on page 225 of our issue of January 30, 1904. Cowles uses a downwardly converging furnace structure with a carbon hearth at the bottom as one electrode and a carbon ring at the top as the other electrode. Since these carbon electrodes are expensive, Price suggests to substitute for them water-cooled metallic electrodes. As the upper electrode he uses a water-jacketed iron ring and as the lower electrode a body of molten metal supported on an artificially-cooled metal plate.

Two patents of Price refer to the treatment of refractory compounds, or mixtures containing metals which are volatile at a temperature approximately that required to effect reduction and which remain liquid at a temperature below that of reduction, for example silica and alumina. For this purpose the inventor proposes to heat the compound to the reduction temperature for a relatively short period only; the maximum temperature of the charge is kept at a point which will substantially prevent volatilization of the reduced metal, and the metal is at once withdrawn from the region of maximum temperature. Several furnaces of the resistance type and of the arc type adapted for this special purpose are described.

Six patents of Price refer to the production of ferro-chromium and ferro alloys in general. In one case he uses an arc furnace and protects the carbon electrodes by embedding them within the charge; the minimum e.m.f. required is used, so that a leakage of the current through the charge is prevented. In a second process he uses a resistance furnace downwardly converging with a carbon hearth at the bottom as one electrode. The ferro alloy is formed directly on this carbon hearth. In a third patent he uses his modification of Cowles furnace as described above.

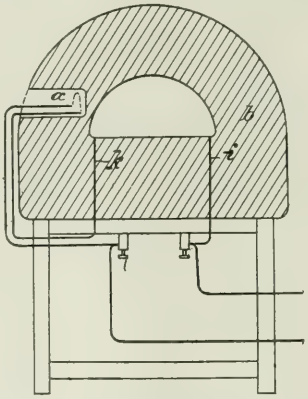
In the three remaining patents Price effects the production of ferro alloys low in carbon in two steps. In the first step he carries out the electric furnace operation so as to be as convenient and cheap as possible and does not care much about the amount of carbon contained in the product. In the second step the carbon is removed from the ferro alloy. For this purpose either the alloy may be tapped from the reduction furnace and solidified, then broken into fragments and mixed with a decarburizing agent, for example, lime; it is melted again in a resistance furnace, the carbon in the alloy now reacting on the lime to produce calcium carbide, which is separated from the purified alloy. The high carbon ferro alloy when removed from the reduction furnace may also be run directly into a second furnace and subjected to the action of lime or may be percolated through a granular body of a decarburizing agent like lime. This method of procedure is somewhat similar to that formerly patented by the Willson Aluminum Company, metallic calcium being used, however, in the latter case to remove the carbon from the ferro alloy.

Three patents granted to F. J. Machalske refer to the treatment of phosphate rock. Rock containing tricalcium phosphate, especially low-grade rock having a phosphate content of below 70 and down to 50 per cent, is crushed and mixed with sodium chloride and carbon and the mixture is heated to a temperature sufficient to decompose the rock and effect the production of phosphoric chloride and sodium and calcium carbides. If the operation is carried out in an atmosphere of nitrogen, the sodium and calcium carbides react with the nitrogen to produce cyanamides. The phosphoric chloride is led off from the furnace and may be treated with water for the production of phosphoric and hydrochloric acids. The calcium-sodium cyanamides are treated with water for the production of sodium and calcium carbonate and ammonia. The cyanamides may also be mixed with sodium carbonate and smelted in an electric furnace for the production of sodium cyanide.

F. A. J. Fitz Gerald and P. McN. Bennie patent a resistance furnace comprising any number of independent consecutively disposed compartments. Within the wall between two consecutive chambers the heating resister is inserted and through the length of the furnace the resister passes somewhat in zig-zag form. Details of construction are given.

A patent granted to L. E. Custer refers to mechanical details of construction of an electric furnace for dentists' purposes.

E. Haagn patents the device shown in the cut adaptable for such muffle furnaces, etc., in which the current is introduced into the furnace through two wires, *i* and *k*. In such cases there is danger that these two wires will be destroyed, since they are heated not only by the current which they carry, but by the furnace shell, *b*. It is, therefore, necessary to prevent the temperature from rising above the safety limit. For this purpose a recess is provided at one place within the furnace wall and a heat indicator, *a*, is inserted in the conductor, *k*. This indicator may be a wire or a strip of sheet metal of required strength so that its color which indicates the temperature within the furnace may be watched from without. It may also be constructed as a fuse so as to break the circuit should the temperature get too high.



HAAGN FURNACE.

LETTER TO THE EDITORS.

Doing the Work of the Institute.

To the Editors of Electrical World and Engineer:

Sirs:—I am glad to note your discussion of plans and methods for securing better representation in the council of the American Institute of Electrical Engineers of members outside New York, but I think you have been led to exaggerate any alleged feeling of discontent that may perchance exist on the matter, throughout the country at large. The membership as a body knows that it is well served; and the recent comparative statistics of President Lieb at Asheville show, if it were not appreciated already, how economically and efficiently affairs have been administered by the council and secretary. The excellent figures of maintenance he gave in his analysis are the best proof of faithful service all around. No doubt there could be improvement in some respects. Human institutions are always susceptible of that; but I doubt, as probably do many others, whether the Institute could gain much if at all by entrusting its affairs more to men hundreds and thousands of miles away from headquarters. I should very much like to see the figures of the number of committees and of committee meeting attendance. They would at once reveal the virtual impossibility of selecting many men remote from the spot, where hard work and frequent calls on time are the rule and not the exception.

Mr. Lieb, as I understand it, has suggested that territorial groups of members could select representatives, but regardless of domicile. If they did, their choice would probably as frequently as now fall upon men near New York, because they recognize that there is a certain large amount of unpaid routine drudgery to be done by somebody, and that it can be done easiest and best by men on whom it inflicts the minimum of effort, travel and expense. Just now the Institute is going through an important stage of growth and development and it is impossible to conceive of the onerous duties connected with the offices being discharged by members unable to put in an appearance at regular board or committee meetings. The Lieb suggestion has its merits, but it is broadly European rather than American. In England, I believe, a member of Parliament can come from any part of the empire, to represent a borough or county; with us the Congressman must live in his district. Both ideas have fundamental merits. In society work we can perhaps hit on a third alternative plan. Meantime, I desire to enter my objection to the notion that because improvement may be suggested, existing conditions are necessarily wrong or subject of indignation and protest. Good-natured and temperate discussion of Mr. Lieb's timely remarks on this electoral point and other Institute affairs is all that is required, and will effect due changes in time, when we are ripe for them.

Patchogue, L. I. Morris Brown.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Compensated Single-phase Shunt Motor.—Bethenod.—The conclusion of his long theoretical article on the Latour shunt motor. The main properties of this type brought out in the article are as follows: First, practically constant speed as with the direct-current shunt motor. Second, adjustable power factor. Third, small torque at starting (this is considered not to represent an inconvenience, since the motor may be started as a repulsion motor without any complications). Fourth, automatic regeneration of energy at speeds beyond synchronism, as with the direct-current shunt motor. The commutation is good at synchronism. The author concludes that the Latour shunt motor is very interesting from a practical as well as theoretical point and that it represents the only actual realization of a single-phase commutator motor with constant speed. "We believe to be able to state that the first motors constructed have proven perfectly satisfactory and it is to be hoped that the results of the tests will soon be published."—*L'Eclairage Elec.*, May 27.

Iron Losses in Induction Motors.—Bragstad.—An article illustrated by diagrams on the measurement and separation of the iron losses in induction motors. These iron losses may be divided into the following parts: *A*, losses due to the main field. 1. Hysteresis loss in the stator core and stator teeth. 2. Eddy current loss in stator core and stator teeth. 3. Hysteresis loss in rotor core and rotor teeth. 4. Eddy current loss in rotor core and rotor teeth. *B*, losses due to the pulsations of the field in the teeth. 1. Hysteresis loss in stator and rotor teeth. 2. Eddy current loss in stator and rotor teeth. The pulsations mentioned under *B* are due to the fact that the teeth are alternately before a tooth and before a slot. Since these pulsations take place with a much higher frequency than those in *A*, the eddy current losses mentioned in *A* and *B* must be separately calculated and added. None of the losses mentioned under *B* is supplied directly by the primary current, but must be supplied mechanically by the rotor, the primary electrical energy being first changed into mechanical energy for driving the rotor. If this is taken into consideration it will be seen that in several existing methods for measuring the friction of induction motors, these iron losses caused by the pulsations in the teeth are included in the results (for instance, slip measurement by Benischke and Blanc). To explain the results of the measurements, so-called additional friction losses have been assumed. The author also points out that a constant rotating field cannot transmit any power to the rotor if there is not produced a mechanical torque equal to the transmitted power divided by the angular velocity of the revolving field. Of the power transmitted to the rotor a certain proportion (equal to the ratio of rotor speed to field speed) is changed into mechanical power, while the balance is consumed for covering the rotor losses due to the main field. With an open rotor winding these will be losses A_3 and A_4 mentioned above. The author gives several measurements made with a 5-hp, three-phase motor and applies the above principles to the result.—*Zeit. f. Elek.* (Vienna), June 18.

Induction Motors.—Workman.—In a continuation of his serial on factory testing of electrical machinery, the author begins to describe the experimental tests made with induction motors. The present installment deals with the following tests: Measures of resistance; running saturation; open circuit saturation; locked saturation.—*Elec. Jour.*, June.

Polyphase Induction Motor.—Rosskoff.—An illustrated note on the construction of the circular current diagram for the polyphase induction motor.—*Zeit. f. Elek.*, (Vienna) June 11.

Lights and Lighting.

Electric Arc in a Vacuum.—Child.—An account of experiments performed between different kinds of electrodes in a vacuum and in hydrogen. With graphite terminals, it was found that with pressures less than 0.7 mm the drop in potential at the anode became less than at the cathode, and that whenever a glow appeared at the anode the drop there increased from 6 volts to 15. There are reasons for believing that this glow is similar to that seen with "Canalstrahlem." At pressures of less than 0.7 mm many of the ions appear to move along magnetic lines of force when in a magnetic field. With carbon terminals and with a pressure of 1 mm the drop at the cathode was somewhat larger than that at the anode. With copper and iron it was found impossible to maintain an arc with pressures of less than about 1 mm, unless there was an oxide of the metal on the cathode. Experiments were performed using graphite for one of the terminals and various metals for the other. When the cathode was graphite, the phenomena of the arc were practically independent of the nature of the anode. It was, however, impossible to maintain an arc on a 100-volt circuit with a pressure of less than 1 mm when the anode was graphite and the cathode any of the metals having a high melting point, such as platinum, iron, nickel, copper or silver. It was very easy to do so when the metal was one having a low melting point, such as antimony, lead or bismuth. With graphite terminals in hydrogen the drop at the anode was less than that at the cathode for pressures above 400 mm, the total drop being much greater than with the arc in air. Between 400 mm and 0.7 mm that at the anode was the greater. At pressures less than 10 mm the arc would start on a 500-volt circuit without bringing the terminals in contact, if they were comparatively warm. Under these conditions there were three distinct forms of the arc. From the experiments it would appear that no theory of the arc is complete which fails to consider the chemical action occurring in the arc. It would also appear that the temperature of the cathode does not alone account for the production of ions there, and their production depends very largely on the melting point of the metal used. The experiments also indicate that with pressures less than about 0.8 mm the positive ions driven off from the anode ionize by impact the gas about the anode, while with less pressures this does not occur.—*Phys. Rev.*, June.

Arc Lamp.—Carbone.—A description of his arc lamp which contains two arcs nearly vertical, side by side, but slightly inclined. The feature of the lamp consists in mechanical details of mounting the two carbons. The arc is deflected by an electromagnet. The construction is described according to German patent specifications. —*Zeit. f. Beleucht*, May 30.

Power.

Regulation of Electric Mine Ventilators.—An account of some tests on ventilators driven by three-phase motors which go to prove that it is cheaper to regulate the air supply of ventilators by varying the speed of the three-phase motors by inserting resistance in the secondary than by throttling the air supply. This contention has not always been accepted, but it becomes plausible when it is remembered that while the air supply increases proportionately with the speed, the power required to drive the ventilator increases at a more rapid rate. The following table refers to tests at the Dahlbush pit:

Position of slip regulating resistance.	10	9	8	7	6	5	4	3	2	1
Revs per min....	243	234	225	218	210	202	197	189	183	175
Air supply in 1,000 cubic ft.	262	248	238.5	231	226	218	212	207.5	202	198.5
Total kw. taken by motor and resist.	420	387	360	338	318	294	277	259	241	226

From *Glückauf*, abstracted in Lond. *Elec.*, June 2.

Electric Power in Collieries.—Brown.—An article giving some notes on the use of electric power in German collieries.—*Eng'ing and Mining Journal,* June 8.

Electric Centrifugal Pumps for Elevator Service.—An article on the electric installation in a dry goods store at Kansas City. There are two 75-kw steam-driven generators, and another of 6 kw capacity. Electric power is used for operating feed pumps, elevator pumps and ventilating fan and ice machine, circulating pumps and other apparatus. The most notable feature is the battery of three high pressure turbine pumps, two of 300 gallons and one of 500 gallons capacity per minute. Each smaller pump is driven by a 45-hp, 220-volt motor, and the large one by a 220-volt motor of 70-hp. These machines were designed to maintain a pressure of 140 lb. in the hydraulic system. The three pumps supply the water required for the complete hydraulic system, upon which all the hydraulic elevators of the store are connected. These elevator machines are separated widely over the premises, in some cases nearly a city block apart.—*Eng'ing Record,* June 17.

Power Plant of Manufacturing Works.—An illustrated description of the power plant of the Ingersoll-Sergeant Drill Company's works at Phillipsburg, N. J. About 2000-hp are generated and distributed by electricity and compressed air to the various points at which power is required. There are three 300-kw and one 100-kw direct-current generators. The multiple-voltage system is used.—*Power,* June.

Efficiency of Steam Boilers.—Booth.—An article criticising the usual method of calculating the efficiency of the steam boiler. The author urges that boiler efficiencies should be based on the correct available value of the fuel, that is, on the heat supplied above boiler temperature.—Lond. *Elec. Rev.,* May 26.

TRACTION.

Labor-Saving and Safety Devices on Tramways.—Some notes on the Walthamstow & District Light Railway, which has 13 miles of single track and which has recently been opened. A new feature is the device provided at each of the seven termini to obviate the turning of the trolley by hand. This consists of a large V of trolley wire constructed horizontally and at right angles to the running wire, and having one side of the V connected to one wire and the other side connected to the other wire. By a proper arrangement of frogs and switches, the trolley head is transferred automatically. This, of course, involves the construction of a trolley pole capable of revolving in either direction, instead of in only one particular direction. Therefore, instead of carrying the cable straight down the trolley base, it is broken and a rubbing contact inserted; the stop on the top of the base is also removed so that the pole may swing around in either direction. Another device which has been used is an arrangement for cutting current off a broken trolley wire. At intervals, the two trolley wires are connected by an arch of bare wire immediately below which runs another bare wire parallel and above the trolley wires, but insulated from them. This third wire is connected to earth through a fuse in the feeder pillar, and the fuse holds up the section switch. Immediately a trolley wire breaks, one of the arches collapses and comes into contact with the bare guard wire. The latter, of course, becomes alive at once, and the fuse in the section pillar is blown, causing the section switch to open automatically. It will be seen, too, that if a telegraph wire should fall it also connects the guard wire with the trolley wire, and blows the fuse as before.—Lond. *Elec.*, June 9.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Safety Devices.—An illustrated description of devices invented by Neu and made by a French company to prevent any danger which might result from breaking of a conductor of a high-tension line if the breaking wire should come in contact with the telephone wire or should fall upon people. There are two different methods employed, according to whether only a single interrupter is placed at the central station or a special interrupter at the beginning of every branch line. In the first case, where there is only one interrupter at the power station, the interrupter *D* is operated by the relay *R D,* which is supplied with current from the secondary of a transformer *T,* the primary of which is connected at one side with the neutral point of the distributing net work and on the other side to the earth through a lightning arrester *P.* At the end of the line the neutral point *B* is also connected to earth, as shown in Fig. 1. The two neutral points at the beginning and at the end of the line have practically the same potential, but as soon as a wire of the line should break a difference of potential is produced, the relay begins to act and opens the interrupter *D.* The lightning arresters *P* are provided in such cases where it is feared that the small differences of potential, which, under normal conditions, exist between the two neutral points, might produce small circulating currents which would have a deleterious effect on telephone communications in the neighborhood if the earth is used for the return circuit. Experiments made on two three-phase systems have shown that practically no time is lost between the breaking of the line and the opening of the interrupter. In the second case it is desired to place an automatic overload circuit-breaker at the beginning of each branch line in such a way that it will break the circuit if the current in the branch line should rise to a value double the normal; the constructions of Fig. 2 or 3 are used. At the end *B* of the line a device as shown in Fig. 2 or Fig. 3 is installed. As long as the line is intact the sum of the ampere turns of the electromagnet is zero. But as soon as one wire breaks the electromagnet is energized and attracts the armature so that simultaneously contact is made between *S S S* and the contact plate shown below them. A strong current then passes through those wires which are still intact, so that the circuit-breaker at the beginning of the branch line is set into action.—*L'Industrie Elec.,* June 10.

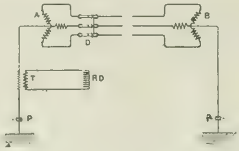
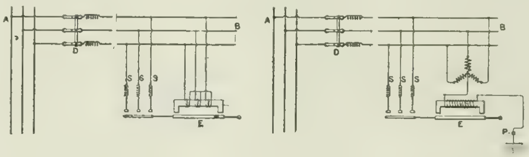


FIG. 1.—SAFETY DEVICES.



FIGS. 2 AND 3.—SAFETY DEVICES.

Protective Apparatus.—Neall.—An illustrated article on present American practice in lightning arresters for low-voltage transmission circuits. The following types are described: Magnetic blow-out arresters for direct current. Moving part arrester for direct current and for alternating current. Non-arcing arresters for direct current and the following three types of non-arcing arresters for alternating current: metal and multigap, metal multigap with resistance, metal multigap with diverging sides. Coherer arresters, either loose or fixed. All these types are illustrated and briefly described. Great stress is laid on the necessity of making a good, short and straight connection from the arrester to the ground. Some rules for making it are given as follows: Dig a hole four feet square directly under the arrester until permanently damp earth has been reached; cover the bottom of this hole with crushed charcoal (about pea size); over this lay ten square feet of tinned copper plate; solder the ground wire, preferable No. 0 copper, securely across the entire surface of the ground plate; cover the ground plate with crushed charcoal; fill the hole with earth, using running water to settle. Rich soil is the best for ground connection. Where possible, a direct connection to an underground pipe system, especially to a town or city water main, furnishes an excellent ground.—*Elec. Journal,* June.

Larger Units in Power Houses.—In continuation of the communications pleading for larger units in central stations, Fox joins in this plea and also recommends the checking of the efficiency of generating sets after once set to work in stations. Turnbull points out the advantage of attaching two dynamos to one and the same engine in stations where both lighting and traction supply is given. He also remarks that when purchasing a new plant it will often be found that the standard size of the engine offered will give considerably more power than may be specified for by the buyer. As the dynamo is so much cheaper than the engine, it may pay very well to have the dynamo increased in size to take all the engine will give it. He also asks whether any stations have tried raising their steam pressure to enable them to meet the winter peak. There are also some editorial notes with reference to the various communications printed on this subject.—Lond. *Elec.,* May 26. Vignoles (whose article, abstracted recently in the Digest, started this whole discussion) shows in a communication that little economy in steam would have resulted in his station if instead of eight steam units totalling 900-kw capacity a single 1000-kw set had been in use. While the average load on the plant during the running hours is a vital point, one of equal importance in determining the size of the unit is the cost of the spare plant required. With a small average load, it is necessary to keep down the size of the unit, not to secure economy in working, but to reduce the cost of the separate plant. He thinks that all sets should be of one size.—Lond. *Elec.,* June 2.

Circuit-Breaker.—An illustrated description of a "reverse current" circuit-breaker originally devised by Andrews, but recently improved. With a slight alteration, it may be used as a combined excess-current and reverse-current device.—Lond. *Elec. Rev.,* June 2.

Control Apparatus for Direct-Current Motors.—MATHER.—A long and profusely illustrated article describing the principal fundamental American types of control apparatus for direct-current motors.—*Amer. Elec.,* June, 1905.

WIRES, WIRING AND CONDUITS.

Heating of Three-Core Cables in Earth.—HUMANN.—The author first gives a summary of theoretical investigations of Mie and Teichmueller. Mie has shown how to reduce the calculation of the heating of a three-core cable to that of a single-core cable, the radius of the core of the latter being given by a relatively simple formula. It is then easy to apply Teichmueller's formulas for a single-core cable. The author gives the results of tests which he has made with various three-phase cables buried in earth and submitted to direct current for ten hours. For one and the same cable, and with different currents, the final temperature in the core equals a constant value multiplied by the square of the current in amperes. If the constant c in this equation is determined by a few tests, the permissible current i, which causes a raise of temperature of t degrees, is found from the equation $i = \sqrt{\frac{t}{c}}$. The author calculates a table for different cables and emphasizes that the rise in temperature is the difference of the temperature of the cable minus the temperature at the surface of the earth, and not the difference between the final and initial temperature of the core of the cable. The greatest part of the drop of voltage is within the cable itself and the humidity of the earth does not exert a very great influence on the heating of the cable. If the bad conductors of heat, i. e., the insulating and compound layers, are reduced, the cables can stand a higher load for the same temperature rise of the copper conductors. This was proven to be correct by an experiment.—*Elek. Zeit.,* June 8.

Aluminum Conductors.—ESSON.—An article discussing the use of aluminum for overhead power lines. In summing up he says that the case for the employment of aluminum wire for overhead power lines is extremely weak. "In consideration of some counterbalancing advantages as regards cost, the several disadvantages of aluminum might possibly be disregarded, but unfortunately such advantages are not present. Though the joints can be made quite satisfactory, the manipulation allows little latitude, aluminum being so highly electro-positive with regard to other metals as to render its exposure in contact with any other material unsafe. Again, the higher co-efficient of expansion for temperature variation is against aluminum, inasmuch as to allow the same headway as with copper, the poles have to be higher. The wire presenting a greater area to the wind, and being lighter, the angle of deflection from the vertical due to wind pressure is greater, and short-circuitings on the line are more likely to occur. And with all this against its use, unless the factor of safety is partially sacrificed, the line is more costly to construct on account of the greater number of poles required. Apparently the only point left in its favor is the lower cost of transport. In an editorial note on this subject it is remarked that for his comparison Esson seems to have chosen as basis a rather poor quality of aluminum. This is pointed out with respect to some of his figures, but it is thought that, nevertheless, his "conclusions remain correct. In certain special cases, however—for instance in well sheltered positions—aluminum may rank equal with or even superior to copper."—Lond. *Elec.,* June 2.

ELECTROPHYSICS AND MAGNETISM.

A New Radioactive Element.—HAHN.—A preliminary note on the discovery of a new radioactive substance in the residue of thorianite. The emanation is in all respects equal to thorium emanation. Yet it is certain that thorium itself was not present. This fact, coupled with the facts that inactive thoria is known to exist and that thorium emanation without thorium occurs at Baden-Baden, lead the author to believe that the new element is the active constituent of thorium.—Lond. *Elec.,* June 9; from *Proc. Royal Soc.,* No. 508, May 24.

Vacuum Thermo Couple.—SCHAEFER.—According to Lebedew, the sensitiveness of a thermocouple may be considerably increased by placing it in a vacuum of 0.01 mm pressure or less. It thus may become 25 times more sensitive than before. The present author describes an apparatus based upon this fact. He uses it for measuring the selective properties of resonator grating. The resonator (Fig. 4) consists of two brass pins, *a a'*. To one of these an iron wire is attached, and to the other a constant wire. These are joined and twisted together in the center, and one is bent up and the other bent down, thus forming a thermo-couple. The ends of the wires and those of the brass pins are contained in the ebonite ring *b b'*. Brass wires *A A* join the thermo-couple to the upper and lower terminals. The period to which the resonator responds may be altered by slipping long caps over the brass pins. The author attained a fivefold or tenfold sensitiveness by this arrangement.—Lond. *Elec.,* June 9; from *Zeit. f. Instrum.,* May.

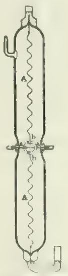


FIG. 4.—RESONATOR.

Evaporation of Metals.—Continuing some work carried out two or three years ago by F. Krafft on the evaporation and boiling of metals in quartz glass, and in the electric furnace in the vacuum of the cathode light, Krafft and Bergfeld have now determined the lowest temperatures at which the metals evaporate. Using a tube of quartz, and working with the electric furnace, they have found the lowest temperatures to be: For silver, 680° C.; for copper, 960° C.; and for gold, 1,070° C. In glass vessels, and when suitable organic liquids were employed as the sources of heat, other lowest temperatures were: Cadmium, 156° C.; zinc, 184°; bismuth, 208°; lead, 335°; potassium, 90°; sodium, 140° C. The former research was described in the *Berichte,* 1903, XXXVI, 1,690.—Lond. *Elec. Rev.,* June 2.

Lead-Antimony Alloys.—ROSSI.—An account of quick methods for determining the composition of lead-antimony alloys for storage battery grids.—*Centralblatt f. Accum.,* June 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Alternating Currents.—PRICE.—An abstract of a British Physical Society paper giving the results of experiments carried out by Wright at Crompton's works at Chelmsford on the possibility of using the resistance of a conductor heated by an alternating electric current as a measure of the current. An alternating current was passed through a thin conductor in series with a standard resistance, and a small direct current from a storage battery superposed on the system. The mean differences of potential at the terminals enabled him to compare the resistances on a potentiometer. The presence of any considerable body of air near the heated conductor was found to affect the results through the irregular currents of air produced, while the neighborhood of solid matter caused the permanent condition to be reached only slowly in consequence of its heat capacity. To obtain uniform results so that the resistance of the conductor corresponded consistently and promptly to the current passing, it was found necessary to enclose the conductor in a relatively large vessel exhausted of air. Nearly consistent results were then obtained, affected, however, to some extent by the changes in the vacuum due to the liberation of gas occluded in the conductor. At moderately good degrees of exhaustion the resistance of the conductor for a given current varies rapidly with the quantity of gas that remains and it was suggested that this might form the basis of a vacuum gauge. The results of experiments on carbon incandescent lamps and on platinum-foil ligaments in exhausted bulbs were shown in diagrams, giving the effects of different air temperatures and of the degrees of exhaustion. The author supposed that such conductors enclosed in large glass bulbs, highly exhausted when the conductors are incandescent, would form useful gauges for electric currents. They would be perfectly portable, not easily liable to damage, capable of highly accurate and permanent calibration, and, of course, very inexpensive. They could be made of exceedingly small inductance and capacity, and their values would be independent of frequency and wave form. Their employment would correspond in precision and sensitiveness to other measurements of electrical resistance. The useful range of currents measured by one such conductor might be of the order of one to four.—Lond. *Elec.*, May 26.

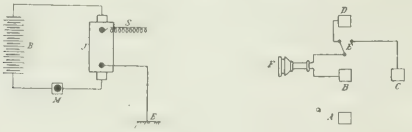
Meters.—Gherardi.—In a continuation of his illustrated serial on electricity meters the Mordey-Fricker meter is described. It is essentially a balance wheel clock, the escapement being affected by the current to be metered in such a manner as to cause the clock to work at a speed proportional to the current. The meter is, therefore, an ampere-hour meter.—Lond. *Elec.*, June 9.

Measuring Magnetic Field Strength—Paschen.—A description of a method of measuring magnetic field strength together with a mathematical theory of the method. By means of a differential method the field to be measured is compared with a magnetic field in the interior of a coil fed with a known current.—*Phys. Zeit.*, June 15.

Variation of Capacity with Temperature.—Terry.—An abstract of an American Physical Society paper giving the results of measurements in which the author determined the temperature coefficient of each part of a subdivided condenser working between 16 and 35° C.—*Phys. Review*, June.

Telegraphy, Telephony and Signals.

Wireless Telephony.—Mosler.—An article illustrated by diagrams describing some observations which he has made in experiments on wireless telephony. The simplest arrangement of the sending station is shown in Fig. 5, where B is a battery of about 25 volts, M a microphone, and J an induction coil, one secondary pole of which is connected to earth at E. At the receiving station is used a telephone, one terminal of which is connected to earth while the other terminal is free. However, in the experiments of the author the telephone had a metal box which was touched with the hand by the hearer. The use of an antenna at the receiving station does not improve transmission. For good transmission it is preferable to connect on the transmitting station the free secondary pole of the induction coil with an insulated suspended coil, S, containing copper wire of about 2.5 km. length. If both poles of the induction coil, J, are earthed the transmission of sounds is very greatly weakened. On the other hand, if at the receiving station both poles of the telephone are earthed, good sound transmission is obtained only under certain conditions, as indicated in Fig. 6, where A is the earth plate of the induction coil of the transmitting station, while $C\,D\,E$ are earthed plates of the receiving station, F being the telephone and E a switch by which either plates C or D may be connected to F. No sound is received when B and C are connected to F, while the transmission of sound is good when B and D are connected to F. The author explains this by assuming that periodic electrifications of the surface of the earth are propagated from the earth plate A of the transmitter. This propagation takes place in circles around A. To get good transmission it is necessary to connect the telephone, F, with two points of different potential. This is the case if $A\,B\,D$ are in one straight line. On the other hand, if B and C are about equally distant from A, they have about the same potential, and no sound is heard in the receiver, E. If only one pole of the telephone, F, is earthed, a second earth connection is produced through the metal box of the telephone to the body of the observer; in the experiments he was then standing on a place like D in Fig. 6. Sound may be transmitted over several kilometers, especially over water, if induction coils with a very high transformation ratio and a microphone which can stand strong currents are used. For wireless telephony over greater distances, however, it is necessary to use ether waves.—*Elek. Zeit.*, May 25.



FIGS. 5 AND 6.—WIRELESS TELEGRAPHY.

Wireless Telegraph Measurements.—Dudell and Taylor.—A continuation of their British Institution paper. In the present installment are described results of tests in which the height of the receiving air wire was varied; in other tests the resistance of the measuring instruments was varied. The authors then discuss the voltage produced at the coherer terminals and the energy of the oscillations in the radiating system of the transmitter. Finally there are described tests in which the distances between the transmitter and the receiver were varied. The results are given in diagrams and tables. The paper is to be concluded. Lond. *Elec.*, June 9.

Fire Alarm.—A description, with an account of tests, of the "Autopyrophone" system of automatic fire alarm.—Lond. *Elec.*, May 26.

Miscellaneous.

Conversazione.—An account of a Conversazione of the Royal Society. Sir Oliver Lodge lectured on the use of electric valves for the production of high-tension continuous current. The kind of electric valve used by him is a vacuum tube with a mercury electrode resembling a Cooper-Hewitt lamp. Another application of the electric valve was shown by Fleming. The valve used by Fleming consisted of a bulb enclosing a carbon filament made like an incandescent lamp. The filament was surrounded by a metal cylinder, and the bulb was highly exhausted. It is well known that, in such an apparatus, when the filament is incandescent, negative electricity can move through the vacuum from the hot filament to the cylinder, but not in the reverse direction. Fleming has used this device to separate out the two opposite currents in an electric oscillation. It was used with a dead-beat galvanometer as a receiver in wireless telegraphy, showing a large deflection to one side, due to the electric waves. The valve replaces the coherer and signals are given by long and short deflections of the galvanometer. Fleming also exhibited an apparatus for measuring the length of the electric waves used in wireless telegraphy. Sir William Crookes exhibited specimens illustrating the action of light and radium upon glass. The radium appears to act on glass containing manganese in the same way as light; *i. e.*, both produce discoloration, but the radium produces as much effect in seconds as light does in years. Beilby illustrated the phosphorescence caused by the beta-rays of radium. Isenthal & Co. exhibited a resonance induction coil and high-potential apparatus. Sir William Ramsay showed the action of actinium emanation on a sensitive screen. Hutton exhibited some new models of laboratory electric furnaces.—Lond. *Elec. Rev.*, June 2.

Manufacturing Plant.—An illustrated description of the new works at Gateshead of Ernest Scott & Mountain, manufacturers of electrical machinery especially for mining purposes.—Lond. *Elec. Rev.*, May 26.

Titanium.—Goldschmidt.—The conclusion of his article on vanadium and titanium. In the present installment the author deals with the effect of an addition of titanium to cast iron or steel.—*Electrochem. and Met. Ind.*, June.

Röntgen Congress.—An account of the papers presented at the first International Röntgen Congress recently held in Berlin.—*Phys. Zeit.*, June 1.

BOOK REVIEWS.

EXPERIMENTAL ELEKTRIZITATSLEHRE. (Experimental Lessons in Electricity.) By H. Starke. Leipzig: B. G. Teubner. Cloth, 422 pages, 275 illustrations.

The textbook here considered deals with electricity and electrical apparatus from a somewhat novel standpoint, namely, that of the physical experimentalist. The experimental side of the subject is developed with the aid of excellent illustrations and clear description.

The first two chapters deal with fundamental electromagnetic units and conceptions. The second division treats of electrostatics. The third considers magnetism. The fourth entertains electromagnetic definitions and laws. The remaining chapters deal respectively with electric measurements, electromagnetic induction, magnetic measurements, dynamoelectric machinery, alternating currents, electric oscillations, electric conduction in gases and thermoelectricity.

The book is well up-to-date and original in many ways. The illustrations of electrical measuring apparatus are particularly clear.

The treatise is to be recommended to electrical students of physics and electrical engineering who have some knowledge of mathematics.

TELEGRAPHIE UND TELEPHONIE OHNE DRAHT. (Wireless Telegraphy.) By Otto Jentsch. Berlin: Julius Springer. 211 pages, 156 illustrations. Price, 5 marks.

This is a descriptive text-book on the elements of wireless telegraphy. A short account is given of the historical development of the subject, including wireless telegraphy by visual signals, by earth conduction, by magnetic induction and by static induction. The bulk of the treatise is, however, devoted to Hertzian wave telegraphy. The apparatus and systems used are clearly described with the aid of abundant illustrations. There is practically no mathematical discussion, the treatment being qualitative throughout, with the exception of a few well-known formulas. The principal systems described are those of Marconi, Slaby-Arco, Braun-Siemens, Lodge-Muirhead, Fessenden, Forest and Artom.

The concluding chapter deals with wireless telephony. The book commends itself to students of the art of wireless telegraphy as practiced hitherto in Germany. The account of German work in this direction is both full and up to the date of publication.

RESISTANCE, INDUCTANCE ET CAPACITE. By J. Rodet. Paris: Gauthier-Villars. 257 pages, 76 illustrations. Price, 7 francs.

This book is divided into three chapters, one on resistance, one on inductance and one on capacity. The author has compiled a large amount of tabular information concerning resistances and resistivities, and has drawn them up in revised form. They are thoroughly up to date. The volume will, therefore, be useful to engineers as a resumé of such information.

The chapter on inductance is more theoretical in its treatment. It contains a good mathematical exposition of the subject from the engineering point of view. The formulae are developed of circuit inductances, both in absolute units and in henrys per unit length. Modern terminology is adhered to. The gauss and maxwell are fully employed as working units.

The chapter on capacity receives a treatment similar to that on inductance. The formulae for circuit capacities are developed in terms of the absolute unit and also of the farad per unit of length.

The book is to be recommended for the use of students in electrical engineering. The mathematical style is clear and well illustrated by numerical examples. The book would be considerably enhanced in value if an index of subjects discussed were appended.

ELEKTROTECHNISCHER FABRIKEN. By Dr. F. Niethammer. Stuttgart: Ferdinand Enke. 364 pages, 378 illustrations. Price, 9 marks.

This is Volume II of the "Handbuch der Electrotechnischen Praxis," edited by Arthur Wilke. This subject, "Arrangement and management of electrotechnical factories," is treated extensively in a space of 36 pages and is profusely illustrated by means of 378 figures. To cover this vast subject efficiently, as has been done, requires an intimate knowledge of all the manifold branches which make up an electrical establishment. Dr. Niethammer's wide experience fits him particularly for the task he has set himself. He divides the subject in the following manner: (1) Superstructure of an electric factory; (2) factory location; (3) factory arrangements and specific shops; (4) commercial side of factory organization; (5) prices and wages.

In the first section the fundamental financial condition and the commercial subdivisions are enumerated and explained, as also the successive stages which an order undergoes, which has been received by the factory until the apparatus is ready for shipment. This is followed by many plan and elevation views of factories, shops, foundries, etc., of well-known American and European factories. In this connection he enumerates the many essential points, which should be considered before finally deciding on a site for a factory; the desirability of having the commercial department as near the factory as possible; the factory near the labor market and shipping centers are discussed, and shipping facilities and handling of raw and finished products within the factory are illustrated

In 37 distinct divisions the separate shops and their organizations are described and many points mentioned of practical value. The erecting shops of some of the best-known engineering firms are described and provisions for economical handling of heavy parts of machinery. The stamping, punching and annealing departments, tool shop and department and foundries come in for detailed description, as also drafting room, pattern shop, etc. Considerable space is given to special and improved turning, planing and milling tools as used by the largest firms. The description is not restricted to the enumeration of such devices, but clearly describes their uses and advantages. The winding department is given in all its details, showing the variety of work done by hand or machinery, such as winding and taping of coils for all purposes, baking, testing, etc. Commutator construction and various means for their building up are shown and described. The author here leaves the practical part of factory production and devotes the last two sections to a minute and carefully detailed description of the business end of factory work and organization. The card index and its various time-saving uses are illustrated, time, cost, order and shipping cards used by different makers are reproduced, also those used in the factory for obtaining material from store rooms, etc. The determination of cost price of an article is carried out in every detail by enumerating the cost of material and labor of each department which contributes parts to the completed machine The drafting department and its relation to different departments as well as its own organization is well presented. The last section deals with the determination of prices and wages and contains views which every engineer and manager of experience will readily endorse and which deserve the widest circulation, as they insure success. The only weak point found is the absence of a system of marking patterns, dies, drawings and castings which is adaptable to an expanding business or one that branches out into other departments The book is of considerable value to managers, superintendents and department heads of factories who desire to be up-to-date.

Direct-Current-Engine-Driven Generator.

A line of direct-current, engine-type generators embodying the latest improvements and designed with especial attention to accessibility, performance and low running temperature, is being manufactured by the Westinghouse Electric & Manufacturing Company. The arrangement of brush holder rings and commutator, the position of equalizer rings, the use of retaining wedges in the armature slots, the arrangement of series field coil connections, removable pole pieces and brush holder shifting device contribute to the best performance and the utmost simplicity in operation.

The stationary part of these generators is a circular yoke of cast iron carrying inwardly projecting poles on which are placed the field windings For capacities from 25 kw up to and including 125 kw the standard construction is a vertically split frame, while for larger sizes the horizontal division is regularly built. Machines below 25 kw have solid frames Generators of any size can be built with either the vertical or horizontal division if circumstances require it. The pole pieces are built up of laminations of soft steel, carefully annealed and riveted together under pressure, and held in place by bolts which pass through the yoke and are fastened by lock washers on the outside. The bolted-in construction allows the removal of any one of the field coils with its pole without disturbing any other part of the machine. Spreading pole tips serve the double purpose of giving an excellent commutating field under the pole tips and of furnishing a support for the field coils.

The shunt and series coils are separately wound, with an air space provided between them. The series coils are made of forged copper conductors of rectangular section and the shunt coils are machine wound. These generators are usually over-compounded for an increase in potential of about 10 per cent at the terminals from no load to full load, but may be adjusted for lower percentage of compounding by means of a shunt to the series coils, or they may be designed for a higher percentage as may be required for special cases.

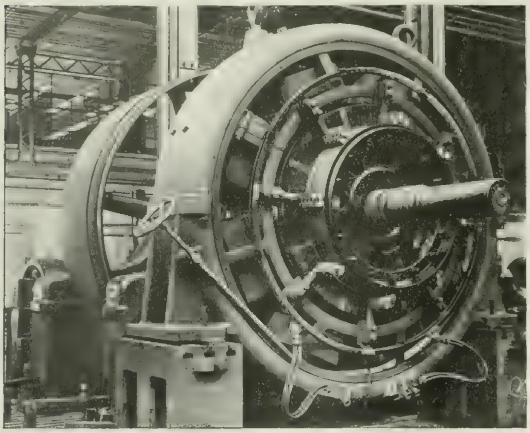


FIG. 1.—DIRECT-CURRENT, ENGINE-DRIVEN GENERATOR.

The armature core consists of sheet steel stampings, built up on a spider which also carries the commutator. The armature may be drawn from the shaft if necessary without disturbing the commutator or windings. Liberal provisions for ventilation are provided, as air spaces are placed at short intervals, and extra spaces are provided between the outer laminations and the end plates. The coils are machine formed and are perfectly interchangeable. By placing fibre wedges in V-shaped grooves near the top of the slots the coils are held in place without the use of band wires. The commutators are constructed of hard-drawn copper of the highest conductivity, and carefully insulated so that a smooth wearing surface is secured with an entire absence of sparking.

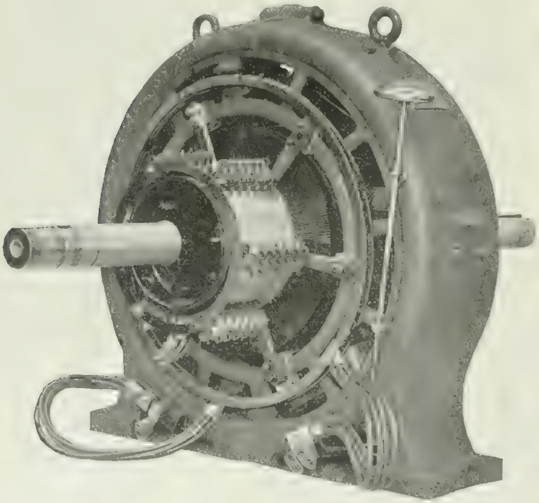


FIG. 2.—COMMUTATOR END OF GENERATOR.

The brush holder mechanism is carried by brackets mounted on a rocker ring concentric with and carried on a machined seat on the front end of the field frame. No part of the supporting ring projects over the commutator face, thus leaving the brush holders and commutator entirely clear of obstructions and readily accessible at any point. Every machine is so arranged that the rocker ring shifting device may be placed on either side. The transmission of current through the springs, and the consequent heating and variation in pressure are eliminated by copper shunts connected directly from a clamp on each brush to the solid part of the holder. Ample means are provided for adjustment as the commutator wears, and for changing the spring tension on the brushes.

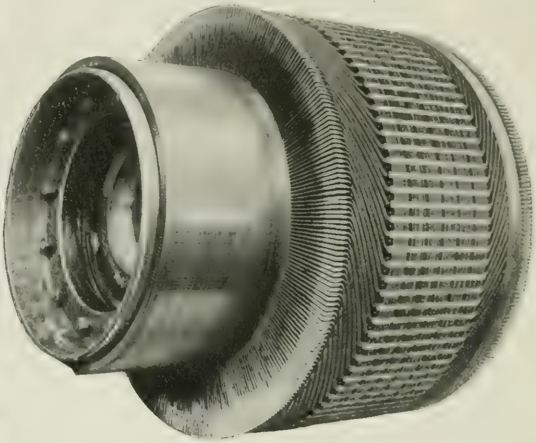


FIG. 3.—COMMUTATOR.

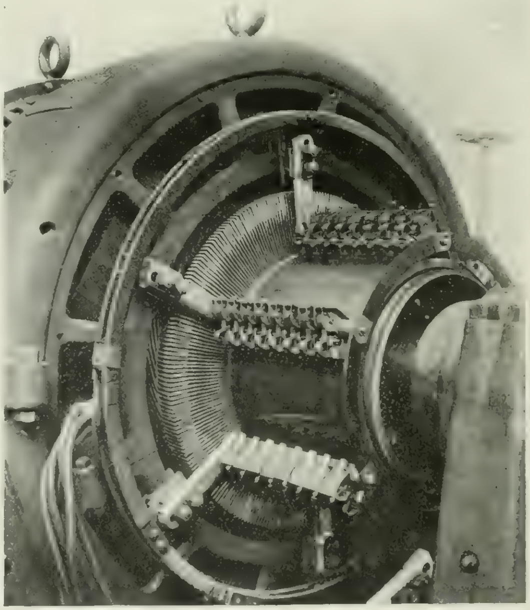


FIG. 4.—BRUSHES.

A very important feature in connection with these generators is that all brushes of the same polarity are maintained at the same potential. Much trouble has frequently been experienced in the operation of large multipolar direct-current machines with parallel wound armatures, owing to the difficulty of securing the same magnetic strength in all the poles. Sometimes the potential generated in the conductors under one pole exceeds or is less than that generated in conductors similarly situated under another pole of the same polarity, the result being a difference of potential between brushes of similar polarity. Troubles caused by currents flowing from one brush to another or from one section of the armature winding to another, attended by annoying and wasteful heating of the conductors and sparking at the brushes, are eliminated by the following method of balancing: In the larger machines with parallel armature windings the points in the armature winding which are normally of equal potential are connected by leads through which currents may pass from one section to others with which it is connected in parallel. These currents are alternating in character and lead or lag with reference to their respective e.m.f's, and thus magnetize or demagnetize the field magnets so as to produce automatically the necessary balance between them. The same troubles would result from the decentralization of the armature in a multiple winding, but are avoided by the system of balancing.

With the balanced magnetic circuits any heavy magnetic pull on one side of the armature due to wear of the bearings is prevented. The pull which may be exerted by one side of the field on a large armature, even if out of center by a small fraction of an inch, may become as high as several tons if this method of balancing is not used. Such an increased pull on the armature would result in the heating and rapid wearing of the bearings. By the above method of balancing the induction under all poles is maintained practically the same, causing the magnetic pull to be equal at all poles and preventing an unbalanced pull.

Double Trolleys in Cuba.

The Havana Central Railway Company, of Havana, Cuba, has placed orders with the foreign department of the General Electric Company for complete electrical equipment of a network of interurban electric railway lines radiating from Havana and covering an extensive territory inland. The system will consist of a central power house in Havana, and eight outside sub-stations, together with line material for about 125 miles of trackage, and rolling stock for passenger and freight service over the entire system.

The power house in Havana will furnish 5,000 kw of 19,000 volt, 25-cycle, three-phase current generated by two 2,000-kw generators and 1,000-kw Curtis steam turbine generators at 2,200 volts and stepped up through air-blast transformers to the line voltage. The transmission lines will parallel the various lines of the railway to the sub-stations, where step-down transformers supply low voltage to rotary converters furnishing 600 volts direct current to trolley lines and feeders.

From Havana one branch will run southeast to Rosario, a distance of about 40 miles. Sub-stations will be located at Cuatro Caminos, Lomas de Candela and Providencia. A second line will run from Havana 17 miles south to Bejucal, with a sub-station on the line at Santiago de las Vegas. A third line running southwest from Havana to Mariel will have a length of 37 miles and branch lines running north and south to El Carmelo, Santiago de las Vegas and Tuira de Melena, amounting to about 30 miles in addition. Sub-stations on the line to Mariel will be placed at Marianao, Hoyo Colorado and Tuanajay and at San Antonio Melena.

The rolling stock for passenger service will consist of twenty-four 30-ton cars, seating 50 passengers and equipped with four motors geared for a maximum speed of 40 miles per hour. The freight service will be handled by ten 40-ton locomotives equipped with four motors geared for a speed of 17 miles per hour when hauling a 300-ton train.

The entire system will have double overhead trolleys both in Havana and on the interurban lines. The high-potential transmission lines will be designed for a future potential of 30,000 volts to provide for extensions. The transformers in the Havana power house and in the sub-stations are also suitable for use on the increased potential.

It is expected that the entire system will be in operation inside of 18 months, and that portions of it will be giving service before that time.

Electric Power on the Mesaoa Range.

A special correspondent of the *Iron Age* at Duluth, Minn., makes the following note of interest to electrical engineers: An effort is to be made at once to supplant steam by electricity at the mines of the Mesaba range. The Great Northern Power Company, whose large plant near this city is well under way, and which should have its wheels in motion in less than a year, is now investigating the matter and has its general manager working out the plans. There is a great field for the use of electrical power on the Mesaba. Between Hibbing and Sparta, a distance of about 36 miles measured along the line of the ore bearing formation, there are 52 operating shafts and more heavy steam shovels. Many of these shafts are pumping heavily and steadily, several of them up to 1,200 to 1,500 gallons a minute. None of these operations is more than 55 miles from the company's power station at Duluth, measuring in a direct line. At Buhl a very heavy electric stripping installation is going in, to be operated late this fall or early next year, and if this is as successful as is expected by the owners and engineers it is sure to be followed by others of a similar character and the field of stripping will be extended to greater depths of overburden. East of Sparta, on the same range, and fully as well located for taking power from these works, are eight or nine shafts now in commission, several of them heavy pumpers, and west of Hibbing there are now five and a number more planned for immediate development. On this western part of the range, too, will be a considerable power for concentrators and surface pumping. At Soudan and Ely, Vermilion range, are ten deep shafts, some of them down to 1,000 feet, and all big producers. These are farther from the source of power than any of the Mesaba properties, but not too far for economical distribution. While it is by no means impossible that electricity shall be substituted for steam in the movable steam shovel, it is not probable that efforts in this direction will be as urgent as to replace steam engines by motors at shafts and in pumps.

There is just now on all ranges and in the copper region of Lake Superior a very considerable increase of interest in electrical mine power, and at several points important installations are in progress or are soon to begin. At the sixty-first level of the Quincy mine, No. 7 shaft, the ground has been very troublesome and has had a tendency to come together, which has bothered the management for some time. There a development interesting to both miner and engineer will probably take place.

The New Metallized Carbon Filament Lamp.

In our issue of June 24 was printed the Institute paper of Mr. John W. Howell on the new "metallized" carbon filament lamp of the General Electric Company, that paper treating the subject from the technical point of view. The sequel has been the commercial announcement of a new line of high candle-power incandescent lamps, at 2.5 watts per candle, measured by present standards of horizontal candle-power reading, and with a life equal to the present standard 3.1 watts-per-candle lamp. The actual gain is 20 per cent greater efficiency than is at present obtained from the highest efficiency incandescent lamps, on a basis of equal life.

FIGS. 1 AND 2.—METALLIZED CARBON FILAMENT LAMP.

The General Electric Company is developing these lamps first in the high candle-power sizes, in units of 50-cp (horizontal cp rating) and higher, to meet the demand for large lighting units, supplementing its Meridian lamps in the field of general illumination between the arc and the ordinary incandescent lamp. Appreciating the large gain in lighting efficiency that may be secured by the use of properly designed reflectors, the company has designed a special line of Holophane Pagoda reflectors for use with the new high candle-power units. These reflectors are of the well known Holophane design, of prismatic glass, and when used with the lamps form a brilliant and highly efficient lighting combination of attractive appearance.

Two forms of reflectors are provided, the distributing, or "D" form, shown in Fig. 1, giving a lighting distribution similar to that from the Meridian lamp, as may be seen in the diagram Fig. 3. This is the form of reflector for general use. The other form of reflector is known as the concentrated, or "C" form, shown in Fig. 3, giving a concentrated distribution beneath the lamp, as outlined in diagram Fig. 4. This form of reflector is suitable for use in long, narrow rooms with high ceilings, such as hallways, in window lighting, or wherever a concentration of light is desirable.

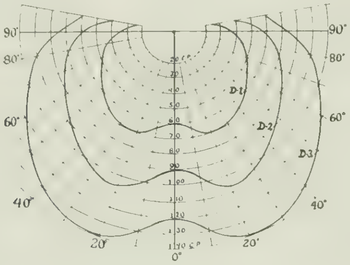


FIG. 3.—DISTRIBUTION CURVES.

The lamps are at present supplied in three sizes as described in the following table:

TABLE OF SIZES AND VALUES.

Type No.	Total watts per lamp.	Distributed candle-power in downward direction with "D" form of reflector.	Concentrated candle-power in in downward direction with "C" form of reflector.
3	125	70 (See Curve D-1, Fig. 3)	120 (See Curve C-1, Fig. 4)
4	187½	105 (See Curve D-2, Fig. 3)	180 (See Curve C-2, Fig. 4)
5	250	140 (See Curve D-3, Fig. 3)	240 (See Curve C-3, Fig. 4)

The appearance of the lamp is enhanced by having the bulbs frosted to within a short distance of the base. The lamps have larger bulbs than are at present used with standard lamps of similar candle-power, and the life of the lamps is equal to that of the present standard 3.1 watts per candle lamps; that is, about 500 hours useful life, or 700 hours average life.

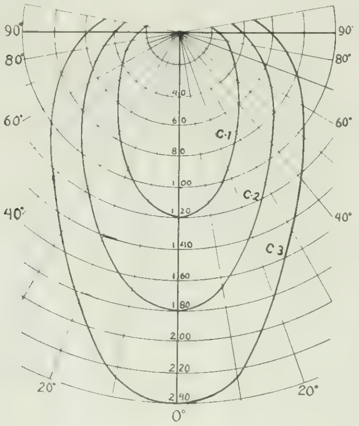


FIG. 4.—DISTRIBUTION CURVES.

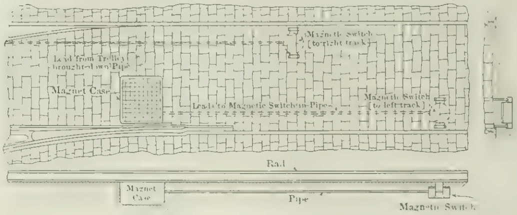
The prices of the lamps and shades are low, so that the investment cost is small; these lamps can be used, therefore, to marked advantage for general illumination in place of more expensive types of apparatus. A new form of shadeholder has been devised by which the shades can be readily attached to, or detached from, the sockets.

Electric Switch for Railways.

Messrs. B. Hughes and H. Young, of Montreal, are the patentees of an electric switch for railways, the design and development of which is in the hands of Albert E. Small, mechanical engineer, Montreal. It is essentially similar to a compass with electric contacts mounted on the same center piece as the needle. The needle and contacts are magnetically held in the neutral position and the swinging to either side controlled by two pole pieces at right angles to the normal position. The switch can be applied to any use requiring the control of electric currents without actual contact between operator and switch being required, such as a block system on railroads, or the operation of track switches on electric railways.

The switch, as at present developed, is arranged for the operation of track switches on electric railways, the operation being under the complete control of the motorman, and does not require the car to be slowed down or the motorman even to see the switch. It does not require any alteration to the roadbed, such as insulated rails, etc., and is proof against damage due to hard usage, climate, frost or wet.

In its application the electric switch is buried beneath the roadbed at a convenient distance away from track switch, the outside or controlling pole pieces being carried up to the surface of the road. The leads from the switch are taken to two solenoid magnets which are in an oil-filled case beside track switch. On the car there is a pilot magnet attached to the truck in such a position that its poles will pass over the pole pieces of the electric switch buried beneath the road bed, at the same time clearing them by at least four inches. The operation is as follows:


Magnetic Switch (to right track)
Lead from Trolley brought down Pipe
Magnet Case
Leads to Magnetic Switch in Pipe
Magnetic Switch (to left track)
Rail
Magnet Case
Pipe
Magnetic Switch

AUTOMATIC TRACK SWITCHES.

On approaching the track switch the motorman sets the handle of the pilot switch in his cab in the direction he wishes to go. This controls the polarity of the pilot magnet on the truck, which in turn magnetically affects the pole pieces in the roadbed and thus causes the electric switch arm to swing over in the desired direction and close the circuit of the solenoid at the track switch, which in turn pulls the switch tongue in proper direction.

The attachment to the switch tongue is of such design that it requires very little alteration to the switch bed and leaves the tongue entirely free so that it can also be moved, if desired, with the ordinary switch iron. There is also an alternative arrangement by which the switch will be brought into action by means of a locomotive or similar iron or steel mechanism passing over it. It is stated that the arrangement will work equally well in all weathers.

◆

New Allis-Chalmers Shops.

The Allis-Chalmers Company has begun the great extensions to its already large works at West Allis, Milwaukee. It has awarded to James Stewart & Company, of Pittsburg, the contract to act as supervising engineers and managers of construction for the entire undertaking. The American Bridge Company, of New York, has secured the contract for the structural steel, erected in place, for three of the new buildings, a contract which calls for approximately 6,800 tons of steel. The Riter-Conley Mfg. Co., of Pittsburg, has been awarded the contract for the structural steel, erected in place, for the foundry and pattern storage buildings and erecting shops, comprising approximately 4,000 tons of steel. All the structural steel for the new Allis-Chalmers works is to be delivered and erected within twenty-three weeks from the date of the signing of the contract. The company expects to occupy its new works by or before next March.

Some idea of the size of the work when extended will be afforded by the fact that the company's present floor space at West Allis has a total area of 652,000 sq. ft., and with the new extensions upon which work is now in progress will add 861,000 sq. ft., or more than double the present capacity, making the total capacity at the West Allis works 1,513,000 sq. ft. of floor space. The plant will be capable of affording employment for 11,000 persons. Thus, in addition to the capacity of the other works of the company in Milwaukee, Chicago, Cincinnati and Scranton, it will bring up the total number employed to the aggregate of 18,000 persons.

◆

Chain Blocks.

The accompanying illustration shows an exhibit which attracted considerable attention at the recent Railway Appliance Exhibition in Washington, D. C. There were arranged in an effective manner, as shown, triplex, duplex and differential chain blocks, as made by the Yale & Towne Manufacturing Company, 9 Murray Street, New York. These blocks are a standard appliance in machine shops, storehouses, round houses and for general lifting work on the leading railways.

THE YALE & TOWNE MFG CO-NEW Y
CHAIN BLOCKS-ELECTRIC HOISTS-YALE LOCKS
ASK YOUR DEALER
THESE HOISTS may be Purchased from leading HARDWARE, MILL & RAILWAY SUPPLY DEALERS throughout the WORLD

CHAIN BLOCK EXHIBIT.

◆

Increasing Boiler Capacity.

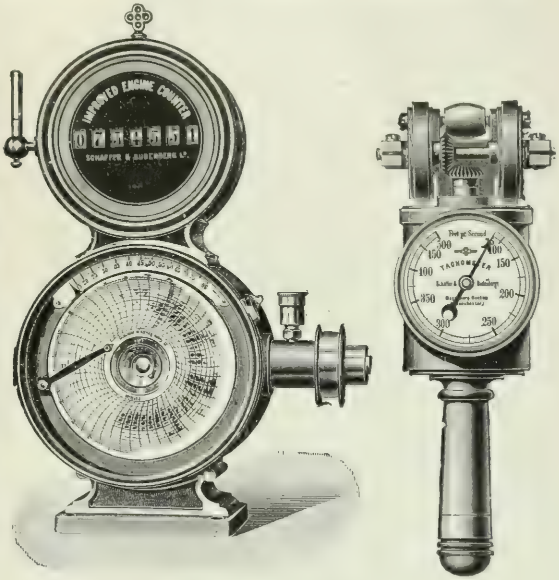
The B. F. Sturtevant Co. in its "Treatise on Mechanical Draft," points out that, independently of the greater economy and higher rates of combustion, mechanical draft stands as the only means by which the increased rate can be economically obtained. Coincidentally the boiler capacity must of necessity be greater, provided the grate area is maintained. The expense or inconvenience of a chimney, to obtain rates above 20 or 25 pounds per square foot per hour, becomes so great as to practically preclude an increase. As observed by A. J. Durston, "As long as draft was dependent upon a funnel for its production, a much greater combustion than 25 pounds of coal per square foot of grate was rarely achieved; with artificial draft, on the other hand, the rate of combustion may be accelerated to any amount, and as a boiler's capability of transmitting heat without injury to itself is simply a matter of degree, experience has been necessary to determine the rates of combustion that can with safety be employed with diffrent types of boilers." When it is considered that in boilers of marine type the combustion rate resulting from the employment of mechanical draft is now carried as high as 40 to 50 pounds, that in torpedo boat and similar service a rate of 70 to 80 pounds is frequent, and in locomotive practice as high as 120 pounds is not at all unusual, the possibilities of increased rates of combustion with mechanical draft are evident.

◆

Tachometers.

The accompanying illustration shows three types of tachometers recently added to the long line of this apparatus manufactured by the Schaeffer & Budenberg Manufacturing Company, Brooklyn, N. Y.

Fig. 1 shows a combined registering tachometer and engine counter, arranged to give a written record of the variations of speed of any machine; a separate pointer indicates the actual running speeds at all times, and the engine counter shows the revolutions. The clockwork is ordinarily arranged to make one revolution of the diagram paper in 12 or 24 hours, but may be arranged for one revolution in seven days. This combination is specially designed for large high-class engines, etc., and is an ornament to any engine when placed on a pillar beside the engine or between a pair of engines.



FIGS. 1 AND 2.—TACHOMETERS.

Fig. 3 represents a new form of tachometer which has been designed for direct attachment to the end of the shaft of high-speed engines, dynamos, turbines, etc. Where the speed is very high, the tachometer is fitted with a noiseless gear, and when required for impact steam turbines or other exceptionally high speed engines, a reducing gear may be fitted.

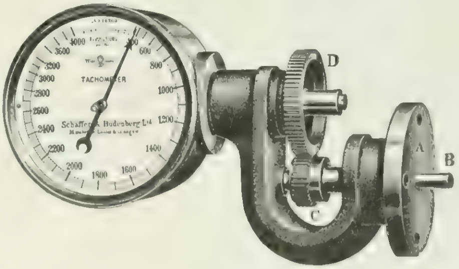


FIG. 3.—TACHOMETER.

Fig. 2 represents a modified form of hand tachometer. It is fitted with bevel gearing and rubber-shod contact wheels, so that when held against a rim or wheel, or the surface of any article running in a lathe, it will indicate directly the speed in feet per minute. The total graduation may be 200, 300, 400 or 500 feet per minute.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Considering the fact that general trade is in what is termed midsummer dullness, business was quite active during the week, although conservative, and values were well maintained in nearly every department. The feature of the week was the usual end of the season offerings by the leading local jobbers. Out-of-town buyers have been in attendance on the sales, and there has been considerable business done. There is still scarcity of spot goods, the mills being well sold up, and it is expected that this will make a higher market later on. Optimism as to the fall trade outlook is the main subject of notice, but it is to be noted that good reorders for summer fabrics are still active at some leading markets. Relatively the best reports come from the Central West and Southwest; the South seems quite generally to hold the improvement reported last week, confidence has increased in the Pacific coast reports, and the only important subject of complaint is that the weather has been too wet or too cool in portions of the corn and wheat belts to allow of the best crop development and harvesting. Textile manufacturing conditions are most satisfactory. Primary markets for cotton goods are strengthened by the sensational rise in the raw material and purchasers are less reluctant to provide for remote requirements, although business of this nature is still far below what might be expected. Efforts to secure immediate delivery comprise the major part of daily inquiries, and an enormous volume of business would be consummated if the mills were able to fill spot orders. Among the industries it might be noted that building and general construction is going forward as never before in the country's history. Manufacturers of machinery and tools are actively employed, the output of hardware is heavy, and the sentiment as to the iron and steel trade is rather more favorable. Crude iron is quiet, but finished products are moving well; rails are selling steadily, and structural material is being called for largely. A heavy conversion order for steel billets has given a stimulus to the trade. Pipe mills are pushed with orders, which is a reflection of the heavy movement going on in extending gas and waterpipe construction. The country's six months' output of pig iron will run little short of 11,000,000 tons, a gain of 33 per cent on 1904 and 12.3 per cent on 1903. Anthracite coal production for six months aggregates about 30,372,000 tons, a total exceeding last year by 3.5 per cent, and only 4.7 per cent less than 1903. Railway gross earnings for the half year will probably show a gain of 6.5 per cent over 1904, and likewise will surpass any preceding year. Copper prices are well maintained at 15c. for Lake and electrolytic and 14¾c. for casting stock. The business failures during the week ending June 29, as reported by *Bradstreet's*, were 186, against 157 the week previous, and 204 in the corresponding week last year.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed a contract with the Kinloch Telephone Company, St. Louis, Mo., for a new central energy lamp line multiple switchboard of 17,000 lines capacity for its main exchange. The contract calls for an "A" board consisting of thirty-seven sections, a "B" board consisting of ten sections, three monitor sections of two operators' positions each, one observation desk of four positions, one combination manager and assistant manager's desk, one combination chief and assistant chief operator's desk, one two-position wire chief's desk. The main switchboard is to be equipped for the present with 12,500 lines, thus making it the largest original installation ever made in the independent field. The Stromberg Company, as might naturally be expected, is very much pleased in having secured this contract because of its size. One of its branch exchanges was installed just before the opening of the St. Louis Exposition, and it is a well-known fact that the manufacturer gave an unusual amount of attention to this installation in order that it might be exhibited as a model central energy exchange to those visitors at the fair interested in telephone equipment. The Kinloch Telephone Company has been well known in the independent telephone field, as the first company to install a large multiple switchboard. The type of board installed was the Kellogg four-division multiple switchboard.

THE MECHANICAL PLANT OF SIMMONS COLLEGE.—An interesting mechanical plant was recently placed in service in Boston by the opening of the new building of Simmons College. The mechanical plant takes care of the heating, ventilating, lighting and power supply required by the college and is located in the basement. The air is drawn into the building by two direct-connected 9-ft. Sturtevant fans, chain-driven from a 10 x 10 in. center-crank engine at 260 r.p.m. The heating and ventilating ducts are of galvanized iron, with the exception of the discharge from the chemical department. Tile ducts are used in the flues of this department, the attic joints being made of 1-in. slate screwed with cemented joints, on account of the effect of acid fumes upon metal ducts. The chemical laboratories are vented by a 42-in. exhaust fan driven by a 1-hp, 110-volt motor, and by a 30-in. fan propelled by a ½-hp motor. A 2-hp motor drives a 60-in. Sturtevant fan in the tower which vents the toilet rooms. The science lecture room table is fitted with a grating through which fumes are exhausted into a duct and drawn away by a fan, so that the most trying experiments with chlorine and other penetrating gases can be carried on with little discomfort. The fans were all installed by the B. F. Sturtevant Co., of Boston.

BELL TELEPHONE OUTPUT IN MAY.—The American Telephone & Telegraph Company's instrument statement for the month ended May 31 follows:

	1905.	1904.	1903.
Gross output	168,764	103,897	96,963
Returned	53,212	51,721	32,297
Net output	115,552	52,176	64,666
Since December 31:			
Gross output	777,065	508,372	1,020,941
Returned	231,115	203,046	441,013
Net output	545,950	305,326	579,928
Total outstanding	5,026,514	4,084,843	3,730,248

The statement for May falls only a trifle short of the record-breaking figures of the preceding months. The total number of instruments outstanding is for the first time brought above the 5,000,000 mark, the actual numbers being 5,026,514. It was just a year ago, or in May, 1904, that the total number exceeded 4,000,000, so that there has been a gain in the last twelve months of no less than 1,000,000 instruments. The gross output for April was 174,207 instruments.

LIGHTING EQUIPMENT WANTED.—Bids will be received until July 12 by the Home Light, Heat & Power Company, of Pittsburg, Kan., for furnishing machinery and apparatus for its new light and power station as follows: One 375 to 400-hp gas engine, direct-connected; one 225 to 250-hp gas engine, direct-connected; one 250-kw, three-phase, 2,300-volt, 60-cycle generator, direct-connected to above gas engine; one 150-kw, three-phase, 2,300-volt, 60-cycle generator, direct-connected to above gas engine; 100 to 150-light, three-phase, series arc lamp transformer and regulator; marble switchboard, station wiring, etc.; 100 6.6 amp. series enclosed arc lamps; three 600-light commercial lighting transformers in large sizes; one second-hand belted 125-kw, three-phase, 2,300-volt, 60-cycle generator with instruments. Owen Ford, Security Building, St. Louis, Mo., is the engineer.

TELEPHONY IN SOUTH DAKOTA.—The reports which have been filed in the office of the State Auditor of South Dakota show that 157 telephone companies have reported for this year. This is an increase of more than 50 per cent in the last year. This applies only to new companies which were completed and in operation prior to the first of May, fifty-four companies having been placed on the list in addition to those of a year ago. Since that time numerous companies have been incorporated.

EQUIPMENT WANTED.—The San Luis Obispo Gas & Electric Company, San Luis Obispo, Cal., is in the market for equipment for its new electric station. The specifications call for three 125-hp, dry-back Scotch boilers; two compound automatic belted engines and one 100-kw single-phase, 60-cycle generator. This generator and another 100-kw single-phase generator, now in operation, will be belted to the engines when the new station is completed.

VENTURA ELECTRIC PLANT.—The Ventura Water, Light & Power Company, of Ventura, Cal., James Barker, manager, has specifications out for equipment for a steam-driven electric plant. Two alternating current belted generators are called for of 75 kilowatts and 150 kilowatts, respectively. There are alternative propositions for a simple Corliss engine or an automatic high-speed engine.

PANAMA ELECTRIC RAILWAY.—It is said that bids will shortly be asked for on the construction and equipment of the Panama Electric Railway, 20 miles in length. Most if not all of the material will, it is expected, be bought in this country.

CANADIAN CUSTOMS DECISION.—A recent Canadian customs decision is to the effect that an electric motor and rheostat for use in connection with a printing press, are subject to duty of 25 per cent.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has just been awarded a large contract in New Orleans for the extension of the subway system of the Cumberland Telephone & Telegraph Company. This is an extension to the original system which Mr. Gest installed several years ago.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market advanced early in the week, but unsettled foreign conditions caused a reaction and at the close of the week the market was dull at moderate declines. A feature was the advance of Reading common to above par and the decided strength of the Pennsylvania group. The action of the leading stocks was reflected throughout both the railroad and industrial list. The electric and street railway securities held their ground, in most cases advances being recorded on the week's business. The advances, with closing prices, are grouped as follows: Allis-Chalmers preferred, ⅝ point, closing at 51⅝; General Electric, 1¾, closing at 176¼; Brooklyn Rapid Transit, 4, closing at 71¾; Metropolitan Street Railway, 3½, closing at 127¾; American Telephone & Telegraph, 1⅜, closing at 142, and American District Telegraph, 1½, closing at 30½. The declines are: Allis-Chalmers, common, ⅛, closing at 13⅝; Westinghouse, 1½, closing at 167½; Western Union, ¼, closing price 93¾; Electric Storage Battery, ¾, closing at 78, ex div., and Interborough Rapid Transit, 2, closing at 200½. The curb market was quiet and irregular, but in the main firm. Following are the closing quotations of July 3:

NEW YORK

	June 27	July 3		June 27	July
Allis-Chalmers Co..........	13⅛	13⅛	Electric Vehicle pfd........	20½	20
Allis-Chalmers Co. pfd....	50⅞	51⅝	General Electric............	175	176
American Tel. & Cable....	90	90	Hudson River Tel..........	..	..
American Tel. & Tel.......	142	139	Interborough Rap. Tran...	201	200⅞
American Dist. Tel.........	29½	29	Metropolitan St. Ry........	124¼	129¾
Brooklyn Rapid Transit. ..	68⅝	72½	N. Y. & N. J. Tel...........	..	
Commercial Cable	..	..	Marconi Tel.................	..	..
Electric Boat..............	28	28	Western Union Tel.........	93¾	93¾
Electric Boat pfd...........	75	73	Westinghouse com..........	166	167
Electric Lead Reduction...	.. .	..	Westinghouse pfd..........	.	..
Electric Vehicle............	16	16			

BOSTON

	June 27	July 3		June 27	July 3
American Tel. & Tel	142⅛	140	Western Tel. & Tel. pfd...	100	101
Cumberland Telephone....	119	117⅝	Mexican Telephone.........	1¼	1¼
Edison Elec. Illum.........	244	*255	New England Telephone...	*139	*139
General Electric............	174¾	175	Mass. Elec. Ry.............	18½	18
Western Tel. & Tel.........	18¾	18	Mass. Elec. Ry. pfd........	61⅛	*62

PHILADELPHIA

	June 27	July 3		June 27	July 3
American Railways.	50½	50⅛	Phila. Traction..............	100	..
Elec. Storage Battery. ...	78	77	Phila. Electric..............	8⅝	8¾
Elec. Storage Battery pfd...	..	..	Phila. Rapid Trans.........	27⅛	28⅝
Elec. Co. of America......	11½	11¾			

CHICAGO

	June 27	July 3		June 27	July 3
Central Union Tel..........	..	..	National Carbon pfd.......	117	117
Chicago Edison............	..	..	Metropolitan Elev. com....	23⅞	24
Chicago City Ry............	..	*190	Union Traction............	..	..
Chicago Tel. Co............	..	..	Union Traction pfd........	..	..
National Carbon......	65	65			

* Asked.

CHICAGO COMMONWEALTH BONDS.—The Commonwealth Electric Company, of Chicago, has sold to a syndicate composed of the Merchants' Loan & Trust Company, N. W. Harris & Co., and Russell, Brewster & Co. $1,000,000 of the company's first mortgage 5 per cent bonds. The price has not been made public, but it is understood to have been well above par. The last sale of Commonwealth bonds on the local exchange was at 107. The three members of the syndicate share equally in the purchase, and the bonds are now being placed with investors. The proceeds of the sale are to be used by the Commonwealth Company in installing three new General Electric turbo-generators, which the company plans to put in the power station at Fisk Street, on the south branch of the Chicago River. One of these turbines will be put in place this year and the other two next year. The constant growth of the demand on the company and on the Chicago Edison Company for electric current makes the enlargement of the Fisk Street station imperative. The station has 30,000-hp at the present time, and is designed to have ultimately 150,000-hp. The sale of the $1,000,000 Commonwealth Electric bonds now makes the issue of first mortgage bonds of the company outstanding $7,000,000.

KINGS COUNTY STOCK.—The directors of the Edison Electric Light Company and the Kings County Electric Light & Power Company have made a recommendation to the stockholders that the authorized capital stock of the company be increased from $5,000,000 to $10,000,000. A special meeting of the stockholders for the purpose of authorizing the increase in the capital stock has been called for July 10 at 11 A. M. It is not the intention to issue all of the $5,000,000 increase of stock at once. Regarding the proposed increase in the capital stock of the company, an officer said: "We have been spending in the neighborhood of $1,000,000 annually for extensions and additions to our general plant and street system, and it has always been the policy of the company to provide liberally, in advance, for the growth in our business. It is in accordance with this policy that it is proposed to authorize the increase of $5,000,000 in the capital stock." The company is doing a very large, growing and profitable business.

DIVIDENDS.—The American Telephone & Telegraph Company has declared a dividend of 1½ dollars per share and an extra dividend of 75 cents per share, payable July 15. The Hall Signal Company has declared a quarterly dividend of 1½ per cent upon the common stock. The Cincinnati, Newport & Covington Light & Traction Company's directors have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable July 15. A semi annual dividend of 1¾ per cent will be paid on the capital stock of the Consolidated Traction Company of New Jersey on July 15. The directors of the United Railways Company of St. Louis have declared the regularly quarterly dividend of 1¼ per cent on the preferred stock, payable July 10. The N. Y. & N. J. Telephone Company's directors have declared the regular quarterly dividend of 1½ per cent, payable July 15. The Consolidated Traction Company, of Philadelphia, has declared a dividend of 1¾ per cent, payable July 15.

NEW YORK LIGHTING BONDS.—The National City Bank and N. W. Harris & Co. have jointly purchased direct from the company and are offering to investors $3,250,000 of first mortgage 5 per cent gold bonds, due Dec. 1, 1948, of the New York Gas and Electric Light, Heat & Power Company. With the purchase of these bonds the entire issue of $15,000,000 is now outstanding. The New York Gas and Electric Light, Heat & Power Company was consolidated with the Edison Electric Illuminating Company in 1901, thus forming the New York Edison Company, practically the entire capital stock of which is owned by the Consolidated Gas Company of New York. The company controls the lighting situation in Manhattan and the Bronx and is growing rapidly.

POWER TRANSMISSION MORTGAGE.—The largest mortgage ever filed in Westchester County, N. Y., has just been recorded at White Plains by the General Transmission Company of Buffalo. The company mortgages its property for $15,000,000 to the Buffalo Loan, Trust & Safe Deposit Company as trustees. The object of the mortgage is to enable the Transmission Company to issue forty-year gold bonds. By filing the instrument at this time the company escapes paying one-half of 1 per cent tax under the new mortgage tax law, which would amount to $75,000.

KEYSTONE TELEPHONE BONDS.—The Keystone Telephone Company, of Philadelphia, has closed a contract with Fisk & Robinson, bankers, of New York, whereby the latter take over $4,000,000 in first mortgage 5 per cent 30-year bonds of the Keystone Company. Local Philadelphia institutions are interested in the allotment obtained by the New York bankers. The telephone company will now be able to clean up its floating indebtedness. The banking interests will be represented on the Board of Directors.

CONSOLIDATED TELEPHONE BONDS.—The Consolidated Telephone Companies of Pennsylvania is making a new offering of its 5 per cent first mortgage bonds at par with a stock bonus of 50 per cent. The bonds are due in 1931, and the authorized issue is $6,000,000, of which $1,000,000 has been reserved to retire prior liens. The amount outstanding is $2,600,000. For the fiscal year ending Dec. 31, 1904, the company had gross earnings amounting to $291,683.

PHILADELPHIA BELL TELEPHONE.—Advices from Philadelphia show that the business of the Bell Telephone Company of Philadelphia for the first five months of 1905 shows a very substantial increase over the same period of 1904. The gross is $1,734,104 and the net is $510,854, an increase in gross of $105,424 and in net of $177,503. The total number of telephones in operation in the system on June 1 was 94,533. At present operation absorbs about 70 per cent of the gross.

EASTERN OHIO TRACTION.—The reorganization committee of the Eastern Ohio Traction Company has recommended the sale of the property under foreclosure of the consolidated mortgage. By the reorganization there will be $200,000 common stock, $1,000,000 preferred stock and $2,500,000 new first consolidated mortgage 5 per cent bonds.

LYNN GAS & ELECTRIC.—The Massachusetts gas and electric light commissioners have authorized the Lynn Gas & Electric Company to issue 2,300 additional shares of stock at $200 a share, of which proceeds from the sale of 600 shares will be used in the cancellation of notes and from the sale of 1,700 shares for additions to plant.

General News of the Week

The Telephone.

IMBODEN, ARK.—The City Council has granted a 50-year telephone franchise to M. H. Long.

OROVILLE, CAL.—H. H. Yard has applied for a franchise for a telephone and telegraph lines along the highways of Butte County.

SAN BERNARDINO, CAL.—Nathan W. Tarr has been granted a franchise for a right of way for telephone lines from Colorado River to San Bernardino.

SANTA BARBARA, CAL.—The Pacific Coast Oil Company was the only bidder for the franchise for the construction of a pipe line and telephone and telegraph line connecting the various oil fields of northern Santa Barbara County. H. D. Morrow, agent for the company, bid $250 for the franchise, which bid was accepted.

COLLINSVILLE, CONN.—The Farmington Valley Telephone Company has raised its capital from $27,000 to $54,000.

MILO, ILL.—The Bradford-Milo Telephone Company has changed its name to the Empire Telephone Company.

POLO, ILL.—The Polo Mutual Telephone Company has been granted the right to operate in Ogle County.

TAYLORVILLE, ILL.—Negotiations are under way to consolidate all the independent telephones in Christian County with the Home Telephone of Taylorville.

HEYWORTH, ILL.—The Heyworth telephone exchange, formerly owned by Henry Fitchhorn, has been turned into a corporate company. The company will make needed improvements.

HACKBERRY, ILL.—The Hackberry Mutual Telephone Company, of this city, has been organized with a capital of $1,200. The incorporators are William McMeese and James F. McKittrick.

ALBION, ILL.—The Edwards County Mutual Telephone Company has recently been organized with a capital of $4,000. The incorporators are E. S. Davis, J. M. Gallagher and others.

RICHMOND, IND.—The Central Union Telephone Company is placing its main street wires under ground.

FRANKFORT, IND.—The local independent telephone company has been sold to the Bell Company for $125,000.

MONSON, IND.—Henry Long, of Medaryville, has purchased the Monson Telephone system. Mr. Long intends building a line from here towards Guernsey and connect with the Monticello system.

CRAIGVILLE, IND.—The German Telephone Company, of Craigvillle, has filed articles of incorporation. The capital stock is $10,000. John H. Barger, Wm. J. Diehl, Alfred S. Abbott, Walter Reed and David C. Huffman are directors.

MARION, IND.—A bitter fight is on in this city over a petition filed by Oscar L. Garber, president of the Converse Electric Company for a franchise for a long-distance telephone line through the city of Marion. The Bell Telephone Company is opposing the petition. The city officials indicated plainly that they favor the granting of the franchise to the new company.

WABASH, IND.—The Home Telephone Company, of this city, has sold its franchise for an exchange at Lagro, a small town in this county, to Messrs. Taylor, Dellinger & Sons, of Bloomfield, O., and the exchange will now be operated independently. The Central Union Telephone Company has petitioned for a franchise in Lagro, but the citizens are opposing the granting thereof.

McCRACKEN, KY.—The Paducah Home Telephone, of McCracken, has been chartered with $250,000 capital stock.

FRANKFORT, KY.—The Lynn Grove Independent Telephone Company, Calloway County, has been formed with a capital of $2,000.

SLEEPY EYE, MINN.—The Sleepy Eye Telephone Company, recently organized with a capital of $25,000, has begun active work in extending lines throughout this section of Brown County.

KANSAS CITY, MO.—The Independent Home Telephone Company has filed a notice of increase in capital stock from $30,000 to $60,000.

MONROE, MO.—The Kilbick Telephone Company, of Monroe, capital $15,000, has been chartered. The incorporators are A. Thompson, E. A. Easter and others.

JERSEY CITY, N. J.—The Coast Line Telephone Company has been incorporated with a capital stock of $1,000,000. The incorporators are D. A. Reynolds, Eugene H. Brook, and Edward P. Clark.

ALBUQUERQUE, N. M.—The Colorado Telephone Company will at once start work on improvements to its system in Albuquerque, to cost in the neighborhood of $60,000.

SANTA FE, N. M.—The Colorado Telephone Company has been granted a fifty-year franchise for the building and operation of a telephone line in [illegible]

WEEDSPORT, N. Y.—The Weedsport Telephone Company has been organized with a capital of $20,000. The incorporators are Charles S. Cay- [illegible] R. Dursten.

FULTON, N. Y.—The Patrons' Telephone Company has been incorporated with a capital stock of $25,000. The directors are G. D. Adams, E. D. Beard[illegible] Kellogg, Fulton.

NEW YORK, N. Y.—The New York & Rockaways Telegraph and Messenger Company has been formed to build a telegraph line from Brooklyn to Rockaway and Far Rockaway; capital, $10,000. Incorporators: Simon E. Ostrom, C. F. Young, Theo. Miller, Edward J. Canty, Brooklyn; D. D. Dillon, Glenn O. Heath, W. L. Kearney, New York City.

ALBANY, N. Y.—The Lake Champlain Telephone and Telegraph Company has been incorporated with the Secretary of State to operate lines from Eagle Bridge through Rensselaer, Washington and Essex counties in New York State and Bennington, Rutland and Addison counties in Vermont. The capital stock is $250,000, and the directors named are Henry E. Hawley, of Albany; J. N. Keller, F. A. Houston, C. T. Keller and F. W. Story, of Boston, Mass.; O. A. Dennis, of Whitehall, and E. D. Raymond, of Fair Haven, Vt.

GASTONIA, N. C.—The Piedmont Telephone and Telegraph Company has purchased the telephone interests of the Bedford Telephone Company.

NEWTON, N. C.—The Piedmont Telephone and Telegraph Company, owner of the local exchange and a number of toll lines, is making preparations to rebuild all its toll lines. Copper wire and juniper posts will be used, and 100 miles of lines will be rebuilt at once.

MT. GILEAD, OHIO.—The Morrow County Telephone Company has increased its capital from $30,000 to $150,000.

HAYNESVILLE, OHIO.—The Auglaize Telephone Company of Waynesville has certified to an increase of capital from $15,000 to $20,000.

WATERVILLE, OHIO.—The Citizens' Telephone Company, of Waterville, has been formed by J. Farnsworth, Elisha B. Southard and others. Capital, $50,000.

UPPER SANDUSKY, OHIO—The North Baltimore Telephone Company, $25,000 capital, has been incorporated. T. P. Sylvan, of Columbus, is one of the incorporators.

MT. STERLING, OHIO.—The Home Telephone Company has been chartered by W. H. Alkire, N. A. Riggin, G. M. Fisher, H. L. Cook, T. S. Alkire, T. P. Sylvan. Capital $15,000.

NEW CARLISLE, OHIO.—The New Carlisle Telephone Company has been incorporated by C. D. Shelton, E. C. Miller, R. B. Hoover, E. A. Reed, T. P. Sylvan. Capital, $25,000.

CINCINNATI, OHIO.—The Cincinnati & Suburban Bell Telephone Company has purchased the plant of the Independence (Ky.) Telephone Company, and it will hereafter be run in conjunction with the local company.

COLUMBUS, OHIO.—Upwards of a quarter of a million of dollars is to be invested in the Central Union Telephone Company's new exchange and division headquarters in Columbus, Ohio, for which plans are now under consideration. The improvements will include a new $100,000 building and complete new switchboard and central office equipment capable of taking care of more than 10,000 telephones.

MESHOPPEN, PA.—The Meshoppen and Auburn Telephone Company has been incorporated with a capital stock of $5,000.

PROVIDENCE, R. I.—At the meeting of the Narragansett Council an unusual petition was presented by the Providence Telephone Company. As a rule when a corporation desires to reduce rates it does so without asking the permission of the representatives of the public. In Narragansett, however, it was necessary to obtain the sanction of the Council before making a 20 per cent reduction in local rates. A 15-year franchise voted by the Council contained a clause fixing rates, and the company was allowed to change them only in the event of a general reduction throughout the system. Local rates were lowered in all the cities and towns covered by the Providence company, but the reduction was not general, and it was considered advisable to request the Narragansett Council to authorize the local reduction contemplated. Accordingly a petition was presented and the council members voted for the reduction as requested by the holders of the franchise.

BOOGE, S. D.—The Rock & Minnehaha Telephone Company has been incorporated with a capital of $2500, by Thos. Thompson and others.

CENTERVILLE, S. D.—The Centerville Rural Telephone Company has been incorporated. Capital, $25,000. W. F. Ege and others are the incorporators.

MEDINA, TENN.—The Iorn Telephone Company is proposing to build a line from Jackson to Medina, a distance of fourteen miles, and to establish an exchange at Medina. The Cumberland people have an exchange here.

NASHVILLE, TENN.—Determined efforts are being made by the officials of the Automatic Telephone Company of Chicago to secure a franchise for their telephone service in Tennessee. Ernest H. Mitchell and C. A. Thatcher, of Chicago, representing the Automatic interests, appeared before the City Council of Nashville recently, and applied for a fifty-year franchise, offering the city the privilege of buying the plant at the expiration of twenty-five years.

MASON, TEX.—Gus W. Schussler has sold out his entire telephone interests here to the Texas Telephone & Telegraph Company for $7,000.

RICHMOND, VA.—The telephone company chartered in Virginia early in the year for the purpose of taking over the property of the Lynchburg Telephone Company, and also the plant of the Bell interests, and to extend and improve the same, has obtained permission to increase its authorized issue of capital stock from $200,000 to $2,500,000. W. T. Gentry is president; Fairfax Montague, vice-president; D. T. Carson, treasurer.

PORT ANGELES, WASH.—The Independent Telephone Company, of Seattle, proposes to extend long distance lines to Port Angeles and elsewhere.

Electric Light and Power.

TROY, ALA.—Messrs. Chas. Henderson, H. D. Boyd and others of Troy, together with the owners of the Elba Electric Power Company, have organized the Pea River Power Company, paid up capital $50,000, authorized $200,000. They are now arranging for the erection of a power house, etc. Their plans include an electric plant and railway service from Troy to Elba and perhaps on the Gulf.

SAN FRANCISCO, CAL.—The local consumers of gas and electricity have formed an organization to secure better service and more accurate metering. The annual dues are one dollar.

SANTA MONICA, CAL.—The City Trustees have decided to appoint a committee to investigate and report on the question of municipal ownership of the gas and electric light plants.

VENTURA, CAL.—The proposed electric light plant for Ventura will cost $25,000, and the water works $100,000. It is uncertain when the contracts will be let, as the matter is delayed by ligitation.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed a resolution awarding to the San Francisco Gas & Electric Company the contract for supplying the city with gas, electric light and power during the year, for $320,000.

OAKLAND, CAL.—The bid of the Oakland Gas, Light and Heat Company for lighting the city for the next fiscal year, has been accepted and the contract awarded it on a schedule that will furnish light all night every night in the year.

SAN FRANCISCO, CAL.—The Shasta Power Company will have a stockholders' meeting, Aug. 26th, to act upon a proposition to create a bonded indebtedness of $100,000 for the purpose of raising money to complete the construction and equipment of its hydro-electric transmission plant on Bear Creek, Shasta County. Work is now in progress.

SAN FRANCISCO, CAL.—The Supervisors of San Francisco have passed to print an ordinance appropriating $320,000 for the public lighting of the city, which is to be paid to the San Francisco Gas & Electric Company in monthly installments for the fiscal year beginning July 1, 1905. There are to be 1,200 arc lamps and 5,550 gas lamps. The public school lighting will cost $4,000 additional.

SAN FRANCISCO, CAL.—P. L. Flanigan, of Reno, Nev., has arrived in San Francisco, to make arrangements for supplying lighting facilities. The large three-phase generator of the Reno Water, Light & Power Company has been burned out by a heavy short circuit on the lines. This is the third accident of the kind that the company has experienced within a few months. The Washoe Power & Development Company recently started up its plant, but has only a few patrons in Reno.

SAN FRANCISCO, CAL.—It is understood that the Merchants' Mutual Light & Power Company, of Santa Barbara, has placed provisional orders for a McEwen engine with Henshaw, Bulkley & Co., and for 250-kw. and 75-kw., 3-phase belted generators with the Bullock Electric Company. There is much public sentiment in favor of a lighting plant to be owned by a number of the local business men who have paid high rates in the past. The Edison Electric Company, of Los Angeles, operates a steam power lighting plant at Santa Barbara, with a capacity of about 600 kw.

FARMINGTON, CONN.—The Farmington River Power Company has elected directors as follows: Austin C. Dunham, James L. Howard, Atwood Collins, Henry Roberts, E. C. Terry, John S. Hunter, W. F. Bacon and H. C. Judd.

YALESVILLE, CONN.—At a borough meeting in Wallingford, $4,500 was appropriated to buy the Hotchkiss Bros.' property and rights. This purchase takes in one of the finest water privileges in the county, and will grant to the electric plant at Wallingford all the power necessary to extend it to Yalesville.

WILMINGTON, DEL.—A franchise has been granted to the Wilmington Light, Heat & Power Company.

COVINGTON, GA.—The town of Covington has awarded a contract to W. R. Jennison, of Atlanta, for installing the new machinery for the electric lighting plant which is to be rebuilt, having been demolished by a boiler explosion.

SAVANNA, ILL.—The Council is considering the question of establishing a municipal lighting plant.

BLOOMINGTON, ILL.—The Consumers' Light & Heat Company has been incorporated with a capital stock of $100,000. The incorporators are George M. Mattis, S. A. Power and Charles Zilly.

MURPHYSBORO, ILL.—The Carbondale Water, Light & Power Company's business has been placed in the hands of a receiver upon application of the American Trust & Savings Bank, of Chicago.

CRAWFORDSVILLE, IND.—The City Council has passed an ordinance governing and regulating the stringing of electric wires in the city.

LOGANSPORT, IND.—The City Council has passed an ordinance governing the stringing of wires in the city, providing for inspection and the licensing of all electrical workers.

KOKOMO, IND.—The Kokomo Gas & Light Company has incorporated with a capital stock of $100,000. Alexander Linderman, K. L. Ames, L. S. Owsley and B. S. Wales are directors.

PERU, IND.—This city has a dead horse on its hands in the shape of a municipal electric light plant, which is sinking money for it every day. About the time natural gas gave out the owners of the old plant were shrewd enough to unload it on the city. Now the city has it, and the Council does not know what to do with it. If the Council undertakes to sell it the cry is raised by municipal ownership advocates that the public utilities are being gobbled up by the big corporations and the councilman is a "grafter" who favors selling them. The neighboring town of Montpelier recently gave its electric light plant away to escape the burden of maintaining it. It is stated that there are a number of towns in Indiana that would be glad to be relieved of municipal plants.

COALGATE, IND. TER.—The Coalgate Electric Light & Water Power Co. has been incorporated with a capital of $100,000. The incorporators are J. H. Carson, A. W. Archer, Joe Begg, Thomas Pope, Ed. McLaughlin, J. S. Hume and Mike Mayer.

SPIRIT LAKE, IOWA.—This city has decided to expend about $6,000 in improving the electric light plant.

DAYTON, IOWA.—The Dayton Heating & Lighting Company has been organized with C. D. Waterbury, president, and H. E. Nelson, secretary, and a capital of $10,000.

McDONOGHVILLE, LA.—The McDonoghville Water, Power & Improvement Company, has been incorporated, with a capital of $100,000. The incorporators are Henry Hart, C. A. Chandler, T. Landry and others.

SHREVEPORT, LA.—The City Council has accepted the bid of the Shreveport Gas, Electric Light & Power Company to light the city for 6 years.

GRAYSON, KY.—Claude Wilson, of Olive Hill, has been granted a franchise to build an electric light plant at Grayson, and to install a telephone system. The two plants will cost $25,000.

CAMPBELLSVILLE, KY.—Articles of incorporation have been filed with the County Clerk at Campbellsville, Ky., to build and operate an electric light plant there, to be known as the Campbellsville Electric Light Company. The officers are J. L. Adkinson, president; C. R. Davis, secretary and treasurer; B. S. Kincart, manager.

BANGOR, ME.—The Bodwell Water Power Company has been organized, with Chas. V. Lord as president and Wm. P. Hubbard as treasurer.

KENNEBUNK, ME.—The Atlantic Shore Line Railway has purchased a tract of land near the Kennebunk River between Kennebunk and Town House and will begin at once upon the erection of a new auxiliary power house. The equipment will include a 400-hp. McIntosh and Seymour tandem-compound engine and a 300-kw. generator.

CLINTON, MASS.—The Clinton Gas & Electric Company has decided to borrow $250,000, a part of which will be expended for improvements.

TEMPLETON, MASS.—A corporation will soon be formed under the laws of Massachusetts to furnish electric light and power in the town of Templeton.

WARREN, MINN.—J. G. Robertson, of St. Paul, has secured the contract for a 125-hp boiler and engine for the electric light plant, and the Fort Wayne Electric Works, Fort Wayne, Ind., for a 75-kw dynamo; total cost, $6,225.

INTERNATIONAL FALLS, MINN.—The International Light & Water Company has been incorporated with a capital stock of $50,000. The incorporators are E. W. Backus, W. F. Brooks, R. L. Horr and C. J. Rockwood, Minneapolis; H. V. Winchell, Butte, Mont.

HAZLEHURST, MISS.—The Town Council is considering the question of issuing $10,000 bonds to procure an additional water supply and improve the electric light plant.

LIVINGSTON, MONT.—John L. Bright has purchased the plant of the Livingston Water Power Co., and will expend about $60,000 in improvements.

JACKSON, MO.—At a special election held here June 27 it was voted to bond the city for $27,000 for a water and light plant. The city will advertise for bids and the work is to commence at once.

KIRKSVILLE, MO.—The Missouri Heat, Light & Power Company, of Kirksville, has been incorporated with a capital of $50,000, three-fifths paid. The incorporators are O. H. Davidson, of Des Moines, Ia.; W. B. Kinnish, of Adel, Ia.; J. H. Shively, of Perry, Ia.; C. H. Shively, W. T. Baird and M. D. Campbell.

ALMA, NEB.—Fairbanks, Morse & Co., of Omaha, have secured the contract for a producer gas plant, for $4,850, and MacKean, Ball & Co., Chicago, Ill., for the balance of water and light plant for $15,740. M. A. Earl, First Nat'l Bank Bldg., Chicago, Ill., is the engineer.

SOUTH ORANGE, N. J.—The Village Board of Trustees has appointed a committee, with President Sinclair as chairman, to inquire into the municipal ownership of an electric light plant.

JERSEY CITY, N. J.—The Southern Power Company has been incorporated with a capital stock of $7,500,000. The incorporators are R. B. Harrington, E. B. Sperry and W. R. Journeay, Jr.

NEWARK, N. J.—The Board of Works has approved the resolution directing Morris R. Sherrerd, Chief Engineer and City Surveyor, to ascertain the cost of equipping either the Belleville or the Clifton Avenue pumping station as an experimental municipal lighting plant.

CAIRO, N. Y.—The Cairo Electric Light & Power Company has been incorporated with a capital stock of $80,000. The directors are C. E. Hewitt, M. G. Hubbard, Chatham, N. J., F. G. Walters, Cairo.

BROOKLYN, N. Y.—Bids will be received until July 10 by C. B. J. Snyder, supt. school buildings, New York City, for installing electric equipment in additions to School 110, Borough of Brooklyn.

WHITE PLAINS, N. Y.—The largest mortgage ever filed in the Westchester County Register's office was placed on record June 27 by the General Transmission Company, of Buffalo, which mortgaged its property for $15,000,000 to the Buffalo Loan, Trust & Safe Deposit Company, as trustee. The object of the mortgage is to enable the transmission company to issue 15,000 $1,000 bonds, payable in gold in forty years.

ALBEMARLE, N. C.—The Albemarle Light & Water Company has been incorporated with a capital of $25,000 by A. L. Patterson, J. M. Morrow and others, all of Albemarle.

SANFORD, N. C. The town of Sanford is considering purchasing the electric light plant of the late A. F. Spooner. The plant is valued at $19,000, but can be purchased at about $6,500.

CHARLOTTE, N. C.—It is reported that the Catawba Power Company, of Charlotte is seeking additional water power for electrical development on account of their rapidly growing business and the increasing demand for power, which has about taken up all the available power in sight.

GALION, OHIO.—The Crawford Gas & Electric Company, recently organized here, is preparing to construct a power house here, at a cost of $75,000.

COLUMBUS, OHIO.—The Merchants Heat, Light & Power Company, of Canton, has been formed by T. F. Turner, W. L. Stolzenbach and others. Capital, $500,000.

BELLEVUE, OHIO.—The Mutual Light & Water Company has secured a franchise to light the streets by electricity. The company is about to be incorporated, with a capital of $50,000. The incorporators are E. C. Crocker, B. F. Bell, Peter Brady, and others.

COLUMBUS, OHIO.—Recently the Council passed an ordinance fixing the rate for lighting purposes at 5 cent per kilowatt hour. The Columbus Railway & Light Company has enjoined the enforcement of the ordinance. Efforts of the City Solicitor to secure expert testimony to support the cent rate have proven disappointing.

SEASIDE, ORE.—The Seaside Electric Company has been incorporated by Dan. J. Moore, A. S. Frosled, and others.

ASHLAND, ORE.—At a meeting of the City Council of Ashland, Ore., an ordinance was passed for municipal electric light and power plant, operated by water power. A city election will be held July 11, to vote on $50,000 city bonds to pay for the plant. The bonds will bear 4½ per cent interest, payable semi-annually.

SHIPPENSBURG, PA.—The Council has appointed a committee to solicit correspondence and secure information relating to cost and expense of constructing and operating a municipal electric light plant. The present contract does not expire until October, 1906.

YORK, PA.—One of the large dynamos at the Edison Electric Light plant burst June 25, entailing a loss of about $1,000. Large pieces of iron were hurled in every direction, some weighing at least ten pounds being projected through the roof and falling a half square away. No one was injured by the accident.

FORT MANSFIELD, R. I.—Capt. E. F. Ladd, Q. M., U. S. A., New London, Conn., writes that contracts for an electric lighting system at Fort Mansfield have been awarded as follows: To J. F. Buchanan, of Philadelphia, Pa., for wiring and fixtures; Malcolm W. Hill Company, Baltimore, Md., for service lines, and Westerly Gas & Electric Company, of Westerly, for the current.

COLUMBIA, S. C.—A merger has been completed of the Columbia Electric Railway, Light and Power Company and the Columbia Water Power Company, and Edwin W. Robertson has been elected president of the new company. A new mortgage will be executed to cover a bond issue for the purchase of the water power company, leaving a considerable sum for contemplated improvements.

TIPTONVILLE, TENN.—Papers are prepared for a 15-year franchise for an electric light plant to be in operation by September 1, 1905. It is understood that Memphis capital is behind the promoters of the new company.

CENTER, TEX.—The electric light plant owned by Fleshman & Harkrider has been destroyed by fire.

DALLAS, TEX.—The Black Belt Electric Railway & Power Company, Dallas, Tex., is to issue bonds for about 200 miles of electric railroad, with power plants. The company has franchises, rights of way, etc. The company will use 70-pound rails. J. M. Carter is manager.

PROVIDENCE, UTAH.—It is proposed to construct an electric light plant, at a cost of $12,000. A. M. Hammond is town clerk.

COALVILLE, UTAH.—The citizens have voted to issue $10,730 bonds for an electric light plant.

SNOHOMISH, WASH.—The plant of the Snohomish Electric Light & Water Power Company is reported to have been destroyed by fire.

TACOMA, WASH.—The City Council on June 22 granted a franchise to the Seattle-Tacoma Power Company.

KENNEWICK, WASH.—C. E. Wood, of Genesee, has petitioned Council for a franchise for water work and an electric light plant.

FORT LAWTON, WASH.—The Seattle Electric Company, of Seattle, has submitted the lowest bid for installing electric light at Fort Lawton, for $13,576.

TACOMA, WASH.—An ordinance was introduced in Council June 22 providing for the construction of a municipal water power electric generating plant. The resolution was referred.

RIO, WIS.—The Milwaukee Engineering Company is preparing plans for improving the plant of the electric light company at Rio. The probable cost of work is $5,000.

PICTON, ONT.—The Glendora Power Company, of Picton, has been incorporated with a capital of $100,000.

DEVONPORT, TASMANIA.—The electrical engineer of Devonport, Tasmania, sends a newspaper noting his first annual report on the municipal lighting plant. It shows the cost for the year to be £1,149 and the income, £1,246, leaving a balance of £96. The balance sheet exhibits a return of 6.4 per cent. upon the capital invested, or 4 per cent. interest, 1 per cent. sinking fund and [illegible] per cent. [illegible]

The Electric Railway.

MOBILE, ALA.—Bids will be received until July 1 by the Mobile Light & Railroad Company for grubbing, clearing, grading, sewer pipe, waterway, masonry and drainage for 2¼ miles of electric car line. Approximate quantities: 13.65 acres clearing and grubbing, 8,000 cu. yds. earth, 260 lin. ft. sewer pipe, 12 cu. yds. masonry.

NORWICH, CONN.—The railroad committee of the Legislature has made a favorable report on the resolution incorporating the Lebanon Street Railway Company. The Consolidated Railway Company offered considerable opposition for a time to the granting of the charter, but a compromise was finally effected and the opposition withdrawn. The charter authorizes the company to construct and operate a street railway in the towns of Norwich, Bozrah, Franklin, Lebanon and Columbia.

WILLIMANTIC, CONN.—The bill incorporating the Willimantic & Stafford Street Railway Company has been passed with two amendments, adding South Street in Willington to the route between Mansfield Center and Stafford Springs, and allowing the company to use water power in the towns of Windham, Mansfield, Willington, Coventry, Ellington and Tolland. The incorporators of the new company are Charles W. Comstock, Edwin W. Higgins, Lewellyn J. Storrs and Costello Lippitt. The capital stock is $700,000. The company is authorized to sell its surplus electricity for light or power in any territory where a regularly organized company is not now operating. The company is chartered to build an electric railway in Windham, Mansfield, Willington and Stafford. It will build from the railroad station in Willimantic to Mansfield Center, thence to South Willington through Spring Hill, Storrs and Mansfield and on to Stafford Springs.

SPRINGFIELD, ILL.—The Sangamon Valley Railroad Company has been incorporated by the Secretary of State. It is proposed to construct an electric interurban road from Decatur to Quincy, with branches from Springfield to Tallula, from Petersburg to Lincoln, and from Springfield to Pittsfield.

WABASH, IND.—The Town Council of North Manchester has granted a franchise to the Indiana Northern Traction Company.

WABASH, IND.—The Indiana Northern Traction Company will soon ask for bids for the construction of a grade for a line between Wabash and North Manchester.

BLUFFTON, IND.—The Muncie, Hartford & Fort Wayne Traction Company has awarded the contract for the construction of its line between Bluffton and Fort Wayne to Hayes Sons, of Cleveland, Ohio.

INDIANAPOLIS, IND.—The North Central Railway Company has filed articles of incorporation, the capital stock being $500,000. The directors are John Conkey, of Valparaiso; C. H. Jones, B. F. Watson and E. L. Gower, of Indianapolis.

ELWOOD, IND.—The stockholders of the Fort Wayne & South Bend Traction Company have elected officers as follows: President and general manager, A. J. Behymer, Elwood; first vice-president, Daniel Zook, Nappanee; second vice-president, R. A. Miller, Indianapolis; secretary, A. R. Kilgore, Syracuse; treasurer, Jacob E. Kilgore, Syracuse; chief engineer, John A. Shafer, Indianapolis.

OSKALOOSA, IOWA. — The Oskaloosa & Boston Electric Railway has been organized with a capital of $50,000. The incorporators are J. L. Spooner and others.

ALEXANDRIA, LA.—The Alexandria Electric Street Railway Company has been organized with the following officers: T. G. Bush, president; M. L. Alexander, vice-president; R. S. Thornton, secretary and treasurer.

BOSTON, MASS.—The Massachusetts Railroad Commission has approved the plans of the Boston Elevated Railway Company for the extension of the elevated structure from Guild Street, Roxbury, to Forest Hills. The Board approves the location of a station at Egleston Square, about half way between Dudley Street and Forest Hills.

FITCHBURG, MASS.—The Fitchburg & Princeton Street Railway Company is being organized to build and operate a line from the terminus of the Worcester & Northern Street Railway at Princeton, through the town of Westminster, to make connection with the Fitchburg & Leominster Street Railway, thereby gaining entrance to that city. The organizers are practically the same as the principal stockholders of the Worcester & Northern Street Railway, the prominent ones being Albion R. Clapp, of Wellesley Hills; Henry W. Warren, of Holden; Henry C. Delano, of Princeton; John H. Daniels, of Fitchburg; E. L. Douglass, J. E. Fuller and Charles C. Milton, of Worcester.

SAGINAW, MICH.—Articles of incorporation have been filed by the Saginaw & Southwestern Railway Company, with a capital stock of $50,000. The line is to extend from Saginaw to St. Johns, a distance of 50 miles, and will connect with the Lansing Suburban Company's lines. The officers of the company are: President, W. L. Linton; vice-president, E. P. Waldron; secretary, William G. Emerick; treasurer, A. S. Corutright.

GRAND RAPIDS, MICH.—Some of the lines of the Grand Rapids Railway Company were put out of commission for nearly a week by a flood which visited that city last month. The company's power house is located in the valley of the Grand River, and is equipped with pumps, in anticipation of such disaster. It was found necessary to brick up the main entrance of the plant to a point above the high-water mark to keep the water from flowing in and putting the boilers out of service. The lines of the Grand Rapids, Grand Haven & Muskegon Interurban Railway were badly damaged by the high water, and were out of service for nearly a week.

MISSOULA, MONT.—George W. Dougherty, representing Eastern capitalists, is seeking a franchise for the construction of an electric railway through the Bitter Root Valley.

BILLINGS, MONT.—Yegen Bros., of this city, will petition the City Council for a franchise for an extensive electric railway system. They are now building a large power plant on the Yellowstone River.

TRENTON, N. J.—The New Jersey & Pennsylvania Traction Company has opened its new line between this city and Lambertville, N. J., via Morrisvilie, Yardley and Newhope, Pa., and is already doing a very large business.

NEW YORK, N. Y.—The Bronx, Yonkers & White Plains Railway Company has applied to the State Railroad Commission for a franchise for an electric railway to run from the Bronx to White Plains and Yonkers.

NEW YORK, N. Y.—At a meeting of the board of directors of the Westchester Company, Marsden J. Perry, of Providence, was elected a director of the company and a member of the executive committee. Mr. Perry is largely interested in electrical roads through New England and is president of the Rhode Island Traction Company, the stock of which company is controlled by the United Gas Improvement Company. Including Mr. Perry, the Westchester directorate now stands as follows: William Lanman Bull, William H. Buckley, attorney, New York; Evans R. Dick, Andrew Freedman, John B. Jackson, Charles E. Lewis, New York; John R. McAllister, Wm. Barclay Parsons, Marsden J. Perry, Robert C. Pruyn, Robert E. Robinson, Frederick W. Whitridge, New York; H. Carroll Winchester.

LOWELL, OHIO.—Citizens of Lowell have agreed to give financial assistance to induce the Parkersburg, Marietta & Interurban Railway, to build from Marietta to Lowell.

YOUNGSTOWN, OHIO.—The announcement of the reorganization of the Eastern Ohio Traction Company and the proposed extension of that company's line from Garrettsville to Leavittsburg is followed by the news that seven new street car lines will be incorporated soon.

CLEVELAND, OHIO.—The Felton ordinance, granting the Cleveland Electric Railway Company a franchise to operate a street railway in Woodland Hills Avenue, from Broadway to Quincy Street, and thence in Doan Street to the intersection of its present line at Superior Street, has been passed by the City Council by a vote of 19 to 13. It is expected that Mayor Johnson will veto it.

LANCASTER, PA.—The building committee of the Lancaster & Eastern Electric Railway Company has been directed to proceed at once with the construction of the line from this city to Christiana Gap.

HARRISBURG, PA.—The Royalton & Elizabethtown Street Railway Company has been chartered. The incorporators are William Trimble, S. L. Hibbard, Jr., C. H. Johnson, G. H. Wolfe, E. M. Raymond and L. G. Souder.

BLOOMSBURG, PA.—The Bloomsburg & Millville Electric Railway Company has given a mortgage to the Commonwealth Trust Company, of Harrisburg, for $250,000, and the construction of the line by Contractor T. H. Regan, of Philadelphia, will now proceed.

COLUMBIA, S. C.—The Oconee County Railway Company has been commissioned by the Secretary of State. The concern is to have an initial capital of $50,000 and an ultimate capital of $200,000. The corporators are W. P. Anderson, J. W. Shelor, Wm. Bibb, J. J. Haley, L. A. Edwards, James Bates, W. L. Thomas, J. D. Sheldon, E. C. Marett, J. R. Heller and J. W. Shirley.

GAINESVILLE, TEX.—The City Council at its regular meeting by a unanimous vote has granted Judge Hassinger and associates a franchise for an electric railway. This is the Gainesville-Sherman interurban line, about which so much has been said lately.

OGDEN, UTAH.—A fifty-year franchise has been granted to the Salt Lake & Ogden Electric Railway Company. Simon Bamberger, of Salt Lake City, is promoter of the enterprise.

NORFOLK, VA.—The company which will build and operate an electric road between Ocean View and Pine Beach has been chartered with a capital stock of $25,000. The name of the new company will be the Ocean View & Pine Beach Railway Company. The officers are H. L. Page, president; B. W. Leigh, vice-president, and M. C. Elliott, secretary and treasurer.

LYNCHBURG, VA.—The Lynchburg Traction & Light Company has given notice of a substantial increase in the pay of all its employees, to go into effect July 1. The increase is voluntary and is a surprise to the employees, who have well-fitted clubrooms, a beneficial organization with medical attendance free, and many other advantages, all engineered for them by R. D. Apperson, president and general manager.

BERRYVILLE, VA.—After carefully examining all the water-power possibilities at numerous points along the Shenandoah River in Clarke and Jefferson Counties, the Winchester & Washington City Railway Company has decided to purchase the estate of former Governor Lowndes, from David Sloan, the Millville milling property, lying 3 miles east of Charles Town and 1 mile south of Millville station. It will supply all the property needed for the proposed development of electric power from the fall in the river in that vicinity.

WINCHESTER, VA.—After a delay of several months the Winchester & Washington City Electric Railway Company will immediately proceed to construct a power house and concrete dam on the Shenandoah River, where power will be developed to furnish electric lights for Winchester, Charlestown, Berryville, Harper's Ferry and other cities and towns in this section. This power house will also furnish electric power for the new trolley line that is to connect with the Southern Railway at Bluemont or some other point off the Blue Ridge for Washington. Engineer N. Wilson Davis is now at work on the plans and specifications.

CHARLESTOWN, W. Va.—The Winchester & Washington City Railway Company has bought a $10,000 water power on Shenandoah River near Charlestown, and will develop the power. An electric railway may be constructed from Harper's Ferry to Winchester via Charlestown. A line will also be built from Berryville to Bluemont, Va., and possibly on to Washington, D. C.

MANITOWOC, WIS.—The Fox River Valley Railway Company, which projects an interurban line from Sheboygan to Kaukauna, via Manitowoc, has been granted a 35-year franchise by the Council, and Mayor Stolze intimated that he would probably sign the ordinance. The company will furnish a $50,000 bridge. Plans to purchase the lines of the traction company were defeated when the company advised the Council that its line was not on the market at any price. The company agreed to pave on streets, which it has heretofore refused to do, if the Council would extend the franchise from thirty-five to seventy-five years.

New Industrial Companies.

THE TROLLEY ELECTRIC VEHICLE COMPANY, of Wilmington, Del., has been chartered at Dover with a capital of $1,000,000.

THE WILLIAM HALL ELECTRIC COMPANY, of Dayton, Ohio, has been formed by William Hall, C. S. Hall, M. W. Nichols, J. E. Sollenberger, J. A. Rickey. Capital, $18,000.

THE ELECTRO-PNEUMATIC TUBE COMPANY, of New York City, has been incorporated with a capital stock of $500,000. The directors are G. H. Usher, W. R. Davis and W. H. McCullom, New York.

THE ANDOVER ELECTRIC POWER AND LIGHT COMPANY, of Andover, N. Y., has been formed; capital, $10,000. Incorporators: R. A. Stout, A. B. Richardson and J. H. Backus, all of Andover.

THE KEYSTONE ELECTRIC CONSTRUCTION COMPANY of Passaic, N. J., has been incorporated; capital, $10,000. Incorporators: George W. Graham and Alex. J. Looss, Paterson; Thos. P. Costello, Passaic.

THE SINGLETON ELECTRIC COMPANY, of Macon, Ga., has been formed with W. H. Singleton, W. A. McKenna and M. O'Hara as the promoters. This new concern will deal in general electric supplies.

THE EGAN ELECTRIC & TELEPHONE MFG. COMPANY, of Petersburg, Ill., has been incorporated with a capital stock of $100,000. The incorporators are Charles E. Egan, John S. Hurie and T. W. McNeely.

THE NEUSTADT AUTOMOBILE & SUPPLY COMPANY was incorporated at St. Louis, June 20, with a capital stock of $30,000, fully paid. The incorporators are J. H. Neustadt, John Piehl and F. E. Kampelman.

THE NORTON ELECTRICAL MANUFACTURING COMPANY, of Camden, N. J., has been incorporated with a capital stock of $100,000. The incorporators are Abner Smith, Frederick G. Norton and David L. Hart.

THE NEW JERSEY ENGINEERING AND CONTRACTING COMPANY has been formed in Camden, N. J., to do a general contracting business; capital, $50,000; incorporators, Charles J. Yost, George Gwinner, Robert W. Page.

THE INTERIOR ELECTRIC CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500, to manufacture electrical devices. The incorporators are Robert Gibson, Fred Grant and Henry McIver.

THE ÆTNA ELECTRIC STAGE LIGHTING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $600, to manufacture electric stage lamps. The incorporators are John A. Jacim, Herman M. Pletz and George H. Graeser.

THE MISSOURI ELECTRIC MOTOR COMPANY was incorporated at St. Louis, Mo., June 20, with a capital stock of $10,000, fully paid. The incorporators are Oscar Raschorn, Christian Steinbrueck, Henry W. Hehmann and William Wehrenbrecht.

Legal.

ELECTRIC LIGHT IN BALTIMORE. A dispatch from Baltimore states that Judge Fowler has delivered an opinion in the Court of Appeals affirming the decision of Circuit Court No. 2 in the case of Alexander Brown against the Maryland Telephone and Telegraph Company, of Baltimore. By the decision the telephone company is granted the power to furnish electric light to the city of Baltimore under such regulations as the Mayor and City Council may prescribe.

THE LA ROCHE WILL. An attempt will be made by the family of Frederick A. La Roche, the electrical inventor and automobilist, who died last March, to break the will or letter by which, it is asserted, Mr. La Roche left nearly $1,000,000 to his wife. The case will come up before a surrogate for a decision as to whether a note written by a man with the realization that sudden death might overcome him and disposing of his property is a valid will. By the terms of the letter or will Mr. La Roche bequeathed to his wife all his cash, securities, and other property. No provision was made in the document for his aged father, Charles La Roche, of Philadelphia, or his two brothers and three sisters, who, with the father, are parties to the suit. Mr. La Roche was at the head of the La Roche Automobile Company and was a pioneer in racing and speed tests. He constantly took risks in order to establish records for fast driving. On the day of a race in July two years ago he evidently had a premonition of danger, and just before starting he wrote the letter to his wife that involved the estate. The races came off and La Roche was uninjured. Whether or not he intended to let the letter stand as his will is to be determined. His attorneys hold, as he was too busy to draw up another will. After the husband's death Mrs. La Roche produced the letter will, and proceeded to probate it, but opposition was made by the brothers and sisters and father. They are confident they can break the will. M. F. La Roche, a brother, says that in the event of contestants succeeding in having the will thrown out, Mrs. La Roche will get half the estate and the remainder will be divided among the heirs.

Obituary.

JAMES T. WAFER, who was for seventeen years chief telegraph operator in the Brooklyn Fire Department, died last week at Phillipsport, N. Y. He was born in 1857 in Brooklyn, and as a boy and young man worked as a messenger in the Oil Exchange and as a reporter on the floor of the Stock Exchange.

WILLIAM GARDAM, well known in the mechanical and electrical fields, was killed in a fire at 4,023 Third Avenue, Brooklyn, last week. He was the founder of the firm of William Gardam & Son, now a corporation, makers of drill presses and general machines, in New York. He was born at Leeds, England, over eighty years ago. Mr. Gardam was an expert in his business and an inventor of note. He leaves a widow, two sons, and one daughter.

Personal.

PROF. G. F. SEVER has received from Columbia University the degree of Doctor of Science.

MR. FRED STADELMAN has been appointed assistant manager of the New York office of the Wellman-Seaver-Morgan Company.

MR. F. W. ROEBLING, of John A. Roebling's Sons Company, has been elected one of the new directors of the Equitable Life Assurance Society.

MR. C. H. HINES, a well-known mechanical and electrical engineer, who was recently in Central America, has received an appointment as constructing engineer with the Consolidated Gas Company, of Baltimore, Md.

MR. A. S. McALLISTER has received from Cornell University the degree of Ph.D., following a post-graduate course. The thesis presented for the degree was on the subject of alternating-current commutator motors.

MR. H. W. RITTERHOFF, for 23 years contract agent for the Bell telephone in Kansas City, has resigned to accept the position of general superintendent of the contract department of the Home Telephone Company there, dating from July 1.

MR. MARSDEN J. PERRY, of Providence, who is already largely interested in electrical enterprises, has been elected a director and a member of the executive committee of the New York, Westchester and Boston Railway Company.

MR. HARRY V. CROLL, M. E., for the past eight years with the E. P. Allis Company, and its successor, Allis-Chalmers Company, of Chicago, has resigned and accepted a position with the Wellman-Seaver-Morgan Company, of Cleveland, O.

MR. E. G. CONNETTE, general manager of the Syracuse trolleys, has been made general manager of the Consolidated Street Railroad Company of Worcester, Mass. He is one of the ablest and most progressive street railway managers in the country.

MR. WM. J. CANADA, who had been in charge of electrical work on the Appleyard interurban lines of Ohio for the past two years, has severed his connection with these companies to take up special work with the National Board of Fire Underwriters.

MR. W. A. STADELMAN, eastern agent of the Wellman-Seaver-Morgan Company, and who has been in charge of the eastern office at 42 Broadway, New York City, has been appointed general sales agent of the same company, with headquarters at Cleveland, O., taking effect July 1.

MR. ALONZO BURT, president of the Wisconsin Telephone Company, is to deliver lectures in the state on the use of the telephone. Mr. Burt's object is to popularize the telephone and incidentally to tell the public how to get the greatest benefits from the service and how to avoid things which cause delays and interruptions.

PROF. H. S. CARHART, of the University of Michigan, leaves New York this week for England and then proceeds from Southampton on July 29 on the "Saxon" for South Africa as one of the guests attending the meeting of the British Association there. On his return to Europe, he will take up official work connected with international units and standards.

MR. HERBERT LAWS WEBB, the telephone expert, has just returned to England after giving evidence at Ottawa, Can., before the Parliamentary Telephone Committee there, which is now making inquiry in regard to the craze for the municipal ownership there of telephone plants. Mr. Webb's testimony was most interesting, and was emphatic as to the superiority of American telephone work free from Government ownership.

MR. W. B. PARSONS.—Mr. William Barclay Parsons, who was the chief engineer of the Rapid Transit Commission during the construction of the subway, and became the consulting engineer of the Interborough Company after his work with the Rapid Transit Commission was finished, denied this week a published report that he had left the Interborough Company to become chief engineer of the Ryan-McDonald-Metropolitan syndicate. "Say for me," said Mr. Parsons, "that I am still the consulting engineer of the Interborough and hope to remain in that position."

MR. G. H. PEGRAM.—The resignation of S. L. F. Deyo, chief engineer of the subway division of the Interborough Rapid Transit Company, was announced last week. Mr. George H. Pegram, who since Feb. 1, 1898, has been chief engineer of the Manhattan division—that is, of the elevated system of the Interborough—has been promoted to Mr. Deyo's place and will hereafter bear the title of chief engineer of the Rapid Transit Subway Construction Company. Mr. Deyo has joined the forces of the Metropolitan interests for their new underground enterprise.

Mr. FRANK H. BETHELL, the general manager of the Chesapeake & Potomac Telephone Company, has announced that, beginning with the September issue of the telephone directory the company will abandon its present plan of printing the names of subscribers in the cities of Baltimore and Washington in one volume, and will print the directory of each city separately, thus materially reducing the awkward bulk of the book and giving space for the restoration of the classified business list. This is emphatic testimony to the rapid manner in which Mr. Bethell has built up the service in the two cities.

Trade Publications.

ADVERTISING FOR PROFIT.—With this title the Manufacturers' Advertising Bureau, 126 Liberty St., New York, has issued an attractive pamphlet pointing out the service it renders to firms who place with it the management of their periodical advertisng.

STEAM HEATING.—W. H. Pearce & Company, 269 Dearborn St., Chicago, have issued a 32-page catalogue devoted to the Crescent system of steam heating. The catalogue describes the specially devised fittings and appliances which are required for this system.

SWITCHBOARDS FOR SINGLE-PHASE CIRCUITS.—Bulletin No. 1064 of the Fort Wayne Electric Works, Fort Wayne, Ind., describes a complete line of switchboard panels for single-phase circuits, designed for 1,100 or 2,200 volts. The instruments used are of the "Wood" type.

TELEPHONE SWITCHBOARDS.—The Dean Electric Company, Elyria, Ohio, has issued folders Nos. 6 and 7, devoted to express type switchboards and common battery switchboards. These folders describe in detail the constructional features of the switchboards and point out the operating characteristics of each.

ORE AND COAL-HANDLING MACHINERY.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, is distributing a comprehensive catalogue devoted to ore and coal-handling machinery. The catalogue contains more than one hundred 9x10-in. pages and is profusely illustrated throughout. The illustrations show numerous installations now in active operation.

JEFFREY SCREENS.—The Jeffrey Mfg. Co., Columbus, Ohio, has just issued a supplement to screen catalogue No. 69. It contains views of many screens adapted for a great variety of uses, such as for sizing coal, screening sand, gravel, etc. One of the views is of a cylindrical coal screen, 7 ft. in diameter and 54 ft. long. The views are half-tones of actual screens, and are interesting.

ROTARY PLANING MACHINES.—The Newton Machine Tool Works, Philadelphia, recently issued catalogue No. 41, devoted to planing machines of the rotary-cutter head type. The preferred method of driving these planers is by means of direct-connected motors. The advantages of the motor drive are pointed out, while the numerous illustrations serve to show the relative economy in floor space.

HYDRAULICALLY OPERATED WATER PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued a folder dealing with its "New Duplex" water lifters, which are described as hydraulic pumping engines operated by city water pressure. These lifters are constructed upon the same general lines as the well-known duplex steam pumps, but city water is used to operate the pump instead of steam.

PREPAYMENT WATT-HOUR METERS.—In a handsome pamphlet, designated as No. 5008, the Fort Wayne Electric Works, Fort Wayne, Ind., present the advantageous feature of the prepayment watt-hour meters which were recently described in these columns. The type K prepayment meter is dealt with separately in Bulletin No. 1,066, while Type W prepayment meter is similarly treated in Bulletin No. 1,063.

CRANES.—Catalogue No. 20 of the Northern Engineering Works, Detroit, Mich., is devoted to cranes for all purposes. The catalogue is attractively arranged, containing more than 100 half-tone illustrations of cranes and hoists. The constructional and operating features of each crane are briefly described, the types being too numerous to be dealt with fully in the 100 pages comprising the catalogue. The illustrations serve to give a fair idea of the wide range of the applicability of the various cranes.

VARIABLE-SPEED MOTORS.—In circulars No. 13 and No. 14, the Electro-Dynamic Company, Bayonne, N. J., outlines the advantageous features of the inter-pole, sparkless, variable-speed motors. Illustrations are given showing the motors direct-connected to machine tools, for which purpose the motors are particularly well suited. The Ward Leonard Electric Company, Bronxville, N. Y., in a recently issued folder, shows one of these motors driving a slotting machine. For use with such equipment the "SKR" type controller is stated to fulfill all requirements.

THE PIGEON-HOLE.—The Peerless Electric Company, Warren, Ohio, is doing some effective advertising by means of a folder which is given the name indicated by the title above. The folder contains short stories relating to the advantages of motors in general, and "Peerless" motors in particular. In discussing the ancient line shaft, it is stated that "sufficient unto the main shaft is the repairing thereof," and "the wheels will never turn with the power that's gone to waste." The reading matter is of a character which will insure that it will be read.

THE ILLUMINATOR.—Under the above title the Cleveland Electric Illuminating Company, Cleveland, Ohio, is publishing an illustrated monthly journal devoted to the numerous uses to which electricity may be put. The current issue contains well-arranged instructions for wiring a house for electric lighting. This matter is presented in an interesting manner, and should prove of value to all present and future users of electricity. The *Illuminator* is supplied with an attractive cover, and its contents should render it a welcome visitor to every user or prospective user of electric current.

INDUCTION WATT-HOUR METERS.—The Fort Wayne Electric Works, Fort Wayne, Ind., has issued instruction book No. 3,021, devoted to type K polyphase induction watt-hour meters. After describing the principles of operation of the meters, the book gives numerous diagrams showing the many ways in which the instruments may be inserted in polyphase circuits. Bulletin No. 1,062 treats of the operating features of the type W induction watt hour meter for single-phase circuits, and Bulletin No. 1,065 gives a complete description of the type K high-torque, single-phase watt-hour meter.

METALLIC SHIELD BLOW-OUT CONTROLLER.—In an exceptionally well gotten up catalogue, Dick, Kerr & Co., Ltd., of London, describe their metallic shield blow-out controllers for railway work. These controllers are equipped with solenoid blow-outs, without any iron in the magnetic circuit, the purpose being to have the effectiveness of the solenoid increase in direct proportion to the current. The main feature of these controllers resides in the fact that the solenoid is placed in a casing of copper and can be brought directly into the sweep of the arc. The external magnetic field created around the shield of non-magnetic metal attracts the arc to the shield and divides it in two parts, one arc going from the contact finger to the shield and the other from the shield to the contact segment. These two arcs travel rapidly in opposite directions on the copper shield and finally become united again in the air; but around the coil and shield, the arc at this stage has become attenuated to such an extent as to rupture, and, in fact, it may be ruptured before it has actually encircled the blow-out device. The catalogue is attractively illustrated.

News of the Trade.

THE VEHICLE EQUIPMENT COMPANY notes its change of address to its large new factory at Borden and Review Avenues, Long Island City, immediately adjoining the tracks of the Long Island Railroad.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has, in addition to the enlargement of its factory recently reported, started another addition which will be 40 ft. by 100 ft. and devoted exclusively to cementing together the parts of multipart porcelain insulators.

THE WILLARD STORAGE BATTERY COMPANY, whose factory was burned June 26, has secured a new location and will be in shape to commence deliveries of material in two weeks. It expects to have its factory going in good shape in 30 days. The new location is 29-31 Academy Street, Cleveland, O.

PASS & SEYMOUR, INC., Solvay, N. Y., announce that on and after July 1, their Chicago office, located at 130 West Jackson Boulevard, will be in charge of Mr. W. P. Upham, formerly of the Electric Appliance Company, of Chicago. Mr. Upham's experience in the supply business makes him particularly well fitted to take up this branch of manufacturing.

BOSTON ELECTRICAL SHOW.—In addition to the exhibitors at the Boston electrical show, beginning at the Mechanics Building, on July 15, under the auspices of the National Association of Electrical Contractors, the following are named by the authorities: American Electric & Controller Company; Condit Electrical Manufacturing Company, Boston; Underwood Typewriter Company, Boston; Worcester Electric & Manufacturing Company, Worcester, Mass.; Mietz & Weiss, through Frank E. Davis, Boston. The indications are that the affair will be interesting and successful along the lines already fully indicated in these pages.

THE FRASER HYDRAULIC COMPENSATOR COMPANY has been organized by R. J. Davis, of the Standard Electrical Construction Company, San Francisco, Cal., and his associates, to exploit commercially a radically new device in hydraulic elevator practice. It is the invention of E. M. Fraser, who for several years manufactured a novel type of high-speed electric elevator in San Francisco under the name of the Fraser Electric Elevator Company. The company finally sold its rights to the Otis Elevator Company and Mr. Fraser joined the Otis force, remaining five years. He is now bringing out the hydraulic compensator and will be chief engineer of the new company.

THIRTEEN LUCKY FOR COOK.—Frank B. Cook recently made an application for a self-soldering heat coil patent on the 13th of one month, it was allowed on the 13th of another month and issued on the 13th of June. Three new men have been added to his sales department and will push Cook's self-soldering protectors, pole cable terminals and construction material in various parts of the country. Mr. M. A. Gurney is covering Michigan, Indiana and Ohio. Mr. C. C. Newburn will travel in Minnesota and the Dakotas, and Mr. F. A. Rider in Kansas, Nebraska and the Territory. New York and Pennsylvania are being covered by Mr. James Strasburg, Wisconsin and Illinois by Mr. G. C. Fricke and Iowa and Missouri by Mr. F. R. Parker.

HEATING IN FACTORIES.—Before installing the blower system of heating and ventilation in their factory at Providence, R. I., Irons & Russell investigated shops using similar systems where benches were located next to outside walls. It was found that the moving air was chilled in passing by windows and travelling across the benches, creating an uncomfortable draft for the bench workers. It was decided to move the benches out about 6 in. from the wall and to use a small amount of direct radiation to offset the effect and produce a sheet of warm air next to the windows. The result has been very satisfactory. Reducing the indirect radiation to equivalent direct, and adding the direct, the actual ratio of cubic feet of space heated to square feet of radiation is about 80 to 1. The fan for the heating system, which was furnished by the B. F. Sturtevant Co., Boston, Mass., is driven by a 10 h.p. electric motor with speed regulation giving speeds varying from 100 to 220 r.p.m. on the fan wheel. At the maximum speed the fan is counted on to deliver 40,000 cu. ft. of air per minute, the fan wheel being about 7 ft. in diameter. There are about 1,250 sq. ft. of heating surface in the heating coils, in five four-row and one two-row sections. The warm air is led through an underground duct to two vertical shafts and is distributed on each floor through galvanized iron pipes. The fan system is designed to effect six changes of air an hour in the front portion of the building, and four changes in the rear.

GAS AND ELECTRIC ADVERTISING.—Publicity work for electric and gas companies is the specialty of the John Craig Hammond Advertising Company, which has been organized by John Craig Hammond, with headquarters in Denver. Mr. Hammond has been the advertising manager for the Denver Gas & Electric Company and is well known to the electric and gas interests of the country. Men who have been on the advertising staff maintained by Mr. Hammond for the Denver and other companies are associated with him in the broader field. They have devoted their time almost entirely to the electric and gas field of publicity. Included in the company are other men, who have not been so closely identified with Mr. Hammond's organization, but who have been working with him along similar lines. All of them have spent time in studying methods, in testing methods, and in evolving plans that they believe will ultimately be successful in getting business for their patrons. They have proved them successful so far, and, Mr. Hammond announces, can show results that justify the conclusion. Mr. Hammond states that the company proposes to go deeper than simple publicity work. It will have special features that will interest electric and gas companies particularly. These include suggestions on methods by which companies may improve their relations with the public, and may increase the efficiency of their general new business work. The organizers of the company know that there is a large field for business-getting by an effort put forward jointly for a number of companies through the same organization. To some extent, therefore, this feature of the system will be co-operative among those who enter into it. The excellent results that have been shown by the Denver Company are familiar to many interested in this line of business. The work of this company, and of others that have been getting their publicity matter from Denver, will be continued by the new organization. Considerable general business has been undertaken, sufficient to make the company a success.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 27, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

793,063. ELECTRICAL INSTRUMENT; John J. Ghegan, Newark, N. J. App. filed Jan. 27, 1904. A polarized relay which will automatically adjust itself to varying strengths of battery current, and also respond to changes in the circuit resistance. The relay coil has a solenoid core which vibrates under current variations, but whose general position is determined by the general current strength. A pair of limiting contacts for the core are sluggishly movable to respond to the general position of the core, but are effective to make and break a local circuit by vibrations of core.

793,065. ROTARY SNAP SWITCH; Monroe Guett, Hartford, Conn. App. filed Mar. 10, 1904. The switch arm has spring means for impelling it rotarily and a pair of radially movable stops to normally limit such movement. When the operating button is turned the stops are moved radially out of the way and the snap switch is thrown.

793,066. ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App. filed Nov. 1, 1904. Relates to modifications of the above, and particularly in the form of the supporting porcelain blocks for the operating parts. The supporting blocks have a relative movement and are so formed that wear will improve rather than deteriorate their bearing relation.

793,076. ANODE-PLATE FOR BATTERIES; Harry C. Hubbell, Jersey City, N. J. App. filed Oct. 3, 1904.

793,077. CATHODE-PLATE FOR BATTERIES; Harry C. Hubbell, Jersey City, N. J. App. filed Oct. 3, 1904.

793,078. CATHODE-PLATE FOR BATTERIES; Harry C. Hubbell, Jersey City, N. J. App. filed Oct. 3, 1904.

793,093. BATTERY-GRID; Henry C. Potter, Waukegan, Ill. App. filed Aug. 19, 1904.

793,112. VACUUM TUBE; Rome V. Wagner, Chicago, Ill. App. filed Nov. 28, 1904. A vacuum tube in which one of the electrodes is loosely screw-threaded to its support so as to be rotarily adjustable thereon. A clutch normally holds the parts in fixed relation, and a permanent magnet on the outside of the glass tube may be used to release the clutch and adjust the electrodes.

793,117. STORAGE BATTERY JAR; Thomas S. Witherbee, Jersey City, N. J. App. filed Mar. 22, 1904.

793,118. ELECTRIC WATER HEATER; Arthur D. Wright and Eli E. Sager, Seattle, Wash. App. filed Sept. 6, 1904. A casing of porcelain has a core at its center which is wound with resistance wire throughout the length thereof. The water is led through the annular space between the core and casing and is heated by the resistance wire.

793,137. ELECTROMAGNETIC ORE SEPARATOR; Erich Langguth, Euskirchen, Germany. App. filed June 18, 1904.

793,138. ELECTROLYTIC DECOMPOSITION OF SALINE SOLUTIONS; Arthur B. Larchar, Oldtown, Me. App. filed Oct. 9, 1902.

793,14[illegible]. JUMP SPARK APPARATUS; Herman C. Mueller, Fond Du Lac, Wis. App. filed Aug. 25, 1904. Instead of a single coil, two separate coils are held in insulating material in a box, their primaries being connected in series. A single interrupter is acted on by the cores of both coils.

79[illegible]. ELECTRIC HEATER; Charles A. Rolfe, Adrian, Mich. App. filed N[illegible]. An incandescent lamp is provided with a holder for an article [illegible] surrounding it so that the article is held in proximity to the lamp and heated thereby. Another form shows a specially constructed lamp having a recess for the curling iron.

793,[illegible]. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles M. Green, Lynn, Mass. App. filed Nov. [illegible], 189[illegible]. (See Current News and Notes.)

793,197. FLUSH ATTACHMENT PLUG RECEPTACLE; Harvey Hubbell, Bridgeport, Conn. App. filed Feb. 25, 1905. Relates to details of a plug receptacle in which all the connections may be made from the front without removing the base or opening the wall pocket. The face plate is secured to the base by screws and the plug is inserted into the face by a sort of bayonet joint.

793,229. HEATING DEVICE FOR CURLING IRONS OR THE LIKE; Charles A. Rolfe, Adrian, Mich. App. filed Jan. 12, 1905. A heater for curling irons comprising a sheet metal casing for an incandescent lamp. The casing is made in two halves formed to be connected together, and each half carries a pocket to receive the curling iron.

793,244. ELECTRIC SIGNALING SYSTEM; Herbert B. Taylor, East Orange, N. J. App. filed Sept. 1, 1904. An over-lapping block signal system in which the track circuits are normally energized and the signal circuits are constantly energized except when a train or car is partly on both track sections, at which time the de-energization permits the signals to return to danger.

793,2[illegible]. AUTOMATIC BLOCK SIGNALING SYSTEM; Herbert B. Taylor, East Orange, N. J. App. filed Dec. 17, 1904. An over-lapping block signal system in which polarization and low-resistance relays are adapted to respond to different circuit conditions to set the home or the distant danger signal.

793,275. SOLAR GERMICIDE; Ira A. Cain, Lompoc, Cal. App. filed July 28, 1903. Relates to the treatment of certain diseases by light and the method of securing different colors and intensity.

793,304. TROLLEY WHEEL AND GUARD THEREFOR; Fridolin Koenig, Newark, N. J. App. filed Dec. 17, 1904. The harp is provided with a pair of spring-held, upwardly projecting prongs, which normally guide the trolley upon the wire, but are capable of yielding in either direction to pass an obstruction.

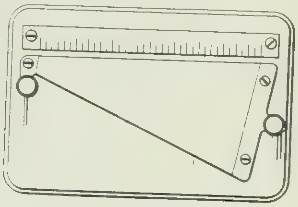
793,312. AUTOMATIC TROLLEY POLE; Alfred W. Margan, Longbeach, Cal. App. filed Jan. 30, 1905. The trolley wheel is journaled in a supplemental frame at the end of the trolley pole, and the movement of this frame when the trolley leaves the wire is effective to release the main pole-holding spring and allow the pole to fall by gravity.

793,325. NOISE AND LIGHTNING ARRESTER FOR TELEPHONE WIRES; Alexander Stiles, Martinsville, Ind. App. filed Nov. 10, 1903. A plug switch of a form adapted for use at any point in a line wire. A copper plug has an enlarged head and fits between spring jaws.

793,329. RELAY; Herbert B. Taylor, Newark, N. J. App. filed Dec. 4, 1903. A form of polarization relay in which the polarization armature vibrates between a pair of opposed fork-shaped pole pieces of the electro-magnet.

793,344. TROLLEY BASE; Peter Best, Elizabeth, N. J. App. filed Sept. 29, 1904. The trolley pole is pivoted to a swiveling or turn-table head on the roof of the car, and spring pressed therefrom.

793,389. TELEPHONE SERVICE-METER; Frank R. McBerty, Evanston, and James L. McQuarrie, Chicago, Ill. App. filed Nov. 19, 1902.



793,491—Maximum Current Indicating Device.

793,424. ELECTRIC OVEN; Levitt E. Custer, Dayton, Ohio. App. filed Sept. 14, 1904. (See page 66.)

793,430. TROLLEY; David D. Evans and Oliver Q. Patterson, Uniontown, Pa. App. filed Mar. 15, 1905. A pair of curved shoes are supported by spring blades from the trolley harp so as to normally close over the wire, but are spread apart to pass any obstruction.

793,436. EAR PIECE OR ACOUSTIC DEVICE; Peter Charles Green, Philadelphia, Pa. App. filed Nov. 7, 1904.

793,444. MICROTELEPHONE; Konrad Hoflinger, Vienna, Austria-Hungary. App. filed March 11, 1904.

793,445. LIGHTNING ARRESTER; Thomas J. Johnston, Brooklyln, N. Y. App. filed Nov. 8, 1901. (See Current News and Notes.)

794,454. MULTIPLE SWITCH RHEOSTAT; Frederick Mackintosh, Schenectady, N. Y. App. filed Dec. 5, 1903. A starter for motors of large horse-power in which a series of contactors can only be closed by hand in a regular order by reason of certain mechanical connections. A second mechanical connection is effective to release all of the contactors when the circuit breaker operates.

793,474. BRUSH HOLDER AND BRUSH-HOLDER SUPPORT; Leonard A. Tirrill, Lynn, Mass. App. filed Nov. 28, 1904. The brush-supporting frame has a pair of slots to engage stationary pins on the motor frame, so that the brush holder is rotarily adjustable with respect to said frame.

793,480. ELECTRICALLY OPERATED RAILWAY SWITCH; Bryan S. Wakeman, Scranton, Pa. App. filed Aug. 30, 1904. The switch point is directly actuated by a two-armed lever controlled by a pair of electromagnets. The lever arms are extensible and the magnets are laterally adjustable in order to vary the leverage.

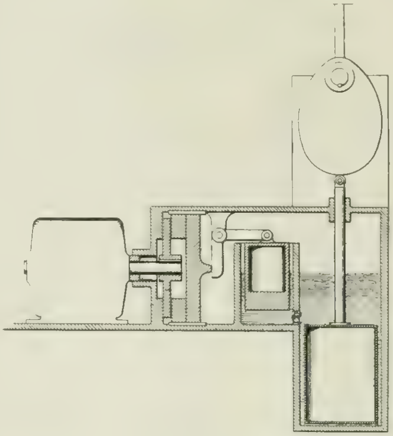
793,491. MAXIMUM CURRENT-INDICATING DEVICE, Maurice J. Wohl, Brooklyn, N. Y. App. filed Nov. 21, 1904. A generally triangular plate of a material which is discolored by a current of electricity, such as cardboard soaked in sugar and sulphuric acid, is connected in the circuit, and the altitude of the point where discoloration begins on the triangle indicates the current strength.

793,493. RHEOSTAT; William C. Yates and Alexander M. Fenwick, Schenectady, N. Y. App. filed Sept. 26, 1904. Electro-magnetic detents are arranged in such a way that the armature circuit of the motor cannot be permanently closed before the field circuit is closed, and the field circuit cannot be opened until after the armature circuit is opened.

793,494. CONTROLLER; William C. Yates; Schenectady, N. Y. App. filed Nov. 28, 1904. The magnet for holding the rheostat arm in its "on" position acts through a friction brake arrangement which permits the arm to be held at any position where it may be adjusted.

793,513. CIRCUIT-CONTROLLING SYSTEM; Arthur C. Eastwood, Cleveland, O. App. filed Dec. 19, 1904. Relates to an operating circuit for motors in which a circuit breaker on the motor panel board opens the motor circuit for low voltage as well as over-load conditions. The circuit breaker may be [illegible] controller.

793,514. CIRCUIT-CONTROLLING SYSTEM; Arthur C. Eastwood, Cleveland, O. App. filed Apr. 15, 1905. An electro-mechanical operating system for electric motors in which the controller arm has a dash pot which restricts its movement to a certain speed. This speed is adapted to the contactors or other regulator upon the panel board and insures a gradual starting of the motor.



793,570—Motor-Controlling System.

793,530. COOLING DEVICE FOR ELECTRIC LAMPS; Richard Kuch, Hanau, Germany. App. filed Mar. 3, 1904. (See Current News and Notes.)

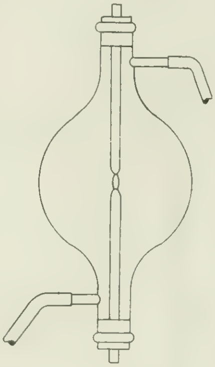
793,541. ELECTRICAL ANNUNCIATOR; Leonard F. Rose, Washington, Ia. App. filed May 3, 1904.

793,563. THERMAL CUTOUT OR CIRCUIT CHANGER; Chas. A. Brown, Chicago, Ill. App. filed Apr. 5, 1902. The heating coil has a core with a threaded opening at its end, and the fusible plug screws into this opening so as to make an electric circuit. The fusible plug is kept under spring tension and opens the circuit when it is softened by heat.

793,570. MOTOR-CONTROLLING SYSTEM; Arthur C. Eastwood, Cleveland, Ohio. App. filed Apr. 15, 1905. A multiple unit control system in which the contact or circuit is in series with a small electric motor upon which the load is mechanically varied from the controller arm. The motor takes a certain current for each load regardless of the line voltage, whereby a uniform action of the contactors is insured.

793,578. ELECTRICAL SIGNALING SYSTEM; Clayton F. Frederickson, Denver, Colo. App. filed Aug. 1, 1904. An automatic switchboard in which the selective arm is stepped around over the different circuit terminals by an electro-magnetic escapement of special form. The release magnet is operated by a separate circuit to restore the apparatus to normal condition.

793,593. ELECTRIC CURRENT COLLECTOR RING; Herman A. Knoener, East Orange, N. J. App. filed Feb. 20, 1905. A brush holder ring is supported from surrounding casing by a plurality of studs engaging recesses therein. Each stud is contained in a porcelain block or cup in a cavity on the brush holder.



793,608—Apparatus for Alternating Currents.

793,608. APPARATUS FOR ALTERNATING CURRENTS; Valdemar Poulsen, Frederiksberg, Denmark. App. filed Sept. 15, 1904. A spark gap designed to attain higher frequencies than hitherto possible in wireless transmission. The spark is caused to take place in an atmosphere of a gas containing hydrogen and at a pressure which may be greater or less than atmospheric. Capacity and inductive resistance are included in the circuits so as to adjust the resonance for the high frequencies which may be attained with the improved spark gap.

793,626. ELECTRIC HOIST; Philip J. Darlington, Glenridge, N. J. App. filed Jan. 28, 1904. The usual rope-operated controller has a clutch which is released by a mechanical device when the rope has been entirely wound upon the drum. At the same time a spring drum is thrown into action to swing the controller arm to its neutral position.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, JULY 15, 1905. No. 3.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE............1139 Monadnock Block
PHILADELPHIA OFFICE............929 Chestnut Street
CLEVELAND OFFICE............402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue 13,000 copies are printed. Total circulation for 1905 to date, 391,500.

NEW YORK, SATURDAY, JULY 15, 1905.

CONTENTS.

Editorial.......... 85
Electrical Exhibition and Contractors' Convention in Boston.......... 88
Committees of Western Electrical Inspectors.......... 88
Development of Telephony in Mexico.......... 89
Municipal Plant for Ashland, Ore.......... 89
"What Is Electricity?".......... 89
Fessenden Wireless Telegraph System.......... 90
The Ontario Power Company Begins Operation.......... 91
Utilizing Water Power on Vancouver Island.......... 91
Production of Artificial Graphite.......... 91
Qualities of the Testing Engineer.......... 91
Current News and Notes.......... 92
Electrical Engineers of the Times. XVIII. J. H. Hallberg.......... 94
Power House for the New York Central Electric Lines.......... 95
The New York and Massachusetts Commissions of Gas and Electricity. By Alton D. Adams, LL.B.......... 97
The Variation of Electrical Resistance in the Contact of Carbon and Cast Iron. By Eric Schoenau.......... 99
The Murgas System of Wireless Telegraphy.......... 100
Works of the Electrolytic Alkali Company at Middlewich, Cheshire, England. By John B. C. Kershaw.......... 101
Combined Telephony and Telegraphy.......... 102
Variable-Speed Dynamo.......... 104
LETTER TO THE EDITORS:
Booster Field Control. By Lamar Lyndon.......... 106
Digest of Current Electrical Literature.......... 106
Book Reviews.......... 110
Direct-Connected Generating Unit.......... 110
The Durability of Steam Turbines.......... 111
"No-Voltage" Release Motor Starter.......... 111
The D'Arsonval-Fulmen Storage Battery.......... 112
Electrical Compressor Plant of the Chicago & Northwestern Railway Terminal at Chicago.......... 113
Small High-Speed Engines.......... 114
Industrial and Commercial Intelligence.......... 115
General News of the Week.......... 115

BATTERY TO THE BRONX.

Thanks to the underground system, the traveler in New York can now go from the extreme southern tip of Manhattan Island far northward on the mainland, for the Battery and Bronx sections have just gone into operation. This is an immense step forward in knitting together the city and its suburbs, and it is to be hoped that the other underground electric roads aiming at similar purposes will soon be running also. The boon that electricity will thus confer on the population of this great center will be inconceivable, and will in some measure compensate for the shortcomings of the past and the discomforts of the present steam regime. That the Subway is not yet all that might be expected is natural, but so far no defect has developed that is not easily curable or that cannot be remedied in later tunnels. At its worst, the Subway even in this hot weather, is preferable to the New York Central tunnel, with its stifling steam, smoke and gases.

Just at this moment, moreover, the Long Island electric system is reported ready on one of the terminal sections, adding an important part to the work that will be completed only when the steam locomotive is banished entirely from the metropolitan region. On Long Island there will be connections of course with more tunnels, but all the work will be on main lines and branches, and in country presenting very few difficulties. There again the period of transition has been one of intense inconvenience for many of the residents, and Long Islanders and summer cottagers are suffering for their sins. It is obvious that no purchases of motive power or rolling stock adapted to the old regime can well be made at this juncture, so that when the change does come the contrast between a decrepit steam system and a modern electrical one is likely to be rather startling. But Long Islanders are quite ready for all the shock of that kind coming their way after these many years of a losing attempt to do profitably with steam a task for which electrical traction methods appear to be peculiarly and felicitously adapted.

USE OF ACETYLENE.

At the recent meeting of the Western Gas Association Mr. J. B. Morehead presented an interesting paper on calcium carbide and acetylene. While a large part of it was occupied by scientific and technical data already familiar to our readers in regard to the electrical production of calcium carbide, there were some points of novelty on the illuminating side of the subject. The increase in the number of acetylene town lighting plants is remarkable. In 1898, there were 4; according to Mr. Morehead there were 202 in 1904, and a number have been started this year. These plants, it is asserted, earn from 6 to 30 per cent on their cost; while incredible as it may seem, "the gas is sold at a price that is quite satisfactory to the consumers." Moreover, there are 80,000 isolated plants supplying from 10 to 2,000 burners, while "there are bicycle and automobile plants without number, and several thousand table lamps supplying a magnificent reading light."

All this goes to show that a new illuminant can make its way on merit, and that acetylene has approved its place in the world of utility. Aside from the fact that calcium carbide owes its present prominence to electricity, twenty to forty thousand horse-power being employed in this country alone in its production, there is the question of its effect on electric lighting; and we are sure all of our electric lighting friends will admit that it is a good stiff competitor, with distinct advantages of its own, even conceding all the possible disadvantages. The discussion of the paper would intimate that all the gas managers are not convinced as to its benefits as an enricher or in any other way, but the figures cited by Mr. Morehead are eloquent as to general adoption and recognition.

AT THE END OF A WIRE.

Hitherto a juryman has been supposed to be a being cut off from the rest of humanity and isolated like some pestilence breeder or dangerous wild beast. He has been separated from his business and family, subjected to pecuniary loss, compelled to plunge his mind and soul into the details of revolting crime or chicane, and expected to find consolation in the jokes from the bench and the dreary imbecilities of the bar. As he is thus supposed to be assisting at the trial of one of his "peers," he is naturally put just about on the level of the said peer, and then is told it is all necessary as part and parcel of the glorious system of trial by jury—a system which, as it stands, is one of the most intolerable relics of barbarism known to modern jurisprudence and humane civilization.

There now promise some mitigations, however, due to the aid of electricity, and we are glad to note that recently a New York judge permitted an anxious New York broker to get the varying quotations of cotton, as he sat sweating and fuming in the jury box. This is a new departure, without precedent, we fancy; and one which if pushed further might reconcile many good men to the regular performance of a task that they long since ceased to regard as a duty or privilege. If every jury box could be fitted up with stock tickers, telephones and messenger calls, there is no doubt that the jury panels would be crowded with desirable recruits and the dispensation of justice would go on with celerity and dispatch. For the poor juryman, besides keeping him in touch with his vital affairs of society and finance, it would come as a welcome relief to the monotony of dreary charges from the bench, the pitilessly prolonged cross-examination, and the dull drone of befuddling counsel. And it is safe to say that the average wisdom and fairness of jury decisions would at least be quite as high as it is today.

Aside from this aspect of the case, or this extreme presentation of needed reform, a halfway measure might be adopted in the general equipment of court houses and court rooms with telephones. Many of the halls of justice in New York are without these essential necessities of modern life, and we believe it is true also of other cities that they are equally behind the times.

THE INTERNATIONAL ASPECTS OF WIRELESS.

Recent work in wireless telegraphy brings very sharply into view questions that were raised in the early stages of the Russo-Japanese war. A few weeks ago it was announced that one of our warships off Cape Cod had been in communication with another anchored some five hundred miles away near Fort Monroe, and about the same time several liners kept in touch with messages from one side of the Atlantic or the other throughout the entire voyage. Compared with this, the work of a year ago seems tame, and the international relations of the system take on a new significance. The problems of wireless in the current war have been two: First, what is the status of a neutral vessel, such as a press boat, using wireless to forward to neutral territory information about a belligerent? Second, what are the responsibilities of a neutral power with respect to the use of its territory as a wireless base for a belligerent? As we intimated at the time of the original discussion, the former question is a fairly simple one. It is both bad manners, and bad judgment, to intrude, quite uninvited, upon the zone of actual hostilities on sea or land. A neutral caught with a wireless outfit between two armies is inferentially a spy, and would be lucky indeed if he could so persuade his captors of his innocent intentions as to escape summary execution. On the high seas, there are as yet no well defined principles for dealing with spies, but there is ample precedent for the summary seizing of neutrals whose escape might lead to dangerous information reaching the enemy, and the greater the facilities of a neutral for obtaining and disseminating information the sounder cause there is for such action.

In short, so far as the action of neutrals in seeking upon the high seas, and disseminating, information as to the movements of belligerents is concerned, it is a case of taking long chances; and it is safe to say that if Togo had found a press boat with a wireless outfit nosing about his base in the Straits of Korea, that boat would not have been heard from again for some considerable time. With respect to land operations, the use of Chinese territory as a wireless base for communication with Port Arthur involved different and much more troublesome questions, which need to be settled by international convention. If Chinese neutral territory had extended within easy sight of the besieged fortress and the Russians had organized a heliograph service with a station in that territory, there can be little doubt that China would have received some pretty sharp admonitions, and for just cause. It seems to us that a wireless telegraph station installed for a like purpose should fall in exactly the same category. So far so good, but in view of the present state of the wireless art far more troublesome possibilities arise. Suppose that there had been at Wei-hei-hei, for instance, a commercial wireless station regularly doing business with other stations along the coast and with passing shipping. And suppose further that this station had sent and received code messages in the ordinary course of its business, really involving systematic communication with Port Arthur. Would thereby any responsibility lie against Great Britain or any other neutral nation owning an offending station? When wireless messages can be sent clear across a belligerent country there are immense chances for acts unfriendly, if not openly in violation of neutrality.

If wireless telegraphy had been in use, for example, during the Franco-Prussian war, it would have been no difficult matter to have kept up communication with London from every besieged fortress, and while the besiegers would have tried to block all messages, they probably could not have succeeded without also intercepting legitimate messages to neutrals as well. Assuming that interception would be possible, would a belligerent be justified in wholesale interference with neutral ether in the endeavor to suppress "improper" communications? A cable can be quietly cut and nothing said, or due apologies made for the mistake, but perhaps the ethereal cable cannot be cut at all or only at cost of strenuous and obvious efforts. At all events, there exists the certainty that in any future war, new and grave responsibilities will fall upon conscientious neutral powers as regards the conduct of wireless stations in their territory. It is an entirely novel situation, and the ordinary precedents cease to have any direct value. If syntonic working should be perfected, the complications would become even graver. There would be practically an invisible network of cables embracing alike the territory of belligerents and of neutrals, either to be regulated in its international relations or taken as one of the unavoidable incidents of war. But from whatever standpoint the subject be viewed, it is clear that there should be some general convention covering the matter. We look with distrust on projects that tend to make wireless telegraphy a government monopoly, and even governmental regulation, in the commercial sense, we are disposed to view askance. It has become pretty clear, however, that when a number of persons utilize simultaneously the common ether in such wise that they interfere with one another, it is high time for legal definition of their respective rights and duties. And when the interfering parties include those of divers nationalities, belligerents and neutral, the case has passed out of the exclusive jurisdiction of any one country and becomes a necessary subject of international agreement. It is time that this was considered seriously, for every month tends to increase its complications and to make a just settlement more puzzling and difficult.

Constant-Voltage, Variable-Speed Dynamos.

One of the earliest attempted applications of the electric lamp was to the illumination of railroad trains; but the problem has proved to be a difficult one. If the dynamo is mounted on the locomotive, it calls for a certain amount of care, and this the driver is loath to afford in view of graver duties. If it be mounted under a car, and driven by the car axle then the locomotive driver is happy, but the car's troubles begin. The car has to travel thousands of miles, perhaps, without any skilled attention for the dynamo. This must run for weeks together without inspection and without getting out of order in spite of dust, mud and much jolting. It is usually necessary to install an auxiliary storage battery to keep the lamps alight during train stops and slow-downs. This means that there must be a switch to disconnect the dynamo from the battery whenever the train speed falls below a certain minimum. The switch must be above suspicion as to the faithful performance of its duties. Nevertheless, automatic switches rebel occasionally, and go on strike, when the dynamo man is away. Even when the automatic switch is innocent, unless it be made fool-proof or inaccessible, an irresponsible passenger, or trainman, will probably abuse it. For all the above reasons, and many others, the path of the designer of a train-lighting dynamo is not bestrewn with roses. Nevertheless, there are several well known train-lighting systems which have stood the test of practical experience. All of these are characterized by simplicity. No complicated system of regulators can stand the severe conditions of railroad operation. A new form of train-lighting dynamo, prepared by Dr. E. Rosenberg, is described on page 104 of this number. It presents a number of interesting features. Although shunt-wound, it bears resemblance to various series-wound constant-current arc-lighting dynamos. In the ordinary constant-potential, direct-current dynamo, armature reaction is a bugbear, and its effect is minimized by employing a powerful main-field excitation with as much reluctance as possible in the armature cross-field. But, according to the proverb that what is one man's meat is another man's poison, armature reaction is utilized and relied upon in the constant-current series dynamos above alluded to. The main-field excitation is weakened in these, and the cross-field strengthened in such a manner that the working e.m.f. is often due more to the excitation of the armature than to the excitation of the field.

In the Rosenberg dynamo the working e.m.f. is due entirely to armature reaction. He takes a shunt dynamo with a high reluctance in the main magnetic circuit and a low reluctance in the cross magnetic circuit. Then he comfortably puts the armature on a dead short-circuit, by connecting its brushes through a heavy cable. If the dynamo were kept powerfully excited, an enormous current would flow through the short-circuited armature. But a very moderate strength of current in the short-circuit is sufficient to produce powerful armature reaction, or a large cross-field. Under these conditions, a pair of brushes applied to the commutator at the perpendicular diameter, will pick up a goodly e.m.f. generated entirely by the cross-flux. This e.m.f. supplies the load of car lamps or storage battery. The load current produces a c.m.m.f. immediately opposing the shunt field m.m.f. and weakening thereby the main flux. Consequently, the machine settles down into a condition of magnetic equilibrium, whereby there is just enough resultant main flux to produce the necessary short-circuit current in the armature, to produce in its turn the cross field necessary for generating the required cross e.m.f. and load current. If the load current falls off, the c.m.m.f. which it produces also falls off. This brings up the main flux, the short-circuit current in the main armature path, the cross m.m.f., the cross flux, the cross e.m.f. and the cross or load current. On the contrary, if the load current becomes too great, the c.m.m.f. thereby produced in the field-magnet circuit becomes large enough to weaken seriously the main flux. This weakens the main e.m.f., the main armature current of short-circuit, the cross m.m.f., the cross flux, the cross e.m.f. and the cross or load current. The automatic regulation, effected in the load current as above, involves constant voltage, if the load is constant, or substantially so, as in car lighting; so that the dynamo is enabled to maintain nearly constant voltage and current in its load circuit under a wide variation in speed. According to the curves and data given, the speed of the car may vary from 20 to 65 miles per hour without producing more than about 12 per cent change in voltage at storage battery terminals. The advantage of the plan is the absence of all moving mechanism or rotating regulators. There remains only the automatic main switch to cut off the dynamo when the speed falls below, say, 15 miles per hour.

Alternators are compensated for terminal voltage by varying the armature reaction in their exciters in accordance with changes of load, and constant direct-current arc light dynamos are regulated, as above mentioned, by their armature reaction; but this is the only shunt direct-current dynamo regulated by its own armature reaction so far as we are aware. Another way of regarding the actions which occur in the armature, is by noting the direction of the resulting flux in the armature at constant load and varying speed. At very high speeds, the resultant field is weak and the angle of distortion large. At low speeds, the resultant field is stronger and the angle of distortion smaller. The tangent of the angle of flux distortion seems to be proportional to the speed; but at an indefinitely great speed, the resultant flux becomes vanishingly small. The short-circuit current through the armature is stated to be only 40 per cent of the load current at normal speed; so that at high speeds the short-circuit current becomes trivial. At low speeds, on the other hand, the current in the short-circuit path is augmented, for this is the real exciting current, and the excitation must be increased to compensate for the low speed. The lower the speed at which a dynamo of this kind has to work, the harder appear to be the conditions of design. At first sight it would seem impossible to apply an extra pair of brushes on the commutator at a diameter perpendicular to the normal neutral diameter. The armature coils short-circuited under the extra brushes are in the strongest part of the main field and are, therefore, likely to develop powerful local short-circuit current. To remedy this difficulty, deep slots are cut in the centres of the field poles at the places where the extra brushes are applied. In this way an artificial neutral diameter is provided for the extra pair of brushes. In a similar manner it should be possible to apply extra brushes to the commutator of an ordinary shunt-wound dynamo, in order to feed a three-wire system, or even a five-wire system. Whatever may be the industrial success of this particular train-lighting dynamo—which is not the question here—the lessons gained from its tests and behavior should be of value to electrical engineers and dynamo designers.

Electrical Exhibition and Contractors' Convention.

Some details have already been given in these pages of the electrical exhibition that is to be held in Boston in connection with the fifth annual convention of the National Association of Electrical Contractors have been perfected. The exposition will open in Mechanics' Building, Saturday evening, July 15, with a musical programme by Reeves' American Band, which will also give concerts throughout the week. A large and efficient reception committee will be at headquarters and will meet the specials due from New York and the west. The opening session of the convention on Wednesday will be a notable event. Addresses of welcome will be delivered by F. L. Barnes, president of the Massachusetts State association; by Governor Douglas in behalf of the State, and Mayor Collins in behalf of the city. F. McCleary, of Detroit, Mich., president of the National Association, will then deliver the annual address, after which will come addresses and topics as follows: "The Electric Contractors' Association," by Charles L. Eidlitz, of New York, ex-president of the National Contractors' Association, and ex-president of the Building Trades Association of New York; "The Jobbers," by A. L. Gorman, of New York, general manager of the Manhattan Electrical Supply Company; "The Manufacturers," speakers to be announced; "The Underwriters," by F. E. Cabot, of Boston; "The Relation of Inspector and Contractor," by P. J. Kennedy, of Boston, commissioner of wires. There will also be other prepared addresses and general discussions.

An executive session of the National Association will be held Wednesday afternoon, July 19, and the annual dinner to the members of the National Association will be given in the evening. Thursday forenoon will be devoted to a session of the association and at 2:30 p.m. delegates and guests will embark at Rowe's Wharf for a steamer trip down the bay, dining at the Rockland House, Nantasket, and visiting Paragon Park in the evening. Friday will be devoted to executive sessions of the National Association and Saturday will be given up to sight seeing and entertainment.

A ladies' committee of thirty has been appointed to have charge of the entertainment of the lady guests of the association. Concord, Lexington, Bunker Hill, Harvard College and other historic and interesting places will be visited and an extended auto trip will be taken along the picturesque North Shore. Side trips for sight seeing and shopping will be made daily. Delegates have already been reported from 39 States.

Following is a list up to date of those exhibitors who have secured space: American Electric Novelty Manufacturing Company, New York; American Circular Loom Company, Chelsea, Mass.; *American Electrician*; American Electric & Controller Company, American Electric Sign Company, Boston; Automatic Electric Train & Station Annunciator Company, Lexington, Mass.; Appleton Electric Co., Bridgeport, Conn.; Booth & Co., Boston; Bryant Electric Company, Bridgeport, Conn.; Benjamin Electric Company, New York; Bova, L. E., Boston; Couch & Seeley Co., Boston; Cotton, Chas. A., Boston; Chase-Shawmut Company, Boston; Condit Electrical Mfg. Company, Boston; Dale Company, New York; De Veau Telephone Company, New York; Dossert & Co., New York; Delaware Hard Fibre Company, Wilmington, Del.; Dorn, Philip, Boston; Electric Gas Light Company, Boston; Economical Electric Lamp Company, New York; Eastern Carbon Works, Jersey City, N. J.; Electro-Dynamic Company, Bayonne, N. J.; Edison Electric Illuminating Company, Boston; Eastern Electric Cable & Wire Company, Boston; Electrical World and Engineer, New York; *Electrical Review*, New York; Elm City Engineering Company, New Haven, Conn.; Erickson Electric Equipment Company, Boston; Forg, Peter, Somerville, Mass.; Felkin, A. C. & M. L., Boston; Gleason, John L., Jamaica Plain, Mass.; General Electric Company, Schenectady; Gould Storage Battery Company, Boston; Greenwood & Daggett Co., Boston; Holmes Manufacturing Company, New York; Harvey Hubbell, Bridgeport, Conn.; Hill, W. S., Electric Company, New Bedford, Mass.; Johnson & Morton, Utica, N. Y.; Johns-Manville Co., H. W., New York; Knowles, C. S., Boston; Lowell *Daily Mail;* McKenney & Waterbury Co, Boston; Mullen, Colman J., Brooklyn, N. Y.; Manhattan Electrical Supply Company, New York; Minimax Company, Boston; Marshall Electric Manufacturing Company, Boston; Mietz & Weiss, through Frank A. Davis, Boston; Miller Anchor Company, Norwalk, O.; National Carbon Company, Cleveland, Ohio; Ovington Manufacturing Company, Boston; Pass & Seymour, New York; Pettingill-Andrews Co., Boston; Proctor-Raymond Manufacturing Company, Detroit, Mich.; Poole, J. W., Columbia Street, Boston; Renim Specialty Company, Boston; Ridgeway Dynamo & Engine Company, Boston; Roebling, John A. Sons Co., New York; Steel City Electric Company, Pittsburg, Pa.; Safety Armorite Company, New York; Sprague Electric Company, New York; Smith Premier Typewriter, Boston; Swazey & Smith, Boston; Stuart-Howland Company, Boston; Simplex Electric Company, Boston; Starbuck Sprague, Boston, Mass.; Street Railway Bulletin, Boston; Trumbull Electric Manufacturing Company, Plainville, Conn.; Underwood Typewriter Co., Boston; Valentine Electric Sign Company, Atlantic City, N. J.; Westinghouse Electric Manufacturing Company, Boston; White, O. C., Co., Worcester, Mass.; Wireless Railway Company, Philadelphia; Y. M. C. A., Boston; Worcester Electric & Mfg. Co., Worcester, Mass. Mr. Chester I. Campbell is the manager of the exhibition.

Committees of the Western Electrical Inspectors.

A bulletin of the Western Association of Electrical Inspectors calls attention to the special committees appointed for the purpose of dividing up the work The classification of duties as thus revealed is of interest. The substance of the bulletin is given below:

The Committee on Uniformity in Rulings shall decide all questions relating to the interpretation of the National Electrical Code concerning which there is a general difference of opinion. It shall promulgate to each member of the association its decision on the question submitted and if approved by a two-thirds vote of all members the decision shall be considered as sustained and binding upon the association membership.

The Committee on National Electrical Code shall receive and prepare for submission to the association all proposed amendments to the National Electrical Code which are to be forwarded in the name of the association to the Electrical Committee of the Underwriters' National Electric Association for consideration at the annual meeting held in December of each year. This committee shall be charged with the responsibility of securing the adoption of such amendments as are approved by the association, when the same are up for consideration at the December meeting of the Electrical Committee of the Underwriters' National Electric Association.

The Committee on Outside Wiring shall have charge of all questions concerning the hazard to life and property involved in outside wiring, and it shall be the duty of this committee to formulate plans and specifications which if followed will eliminate much of the confusion which now exists where overhead conductors are employed.

It shall also report to the association the details of such accidents as come to its notice, arising from defective outside wiring, together with remedies calculated to prevent a recurrence of similar accidents.

The Committee on Theatre Wiring and Show Equipment shall prepare detailed specifications for the installation, maintenance and operation of electric wiring and apparatus used for theatrical purposes.

The Committee on Grounding of Conductors for Safety shall prepare supplementary instructions for the grounding of conductors as contemplated in the National Electrical Code. It shall also be the duty of this committee to prepare for presentation to the members of this association a concise explanation of the hazard to be eliminated by grounding.

The Committee on the Construction and Installation of Electric Signs shall prepare instructions for building, hanging and wiring of electric signs.

The Committee on Show Window and Display Lighting shall prepare instructions for the safe installation of wiring and apparatus used in show windows or for displays of a temporary character, together with suggestions for window trimmers or others engaged in the arrangement of merchandise for exhibition in the vicinity of electric lights, wires or apparatus.

The Committee on Instructions to the Public Concerning the Safe Operation and Maintenance of Electric Wiring and Apparatus shall prepare a simple set of instructions which shall be suitable for distribution to the public, covering the common abuses to which electric wiring and apparatus is subjected and the consequent hazard involved.

Committee on Laws and Ordinances shall draft bills and ordinances for submission to city councils, State Legislatures, etc., covering the electrical hazard, and shall assist in the enactment and enforcement of such laws and ordinances. It shall also be the duty of this committee to prepare a simple system of office records, blanks, etc., suitable for the use of municipal or insurance electrical inspection departments.

Development of Telephony in Mexico.

It is announced from Boston that the operations of the Mexican Telephone & Telegraph Company, the reorganized Mexican Telephone Company, will show that earnings for the twelve months will approximate $167,000 as compared with $139,000 a year ago. For the quarter ended May 31, earnings were as follows:

	1905.	1904.	Changes.
Gross	$76,826	$71,854	Inc. $4,972
Expenses	35,027	39,808	Dec. 4,780
Net	$41,799	$32,046	Inc. $9,752

About 62,000 shares of the Mexican Telephone Company have been deposited for exchange under the reorganization, whereby the holder of nine shares of the old stock receives one share preferred and two common in the new company, par in every instance $10. Of the old company there were 810,000 shares outstanding.

The new management is desirous of dissolving the old company, but is finding some difficulty, as under the New York laws it is necessary for dissolution to present to the State the written consent of two-thirds of the outstanding stock. Slightly less than $350,000 is being spent by the company for additions, extensions and improvements, etc., in Mexico. Under concessions granted by the Mexican Government recently for 30 years, the company was obliged to remove aerial wires in the "limited zone" in Mexico City and place them in conduits. This work has already been commenced and 100,000 ft. of cable has been laid. The company is installing in that city a new common battery switchboard with an ultimate capacity of 7,000 connections. When placed in operation, however, it will be equipped for 3,000. In that instance alone the expense is estimated at about $300,000.

At a cost of about $20,000 the company has installed in its new Monterey office a new switchboard large enough for 1,200 connections. There as well as at Tampico the metallic service is also being placed in operation. In the other 15 cities in which the company operates minor improvements have been made or are in contemplation.

Municipal Plant for Ashland, Ore.

At a meeting of the City Council of Ashland, Ore., held June 21, an ordinance was passed to install a municipal electric light and power plant, to be operated by water power. A city election will be held to vote on issuing $50,000 city bonds to pay for installing said plant. Five of the bonds are to fall due September 1, 1910, and five each year thereafter. On June 10 it was decided by a city election (there being only nine dissenting votes) to issue $30,000 bonds for the purpose of purchasing all the water rights of Ashland Creek not now owned by the city. Both issues of bonds will bear 4½ per cent interest, payable semi-annually. The last-named issue will run for 15 years.

The laying of a complete sewer system is now well under way. The city has for years owned its own gravity water works. The water is supplied by a cool mountain stream, which has its source in the timbered, snow-capped Ashland peak (which is wisely protected by the Ashland Forest Reserve), situated about seven miles distant, to the south, up Ashland Creek Canyon.

As soon as the 500-hp. electric generating plant is installed near the head of the said canyon above the intake of the city water the water will flow directly into the principal main of the city water works, 650 ft. above the city. The mayor of Ashland is Hyrum S. Evans.

What is Electricity?

A very interesting article, bristling with interrogation points, is contributed by Prof. A. E. Dolbear to the *Popular Science Monthly* for July, dealing with the science problems of the twentieth century. It discusses the live issues in each domain of science and intimates the scope and importance of the pressing problems in each. One or two passages may be here quoted. In regard to chemistry, Prof. Dolbear remarks: "We say 'chemical energy,' but we have no idea how it differs from heat or from gravitative energy. It is a mystery. What form of motion or stress can be thus embodied? In some way it is related to the ether. It seems as if in some unique manner atoms drew from the ether as from a common reservoir, each particular atom capable of holding so much of that kind and no more, like pint cups and quart cups, and this at once transformed into heat at the instant of combination. When combinations of atoms such as water are decomposed, they again absorb the energy spent to separate them, and an atom, therefore, possesses more available energy than any combination of atoms. It seems as if atoms acted as transformers of ether energy into the ordinary and familiar forms, such as heat and electricity, and vice versa, transforming the latter into ether energy. When we learn this secret we may likely enough be able to artificially extract from the ether as much energy as we need for any purpose, for as I have said, it is inexhaustible, and every cubic inch of space has enough for all the needs of a man for many days. This seems fairly probable, and when the source of atomic energy is discovered, it will rank with the greatest scientific achievements of all time. We shall know more of the ether, of the structure of matter, of the antecedents of most of the energy we are familiar with, as this phenomenon underlies most if not all of the phenomena in all the sciences. It is yet regarded as a mechanical paradox that a medium without friction should have waves set up in it by molecular vibration, and little is known of the physical relations existing between matter and ether by which electrical and magnetic phenomena are produced, and one may say that of the nature of ether we know nothing. Think of the amazing extent of it. As limitless as space itself, with no break or separation of its parts, not made up of particles like matter, but completely filling space and so constituted that any movement of a particle of matter in some way affects the whole body of it to the remotest part of the visible universe."

Coming to the all-embracing mystery of electricity, Prof. Dolbear says: "Here on the threshold of the new century we are confronted with the question 'What is electricity?' and the answer implied by the question seems to demand a something which could be described by one who knew enough, as one would describe some new mineral or gas or thing. Some eminent scientific men are befogged by the question, say it is some ultimate unknowable thing, and hopeless as an inquiry. If it be a something it must be described by its constant properties as other things are. If it be unlike everything else then it cannot be described by terms that apply to anything else. All material things have some common properties. A glowing coal is an incandescent solid, a flame is an incandescent gas, but neither glow nor flame exists apart from the matter that exhibits the phenomena. Both are conditions of particular kinds of matter. If electric phenomena are different from gravitative or thermal or luminous phenomena it does not follow that electricity is miraculous or that it is a substance. We know pretty thoroughly what to expect from it, for it is as quantitatively related to mechanical and thermal and luminous phenomena as they are to each other; so if they are conditions of matter, the presumption would be strongly in favor of electricity being a condition or property of matter, and the question 'What is electricity?' would then be answered in a way by saying so, but such an answer would not be the answer apparently expected to the question. To say it was a property of matter would be not much more intelligible than to say the same of gravitation. At best it would add another property to the list of properties we already credit it with, as elasticity, attraction and so on. In any case the nature of electricity remains to be discovered and stated in terms common to other forms of phenomena, and it is to be hoped that long before this new century shall have been completed, mankind will be able to form as adequate an idea of electricity as it now has of heat." Prof. Dolbear intimates in his article the belief that the field of investigation and research remains as large and fruitful as it has ever been.

Fessenden Wireless Telegraph System.

A budget of eight patents containing a total of 100 claims was issued on July 4 to R. A. Fessenden for improvements in wireless telegraphy. These patents deal with all of the constructional details of a system for signaling by electromagnetic waves, and disclose several distinctly novel features. One of the patents relates to that form of receiver called the "liquid barretter," as illustrated in Fig. 1.

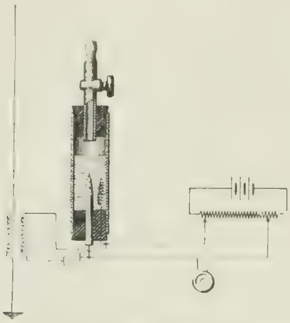


FIG. 1.—LIQUID BARRETTER.

The receiver consists of a glass tube containing a solution of nitric acid or caustic soda. A fine wire terminal is immersed in the solution. The oscillatory currents to be detected and a constantly flowing current from a local source both flow through the constricted conducting fluid path; and the oscillatory currents produce a change in the amount of current flowing through the local circuit. The present invention refers specifically to the use of a pressure on the liquid above atmospheric pressure so as to increase the loudness and clearness of the signals obtained in the telephone receiver. The inventor states that very good results have been obtained with pressures as high as 40 or 50 pounds per square inch.

Two of the patents relate to condensers. In one of these the inventor suggests the use of short lengths of cables such as are used for high-voltage power transmission circuits, the advantages being that the condenser is not subject to heating, is little affected by hot weather, has very small losses, is very conveniently arranged, is readily repaired in case of damage, and is comparatively inexpensive. Another form of condenser is that illustrated in Fig. 2, in which the dielectric is compressed air. The great fact in the efficiency of compressed air condensers is that at a pressure greater than about 60 pounds per square inch, the static discharge and its accompanying loss of energy, which may amount to 50 per cent in air at ordinary pressures, seems to disappear entirely. The inventor states that with plates one twelfth of an inch apart under a gas pressure of about 175 pounds per square inch, when the potential is raised to 27,500 volts, there is no apparent loss of energy, while at 28,500 volts a spark passes between the plates; and that it is practicable to make condensers of reasonable size and cost and having a higher efficiency than condensers with any other dielectric. With the air condenser there is no dielectric hysteresis or brush discharge, and apparently no loss of any kind, and almost any degree of resonance appears to be obtainable by its means. The period of oscillation and hence of the frequency of the wave produced, appears to remain absolutely constant irrespective of the temperature and other conditions, so far as can be measured; that is, to within about one-tenth of one per cent as determined by the hot-wire barretter.

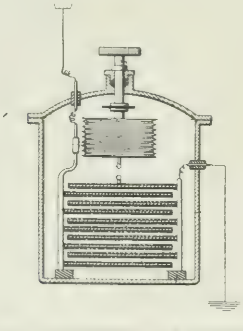


FIG. 2.—COMPRESSED GAS CONDENSER.

The subject of aerials is treated in two patents. For permanent land stations there is described an aerial consisting of a cylindrical structure insulated at the base from the ground and provided at the top with a collection of wires radiating from the aerial. By using cylindrical sections of suitable diameter a great height may be obtained. Provision may be made for access to any part of the aerial by an internal ladder. A water jet aerial is shown in Fig. 3. This type is intended for use on board ships where the masts have been shot away, or where long distances are required on fortifications at which a permanent mast is not desired.

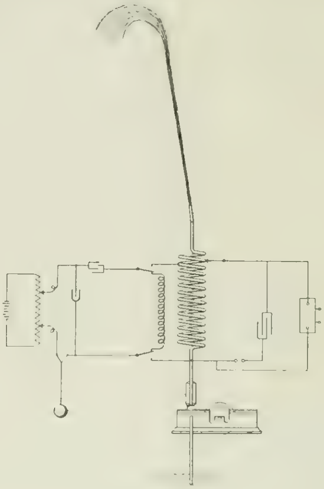


FIG. 3.—LIQUID AERIAL.

Three patents relate to the general subject of signaling by electromagnetic waves. According to one of these, the inventor suggests as the initial source of energy an alternating-current generator with which is employed a condenser that may be placed in operative relation alternately to the generator and to the aerial. A commutator driven synchronously by the generator is used for interchanging the connections of the circuits as desired. Two of the patents relate rather to wireless telephony than to wireless telegraphy. Broadly considered, the method employed consists in the practically continuous generation of electromagnetic waves and in modifying the radiations without interrupting their continuity. Numerous methods are proposed for using the sending and receiving telephone apparatus. According to one method, there is employed a dynamo capable of producing directly in the sending conductor the desired wave frequency—as, for example, a dynamo having frequencies up to 300,000 per second, and capable of radiating several horse-power. A telephone transmitter is inserted in the field circuit of the dynamo. On speaking into the transmitter, the field strength of the dynamo will be varied, and the intensity of the radiation from the sending conductor will vary to correspond with the tones of the voice. The usual telephone receiver equipment is used at the receiving station. The capacity effects which are so prejudicial to good speed in cable telephony are absent in the transmission by electromagnetic waves, and the higher harmonics of the voice are transmitted without distortion, resulting in extraordinary clearness of articulation. The inventor states that there is not the slightest doubt that the transmission of speech across the ocean is quite possible by this means.

The Ontario Power Co. Begins Operations.

On July 1 the Ontario Power Company, of Niagara Falls, for the first time applied potential to its 60-000-volt transmission lines. Work was begun upon this development of 200,000 e.h.p. in March, 1902, something over three years ago. On June 15 water was admitted to the intake works, now completed for the full capacity, and on June 22 the first 10,000-hp. unit, generating three-phase, 25-cycle current at 12,000 volts, was put in motion. The first set of step-up transformers to raise the potential from 12,000 to 60,000 volts, each of 2,500 kw capacity, oil-insulated and water-cooled, was put in service on July 1. The permanent transmission line, at present only partially completed, consists of duplicate lines of 49-ft. tripartite steel towers, carrying porcelain insulators of a new type on iron pins, and aluminum cables nearly an inch in diameter. The average length of span is 550 feet. The present expectation is to have three units, with a total capacity of 30,000 horsepower, delivering power by the last of September.

◆

Utilizing Water Power on Vancouver Island.

Mr. L. E. Dudley, U. S. Consul at Vancouver, British Columbia, gives this interesting account of water power development on Vancouver Island: "The great engineering enterprise undertaken by the British Columbia Electric Railway Company (Limited) to furnish electric power is now approaching completion. About 16 miles from this city there is a small lake covering about 300 acres. This is called Trout Lake, or Lake Beautiful, and lies about 400 feet above the high-water mark. A power plant has been established at the foot of the mountain, and water is brought down in large pipes, having a fall of 390 feet in 1,600 feet. But this lake does not contain sufficient water to meet the demands in the dry season, and therefore it was decided to bring down the water of Lake Coquitlam, which lies about 35 feet higher than Lake Beautiful and has an area of about 2,000 acres. Between the two lakes there is a range of mountains rising to a height of about 4,000 feet, and to bring the water from Lake Coquitlam to Lake Beautiful required the construction of a tunnel almost the entire distance, some two and one-half miles, through solid rock.

"Work was begun about two and a half years ago at both ends, and continued until a few days since, when two gangs of men met in the middle of the tunnel. Sufficient water has thus been secured to produce all the electrical power that is likely to be needed in this vicinity for many years.

"The tunnel is regarded as one of the largest and most successful engineering enterprises yet undertaken in this province, and the following are facts concerning it: Cost, $320,000; total length, 2½ miles; size, 9 by 9 feet, with rounded corners; area of normal cross-section, 73 square feet. The consulting engineer was Mr. Wynn Meredith, an American, who has been employed upon great works at several points in the United States."

◆

Production of Artificial Graphite.

The U. S. Geographical Survey publishes a monograph by Mr. J. H. Pratt, on the production of graphite in 1904. The following passage relates to artificial graphite, now largely made by electricity: The production of artificial graphite has been steadily increasing since its introduction upon the market in 1897, and in 1904 there was a very large increase in the production as compared with that of 1903. This is due to its being introduced into the manufacture of other graphite products besides those used for electrical purposes. The quantity of this variety of graphite that was manufactured in 1904 amounted to 3,248,000 pounds, valued at $217,790, which is the largest quantity produced in any year since its first introduction on the market. This is an increase of 628,000 pounds in quantity and of $39,120 in value as compared with the 1903 production of 2,620,000 pounds, valued at $178,670. The average price per pound received for the 1904 product was 6.7 cents, a decrease of 0.12 cent as compared with the price 6.82 cents per pound received for the 1903 product. In the table following are given the quantities and value of the graphite manufactured for each year since 1897:

Production and value of artificial graphite, 1897-1904.

Year	Quantity	Value.	Unit value per pound.
	Pounds		*Cents.*
1897	162,382	$10,149	6.25
1898	185,647	11,603	6.25
1899	405,870	32,475	8.00
1900	860,750	68,860	8.00
1901	2,500,000	119,000	4.76
1902	2,358,828	110,700	4.69
1903	2,620,000	178,670	6.82
1904	3,248,000	217,790	6.70

This table shows clearly the increase in the demand for artificial graphite, and when this table is compared with the one for domestic production it is at once recognized that the artificial graphite has assumed a very important position in the graphite industry of this country.

◆

Qualities of the Testing Engineer.

In a presidential address before the American Society for Testing Materials, Mr. Charles B. Dudley said: "There are three kinds of testing engineers to occupy these two fields, viz.: the unattached engineer, the consumer's engineer and the producer's engineer. At first there were apparently only two kinds of testing engineers—viz.: the unattached and the consumer's. But it did not take long after consumers began to study and test materials and prepare specifications before the producers found it necessary to protect their interests and defend their materials by means of testing engineers in their own employ.

"It is perhaps hardly necessary to say that in this our analysis of the scope and field of the testing engineer we have not forgotten the various inspection bureaus and testing laboratories which are doing such excellent work in various parts of the country. As we understand the matter, these organizations, while perhaps not strictly covered by the definitions given in that they do not derive their continuous sustenance in such a way as the unattached testing engineers nor in the same way as those who defend the interests of the consumer or the producer, yet in a certain sense these independent organizations do perform exactly the same functions as the three classes of testing engineers which we have described. Any one of them will make investigations either in the interests of a client or for the sake of the truth alone; and one of them will temporarily or continuously, if the retainer be sufficient, defend and care for the interests of a consumer, or will render a like service for a producer, provided of course that the interests of the two are not antagonistic at the same time.

"What shall be the cast of mind and what the mental equipment of the testing engineer? Upon the first of these topics it is difficult to say much that is positive. It is perhaps easier to say what kind of mind will not succeed in this branch of engineering. We will perhaps all agree that he should be independent, self-reliant, gifted with the power of analysis of facts as well as with the power of drawing conclusions from the data at hand. He should be ingenious in devising methods to demonstrate the points at issue and a careful observer of data. He must keep himself free from bias or prejudice and take especial pains that he does not deceive himself. He should be fond of experiment and have a genius for it. Many times during our nearly 30 years' attempt to do something in the line of the work of a testing engineer we have had occasion to paraphrase the Latin apothegm, and say: "Experimenters are born, not made.' He should keep constantly in mind the end to which his experiments tend and understand clearly the effect of every step in the progress of his tests and its influence on the final result. Above all, he should be a thinker. No man who when a problem is presented to him simply searches his memory for whatever he may have learned in the schools, or have perchance picked up in his reading which bears on his problem, has any especial call to be testing engineer. We are quite ready to allow that the power of seeing analogies between your own problem and one that some one else has had, and perchance successfully solved, is a legitimate and useful, not to say time saving, habit of mind. But the point we want to make is that the one who habitually and continuously approaches every problem through memory or by studying up what others have done is far less likely to succeed as a testing engineer than one who habitually attacks a problem by an analysis of its elements."

CURRENT NEWS AND NOTES.

THE CITY OF MORALIA, in the State of Michoacan, Mexico, has sold its electric light plant to a company in that city. The plant has been operated by steam. The new owners propose to utilize the San Pedrito Falls, estimated to yield at least 2,000 hp, within the next two years.

A CAT-ASTROPHE.—A San Francisco correspondent reports that a cat climbed a pole of the high-tension transmission line in Reno, Nev., and caused a short-circuit, which necessitated a 10 days' shutdown at the power house to rewind the armature. It is not stated what became of the cat.

WHAT CONSTITUTES SUCCESS.—The following appears in a Lynn, Mass., newspaper: "Marblehead appears to have been the most successful of the towns operating their own plants, for its net loss amounts to $1,500, while that of Danvers amounts to $4,000 and of Peabody to $9,000."

LIGHTNING IN GERMANY.—A cable dispatch from Dantzig, Germany, of July 3, says: "The imposing tower of St. Catherine's Church, built from 1326 to 1330, was entirely destroyed by lightning. Some of the thirty-five musical bells composing the chimes, which were cast in 1634, were melted."

HONORS FOR CURIE.—From Paris comes the following dispatch of July 8: "Prof. Curie, the celebrated discoverer of radium, was elevated this week to the dignity of Member of the Academy of Sciences, the honor following after his decoration with the Legion of Honor. The creation of a special chair at the College de France for Curie represents the last token of approval any French scientist can aspire to."

RESERVED SEATS ON TROLLEY CARS.—It is stated that the Hartford & Springfield Street Railway Company is running from Hartford a series of what it has named "reserved seat trolley trips," and in connection with these trips it has arranged to run from Springfield on special occasions for special parties, finely equipped, reserved open trolley cars with special service and on special times to any of the points of interest within trolley reach of the city.

ELECTRICITY AND RED NOSES.—A cable dispatch from Berlin of July 8 says: "Prof. Lassar, a famous Berlin skin specialist, has found means to restore red noses to their normal color and uses. An instrument, shaped like a large tooth brush, with forty platinum wires instead of bristles is used, and this is connected with an electrical machine. The treatment consists of hammering the lurid nose till it bleeds, when the treatment is stopped for a day. Two hammerings a week for some months suffice to eliminate the excessiv redness."

FRANCHISE VALUATIONS.—A large number of attorneys appeared before Supreme Court Justice Hasbrouck in Special Term at Albany, July 8, and on stipulation with Attorney-General Mayer the valuations placed on their special franchises by the State Tax Commission were equalized to the rate of valuation at which other classes of real estate are assessed in the localities in which the franchises are operated. The valuations on the New York City telephone system franchises were fixed as follows for 1904: New York Telephone Company, $4,463,530; New York & New Jersey Telephone Company, $1,481,220; Empire City Subway Company, $57,918.

TROUBLE IN THE TUBE.—A cable dispatch from London of July 1 says: "The inauguration of an electric service in the 'tube' underground railroad system resulted disastrously to-day. It had been intended to run four electric trains hourly, alternating with steam trains. For two hours all went well, but torrential rains flooded the track at one point, which prevented the electric trains going through. One electric train caught fire, throwing the passengers into a panic. The flames were quickly subdued with sand, but a live rail became displaced, bringing all the electric trains to a standstill. They had to be removed by means of steam engines." It looks as though the London tube, like the New York Subway, ought to be provided with electric launches.

MICHIGAN CENTRAL TUNNEL.—President Newman, of the Michigan Central Railroad Company, has announced that the construction of the Detroit Tunnel Line from Windsor, Ont., to West Detroit Yard, Michigan, including the electrification thereof, has been placed in charge of an advisory board of engineers consisting of William J. Wilgus, vice-president of the New York Central & Hudson River Railroad; Howard Carson, consulting engineer, and W. S. Kinnear, chief engineer of the tunnel company. The chief engineer will be in direct charge of construction, reporting to H. B. Ledyard, chairman of the board of directors, on executive and financial matters, and to the board of advisory engineers as to plans, specifications and methods of doing the work.

A WIRELESS FLOATING POOLROOM.—Hereafter "poolrooms" may be known as "lakerooms." A special dispatch from Chicago of July 3 says: "Chicago's wireless telegraph floating poolroom, the *City of Traverse,* was out of business for a short time to-day, when detectives entered the offices of the wireless telegraph company and arrested the manager and two assistants. The wireless telegraph company has been receiving racing results over the telephone from an information bureau outside the city limits. The telegraph service to the boat, according to the police, is in direct violation of the city ordinances governing gambling. The poolroom was twenty miles out on Lake Michigan when detectives made the arrests and seized all the apparatus used in the transmission of racing information. The *City of Traverse,* after a delay of an hour, connected with another station, the situation of which is unknown to the police."

TELEPHONES IN COURTS.—In a letter to the New York *Times,* Mr. J. Brownson Ker says: "My attention has been called from time to time to the inconvenience suffered by the public by reason of the custom which prevails in several of the municipal courts of this borough, of maintaining a private telephone, the number of which is not to be found in the telephone directory and cannot be ascertained from the telephone company. The absence of telephone communication necessitates persons having business with these courts sending to the court whenever they desire any information, and frequently they find that, owing to the removal of judges and stenographers from one district to another, another trip has to be taken in order to locate the official with whom communication is desired. It seems to me that as the people pay for this telephone service it should be accessible to them. There may be good reason for the present practice. If so, I should like to know upon what grounds it is upheld."

UTILIZING HEAT TO PRODUCE HEAT.—Having observed that careless locomotive firemen allow considerable energy to be needlessly wasted in the draft through the smokestack, Mr. W. H. Jordan, according to a patent issued July 4, proposes to mount a revolvable fan in proximity to said draft and to connect therewith a generator adapted to produce an electric current, and to provide an electric resistance heating device in proximity to the tubes of the locomotive boiler for the purpose of utilizing as heat the power from the said generator. The design details of the generator are omitted, but since it is suggested that the fan be mounted on a platform so as to be movable with respect to the main body of the draft, it is possible that the inventor contemplates the use of some commercial type of dynamo. Just why the engineer or fireman would take more care with the lever for moving the fan than with the lever for controlling the draft is not stated. It would be interesting to learn what induced the inventor to apply for the patent.

FORNES ON MUNICIPAL OWNERSHIP.—President Fornes, of the New York Board of Aldermen, returned from England last week. He made a careful study of conditions in Glasgow, London and Liverpool, and on landing said: "There are three great obstacles which stand in the way of municipal ownership being the success here that it is on the other side. These are the cost of material, the cost of labor and politics. While I am not opposed to government ownership, I believe the subject is one which will require the most careful consideration and study. The political system in England is different from our own. The people over there do not really elect their officers. They are mostly honorary offices, and even mayors and aldermen receive no salaries. This system must be considered, as well as what effect our own can have on the subject. We must go slow and with reflection. In proceeding, too, one must look up the tables of comparative cost. Entirely different conditions and influences hold on this side of the Atlantic, and all must be taken into consideration."

COREAN CABLE RATES.—In effect from July 1 the rate to Corea will be reduced by 25 cents per word via the Commercial-Pacific Cable; that is, Chemulpo, Fusan and Seoul will be $1.21 per word beyond San Francisco, and other places in Corea $1.29 per word beyond San Francisco.

THE TELEPHONE IN THE PHILIPPINES.—A cable dispatch from Manila, P. I., states that the Philippine Commission has passed an act granting to John I. Sabin and Louis Glass, of San Francisco, a franchise to construct telephone and telegraph systems throughout the Philippine Islands. Mr. Sabin is president and Mr. Glass vice-president of the Pacific States Telephone & Telegraph Company, representing the Bell telephone interests on the coast.

UNITED ENGINEERING BUILDING.—The United Engineering Building Committee voted a contract last week for $795,000 to the Wells Brothers Company, of New York City, for the construction of the new building under the Carnegie gift, on West Thirty-ninth Street, this city. This contract does not include anything for electrical plant, wiring, steam heating, etc., but deals solely with the construction of the edifice. The lots have already been excavated, and work will begin without delay. October, 1906, is spoken of as the time of completion and readiness.

INTERNATIONAL COMMISSION ON ELECTRICAL UNITS AND STANDARDS.—A conference has been called by the Reichsanstalt as a preliminary to the meeting of the International Commission on Electrical Units and Standards. To this conference the Reichsanstalt has invited the heads of bureaus in America, England, Belgium, Austria-Hungary, also Lord Rayleigh, Profs. Kohlrausch and Mascart, and Prof. H. S. Carhart. The conference will be held in Berlin, probably the latter part of October, the exact date not having as yet been fixed. It seems probable that the commission will be called together within the next two years.

TELEGRAPH LINES BURNED.—Reports from Dawson, Alaska, are to the effect that thousands of miles of northern telegraph lines have been made useless by sweeping forest fires throughout British Columbia, Yukon Territory and Alaska. Dawson's communication with the outside world has been broken several days, except for interrupted connection by way of Skagway and the cable. Between Dawson and Whitehorse the line fell in many places and the poles were burned. From Eagle to Valdez is another raging furnace. The line from Dawson to Fairbanks is also out of business. It is not known how much farther north the fire reaches. Nome and Fairbanks have been without telegraph service for many days.

MUNICIPAL OWNERSHIP AT GREENFIELD, IND.—A special dispatch from Greenfield, Ind., says: "Municipal ownership does not appear to be a success in Greenfield. The city owns and operates the water works and electric light plants. Over $17,000 is required for making repairs and improvements at the electric light plant. The city has no money available, and is in debt the full 2 per cent limit. An expert was employed by the council recently to investigate conditions and make a report, and he reported that a new 350-hp. engine and two new boilers were necessary, and that the cost would be $17,500. He also recommended the consolidation of the water works and the electric light plants as a saving of fuel and labor. Members of the council favor selling the electric light plant to a private company."

AMERICAN WORTHIES.—In his address last week at Asbury Park to the members of the National Educational Association, President Roosevelt said: "The roll of American worthies numbers men like Washington and Lincoln, Grant and Farragut, Hawthorne and Poe, Fulton and Morse, St. Gaudens and MacMonnies; it numbers statesmen and soldiers, men of letters, artists, sculptors, men of science, inventors, explorers, roadmakers, bridge builders, philanthropists, moral leaders in great reforms; it numbers all these and scores of others; it numbers men who have deserved well in any one of countless fields of activity; but of the rich men it numbers only those who have used their riches aright, who have treated wealth not as an end but as a means, who have shown good conduct in acquiring it and not merely lavish generosity in disposing of it." This sentiment was tremendously applauded by the audience.

WESTERN UNION AND POOLROOMS.—The wide currency given last week to a statement by the City Club of New York that agents of the Western Union Telegraph Company had recently agreed to furnish racing news to persons in this city for poolroom purposes brought emphatic denials from officials of the telegraph company. Affidavits by William J. Dealy and David B. Mitchell, who were named as having dealt with agents of the City Club, who were working to trap the company, were issued in which absolute denial was made of all the allegations. It will be remembered that this matter of supplying telegraphic news to gambling resorts was the subject of a vigorous public agitation some months ago.

DEEP SEA SIGNALS.—The Cunard Steamship Company is fitting its entire fleet with the submarine signal bells, such as have been tried successfully on the three big North German Lloyd liners, Kaiser Wilhelm II, Kronprinz Wilhelm, and Kaiser Wilhelm der Grosse. The Lucania is provided with the bells and used them with good results on the last voyage. The Caronia, Campania, and other big Cunarders are to have the new system. The sound of the bells travels through the water and is intercepted by receivers attached to the inside of the vessel near the bottom. The officer on the bridge hears the signals through a telephone and can tell exactly the direction the sound comes from and the distance his ship is from the lightship or land station. The system has been illustrated and described in our pages.

TROLLEYS IN TRINIDAD.—Mr. W. R. Holloway, United States Consul-General at Halifax, Nova Scotia, writes: "The Trinidad (West Indies) Electric Company, in which Halifax capital is so largely interested, will share in the prosperity of the colony. The company is negotiating with the government regarding the extension of its lines to St. Joseph, eight miles from Port of Spain, an extension which would pass through several large and growing villages and materially enhance the company's income from passengers and electric light traffic. The present power plant at Port of Spain is sufficiently large to supply the proposed new district. The net earnings for the first four months of this year show an increase over the corresponding period last year of nearly $5,000, and the reserve, after but two years of operation since construction was completed, amounts to more than $82,000."

MUNICIPALISM IN CHICAGO.—Mayor Edward F. Dunne has explained to the Chicago City Council his plans for municipal ownership of traction property. It was not municipal ownership absolutely, but the nearest thing possible under existing conditions. Absolute municipal ownership and operation, the mayor said, he does not consider practicable just now. The plan which the mayor offered provides for the incorporation of a company, managed by five men who command the confidence of the people of Chicago. To this company is to be granted a 20-year franchise, covering the streets in which the rights of the old companies already have expired, or soon will expire. It is to be stocked to the amount necessary to establish a street car system in these streets, roughly estimated at 240 miles. No bonds are to be sold. The stock is to be deposited with a trust company which the five directors are to select so as to prevent a purchase of it and consequent control by outside interests. The stock is to be sold at popular subscription. At any time the city may elect it can take over the property on an appraised valuation.

SUBWAY SUB-RIVER TRAINS.—The New York (Interborough) Subway has now pushed across the Harlem River and by its tunnel has access to the Bronx Borough, where the service will be highly useful to a large and growing population. The Lenox Avenue line runs to One Hundred and Forty-fifth Street. The new line to West Farms branches off at One Hundred and Forty-second Street, and a short distance farther on the trains enter the tubes under the Harlem River. These tubes are 687 ft. long, and are about 30 ft. below the water level. They are lined with concrete, and, according to General Manager Hedley, are the dryest points along the line of the Subway. The tracks are in separate tubes, each 12 ft. in diameter. There are also three pumping stations connected with the tubes to deal with leaks or overflows. The first station beyond the tunnel differs in many respects from the stations on other parts of the Subway. It is at Mott Avenue, but is about 50 ft. beneath the surface. There are two elevators with a capacity of twenty persons each as well as the regular stairway.

TELEPHONY IN CANADA.—Postmaster-General Sir William Mulock, chairman of the telephone committee of the Dominion Parliament, will visit a number of cities and towns in Great Britain where municipal telephones are in use, and will report the result of his investigations to his committee on his return. Sir William, also proposes to consult with the authorities of the British Telephone Department with a view to ascertaining how the trunk line telephone system is being operated in Great Britain.

A BUST OF VAN DEPOELE.—Some time ago a bust of the well-known electrical inventor and electric railway pioneer, Charles J. Van Depoele was presented to the Lynn Public Library. Last week it was installed in a proper position by a committee of the trustees, made up of Judge R. A. Harmon and James E. Odlin, at the front of the building, near the entrance. There are several niches especially provided for the purpose, and in which other busts of national characters have reposed since the opening of the library. These are at the entrance to the library to the right of the main door as one enters. It is in one of these that the bust has been placed. Later the trustees will place a bronze tablet under it bearing an inscription descriptive of the work and life of the man. The idea of honoring other Lynn men of prominence in scientific lines is one which will be followed out in such instances as the work of the men may warrant.

VENTILATING THE SUBWAY in New York City has become a problem during the hot weather, and some small electric fans have been put in to grapple with the problem. Mr. A. A. Cary, a well-known mechanical engineer, writing to the New York *Times*, suggests this plan: "All openings not positively needed for the influx or efflux of the moving air must be closed, and doubtless other openings would have to be provided. The fresh air should be introduced at the bottom, while the foul air should be ejected from the top of the Subway, or vice versa. The inlets and outlets should be placed at positive distances in relation to each other, and the fans should be preferably of the centrifugal type and of carefully calculated capacities. The mere placing of exhaust fans at haphazard places, wherever convenient openings may present themselves, without considering the other requirements set forth above, will afford, at the best, but partial relief, and the placing of small fans (such as are found on office desks) may give some comfort to those who come within the reach of the air they set in motion. They, of course, have nothing more to do with the ventilation of the Subway than the revolving propeller of a vessel in a dirty stream has to do with the purification of the water behind it."

HIGH SPEED IN BELGIUM.—Consul-General G. W. Roosevelt, at Brussels, Belgium, writes: "The Belgium Government has sent to the Chamber of Deputies a project of law approving the convention concluded at Berlin August 15, 1903, for improved railway communication between Belgium and Germany. The agreement calls for the construction of a direct rapid line between Brussels and Aix la Chapelle. It is confidently expected that the Chamber of Deputies will pass the bill authorizing the construction of the proposed line before the close of the session, as it is a recognized fact that the present line between the two countries no longer adequately responds to the constantly increasing passenger and freight traffic. The creation of a new line is considered an almost imperative necessity, in view of the energetic competition by the Dutch lines for the transportation of passengers and freight from England to Germany and other central European countries. Immediately after the bill is passed work will be begun on the new road, the total cost of which is estimated at about 55,000,000 francs ($10,615,000). The present line running between Brussels and Aix la Chapelle will be maintained practically as it now exists as far as Louvain, from which point it will start in a straight line, passing through the towns of St. Trond, Tongres and Argenteau, to arrive direct at Aix la Chapelle. In view of the progress of the application of electricity, it is the opinion of competent engineers in this country that it will be possible in the near future to run a train of cars at the high speed of 200 kilometers (127.27 miles) per hour. The new line is to be constructed so that it may at any time be transformed into an electric road, and with this eventuality in view there will be no level crossings or ordinary bifurcations. The grades will not exceed 10 millimeters per meter (0.394 in. per 39.37 in.), and the curves not more than 8,000 meters (26,240 ft.) nor less than 2,000 meters (6,560 ft.) in radius."

Electrical Engineers of the Times.—XVIII.

J. H. HALLBERG.

Josef Henrik Hallberg was born in Falkenberg, Sweden, in the year 1874. In the spring of 1890 he graduated from Latin-Laroverket, Halmstad, Sweden. Shortly thereafter he came to America, and in October of the same year entered the Ottumwa Iron Works, Ottumwa, Iowa, as apprentice in the machinist trade. During the three years of his apprenticeship he gained much practical experience in building and testing, erecting and operating steam engines, coal mining and hoisting machinery.

After completing the apprenticeship course in 1893, he became associated with Kohler Brothers, contracting engineers in Chicago, which connection he severed in 1894 to accept a position as sales engineer with the Electric Appliance Company, Chicago, with which company he remained until 1896. For three years, or until 1899, he served as electrical engineer and designer for the Standard Thermometer & Electric Company, Peabody, Mass.

From 1899 until 1903 he was electrical engineer and designer with the General Incandescent Arc Light Company, New York. While with this company he patented and developed a complete line of modern enclosed arc lamps, alternating-current regulators, automatic transformers, switchboards and protecting devices. He has also engineered many important street lighting installations, the most notable of which is the street lighting system in Cincinnati, O., which is remarkable in that there are installed about 6,000 4-ampere series alternating-current arc lamps which require over 105 separate circuits, with transformers, regulators and switchboards located in sub-stations. This is the largest arc-lighting installation in the world using series alternating-current arc lamps.

J. H. HALLBERG.

In 1903 Mr. Hallberg was appointed general superintendent and electrical engineer for the Cincinnati Gas & Electric Company, with full charge of its electric power stations and distribution system, comprising about 30,000 horse-power of steam and electric equipment and a large storage battery. While in charge of this plant he made many important changes in the methods of operating the power plants and the storage battery, considerably reducing losses and operating expenses. In the early part of 1904, Mr. Hallberg was elected vice-chairman of the Cincinnati Chapter of the American Institute of Electrical Engineers, in which capacity he acted during that year.

In 1904 Mr. Hallberg established an office in New York City as consulting engineer. He has been retained as consulting and advisory engineer to the Commission on Municipal Electric Lighting of New York City, and has been appointed consulting expert for the National Carbon Company, Cleveland, Ohio, in all matters relating to carbon for electrical purposes. He has also been retained as consulting engineer by several large lighting and power, industrial and manufacturing plants.

Mr. Hallberg is the author of numerous technical papers and articles. He is the inventor and patentee of electrical apparatus and systems, among which may be mentioned a single-phase to polyphase alternating-current trunk-line electric-railway system. He is an associate member of the American Institute of Electrical Engineers, an associate member of the National Electric Light Association and a member of the Swedish Engineers' Club of America.

Power House for the New York Central Electric Lines.

UTICA, 78 miles from Schenectady and 53 miles from Syracuse, has been selected as a generating and distributing point of power for the electric lines of the New York Central Railroad. The plan is to transmit water power to Utica and then to distribute it east and west along the lines of electric railway that parallel the New York Central.

In order to provide for any lack in quantity or constancy of water power, a steam turbine station of 8,000 kw capacity is being erected in Utica. At first the steam power station will carry the entire electric load, as the transmission of water power to Utica is not yet under way. The 8,000-kw steam turbine station at Utica is located on the Mohawk flats close to the point where the main line of the New York Central is joined by the Black River branch, and about 1,100 ft. from the Mohawk River. Both fuel and water are easily procured at this location, as the railway brings coal to the station conveyor, and a double line of steel pipes conducts water for boilers and condensers between the river and the steam equipment. To make doubly sure of a supply of water for the boilers, a line of pipe has also been laid from the city supply system to the electric station.

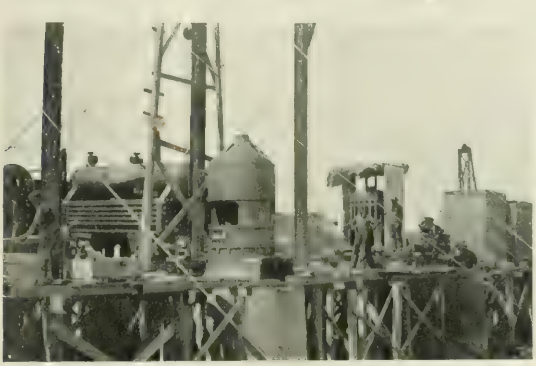


FIG. I.—STEAM TURBINES.

At the location of the station the flats are marshy and only a little above the level of the Mohawk, so that it has been necessary to drive piles over the entire foundation area. Because of the expiration of a certain contract under which power has been supplied to the Utica & Mohawk Valley Railroad, it was deemed necessary to have the new turbine station in operation on July 1, 1905, and this fact has led to some exceptional methods of construction. One of these has been to build the foundations for generating equipment sooner than any other parts of the station, and then to erect the boilers and turbines before the walls were up or the roof on. (See Figs. 1 and 2.)

Above the piles the entire foundations of the station and its equipment are of cement concrete, and the upper part of the building is of steel, reinforced concrete and masonry construction. Between the center lines of its outside walls the station has a ground area of 162 by 172 ft., and besides this there is an adjoining blower house that measures 29 by 45 ft., and a building for coal machinery.

Aside from the blower and coal machinery house the station is divided into two main parts, the boiler room and the turbine room, by a steel and masonry wall that rises to the roof, as seen in Fig. 3 In elevation the boiler room is divided into basement and main floor and the turbine room has a basement, main floor and gallery floor. From basement to main floor in both the boiler and the turbine space the elevation is 9 ft., from main floor to the lower cord of roof trusses in the boiler space is 36 ft., and from main floor to lower cord of roof trusses in the turbine space is 41 ft. In the turbine space the gallery floor is 16.4 ft. above the main floor, and from the basement to the gallery floor a steel and masonry partition shuts off a space about 16 ft. wide along the outer wall of the station, and parallel with the row of turbine generators, for the bus-bar compartments, high-tension transformers and the oil switches.

In the basement portion of the space just named are the bus bars, and at the main floor level the oil switches and the transformers.

On that part of the gallery that is mostly above the oil switch room are located the low-tension transformers, rotary converters and operating switchboards. Above the gallery floor is a traveling crane that sweeps the entire space 48 ft. wide over both the turbines, transformers and rotaries. The roof over the turbine space and switchboard gallery has a monitor along the direction of its greater dimension, and there is a still larger monitor on the roof, over the boiler room.

The boiler room is designed for sixteen 500-hp horizontal water-tube boilers. The boilers are arranged in two rows with fronts facing each other along the center of the room, in the direction of its greater dimension. Over the central space between the boilers runs the coal conveyor that feeds the automatic stokers. Both rows of boilers are connected to lines of main and auxiliary headers, near the wall between the boiler and turbine rooms, and from these headers a pipe carrying a separator passes through the wall and to each turbine. Ashes from the boilers drop to pits in the basement beneath, and are thence conveyed to the railway outside. The furnaces operate with induced draft provided by steam-driven blowers, and the products of combustion pass to the outside air through short steel stacks. Water for the boilers passes through a Cochrane heater of 6,000 hp rating, and as surface condensers are employed to handle the exhaust steam, the boiler water is used over and over. A part of the horizontal water-tube boilers are the product of the Franklin Works at Troy

In the turbine room foundations are provided for five vertical generators that are to be made by the General Electric Company. Two of these turbines will be of 1,000 kw and three of 2,000 kw each, thus giving the total capacity of 8,000 kw Each of the 1,000 kw units is connected to a surface condenser of 3,500 sq. ft., and each of the 2,000 kw units to a condenser of 6,850 sq. ft., both of the Worthington make.

With these units there are the necessary vacuum and hot well pumps. From each condenser there passes one pipe to the intake main and one to the discharge main, that carry water between the generating station and the Mohawk River, 1,100 ft. distant. Each of these main pipes is of steel and is 36 in. in diameter. The discharge pipe vents directly into the river, but the intake pipe terminates in a pump house on the river bank This house, a view of which is given in Fig. 4, measures 23 ft. 10 in. by 38 ft. 10 in. in plan outside, is one story in height above the water chamber, and is constructed of concrete, steel and expanded metal.

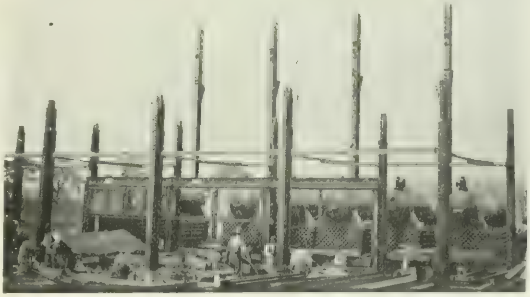


FIG. 2.—BOILER HOUSE IN PROCESS OF ERECTION.

On the river front of the pump house there is a steel intake frame with screen through which the water flows into the chamber beneath the house. The circulating pumps must lift the condensing water about 15.5 ft. above the low river level, besides overcoming the friction of the pipes. For this work three centrifugal pumps direct-connected to as many induction motors are located in the pump house, and lift the water from the river level and force it into the 36-in. intake main Each of these motors is rated at 100 hp with 2,300-volt, 40 cycle, three-phase current, and operates with its connected pump at 600 r.p.m. Besides its connection to a condenser, each steam turbine has another pipe that joins a 30-in. free air exhaust that rises above the roof of the station.

Each of the above-named turbine generators develops three-phase current at 40 cycles per second and 2,300 volts. This current all goes to transformers by the way of oil switches, save that consumed in the 2,300-volt induction motors at the generating station and the pump house. Exciting current for the turbine generators is to be supplied by two dynamos, each of which is direct-connected to a 2,300-volt, 40-cycle, three-phase induction motor.

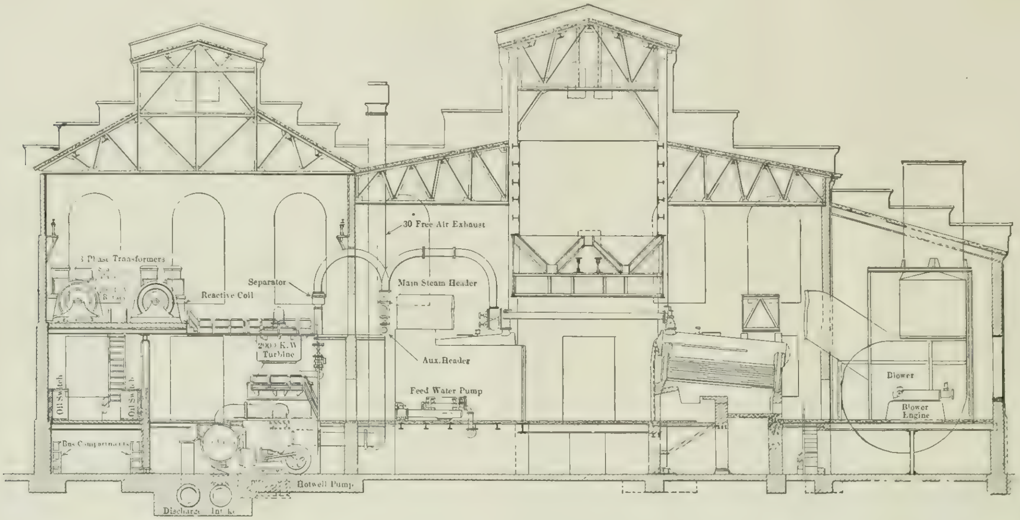


FIG. 3.—SECTION THROUGH BOILER AND TURBINE ROOMS.

On the gallery floor at one side of the turbine room space is provided for the motor-driven exciters, for transformers and for rotary converters and reactive coils, besides the switchboard and benchboard. Beneath this gallery is the oil switch room and the space for the high-voltage transformers.

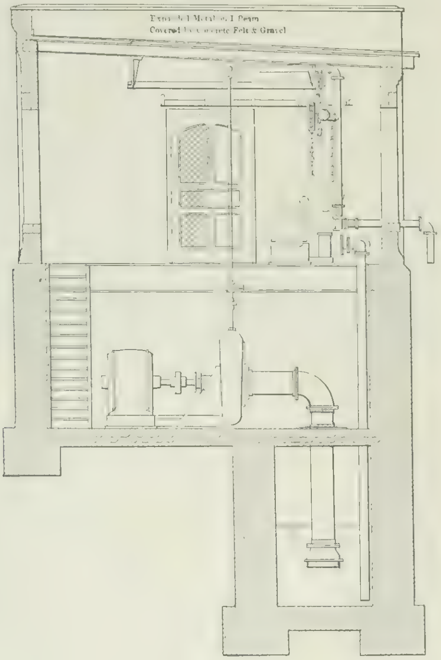


FIG. 4.—VERTICAL SECTION THROUGH PUMP HOUSE.

The transformers will be located in fifteen concrete cells, each of which has a floor area of 8.66 by 13 ft. and is designed to contain a transformer of 1,333 kw capacity. A pair of rails is laid in front of these transformer cells, which are in a single row, and by means of a truck any transformer can be moved into or out of its cell.

On the gallery floor above these high-voltage transformers there will eventually be located six 600-kw rotary converters at 600 volts direct current. Each of these rotaries will be provided with a reactive coil of 90 kv-amp. rating, and will receive 40-cycle, three-phase current from a 600-kw, three-phase transformer. These transformers for the rotary converters will take current either from the 2,300-volt turbine generators or from the high-voltage transformers in the room beneath the gallery when these latter receive the transmitted water power.

Each of the 1,333-kw transformers will be single-phase, and they will, therefore, be connected in five groups of three each to handle the three-phase current from either the turbine generators or from water power plants. These five transformer groups will have a combined rating of 20,000 kw. Each transformer has one set of windings for 2,300 and the other set for 17,100 volts. The 17,100-volt winding is in two parts and when these parts are connected in series the winding either takes or delivers current at 34,200 volts. When the 2,300-volt winding is used as the primary, taps in that winding make it possible to develop either 20,000 or 30,000 volts in the secondary coils, according as they are connected in multiple or in series.

From the characteristics of each transformer, it may be seen that when three have their high-pressure coils connected in delta these coils may either receive or deliver three-phase current of 17,100, 20,000, 30,000 or 34,200 volts. With the high-pressure coils of three transformers connected in star form, three-phase current at as high as 60,000 volts may be received or delivered. The utility of this variety of possible voltages may be seen from the fact that three-phase, 40-cycle current is to be transmitted from the turbine station at all of them from 17,100 volts up, and that current of the same sort is to be received at this station from water power plants. Under these conditions the fifteen 1,333-kw transformers will be used to

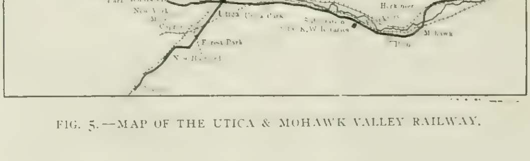


FIG. 5.—MAP OF THE UTICA & MOHAWK VALLEY RAILWAY.

step up or step down current, according as it is generated by steam or water power.

The first work to be done by the new turbine station is to supply current for the operation of the Utica & Mohawk Valley Railway, whose main line is parallel with the New York Central for a distance of 35 miles between Little Falls and Rome, passing through Utica on the way, as shown in Fig. 5. In 1904 this electric railway system comprised 95 and operated 110 miles of road, and it now forms a part of the New York Central electric system.

The Utica & Mohawk Valley road operates four sub-stations, one near Little Falls, one at Frankfort, one at Utica, and one at Oriskany. After July, 1905, the Utica sub-station will be at the new generating station above described, and will, for the present, contain one 500-kw and three 300-kw rotary converters.

At each of the other three sub-stations named above there are two 300-kw rotary converters, and each pair of these rotaries is fed with current from 200-kw transformers. These transformers are wound for either 17,100, 20,000, 30,000 or 34,200 in their high pressure coils, like the 1,333 units that are to be installed at the generating station. It is expected that at present they will receive current at 20,000 volts.

It was April 16, 1905, when the flats where the new plant is located were dry enough so that work could begin, and the station is at present ready for operation.

So great has been the haste on this station that the General Electric Company, which is supplying the electric equipment, has been unable to deliver the 1,000 and 2,000-kw turbines when they were wanted, and has loaned some 500-kw turbine units until the larger machines can be completed.

Mr. C. E. Parsons, Chief Engineer of the Hudson River Electric Power Company, has supplied the facts as to this interesting plant.

◆

The New York and Massachusetts Commissions of Gas and Electricity.

By ALTON D. ADAMS, LL.B.

MASSACHUSETTS established a gas commission by an act of its Legislature, in 1885, and New York, after twenty years, has just followed the unique example of the Bay State. Two years after its creation the authority of the Massachusetts commission was extended to the new industry of electric lighting, and later statutes, from time to time, have greatly increased its powers over these two lines of public service. In a large degree the New York commission of gas and electricity just created, has been clothed with the same important powers that have been delegated to the Massachusetts commission. Though it cannot be fairly said that the New York act is a copy of the Massachusetts statutes on the same subject, it seems plain that the legislators of the former state have profited by the experience of the latter.

In New York, as in Massachusetts, the commission consists of three members appointed by the governor, one of whom is designated as chairman. No person is eligible for appointment in New York who holds any official relation to a gas or electric corporation, or who owns any stock or bonds therein. To these requirements the Massachusetts law adds that no commissioner shall engage in any business save that of his office. Besides its principal office in Albany, the commission may have one branch office in New York City, and one in Buffalo. In the Bay State, the only office of the commission is at Boston, but, as in New York, meetings of the commission may be held in any part of the state. The governor of Massachusetts appoints the clerk of the commission there, but the Empire State commission selects its own clerk, as well as its other assistants, subject to civil service law. In the matter of salaries, New York is more generous than her sister state, and pays to each commissioner eight thousand dollars yearly; while the chairman receives four thousand dollars, and each of the other commissioners three thousand five hundred dollars, in Massachusetts.

The commission in each of these states has general supervision of all persons and corporations engaged in the distribution of gas or electric energy by way of the streets or highways. In each state the power of the commission extends over both the physical and financial operations of corporations engaged in gas or electric supply. By the definitions of the New York statute, the term corporation covers a company, association and joint-stock association, but does not include a municipality. The New York commission may regulate the physical operations of the gas and electric systems operated by a city, village, town or lighting district, and may inspect the books relating to these systems, but cannot control the financial doings of a municipality in relation to its gas or electric business. In this respect the Massachusetts commission has greater powers, for it can fix, under certain conditions, the rates at which a city or town shall furnish gas or electric service to private consumers.

A corporation, "incorporated" after the New York statute went into effect, cannot engage in gas or electric supply until it has obtained a certificate of authority from the commission, and if in the opinion of the commission the territory where the corporation proposes to operate is already well supplied with the kind of service that the corporation proposes to render, then the commission may refuse to grant the certificate. It is to be noted that this provision applies only to corporations "incorporated" after the act creating the commission went into effect; and as voluntary associations and partnerships are not "incorporated," it seems probable that the provision does not apply to them. Certainly the provision does not apply to a single, natural person who proposes to erect a gas or electric system. The provision in question evidently does not apply to corporations that were chartered before the act creating the commission was passed, and it is understood that a large number of corporations were formed to do gas and electric business pending the enactment of the statute. Even if the New York commission desires to prevent competition in the gas and electric business, it is evident that it has not the power. In this respect the authority of the Massachusetts commission is much greater, for it may refuse to allow either a single, natural person, a partnership, or any corporation to invade the territory occupied by a gas or electric company with another similar system. No municipality in New York can erect and operate a gas or electric system for other than municipal purposes without authority from the commission. In Massachusetts, this matter is not subject to the commission in any way, but it is provided by statute that a city or town cannot erect a gas or electric system, even for the sole purpose of lighting its own streets, without first buying the local system of the sort that it proposes to erect, if the owners of the local system elect to sell. A gas or electric corporation "incorporated" after the act creating the New York commission went into effect cannot issue either stock or bonds until it has obtained the above named certificate of authority from the commission, and until the commission shall certify as to the amount of stock or bonds reasonably necessary for the purposes of the corporation. The issue of stock or bonds by the new corporation shall not be greater than the amount as certified. No corporation subject to the commission, whenever incorporated, can increase its issue of stock or bonds without the written consent of the commission, stating the amount of the increase, but the statute does not say that the increase shall be limited in any way. To reach its decision as to the amount of issue or increase of stock or bonds, the commission may take testimony, examine the books and papers of the corporation, and require verified statements from its officers. In Massachusetts the amount of stock or bonds that any corporation engaged in gas or electric supply may issue is limited to what the commission finds to be reasonably necessary for the purposes for which the issue is authorized by it. Before this commission authorizes an increase in the stock or bonds of a corporation, it may require that the structural value of the plant of the corporation be brought up to the amount of the capital stock and debt.

A gas or electric corporation in New York cannot transfer or lease any part of its franchise or property, or contract for the operation of its system, without the consent of the commission. Neither can such a corporation, directly or indirectly, acquire the stock or bonds of another corporation engaged in or proposing to engage in the same or a similar business, unless authorized by the commission to do so. This provision of the statute does not seem to reach the case of a holding corporation which may be formed for the sole purpose of acquiring the stocks and bonds of gas and electric companies. Whether a gas or electric corporation in New York can mortgage its property or franchise without the consent of the commission, under the provision just cited, is an interesting question, but the probability is that it cannot.

In Massachusetts, a gas or electric corporation may freely mortgage its property and franchises to secure its bonds, but these bonds can be issued only by the authority of the commission. This commission may authorize the purchase of the property and franchise of an electric company by a gas company, but it does not appear to have authority to sanction the consolidation of two gas companies or two electric companies. It is interesting to note, however, that these companies have found a way to consolidate, in Massachusetts, without the consent of either the legislature or the commission. As to the purchase of the stock or bonds of one gas or electric company by another, in the state just named, it seems that the commission has no direct authority, but it may refuse its consent to an issue of stock or bonds for such a purpose.

If the New York commission refuses any certificate, authority or consent as to the transaction of gas or electric business, the issue of stock or bonds, or the transfer of franchise or property, which it has power to grant, an appeal lies to the appellate division of the supreme court of the third department, and this court may order the commission to grant the certificate, consent or authority desired. No such appeal as this can be had in Massachusetts, and the decision of the commission there on matters that lie within its discretion is final, except in cases where a special act of the legislature allows an appeal as to a particular company. Of course, the Massachusetts and the Federal courts are open to a suit based on a claim that some action of the commission there is illegal.

One of the most important powers delegated alike to the New York and the Massachusetts commisson is that of fixing maximum rates for electric and gas service. Neither commission can fix rates on its own motion, but can act in the matter only after a complaint to it has been made. In New York, a complaint as to either the quality or rates for gas or electric service may be lodged with the commission by either the mayor of a city, the trustees of a village or the board of a town, in which a person or corporation is authorized to supply gas or electricity. One hundred consumers of gas or electricity may likewise bring a complaint before the commission as to quality or prices. After an investigation of the plant and books of the gas or electric system, and after a public hearing before it, at which all interested parties may be represented, the commission may order an improvement in the service, or may fix the maximum price to be charged for gas or electricity. The price so fixed is the maximum price that may be charged for gas or electricity by the person or corporation affected in that place for a period of three years and until, after the expiration of this period, the commission shall again upon complaint reconsider the evidence and fix the price of gas or electricity.

Any person or corporation aggrieved by an order made by the commission upon complaint or otherwise may apply to the appellate division of the supreme court. "Such court may affirm, reverse in whole or in part or modify the order appealed from, or may make such order in the premises in its discretion as it may deem just and proper." This provision of the act raises a question under both the New York and the Federal constitution, and its validity will no doubt be tested in the courts. It is generally held by the courts that the fixing of rates for public service is a legislative and not a judicial function, and that it cannot be delegated to the courts. A court can probably review a rate that has been fixed by a commission, and if the rate is found to be reasonable affirm it, though even this power is question by some lawyers. But when a court modifies a rate fixed by a commission, and makes such order in the premises as it may deem just and proper, the court is evidently fixing rates, pure and simple. Will the New York courts support this fixing of rates as a judicial function? If supported by the New York courts, will this judicial rate-making pass muster with the Federal courts as due process of law?

The New York statute makes no provision for a petition by a gas or electric company for an increase in rates previously fixed by the commission. In Massachusetts, the mayor of a city, the selectmen of a town or any twenty consumers may bring a petition before the commission asking for a revision of rates or for improved service. The owner of a gas or electric system may also petition the commission to reconsider a rate that has previously been fixed by it. Under the New York statute no action can be brought before the commission there to fix the rate for gas or electric supply from a plant operated by a town, city or village, but this can be done by consumers served by a municipal gas or electric plant in Massachusetts. In that state also no municipal plant may furnish gas or electricity to private consumers at rates that do not yield a certain profit, save with the consent of the commission. From the rates fixed by the Massachusetts commission there is no appeal, except that the constitutional and Federal question as to the reasonableness of these rates can always be raised, just as it can in New York. The constitutional test of reasonable rates, as applied by the Federal courts is, in general, that they shall yield a fair return on the value of the property devoted to the public service. During the twenty years since the creation of the Massachusetts commission, in which it has fixed scores of gas and electric rates, it seems that the question of their constitutionality has been raised before the courts in only a single instance. Orders of the Massachusetts commission as to rates or other matters relative to gas and electric plants are enforced by suits in equity brought by the attorney general on behalf of the commission. In New York, either the commission or any person, corporation or municipality interested in the enforcement of its orders, may apply to the supreme court for a writ of mandamus to compel compliance therewith. The statute also provides that if any charge for gas or electricity is greater than that fixed by a statute or by the commission, this fact shall be a complete defence to any action that may be brought to recover payment for the gas or electric service.

A duty imposed on the New York commission is to investigate the methods employed by persons, corporations and municipalities in the supply of gas and electricity, and to order such improvements as will best promote the public interests. The illuminating power of gas, and the pressure at which it is delivered, are to be fixed by the commission, and the same body may prescribe the methods of bookkeeping to be followed by persons, corporations or municipalities engaged in the manufacture and distribution of gas or electricity. Books and papers pertaining to affairs under investigation may be ordered before the commission which may also subpœna witnesses, administer oaths and take testimony in proceedings by or before it under the act.

A systematic method for the inspection of gas meters, may be provided for and regulated by the commission. Each corporation under the supervision of the commission is required to make an annual report to it, verified by oath, showing in detail the amount of its stock, bonds, income, expenses, dividends, salaries and wages, also giving the location of its plant, a description of its property and franchises and such other facts pertaining to its affairs as the commission may demand. These reports must be in the form and submitted at the time prescribed by the commission. On its part the commission must make an annual report to the legislature of its investigations and proceedings. This report must also contain an abstract of the reports of gas and electric corporations, explanations of the methods employed in the manufacture and sale of gas and electricity, and suggestions for the better protection of the public interest as to the operations of these corporations.

Powers vested in the New York commission as to the investigation and regulation of the gas and electric business, as just outlined, appear to be somewhat more extensive than the corresponding powers of the commission in Massachusetts, as to corporations. In this latter state, however, the power of the commission to investigate and to require reports, extends to all persons and municipalities engaged in gas and electric supply, as well as to corporations. Though the Massachusetts commission has power to inspect the books and papers relating to gas and electric systems, there seems to be much doubt as to its authority to require the production of such books and papers before it, and the commission does not, in fact, subpœna witnesses or put them on oath.

In its supervision of gas and electric systems, the Massachusetts commission does not attempt to regulate their physical operations beyond the requirements of proper service to consumers, save as to matters expressly fixed by statute. The New York statute provides simply for the payment of the salaries and expenses of the commission from the state treasury, but in Massachusetts all of these amounts are subsequently assessed upon the gas and electric systems.

For twenty years the Massachusetts commission has been making decisions on questions of capitalization, reasonable rates, and many other matters such as must now come before the commission in New York. These questions as they come up involve considerations of both law and of sound public policy. While these decisions can have no binding force in New York, it seems not improbable that they may be allowed some persuasive weight with the commission there.

The Variation of Electrical Resistance in the Contact of Carbon and Cast Iron.

By ERIC SCHOENAU.

A LARGE number of induction motors are built in which the rotor is connected to the starting resistance through carbon brushes resting on cast-iron collector rings. In testing a motor of this character in the laboratory of the University of Kansas it was found impossible to get satisfactory results by the usual core loss and impedance method, owing to the magnitude and variable nature of the contact resistance of the brushes. This experience led the writer to choose as the subject of his graduating thesis a more extended investigation of the variations of the resistance of such contacts. The results of this investigation appeared to be of sufficient interest to warrant publication, and they are presented herewith.

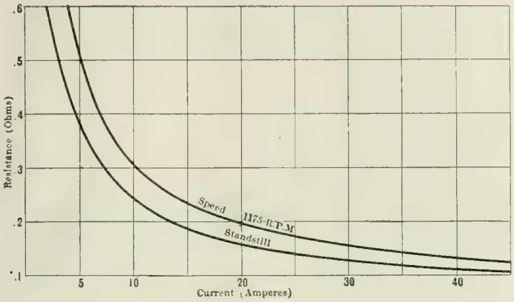


FIG. I.—CURVES OF SECONDARY RESISTANCE.

Fig. 1 shows the secondary resistance of a 7½-hp General Electric three-phase motor, plotted as a function of the current. The extreme variation of this resistance with the current is remarkable, as is the magnitude of the brush and contact resistance, the resistance of the rotor alone being 0.0387 ohms. Evidently the assumption of a constant secondary resistance in working up core loss and impedance readings on this motor would lead to serious error, and the use of contacts of this nature in the secondary circuit very materially effects the performance of the motor, particularly the slip and efficiency.

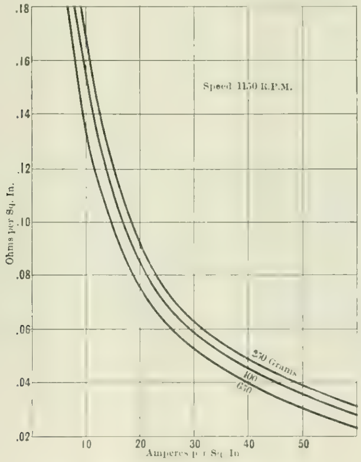


FIG. 2.—VARIATION OF RESISTANCE.

Further experiments were carried out with a cast-iron wheel placed on the shaft of a small direct-current motor and rotating in contact with carbon brushes in the familiar old style brush holders. The front faces of the brushes had an area of 0.469 sq. in. and the resistance was measured by means of a Weston ammeter and a low-reading Weston voltmeter, both having been carefully calibrated.

The curves of Fig. 2 show the variations of resistance with current density. At low values of current density the resistance is low, but by increasing the density the curves show a falling off along a curve to a hyperbola, which is to say that the voltage drop across the gap is almost independent of the current.

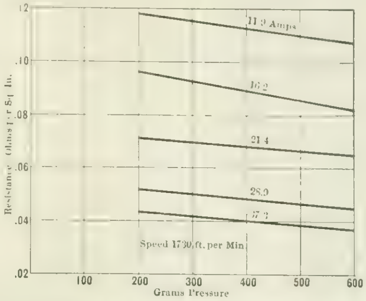


FIG. 3.—RELATION OF RESISTANCE AND BRUSH PRESSURE.

A fact to be considered in all the observations is that graphitic carbon has a negative temperature coefficient of resistance and hence, on heating, the resistance is lowered. However, the film of carbon through which the current had to pass was so small that any such change would necessarily have to be very small.

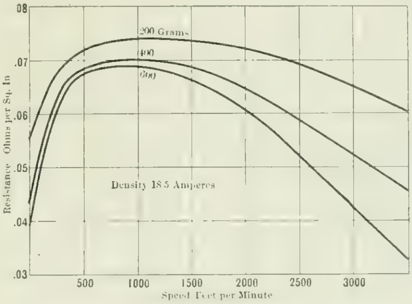


FIG. 4.—RELATION OF RESISTANCE AND SPEED.

The curves of Fig. 3 show the relation between resistance and brush pressure when the disc was revolving at a speed of 1,730 ft per minute. The resistance is lower, of course, at higher than it is at lower pressures, while with lower densities there is a more rapid falling off of resistance than there is with high densities.

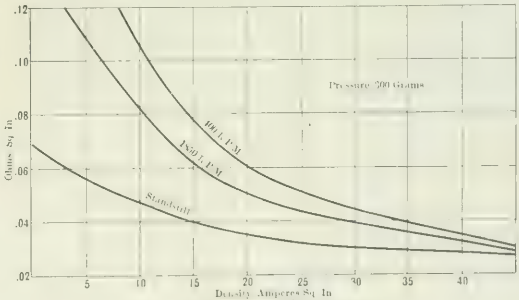


FIG. 5.—RESISTANCE AND DENSITY.

Fig. 4 shows the relation between resistance and speed in feet per minute. The density was held constant at 18.5 amperes and data were taken at various brush pressures. The resistance rises from standstill up to about 800 ft. per minute, and then falls off. At higher pressures the more rapid decrease in resistance is probably due to heating.

The curves of Fig. 5 show the resistance as a function of the density. After 45 amp. per sq. in. has been reached, the resistance has practically attained a constant value regardless of speed. At 400 r.p.m. we find a greater resistance than either at standstill or at 1,850 r.p.m. This may also be noticed by reference to Fig. 6.

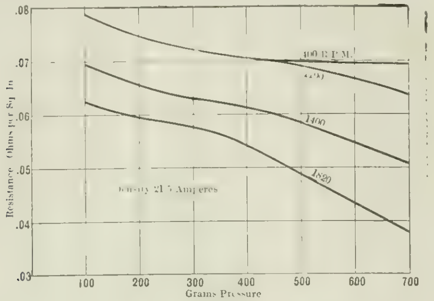


FIG. 6.—RELATION BETWEEN RESISTANCE AND BRUSH PRESSURE.

Fig. 6 shows the relation between resistance and brush pressure.

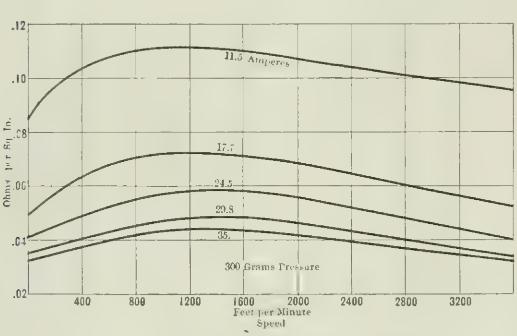


FIG. 7.—RELATION BETWEEN RESISTANCE AND SPEED.

The contact resistance between speeds of 410 r.p.m. and 1,100 r.p.m. is about the same until a pressure of 450 grams is reached.

The curves of Fig. 7 show the relation between resistance and speed. The pressure maintained on the brush was 22.8 ounces per sq. in., which is an ordinary value in practical work.

The Murgas System of Wireless Telegraphy.

The Murgas wireless system which has been successfully tried in the vicinity of Wilkesbarre, has been confined entirely to land operations. Many of the mountain ranges rise up 1,500 ft. higher than the hill on which the Wilkesbarre station stands, and between Wilkesbarre and Scranton, where the second station has been erected, there are several peaks of this height in the range which runs at an angle across the path of the waves, but so far the contour of the land seems to have had little effect in preventing the proper transmission of signals.

The only troublesome element is the presence of inductive disturbances. The line, as it may be called for convenience sake, is situated in a particularly awkward position as regards electric railways. There are three short roads which lie about one-quarter of the distance, two lie at least half, and one, the famous "cannon ball," of the "Laurel line," and a third-rail system, not only parallels the whole from station to station, but at the Scranton end makes an entire circle around the building. Measurements taken with a ballistic galvanometer on the antennæ at all hours at Wilkesbarre show the inductive disturbance to be very great, at times the spot of light from the mirror of the galvanometer traveling by a series of jerks entirely off the scale. On other occasions when the antenna was brought into proximity to the earth there could be obtained in the air gap sparks ¼ to ½ in. in length, and at very regular intervals, the period averaging from above five to one per second.

Such a problem as this was no easy one to solve, and Rev. Father Murgas, the inventor of the system, when he found this state of affairs to exist, after having gone to the expense of building both stations and thoroughly equipping them, taking years of planning and months to erect, learned that his work was by no means near completion. After several weeks of careful and minute investigation he at last hit upon the proper syntonization, and messages passed freely back and forth with no disturbance from external influences whatever. In arriving at this point of perfection, Father Murgas found it necessary to reconstruct the transformers, readjust the condensers and choke coils several times. Calculation could not often be depended upon, so that it was a matter of continuous experimentation to arrive at the proper tuning.

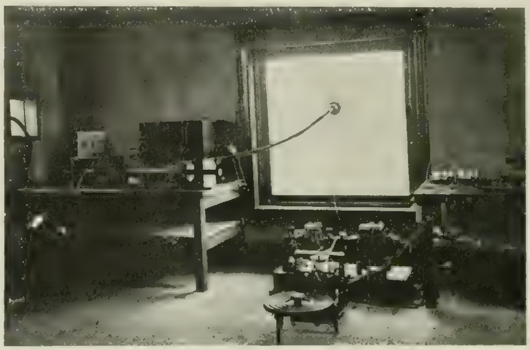


FIG. 1.—TRANSMITTING APPARATUS.

The fundamental features of the system involve the use of separate tones or tone impulses by the use of two interrupters working on the same induction coil. Such impulses being received in an ordinary telephone receiver by means of proper apparatus, tones differing in pitch will be produced, and while the number of tones which may be produced is indefinite and a variety of codes may be used, two tones are sufficient to produce a system analogous to the Morse, one tone corresponding to the dot and the other to the dash. For reasons as already stated the rapidity of transmission will be greatly increased by such a system, and, moreover, signals differing in character are more readily distinguished from each other than those which depend upon time intervals for differentiation. Tones are well distinguished in physics from other sounds, and the range of frequencies of vibration within which tones are produced is sharply defined. They are more readily distinguished than other sounds, and hence in systems employing a telephone receiver it is preferable to make the frequencies of the impulses come within the range to produce a tone. The interrupters above mentioned are running constantly and are connected through a double key similar to that used in the syphon recorder system, except that the keys are quite distinct from each other, and each operates one interrupter. The signals will, therefore, be transmitted to some extent as in long-distance cable telegraphy, but will be received by telephone or by an apparatus similar to the old needle with the differently toned bells, used by the British Post Office some twenty-five years ago.

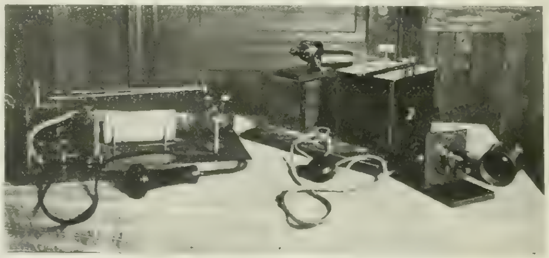


FIG. 2.—RECEIVING APPARATUS.

The power for transmission is supplied at twenty-four volts and three amperes on the primary circuit, and the spark from the great induction coil on open circuit is about six inches when operating to Scranton. With this small current the common telegraph key is found to be large enough. A view of the transmitting apparatus is given in Fig. 1.

The coherer used with the telephone is of the imperfect contact type. It consists of a needle, making about one revolution in two hours, on which rests on their edges several small carbon pieces cut from a thin disc or diaphragm like those used in a telephone transmitter. It is perfectly self-restoring and increases the tones about ten times. Fig. 2 shows the receiving apparatus.

The towers are 150 ft. high, with an additional mast arm, making a total height of 200 ft. They are substantially built of good pine, with elbow and connecting plates of iron, as may be seen from the illustration, and there are no guy wires except those used between the top of the towers and the top of the mast arms, and these are of galvanized iron broken in several places by strain insulators. (See Fig. 3.)

The antenna is composed of 10 cables made of No. 10 B. & S. stranded, well-insulated copper wires. Each cable hangs from a separate insulator of particularly well-insulated construction. Each insulator is a rubber rod 30 in. long and 1.5 in. thick, with outer petticoat tubes of polished hard rubber. The insulation of the antenna cables is practically perfect, hanging as they do from a cross rope connected to the top of the mast arms. At a height of 30 ft. from the ground all of the cables are fastened to another cross rope attached at each end to a 150,000-volt insulator, and from that point they are gathered in a bunch and brought into the operating room through a hole in the center of a square plate glass window.

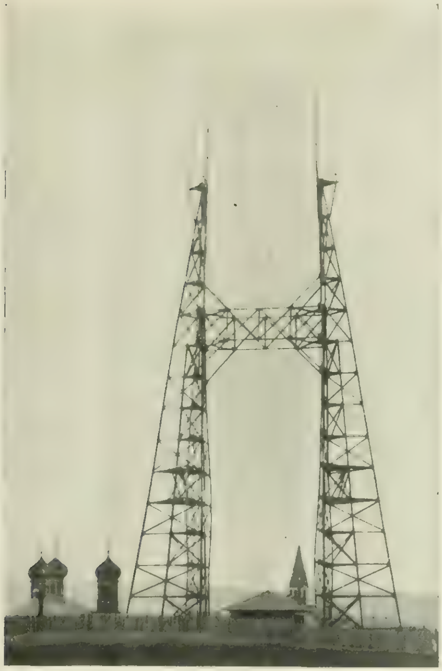


FIG. 3.—TOWERS AT WILKESBARRE.

The earth connection, which measures 4 ft. on each side, goes through a smaller window, and is made of a flat strip of copper attached to the water pipes of the regular city water supply.

The tuning device is similar to the Slaby-Arco system, but with a peculiar arrangement of the auto-transformer by which the tuning can be adjusted very readily.

Signals have been transmitted recently with great regularity and outside interference seems to have been entirely overcome. The earlier experiments, up to the point where something really definite was arrived at were carried on entirely at the inventor's own expense. This covered a period of several years and was a heavy drain on his own private resources. Fortunately, at this point he was able to obtain the aid of the Electric Signal Company, of Philadelphia, and through the president, Mr. Joseph F. Stokes, he has been placed in a position to carry out all experiments on any scale desirable. The Wilkesbarre station is built of concrete and is very roomy and comfortable, with quarters for an operating staff. The station at Scranton is also completed.

* * *

Works of the Electrolytic Alkali Co. at Middlewich, Cheshire, England.

By JOHN B. C. KERSHAW.

THE works of the Electrolytic Alkali Company at Middlewich, Cheshire, were erected in the years 1900-1901, and the first unit of plant was put in operation in April of the latter year. Middlewich was chosen as the site for these works on account of its being situated above the Cheshire salt deposits. Brine is pumped directly from the company's own brine wells into the decomposing cells, without the necessity for, or expense of, any intermediate separation in the solid form, and re-solution in water.

The works cover a very large area of ground and are well placed as regards railway and canal services. The boilers are of the Lancashire type, partly hand-fired and partly provided with mechanical stokers of the underfeed type. The generating machinery comprises six sets of horizontal cross-compound Roby engines, each rope-geared to two continuous-current generators, producing current at 60 volts. The normal output of each dynamo is 2,000 amp., and the total capacity of the generating plant is, therefore, 1,440 kw.

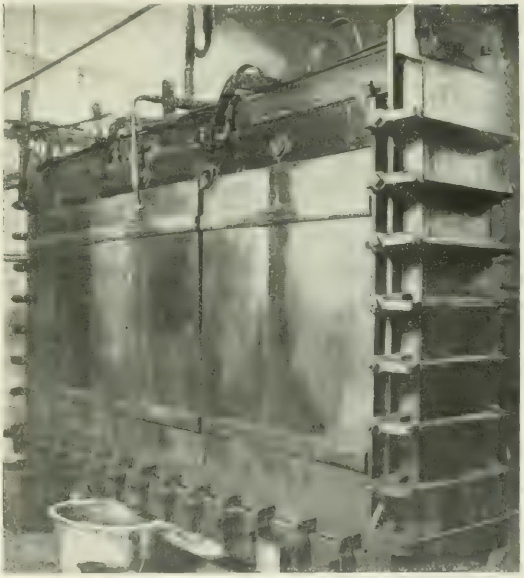


FIG. 1.—VIEW OF CELL UNDER WORKING CONDITIONS.

The cell room is a very spacious building containing 250 cells of the Hargreaves-Bird type, two-thirds of which are kept in constant operation. Fig. 1 is a photograph of the Hargreaves-Bird cell in working condition, and Fig. 2 shows a sectional elevation of the cell. The cell is 10 ft. in length, 5 ft. in depth and 14 in. in breadth, the narrow chamber enclosed between the two diaphragms being filled with brine and provided with a row of anodes as shown in Fig. 2. The two outer compartments of the cell on each side are the cathode chambers. These are supplied with steam and CO_2 gas, and the sodium carbonate which separates on the gauze cathodes is at once washed away as a solution of sodium carbonate by the condensing steam.

It was originally intended to employ gas engines for generating the electric current, and to employ the exhaust gases from these in the cathode chambers of the cells, in place of steam and CO_2; but it was found that solid carbon from the hydrocarbon gases remained in suspension in the exhaust gases and that this carbon entered and discolored the final product—the soda crystals. It has, therefore, been necessary to erect a lime-burning plant at Middlewich for supplying the necessary CO_2 gas to the cells, and the steam is obtained from the boiler plant.

Some portion of the caustic lime produced in the lime-burning plant at Middlewich is employed in the bleach chambers, and the remainder is sold. The carbonated soda liquors from the cells are passed through a refrigerating plant in order to obtain the maximum yield of crystal soda, and the mother liquors are finally thrown away. The decomposing cells are worked in series of 14, two of these being held in reserve for cleaning and repairs. A current of 2,000 amp. is the normal one for these cells, the row of 12 thus taking the electrical output of one dynamo. The e.m.f. required per cell varies from 4 to 4.5 volts; and each decomposes about 220 pounds of salt per 24 hours.

The anodes and cathodes employed in these cells are of special construction, and a large number of men are employed in the works in manufacturing them. The cathodes are of strong iron-wire gauze, covered on one side with the special silicated asbestos composition, which forms the diaphragm. Each cathode is 10¼ ft. by 5¼ ft. in superficial area, and each cell possesses two of these composite diaphragm cathodes, one placed on each side of the inner anode chamber and forming its sidewall.

The anodes are made up of rows of rough blocks of gas carbon, strung upon a central support of lead-copper alloy. Cement is used to cover the latter, where it is not covered by, and in close contact with, the gas-carbon. Formerly the gas-carbon blocks were simply bored through and placed upon the copper-lead supporting shaft; but now short rounded blocks of Acheson graphite are employed to support the gas-carbon, in the manner shown in Fig. 3. The diaphragms last 30 to 40 days in constant work, and the anodes about the same period; the cost of renewing these portions of the cell is, therefore, a considerable item in the total working costs of the process.

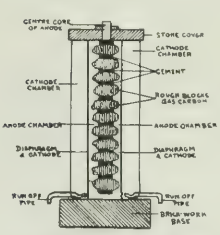


FIG. 2—SECTION OF HARGREAVES-BIRD CELL.

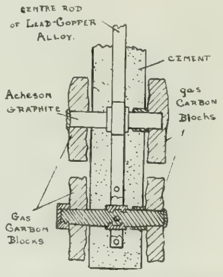


FIG. 3.—SECTION OF ANODES

The brine supplied to the cells is pumped, as already stated, direct from the company's own wells, and the supply of brine is so plentiful that a large plant was erected in 1904 and is now at work producing fine salt for sale from the surplus brine. This plant is worked on the multiple effect evaporative system, and has a capacity of 30 tons of salt per day.

Process Wet Processes.	E. M. F. Required in volts	Actual yield in grams —Per amp.-hr. NaOH	Cl.	—Per kw.-hr.— NaOH.	Cl.	Efficiencies, per cent Cur.	Energy.
Castner-Kellner	4.0	1.363	1.136	340	284	91	52.3
Hargreaves-Bird (1) . .	3.4	1.196	1.057	351	310	80	54
Rhodin	5.0	1.340	...	260	...	90.2	41.4
Aussig "bell"	4.9	1.308	...	266	...	87.5	40.9
Theoretical figures .	2.3	1.495	1.322	651	574	100	100
Fusion processes: Acker	7.0	1.371	.	195	...	91.6	54.0
Theoretical figures	4.2	1.495	1.322	356	314	100	100

(1) The Hargreaves-Bird process is used only for producing carbonate of soda.

The chlorine gas is pumped from the anode cells by two pumps of special design to the bleaching powder chambers, which are placed at a considerable distance from the other portions of the works. These chambers are of the usual type (sheet lead supported on timber frames) and have a capacity of 20 tons of bleach per charge. The lime required for absorbing the chlorine is obtained partly from the CO_2 producing plant of the company and partly by purchase of the better quality of lime produced in the peak district of Derbyshire. Only soft-wood or "low-strength" bleach is produced at the Middlewich works, the normal output being about 150 tons from a weekly decomposition of 115 tons of salt.

As regards the efficiency of the Hargreaves-Bird cell and process, some figures bearing upon this are given below. In each case the calculations have been based on figures published by the inventors for the actual work of the processes on a commercial scale, and they are consequently of greater value than mere laboratory results.

Using the above figures, we find that to obtain one metric ton of 72 per cent caustic soda, by the various processes, the following number of kilowatt-hours are required, and that the relative costs of power for the processes are as stated in column 3 of the table.

Kilowatt hours required to obtain one metric ton of 72 per cent. caustic soda and the equivalent amount of bleaching powder by various electrolytic alkali processes.

Process.	Kilowatt hours.	Cost at ¼d. per kw.-hour.
Castner-Kellner	2733	£2.17.0
Hargreaves-Bird (1)	2649	2.15.2
Rhodin	3457	3.12.0
Aussig "bell	3492	3.12.10
Acker (fusion process)	4769	4.19.4

(1) The Hargreaves-Bird process is only used for producing carbonate of soda.

* * *

Combined Telephony and Telegraphy.

At the Chicago convention last week of the National Interstate Telephone Association, Mr. Samuel G. McMeen presented a paper describing in detail the various methods of combined telegraph and telephone working in the same circuits. The author referred to the accompanying Fig. 1 as illustrating the fundamental principles of such workings. In this figure it will be seen that over a line of a single wire, using earth as a return, one telegraph and one telephone service may exist at the same time. Over a two-wire line, by one method of operation, one telegraph and one telephone service may be secured at the same time; and this may be accomplished in two different ways so far as the apparatus and principles are concerned.

By another method of working, a two-wire line may be made to furnish one telephone and two telegraph services at the same time. In all of these arrangements, under proper conditions, there is no interference between the two classes of service. The whole matter of superadding telegraph to telephone service on a one-wire line, or the reverse, may be dismissed by saying that it is not yet shown to be possible to do both things over a single wire without reducing in some degree the quality of the telephone service. The principal commercial application of such a plan is to convert the existing grounded telegraph lines into combined ones, thus securing telephone service of some value, without serious interference with the simplicity and convenience of the telegraph service. This is accomplished by the introduction of certain rather delicate apparatus for signaling, of more than usually powerful transmitters, and of receivers of less than usual sensitiveness. A little thought will show that circuits specialized in this way cannot be connected to the standard telephone systems of cities, so that this form of combined working must be considered special, though valuable. Combined working over two-wire or metallic circuit telephone lines, however, is free from this objection, and, indeed, from any other very serious ones.

Any metallic circuit telephone line which is good enough for quiet commercial telephone service, may be made to furnish one telegraph circuit by having impedance coils bridged across it, as shown in Fig. 2. These coils should contain turns enough to enable them to be bridged across the circuit with no greater reduction in telephone transmission than would be caused by bridging across a high impedance standard drop or ringer. The magnetic circuit may be open or closed; that is, the windings may be upon a straight bundle of iron wires, or upon a ring-shaped core. A tap is to be taken from the middle of the winding, or, what is equivalent, from the junction of two similar windings on the same core. This tap is carried to the telegraph apparatus and may be considered simply to be the end of the telegraph line. Any desired arrangement of telegraph apparatus may be added to the circuit thus secured, the only limitation being that the method of working should not involve high frequencies, such as are met in the Edison phonoplex or in any of the high-speed systems of automatic telegraphy.

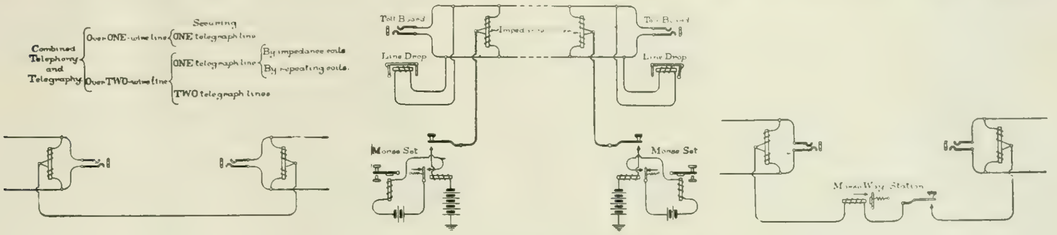
Should it be desired to build up a telegraph circuit longer than the available metallic circuit, or to carry the telegraph circuit over a route not already provided with a telephone circuit, the tap for the purpose may be taken from the telephone pair through an impedance coil and into another pair in a similar way. This arrangement is shown in the tabulation of Fig. 3.

If desired, a telegraph set may be inserted at such a point as this, where the telegraph line transfers from one pair to another. Fig. 4 shows this condition.

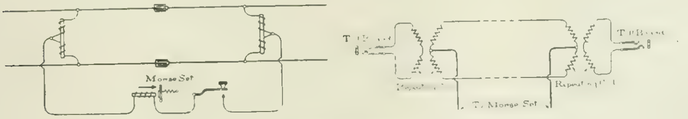
Should it be desired to insert a pay-station in a telegraph circuit at a point which is not a terminus of a telephone circuit, condensers may be inserted in each of the wires, impedance coils bridged beside them, and the Morse apparatus inserted in the bridge wire which thus emerges from the pair. This arrangement is shown in Fig. 5.

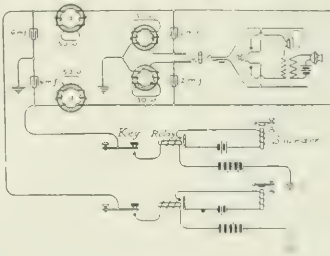
In all the foregoing plans involving the use of impedance coils, there exists the difficulty that in case the two telephone lines so equipped are switched together through a toll board having no condensers or repeating coils in its cord circuits, the two sets of Morse apparatus will be connected together and confusion may result, quite as does when two telegraph lines become crossed. Inasmuch as condensers of two mf. or greater capacity do not interfere with successful telephone transmission, cord circuits so equipped will be free from this fault. For the same reason the loop arrangement shown in Fig. 5 is free from any telephonic objection.

There is another fault in the impedance coil plan, in that ringing generators, suitable for local exchange line signaling, often require to have one terminal permanently grounded, or to have temporary ground applied during the time signals are being rung upon party lines, grounded rural lines, or other circuits involving ground in any way. If the same source of ringing current is used for toll line signaling, a little thought will show that the telegraph outfit will frequently be disturbed by a series of dots, caused by ringing current passing to ground through the Morse relays.



Figs. 1, 2, 3 and 4.—Combined Telephony and Telegraphy.





Figs. 5, 6 and 7.—Combined Telephony and Telegraphy.

A preventive for such a derangement is found is providing separate ringing apparatus for toll operators, or by securing the ringing current for these operators through special transformers.

Roughly speaking, the best conditions of operation with the impedance coil plan will be secured when, with a high resistance total Morse circuit, high resistance telegraph relays are used. It is not required that the resistance of the impedance coils be great, but only that their inductance and consequent choking due to voice currents be great. This is an immediate result of the iron core and the turns. For an expedient, a ringer may be used as such a choke coil, its two terminals being bridged across the telephone line, and a telegraph tap taken by extending the junction between the wires of the two spools. Such an arrangement, if the spools are at all nearly equal, will be quite successful. If a number of circuits are so treated, the ringers of the different circuits must not be stored close together with their cores parallel, or cross-talk between the circuits may result. This may be prevented by placing the adjacent ringers with their cores at right angles to each other.

It is obvious that a high impedance tubular drop having a middle terminal may also be used for such a telegraph tap, and in such a case danger of cross-talk disappears, being prevented by the shield.

If such high impedance devices as ringers and drops are used for these taps, the Morse relays should be wound to high resistance, say 500 to 1,000 ohms.

By the use of repeating coils to be permanently inserted in the telephone line at the points where the telegraph tap is to be taken from the circuit, one Morse line may be secured from a two-wire circuit quite as has been described for the use of impedance coils. Fig. 6 illustrates how the tap is taken from the line side of the repeating coil. Coils may be secured in the market with arrangements made for taking out this tap. Connections to Morse apparatus are quite the same as are shown in Figs. 2 and 4. This arrangement has the advantage that no connections between telephone lines in the way of ordinary switching, nor any peculiarities of ringing apparatus, will affect the telegraph apparatus adversely. It has the disadvantage that the introduction of two repeating coils in a circuit causes a distinct loss in both voice and signal transmission, all the more marked when several lines so equipped are connected together. From the practical standpoint, this plan is not recommended for other than short lines, and then only under excellent conditions where freedom from interference is the thing most greatly to be desired.

The reason for non-interference between the telegraph and telephone services in either the impedance coil or repeating coil plans is that at any point where telephone apparatus connects to the two wires of the circuit, the potential difference of the two wires due to telegraph currents is always zero.

The arrangement of things shown in Fig. 7 is that which gives two telegraph circuits in addition to one telephone circuit from each pair of wires. The drawing shows the situation far more clearly than it can be described in words. The principle involved is that of different frequencies, the pulsations which make up the telegraph signals being very much slower than those of the voice currents. When it is remembered that this drawing shows the equipment at one end of the line, and that the distant equipment is an exact duplicate, that the impedance coils *a a* are capable of passing telegraph impulses with little or no harmful effect upon them, that these coils further act with such a choking effect upon voice currents as to be practically opaque to them, and that the condensers of 2 microfarads each are relatively transparent to alternating currents and opaque to direct currents, it will be easy to see how the two systems of communication can go on at the same time.

A close examination of the drawing will show that the direction of windings in the coils *a a* is such that the two halves of the total winding are connected in the familiar differential or reverse relation to each other. It will also be noticed that this is not true of the coils *b b*. In the coils *a a*, therefore, so far as direct currents are concerned, the magnetizing effort of one winding of each complete unit neutralizes that of the other; and this is also true for direct currents, even if interrupted at the highest frequency used in telegraphic hand work; but for currents of such high frequency and small volume as those of speech, the windings of each unit are practically two independent choke coils in series.

While the other arrangements which have been discussed secure non-interference between the two systems of communication by preventing the telegraph from producing any effect at all in the telephone receivers, this plan operates to modify the telegraph signals in such a way that, although they affect the receivers, they do not produce audible sound. A careful examination of the diaphragm of a receiver properly connected across a composite line while the telegraph is working, will show that it is moving through a considerable range, even though nothing whatever can be heard when the instrument is held to the ear.

Each of the plans has some disadvantages. The flaw in this plan is that the shunt across the circuit through the coils and condensers is sufficient to prevent any ordinary ringing. Signals from one station to another require to be given over some Morse line, or by the assistance of special apparatus adapted to respond to currents of very high frequency. As the voice current is of a high frequency and can pass over the pair, so some other high frequency, but of larger volume, may be used to operate a relay at the distant station, and that in turn to display a signal. There is, however, no simple and convenient arrangement available.

The ordinary ringing current is of sixteen cycles per second; a skilled telegraph operator will send thirty-two dots per second; the half waves of the ringing current are less abrupt in change than the telegraph dot. For these reasons it is apparent that one may send ringing current instead of telegraph current over any composite Morse line without interfering with the telephone. This possibility enables one to sell the service of one side and retain the other for ringing. The arrangement of keys and signals is obvious.

Telegraph circuits secured in any of these ways may be treated as may be desired within reason, in the way of extending by repeaters.

There are three reasons why it is commercially of advantage to apply these composite methods to some of the circuits operated by almost any long-distance organization.

One of them is to secure an additional earning from the property, because by the very nature of things the lines are practically out of use during a large part of each total day. It is not found difficult to secure an annual telegraph revenue equal to 5 per cent on the total cost of the circuit, and this without establishing offices or maintaining a special organization to care for commercial messages.

There is more demand for telegraph service in its private line form than is being fulfilled by all the existing telegraph equipment. An active canvass of commercial interests in one's locality, and particularly of those having offices, factories and branch houses in different places, is certain to produce contracts, at a rate less than for other methods, which will supply the consumer with a better result than he is now securing.

The investment on the part of the telephone company per telegraph station, varies with the different plans, but in all cases is only about as great as the cost of the line and equipment of a telephone subscriber located a similar distance from the central office. This statement is meant to cover the complete equipment, including the telegraph apparatus required at the consumer's station.

The second reason is the advantage of ticker wires over which much or all communication between toll operators may take place. Naturally, this enables toll operators to prepare for one conversation over an important circuit, while another is going on. An intelligent use of such facilities will enable the carrying capacity of the more remuneratve lines to be increased enough to defer the stringing of additional circuits.

The third reason is in the transaction of the official business of the telephone company. By its very nature such a company has its offices scattered about the country, and it is too often its tendency to overburden its own circuits with its official business during the day, while on certain routes there may be too few circuits to carry even the remunerative business of the public. It is inconvenient to force the official business into the less busy hours of the day. A very small investment in composite circuits, and a slight rearrangement of the company's organization, will enable an official to dictate telegrams which the stenographer herself, with a little knowledge of Morse, may place immediately upon the line. Such business may or may not be confirmed by mail. It is not essential that the operators be skilled to high speed, as training in accuracy only is sufficient, and even fifteen words per minute is a sufficient rate. Very fast operators reach sixty.

If it is not desired to extend the telegraph network over an entire system, official telegrams may be landed in important centers and transmitted by telephone to destination. Experience in this method of handling messages will show that errors are less frequent than might be expected.

Variable-Speed Dynamo.

In the Digest on page 898 of our issue for May 13 was given a brief description of the new variable-speed dynamo designed by Dr. E. Rosenberg. We give below a fuller account of the characteristics of the machine, supplemented by curves, showing the performance of the dynamo in actual service. As was stated in the article just referred to, the machine is built like an ordinary continuous-current dynamo, but has extra brushes spaced 90 electrical degrees between the main brushes and connected externally by a heavy conductor, and the armature reaction is intentionally made very strong, by the design of the machine. In fact, the cross turns are depended upon for the regulation of the dynamo.

The construction is diagrammatically indicated in Fig. 1. The armature is of the ordinary type and the dynamo is self-exciting, like any shunt-wound machine. In the diagram, however, it is shown connected to a battery to which it supplies current. The battery sends a current of constant strength through the field coils *ff*, which produce a "primary" flux indicated by *ss* and *nn*. This flux is mechanically in line with the brushes, *BB*. When the armature is in motion, due to the cutting of this flux by the armature conductors, there is generated at the auxiliary brushes, *bb*, an electromotive force, which sends current through the heavy conductor connecting these brushes, and there is produced thereby a flux which tends to place itself in mechanical line with the brushes, *bb*. This latter flux, which divides and passes obliquely into the pole tips, is indicated in Fig. 1 by *NN SS*. Since the armature conductors cut this flux, there is generated therein an e.m.f., which is effective at the brushes, *BB*. When the speed is sufficiently high this e.m.f. sends current *I* into the battery. Now this current *I* tends to produce through the armature a vertical flux opposite in direction to the main field flux. That is to say, the current *I* is opposite in magnetomotive force to the field current, and the resultant vertical flux is, thereby, reduced in magnitude. The short-circuit current between *bb* is thereby also diminished, likewise the horizontal armature flux and the voltage between *BB*. This leads to a reduction of the external current *I*, and consequently to a reduction of the vertical armature flux opposed to the "primary" flux, and so on until a final state of equilibrium is reached.

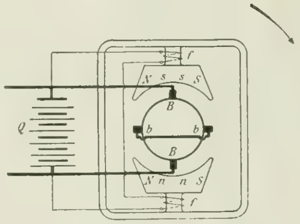


FIG. 1.—DIAGRAM OF VARIABLE-SPEED DYNAMO.

Since the whole action of the dynamo is primarily due to the "primary" flux, *ss-nn*, it follows that the external current cannot possibly increase beyond a certain value, howsoever high the speed of the armature may become. The limiting value of *I* is that for which its magnetomotive force is equal to the magnetomotive force of the field current. It is evident, therefore, that there corresponds a certain value of *I* to every value of the field current. The fact that the compensation for speed depends upon the differential action of two practically equal quantities, is the principal reason for the extremely exact automatic regulation which is obtained with these machines.

Fig. 3 shows whiat might be called the external characteristics of these machines working in parallel with a battery, i. e., with constant external voltage. The various characteristics are obtained with different exciting currents in the coils *ff*. Starting with curve *I*, which represents the working of the machine with maximum excitation, it is seen that at about 340 revolutions, the terminal voltage of the machine becomes equal to the battery voltage, and that the current supplied by the machine increases rapidly as the speed increases above this point. When a speed of about 700 revs. per min. is reached, the current attains practically a maximum, since the curve runs asymptotically toward a definite limiting current. Thus a change of speed from 2,400 to 800 revolutions produces a drop in current of only about 12 per cent. Curves II to VIII represent the working of the machine with a smaller excitation in coils *ff*. At half excitation (curve V) the speed at which the battery voltage is reached is only slightly higher than before, and the maximum external current is almost exactly half that for full excitation.

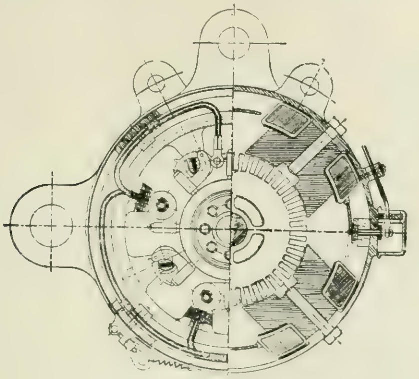


FIG. 2.—SECTION OF DYNAMO.

Fig. 4 represents the working of the machine directly on a constant external resistance instead of a battery. For a given exciting current both the current and voltage start, of course, from zero. After a speed of about 600 or 700 revs. per min. is reached the curves assume nearly exactly the same form as the current curve in Fig. 3, that is, both the current and the voltage remain practically constant. When working on incandescent lamps the effect of the speed variations is even less noticeable, owing to the fall in the resistance of the lamps as they get hot.

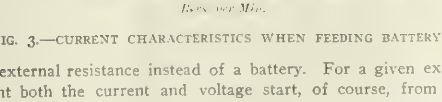


FIG. 3.—CURRENT CHARACTERISTICS WHEN FEEDING BATTERY.

In order to avoid the possibility of the short-circuit current, which rises rapidly as the speed increases, from reaching a dangerous value in any case, it is found advisable to let the iron of the magnet core become saturated when the flux reaches a value corresponding to the maximum safe short-circuit current. Then, if the speed falls below that corresponding to this point, the short-circuit current will decrease, until finally the voltage of the machine will fall below that of the battery. To prevent a current from being sent back from the battery through the machine a reverse-current cut-out is inserted between the two.

Fig. 2 is a cross section through a four-pole dynamo designed for train lighting, and serves to indicate the method used for obtaining abnormal armature reaction. One of the most important points in connection with this type of dynamo is, of course, the commutation. The short-circuited brushes are working in the neutral zone, and are thus in a relatively better position than are the brushes of any reversing motor, more especially so as the current flowing through the short-circuited brushes is only about 40 per cent of the full-load current. Besides, the current in the short-circuited brushes decreases with increasing speed, so that the product of commutated current and speed which determines the reactance voltage is nearly constant for all speeds. Thus it will be seen that the commutation at the short-circuited brushes is equally good with low and high speeds. The main brushes, *BB*, are in the centre of the "primary" flux, but in the neutral zone of the horizontal armature flux. Now the "primary" flux is always only of such an amount as to produce a certain limited current through the resistance of the armature and the short-circuited brushes, and the separate short-circuiting of a few sections by the brushes, *BB*, cannot cause anything more than this limited current to flow. As a matter of fact the coils, *ff*, may be considered as compensating coils, neutralizing and overpowering the armature ampere-turns due to the external current. This compensation, however, is not a very exact one, because, as the external current increases, the amount by which the ampere-turns of the coils *ff* exceed the armature ampere-turns falls off instead of increasing. For this reason, and in order to allow for a slight lack of magnetic symmetry in the main flux, it has been found advantageous to cut slots in the pole faces just opposite the brushes *BB*; the commutation of these brushes takes place in a real neutral zone. Thus, also, the brushes *BB* work under exactly the same conditions as the brushes of an ordinary reversible motor, and have been found to work absolutely sparkless when running in either direction and with any speed.

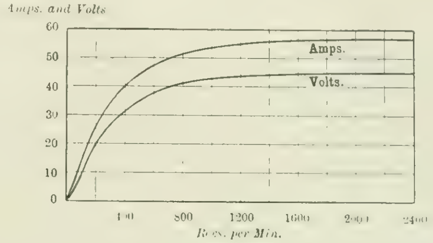


FIG. 4.—CURRENT CHARACTERISTICS WITH CONSTANT EXTERNAL RESISTANCE.

Considering the field magnets, a considerable amount of material is saved here. The main flux being produced in the armature and flowing from the latter into the air through the pole-shoes and back to the armature, the iron of the pole shoes has only to be of sufficient section for this flux. The magnet frame and the cores have only to carry the small "primary" flux produced by the coils *f f*, and can, therefore, have an extremely small section

It is stated that the efficiency of the new machine is about the same as that of an ordinary dynamo of the same output. The commutator losses are slightly larger, but this additional loss is compensated by the smaller excitation loss. The efficiency at a given output remains practically constant over a wide range of speed, for the increased friction losses at high speeds are compensated by the reduced loss in the short-circuit.

Among the railway authorities which have made extensive orders for this machine are the Prussian State Railways, the Bavarian State Railways and the Bagdad Railway

Letter to the Editors.

Booster Field Control.

To the Editors of Electrical World and Engineer:

Sirs:—I have been somewhat interested in the article entitled "Booster Field Control," by Mr. Carl P. Nachod, which appeared in your issue of June 21. The type of rheostat and connections which are described have been in use for the control of storage battery boosters at least eight years, and have several times been described in print.

Mr. Nachod's graphical method of computing the resistances of the successive steps in the rheostat is new and ingenious. It, however, involves too much calculation combined with the graphical construction, to make it an easily-handled, accurate method in practice. An analytical formula suitable for slide rule computation is simpler, more expeditious and accurate.

Mr. Nachod suggests that the best form of rheostat for booster control would be one provided with connections and a switch so arranged that it would act as a potentiometer through a portion of its range, and as a series resistance through the rest of its movement. In this opinion I heartily concur, and so favorably have I viewed this particular arrangement that about two years ago I patented it.

New York, N. Y. Lamar Lyndon.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Temperature Curves of Field Coils.—Glazebrook.—A communication with respect to the two papers of Rayner and Goldschmidt, abstracted some time ago in the Digest. Goldschmidt had called attention to the fact that all curves of Rayner are parabolas. The present author shows theoretically the reason for this and reaches a conclusion of practical importance to the effect that by a series of experiments on one coil, makers can determine with ample accuracy three constants—the internal thermal conductivity of the insulating material and the exterior thermal emissivities of the two surfaces—and can therefrom deduce the thermal conditions which will prevail in other coils not altogether dissimilar in pattern.—Lond. *Elec.*, June 16.

Eddy Current Losses in Solid Pole Pieces. Ruedenberg.—A translation in abstract, but of considerable length, of his German paper recently noticed in the Digest.—Lond. *Elec. Rev.*, June 16.

Electromagnetic Field in Machines.—Emde.—The first part of a highly mathematical paper on the stationary electromagnetic field in the air-gap between two concentric hollow iron cylinders which may represent the stator and rotor of an electric machine.—*Zeit. f. Elek.*, (Vienna), June 25.

Lights and Lighting.

Standardizing Arc Lamps.—Norden.—A paper read before the recent annual meeting of the German Association of Elec. Eng. The speaker requested the coöperation of the association with the Association of German Electricity Works for devising methods of standardizing arc lamps. In the first place it is necessary to get a uniform formulation of all statements as to illumination. With arc lamps it is usual in Germany to give the mean hemispherical intensity. On the other hand the Reichsanstalt recognizes only the spherical intensity in its tests. Further, there should be a standard rule how to take into account the light absorption due to glass globes. It may be considered correct to test arc lamps without globes and to take the absorption into consideration by conducting a certain percentage according to the kind of glass used. On the other hand, the light emission with the globe is really that feature which characterizes the lamp in practical use. The economy of lamps, indicated by the watts consumed per candle, should also be clearly defined. As a matter of principle it is correct to measure simply the electrical power consumed at the terminals of the lamp when giving a known illumination. On the other hand, this principle neglects the consumption of a certain power in series resistances if such are necessary. Flame arc lamps for direct current are adjusted to an e.m.f. at the arc of about 47 volts, while ordinary direct-current arc lamps are adjusted to 42 volts. For the same current, therefore, the watt consumption of both lamps would be different. Nevertheless, if the supply voltage is 110 or 120, not more than two lamps can be connected to the network in either case, so that in practice both arc lamps would consume the same power. However, the latter consideration would not lead to a characterization of the economy of an arc lamp, since different values would obtain for the same type of lamp if it is in one case connected to a 110-volt supply and in the other case to a 120-volt supply. Another important point which should be decided is a uniform method of photometric measurement. Great complications are here due to the fact that the reliability of usual measurements is impaired by the difference of color of the lamp tested and the lamp of comparison. Moreover, in arc lamps with inclined carbons, the illumination is not symmetrical around the axis of the arc lamp, so that the usual test in one single vertical plane is no longer sufficient. The German Association of Elec. Eng. appointed a committee which shall take up the problem of standardizing electric lamps in general. This committee was instructed to act in coöperation with the Association of the German Electricity Works as far as arc lamps are concerned.—*Elek. Zeit.*, June 22.

Power.

Power Transmission Line in Nevada.—Prince.—An account of the electric power transmission of the Nevada Power, Mining & Milling Co., from the Bishop Creek in Inyo County, Calif., to the Goldfield and Tonopah districts of Nevada and the interlying towns and mining districts. The power developed at the hydraulic plant will be 3,500 hp. and a combined efficiency of the system of 60 per cent is assumed. It is expected that 2500 hp. will be delivered in Tonopah and Goldfield without too much of an overload.—*Eng. News*, July 6.

Belting.—Carle.—An article illustrated by diagrams on the power transmitted by belting.—*Power*, June.

Some Things Encountered in Power Plants.—Cavanagh.—A short article containing many practical hints on the care and operation of various pieces of apparatus found in a power plant.—*Amer. Elec.*, June, 1905.

Traction.

Single-Phase Traction in Paris.—Reyval.—The French Thomson-Houston Co. has constructed for some time single-phase motors of various frequencies for elevators, machine tools, etc. These motors, which are based on the principles of the patents of Latour and designed by Gratzmueller, have proven so perfectly satisfactory that the same type of motor is now used for a single-phase traction experiment on a street railway line in Paris. One single car is used for this purpose, making round trips on a line one mile in length. It is an ordinary direct-current tramway car; from its truck the two direct-current motors have been removed and replaced by single-phase motors; the controller has also been changed. The two motors are connected to the axles through a gearing which reduces the speed in the ratio of 4.6 to 1. Each motor has four poles and has a capacity of 50 hp. at 300 volts and 25 periods; its weight is 1,350 kg.; the maximum increase of temperature at the end of one hour of service is 75 deg. C. It is composed of a stator with distributed winding, absolutely analogous to the stator of a single-phase induction motor. Within this stator revolves the rotor, the air-gap being 2 mm. and the construction of the rotor being quite similar to the armature of a direct-current motor; the only difference is that in the experimental motors under test the commutator has been made large and constructed with considerable care in order to obtain perfect commutation. The commutation problem presents the greatest difficulty with single-phase series motors for the reason that in ordinary series motors the flux of the stator induces in the coil short-circuited by the brushes static e.m.f.'s of the form $e \cos \omega t$ and the flux of the reaction of the armature while running generates dynamic e.m.f's $e \sin \omega t$. These two e.m.f's are added to each other and produce, under the brushes, currents which render the commutation bad. One solution for improving the commutation consists in placing on the stator a winding which generates at any moment magnetic motive force equal and opposite to that of the rotor, so that their effect is suppressed. This method gives a compensated series motor. Another solution devised by Latour and used by the French Thomson-Houston Co. consists in utilizing the perfect commutation of the repulsion motor during running, and to combine with it the advantage of the series motor of having a strong starting torque. In both cases there is at starting a tendency to sparking, if the commutator is not carefully designed. The four-pole motor has eight brushes, four short-circuited and four introducing the current into the rotor. The two motors of the car are permanently connected in series and are fed from an oil-cooled transformer placed between the two axles and having a total weight of 1,100 kg.; its design is probably too liberal. The secondary winding has a certain number of terminals from which the current may be tapped in order to vary the potential difference at the motor terminals for the sake of speed regulation. The secondary voltage corresponding to the highest speed is 300. Fig. 1 shows the equipment of the car with a controller at each end. The primary current passes from the trolley wire through two circuit-breakers at the front and back of the car to the primary of the transformer and then to the rails. In shunt with the conductor leading from the trolley is a lightning arrester. Each motor has four terminals, of which one is connected to the fixed terminal of the secondary winding of the transformer, while the other three are connected to the three corresponding terminals of the "inverseurs." The regulation of speed is obtained by the controller, which contains a commutator with seven contacts so that different connections may be made as indicated in the diagram. Before the motors were placed on the car they were subjected to very severe tests, without showing the slightest tendency to sparking. It is believed their design has been unnecessarily liberal and that even if the dimensions of the commutator and the general dimensions of the design are reduced, and the air-gap is made much larger, the Latour motor will still be equivalent to the best direct-current traction motors. The tests have indicated a complete success.—*L'Eclairage Elec.*, June 24.

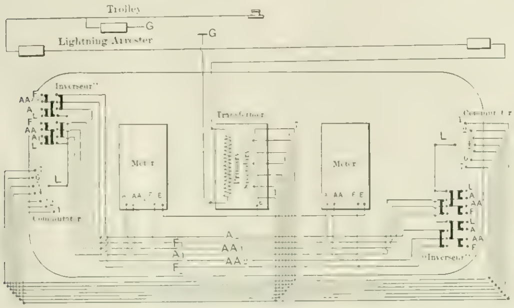


FIG. 1.—DIAGRAM OF CAR WIRING.

Single-Phase Traction in Germany.—SCHIMPFF.—A paper read before the annual meeting of the German Assoc. of Elec. Eng. The author first gives a review of the coöperation of the German government with electric manufacturers in the development of heavy electric traction. He then sketches the equipment of the Hamburg road, from Blankenese to Olsdorf, which is now in course of erection. The single-phase system will be used and steam turbines of the Brown-Boveri-Parsons system will be installed in the power station. There will be five turbines each of 1,250 kw. normal capacity, and of 1,700 kw. maximum capacity; also two turbines each of 600 kw. for lighting. The number of revolutions of the turbines will be 1,500. The 1,250 kw. turbines drive each a two-pole dynamo, giving single-phase, alternating current of 6600 volts at a frequency of 25, the power being 1,250 to 1,700 kw. at a power factor of 0.75. The lighting dynamo gives a current of 6600 volts with a frequency of 60. The road, which has a length of about 14 km., with some considerable grades, will be supplied with current at 6600 volts. There are four feeding points. To one distant part of the line the current is transmitted at 20,000 volts and then reduced to 6600. The construction of the trolley wire is the same as on the Spindlersfelde road. The rails are used for the return current. Double cars, each car having three axles, will be used with a controller stand at the front and one at the back. Each of the two cars has one truck and one driving axle. The trucks are placed at the beginning and end of the double car. One truck is provided with two motors, the other truck with one 125 hp. motor. Such a double car will have seating capacity for 118 passengers and will have a total weight, including passengers, of 180 tons. Each train will be made up of two or three such double cars. Finally some data are given comparing the cost of this single phase system with a direct current system with three-phase transmission and converter sub-stations. The total cost of conductors, transformers, converters, for the latter system would be more than double that of the single phase system ($720,000 against $310,000). On the other hand, the weight of the alternating-current cars is higher than that of the direct current cars, by about 7.5 per cent, so that the consumption of power is correspondingly greater. Both the direct-current line and the alternating-current line were calculated in such a way that in the former case the voltage drop from the sub-stations and in the latter case the voltage drop from the power house and the train should not be more than 10 per cent. With the combined three-phase and direct-current system there is also the energy loss from power house to sub-stations, which is calculated to be about 20 per cent on the average. It is thus found that the mean load at the power house will be about 12.5 per cent smaller with the alternating-current system, in spite of the greater weight of the trains. Nevertheless, the capacity of the turbines and dynamos must be made higher, since there is no storage battery which would equalize the load. It is finally claimed that the combined three-phase and direct-current system, in comparison with the simple alternating-current system, would require annually an expense of about $29,000 greater, which is 23 per cent of the annual cost of power generation and distribution (about $125,000).—*Elek. Zeit*, June 22.

High-Tension, Direct-Current System for Traction.—See the abstract under Installations.

Electric Rail Welding.—See the reference under Miscellaneous.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Series Direct-Current System.—The Compagnie de l'Industrie Electrique et Mecanique of Geneva (Thury system) has received the order for installing the power transmission plant for supplying the street railways of Lyon. Between the power plant at Montiers in Savoy with a capacity of 6,500-hp. and Lyon there is a distance of 180 km. Direct current at 57,000 volts will be used. The arrangement is shown in Fig. 2. The power plant will contain four groups of machines. Each group consists of one 15,700-hp. turbine directly coupled with four direct-current generators each of 3,560 volts and 73 amperes. The generators are in one group and all the groups are connected in series so that the voltage at the outside terminals is 57,000. The sub-station at Lyon will contain six groups of motor generators, each consisting of two 73 ampere, 3,840-volt motors and one railway generator. All the motors are connected in series. Originally the intention was to use the earth for the return, but this was abandoned, although experiments in this direction had been quite satisfactory. The earth will now be used only for reducing the voltage of the conductors against earth to 28,500. For this purpose the centre of the system in the power station and the centre of the system in the sub-station are earthed. The cost of installation with this method was found to be not higher than if the earth had been used for the return, since in the latter case a stronger insulation against earth would have been necessary. An advantage of this arrangement is that the earth may be used as a reserve conductor

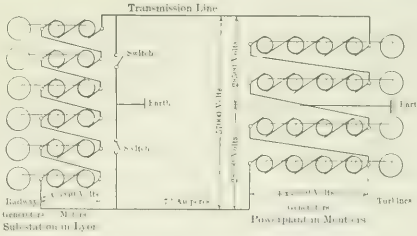


FIG. 2.—SERIES DIRECT CURRENT SYSTEM.

whenever a defect develops within one line conductor. For this purpose two switches are provided in the sub-station, as shown in the diagram. Of course, in such cases, only one-half of the generators in the power plant and one-half of the motors in the sub-station can be used.—*Elek. Zeit.*, June 15; from *Bull. de l'Assoc. Montefiore*, April.

South Africa Central Station.—An illustrated article on the new direct-current municipal station which is being erected at Johannesburg. The station, which is not far from the centre of the town, will supply a three-wire, direct-current system in the central district, and will also supply the tramways with direct current without transformation, the dynamos being available for either purpose. The very large outer or residential area will be supplied by two-phase alternators at 50 periods per second at 3,000 volts, the distribution being mostly single-phase. The generating machinery aggregates 13,000 hp and consists of three 1,350-kw continuous-current generators, two 675-kw continuous-current generators, two two-phase 1,350-kw alternators, and one two-phase 675-kw alternator. Their construction is described and illustrated.—Lond. *Elec.*, June 9.

Motor-Controlling Apparatus.—APPLETON.—A short article in which the author points out the need of further improvements in motor-controlling apparatus.—*Amer. Elec.*, June, 1905.

ELECTROPHYSICS AND MAGNETISM.

Hysteresis.—At the last meeting of the German Association of Electrical Engineers, Epstein presented the report of the hysteresis committee. The committee has reached the conclusion that the three industrially developed instruments for iron testing, namely, those of Epstein, Moellinger and Richter, should be admitted for engineering tests. In giving the "loss figure," it should be stated which instrument was used for the measurement. Concerning the ageing of iron, the committee has introduced the term "ageing coefficient," which is defined as the percentage increase of the loss figure after 600 hours' heating to 100 degrees C. The Reichsanstalt will undertake a systematic study of the total field of the relations between magnetization and chemical composition, which is expected to require 4 or 5 years.—*Elek. Zeit.*, June 22.

Genesis of Chemical Elements.—According to J. J. Thomson an atom is a structure of shells of negative corpuscles within a sphere uniformly charged with positive electricity. The atoms of different elements are all made up of the same kind of electrons and differ among themselves only in the number and configuration of the electrons. It is, therefore, no longer absurd to consider the possibility of the transmutation of chemical elements. Moreover, the facts of the radioactivity strongly suggest that such a transmutation is actually going on. According to Rutherford and Soddy, the atom of a radioelement suffers spontaneous disintegration and passes through a succession of well marked stages (metabolons), accompanied in most cases by the emission of alpha rays. By various recent researches, especially of Ramsay, Boltwood and Soddy, one such disintegration series has been determined, as follows, the figures in parentheses representing the atomic weight: The parent is uranium (238), metabolons are radium (225) and polonium (212); the final element is probably lead (206.9), or possibly bismuth (208.5). The alpha particles emitted during the different changes and causing the lowering of the atomic weight of the residue form helium. Editorially, attention is called to the fact that these radioactive changes are entirely spontaneous and that with none of our strongest agencies, like application of heat, etc., are we able to influence in the least the rate of change of radioactive processes. There is no experimental evidence whatever in favor of the hope that we might learn to bring about at will the transmutation of elements.—*Electrochem. and Met. Ind.*, July.

A New Radium Phenomena.—PETRI.—A note on a curious effect observed in taking radiographs of coins in a magnetic field. He placed a silver coin, a nickel coin and a copper coin side by side on a sensitive plate and nearly touching. Near them, at about 1.5 cm distance, he placed a bar magnet pointing towards the coins. Three other magnets were laid on this, each one projecting further towards the coins, and on the topmost one was placed an oblong preparation of radium bromide, weighing 10 milligrammes. The negative, when developed after an hour's exposure, showed an impression of the three coins and the nearest magnet pole. The impression was normal, except that the rays had not penetrated into the narrow channel separating the coins, the negative showing a kind of bridge between them, giving the appearance of the coins having become fused together. In addition, a rudimentary bridge appeared to start from the magnet pole towards the nearest coin. On repeating the experiment without the magnets, no bridges were seen, thus showing that the coins had not been affected themselves. Experimenting with various metals, the author found that the most pronounced effects were obtained with metals which lie far apart in the thermo-electric series, as between iron and nickel.—Lond. *Elec.*, June 2; from *Ann. der Physik*, No. 5, 1905.

Transparency to Hertzian Waves.—BUSCEMI.—An account of experiments in which he measured the transparency of various substances for Hertzian waves by means of a detector based on the magnetic principle adopted by Fleming. About a core of soft iron wires, 13 cm long, he wound a layer of paraffined cardboard and then a layer of insulated copper wire 0.2 mm thick. Then came another layer of cardboard and then another layer of wire, 0.47 mm thick. The inner coil magnetizes the core, and any wave passing through the outer coil demagnetizes it. The author constructed 14 of these small coils, joining the magnetizing coils in series and the demagnetizing coils in parallel. He thus was enabled to obtain a current due to the diminution of the residual magnetism of the iron cores. The secondary winding consists of 7,000 turns with a total resistance of 9,900 ohms. The author designed a special commutator which enabled him to insert the magnetizing current at a given moment while the induced currents due to it were excluded from the galvanometer. The next moment the magnetizing current was interrupted, and at the same time the electric waves arrived and demagnetized the iron. The induced currents due to this demagnetization were received in a very sensitive galvanometer. The measurements showed that vaseline oil was practically transparent for Hertzian waves. Next came petroleum, benzine, ether and distilled water, and lastly the acids.—Lond. *Elec.*, June 9; from *Nuovo Cimento*, Feb.

Electronic Theory.—LORENZ.—A long paper read before the Berlin Elec. Soc'y, in which the author summarizes the results and problems of the electronic theory.—*Elek. Zeit.*, June 22.

ELECTROCHEMISTRY AND BATTERIES.

Electrochemical Industries of Niagara Falls.—FITZ GERALD.—A paper in which the author discusses the development of the electrochemical industries of Niagara Falls from an evolutionary point of view and describes several new electrochemical products now made at Niagara. Among the latter is acetyvone, i. e., calcium carbide prepared in a special form for use in acetylene generators of very simple construction. Vanillin is made by oxidation of iso-eugenal, which is prepared from oil of cloves; the oxidation of the iso-eugenal is accomplished by ozonized air, the ozone being produced by silent discharges through air. The Acker Process Company makes, besides bleaching powder, carbon tetrachloride from their electrolytic chlorine, also tin tetrachloride and tin oxide. The Roberts Chemical Company electrolyze potassium chloride to get caustic potash at the cathode, besides chlorine at the anode and hydrogen at the cathode; the chlorine and hydrogen are combined to form hydrochloric acid. Sodium made by the Niagara Electrochemical Company is the starting point of certain important new derivatives. Thus sodium peroxide is now produced in fused form under the name oxone. In contact with water it develops oxygen in the same way as calcium carbide develops acetylene. On account of the absorption of carbon dioxide by the sodium hydrate formed on the decomposition of sodium peroxide, it is proposed to use oxone for supplying oxygen and absorbing carbon dioxide in cases such as arise for instance in submarine boats. Oxone is far more stable in air than sodium peroxide in the ordinary form. Other new compounds are calcium peroxide for sterilization and preservation of foods, for ageing spirits and wines and for therapeutic purposes; magnesium peroxide for sterilization of water; zinc peroxide for antiseptic dressings; sodium perborate, in contact with water, yields hydrogen peroxide and is, therefore, a strong bleaching agent. The Pittsburg Reduction Company now makes more aluminum than is made in all the rest of the world combined. The growth of the carborundum industry is indicated by the figures of output: ½ ton in 1891 and 1892 combined, 595 tons in 1896, 2,380 tons in 1903, while the future annual production is estimated at 3,970 tons. Carborundum fire sand is a very good refractory material under certain conditions. Carborundum powders have been used as a substitute for ferrosilicon in the steel industry. Carborundum is now proposed as a starting material (instead of silica) for making ferrosilicons. The production of artificial graphite was 81 tons in 1897, 440 tons in 1900, 1,333 tons in 1904, and is estimated as 2,600 tons next year.—*Electrochem. and Metal. Ind.*, July.

Chemical Energy Transmission.—Chemical energy transmission consists in the transport of compounds with high chemical energy content to a distant place. Chemical energy transmission has two distinct advantages: first, it is not bound to a fixed route—it requires no line wires; second, it is not bound to a certain locality. Being stored latent energy, chemical energy may be set free at will when and where desired. An example is the aluminothermic reaction. Whether tramway rails are welded by thermit or the broken sternpost of a steamer is repaired by thermit, the energy for this purpose has been transported to that place from the electrochemical plant where the aluminum was made. Calcium carbide gives acetylene where and when it is wanted. Since chemicals with a very high energy content are required for chemical energy transmission, and since most of such chemicals require the agency of the electric current for their manufacture, many chief reagents for chemical energy transmission are products of electrochemical industries.—*Electrochem. and Met. Ind.*, July.

Electrolytic Deposition of Alloys from Mixed Solutions.—JACOBS.—An abstract of a paper on a method which is now used commercially by a lithograph company. In the simultaneous deposition of two metals from a mixed solution of their salts, the difficulty is met that the solution attacks and dissolves the more electropositive metal after deposition. This may be prevented by the use of two anodes, one of the more electropositive and the other of the more electronegative metal, connected to separate generators running at different voltages, the current returning through the cathode in the bath by a common third conductor to the generators. Alloys of zinc and nickel and of zinc and copper were deposited in this manner from neutral solutions. With cyanide solutions of copper and zinc a great variety of brass work was plated from the same, by changing the voltage on either anode in order to precipitate a brass running high in copper and low in zinc or vice versa.—*Electrochem. and Met. Ind.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Comparison of Mutual Inductances.—TAYLOR.—An abstract of an American Physical Society paper. The same alternating current is sent through the primaries of the two pairs of coils, and across the secondary giving the higher e.m.f. is placed a very high resistance—5,000 to 100,000 ohms. If this resistance be made up of two parts, r_1 and r_2, and M_1 is the coefficient of mutual inductance of this pair of coils, then the e.m.f. over r_1 may be made to balance the e.m.f. of the secondary of the second pair of coils. Or,

$$\frac{M_1\ (r_1)}{r_1 + r_2} = M_2,$$

where M_2 is the coefficient of the second coil. Balance can be obtained with a telephone, but a higher order of accuracy may be attained with an alternating-current galvanometer. For instance, for a mutual inductance of 0.035 millihenry the order of precision is about 0.1 per cent, while for as small a mutual inductance as 0.002 millihenry (the Tesla coil of a wireless telegraph sender, primary four turns, secondary two hundred turns) consecutive settings with different resistances for r_1 and r_2 agree to about 2.5 per cent. For higher inductances, of the order of a few millihenries, the order of precision is very nearly that of the resistance boxes used, i. e., 0.1 per cent.—*Phys. Rev.*, June.

Calculation of Measuring Instruments.—JANUS.—An illustrated paper giving exact instructions for the calculation of measuring instruments with revolving coils. Rules and formulas are given for the determination of the field strength of the permanent magnets, the torque and weight of the revolving coil, the construction of the springs and the construction of the windings.—*Elek. Zeit.*, June 15.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Resonance Effects in the Receiving Station of Wireless Telegraphy.—HETTINGER.—A discussion of the arrangement shown in Fig. 1. The lower end of the vertical wire is connected with two self-induction coils, their values, L_1 and L_1, being always identical. The terminals of these two coils are joined at point 2 and connected to earth. If the receiving station operates with a certain wave length, the values $L_1 L_1$ must be so chosen that they, in combination with the vertical wire, oscillate with the corresponding quarter wave length. Fulfillment of this condition gives the first resonance effect and the e.m.f. between 1 and 2 becomes a maximum. If a capacity C_1 is in parallel with the self-induction coils $L_1 L_1$ and if the resonance condition $M^2 C_1 \dfrac{L_1}{2} = 1$ is fulfilled (where $m = 2\pi n = \dfrac{2}{T}$ and T the period of the oscillating currents), a second resonance effect is obtained. For the same total current entering in 1 and leaving by 2, the partial currents circulating in the parallel connected branches reach a maximum value. Between one winding of one self-induction coil, L_1, and any winding of the other coil, L_1, there is a certain e.m.f. of a certain frequency ($m = 2\pi n$). If between two such points (3′ and 4′) a self-induction L_2 and a capacity C_2 is inserted, so that the resonance formula, $m^2 C_2 L_2 = 1$ is fulfilled, a third resonance effect is obtained. If the wave inductor reacts on voltage or current, L_2 and C_2 are to be connected in series or parallel respectively. In the first case the partial voltages reach a maximum value, in the second case the partial currents. The wave indicator is shown in the illustration by *D*. By using these three resonance effects it is possible to get the most pointed resonance curve for operating the wave indicator. It can become of practical value, however, only by using the following method: "In order to enable the transmitted currents to act on the wave indicator, a current minimum or voltage minimum of the same is required. If the amplitudes of the resonance curve are uniformly suppressed until the maximum tuning value becomes equal to the required minimum for action, the maximum possible safety of selection is obtained." It is easy to find this minimum. Since the two self-induction coils, $L_1 L_1$, are perfectly equivalent in every respect and are, moreover, symmetrically arranged, there will always be the same potential in the two windings at analogous points, and also the same current. If the bridge consisting of $C_2 L_2$ and the wave indicator is connected between two such points, 3 and 4, the potential difference and the current flowing through the bridge is zero. The regulation of the active e.m.f. is obtained by inserting simultaneously one winding at the one side and taking out one winding at the other side. The branches which are in parallel with the bridge ($3'\,L_1'$, $1\,L_1'$, $4'$ and $3'\,L_1''$, $2\,L_1''$, $4'$) then always retain the same value, while the potential difference between 3′ and 4′ may be increased at will. The minimum for which the wave indicator begins to act may, therefore, easily be found.—*Phys. Zeit.*, June 15.

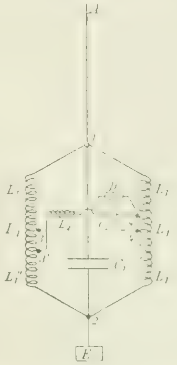


FIG. 3.—RESONANCE EFFECTS IN WIRELESS TELEGRAPHY

Telephone Exchange Lamps.—In order to indicate at once whether one of the lamps in a telephone exchange is burned out, a German company makes a double filament lamp. Instead of the otherwise necessary resistance connected in parallel with the lamp, another high-resistance filament is inserted in the lamp in shunt with the ordinary filament. The auxiliary filament is not observed as long as the main filament is intact. When the latter burns through the auxiliary filament is heated to dark red heat. It has, of course, a longer life than the main filament.—*Elek. Zeit.*, June 22.

Miscellaneous.

German Association of Electrical Engineers.—The annual meeting has been held from June 4 to 8 in Dortmund and Essen. The number of members has increased during the last year by 215 and is now 3,636. The new president is Dr. E. Budde (Siemens & Halske Co.). In place of Gisbert Kapp, who has accepted a professorship, Chief Engineer Georg Dettmar was elected general secretary of the association.—*Elek. Zeit.*, June 22.

Electric Welding.—Some notes on a system of electric welding developed by a German storage battery company. An electric arc is used, which is formed at the place where the weld is to be made, between the part to be welded and a carbon electrode. The latter is carried along the line where the weld is to be made. The current is taken from a small generator in parallel with a storage battery. It is stated that the method is applicable to small repairs of castings and especially to the welding of electric tramway rails.—*Elek. Zeit.*, June 22.

Research Laboratories.—A plea for the erection of research laboratories in metallurgical and chemical works. An outline of their work is given.—*Electrochem. and Met. Ind.*, July.

Vanadium.—An article giving notes on various methods for the extraction of vanadium from its ores and on the properties of vanadium steels.—Lond. *Engineer*, June 9.

BOOK REVIEWS.

Elementare Vorlesungen Uber Telegraphie und Telephonie. Elementary Readings on Telegraphy and Telephony. By Dr. Richard Heinbrun. Berlin: Georg Siemens. Sixth Section. Pages 321 to 368.

We have already had occasion to review the preceding sections of this book. This section deals in part with the Morse system, and the Pollak and Virag rapid telegraph system; but is mainly directed to an exposition of the Hughes typeprinting telegraph. The description is clear and the illustrations are excellent.

The Hughes apparatus is not employed in America, but this section of the volume gives a good and clear description of the principal mechanical and electrical features of this well-known instrument.

Cement and Concrete. By Louis C. Sabin. New York: McGraw Publishing Company. 507 pages. Price, $5.00.

The increasing number of uses to which cement has been applied has naturally created a demand for literature in that direction, and the book under review attempts to furnish engineers and others with a working knowledge of that subject. Mr. Sabin has divided his book into four parts: the first, covering 27 pages, treats of the classification and manufacture of cements; the second, of 126 pages, covers the physical properties and methods of testing; the third, of 146 pages, the preparation and properties of mortar and concrete, and the fourth, of 142 pages, is on the use of mortar and concrete. In Part IV the author describes the various systems of reinforced concrete in use at present, and also discusses and furnishes formulæ for the design of that class of beams. It is to be regretted that the author has made such sparing use of diagrams in discussing the physical properties, or of illustrations of such articles as concrete mixing machinery, or descriptions of structures, etc., as such illustrations would much enhance the value of the book.

The data furnished by Mr. Sabin, there being more than 160 tables, are taken for the greater part from the tests conducted at the construction of the Poe Lock, at St. Mary's Falls Canal, Mich., at which the author assisted, and to which every writer on the physical properties of cements has been, in the past, obliged to refer.

In addition to this class of data, the author has, in his description of concrete construction, in nearly all cases, furnished items of cost—factors of necessity and therefore of immediate value to the designing engineer. The book in this particular, and in the vast amount of practical information which it contains, is of especial value to the contractor and to the engineer placed in charge of concrete work who has had little previous knowledge of the details of cement work. Indeed, the practical nature of much of the data and information renders the work suitable also to the needs of the master mason seeking for information of direct practical application only.

Direct-Connected Generating Unit.

The accompanying illustrations show a compact type of electric generating unit manufactured by the B. F. Sturtevant Company, Hyde Park, Mass. The set consists of a 9x8-in. single, vertical enclosed, automatic engine, direct-connected, with solid sub-base, extended shaft through bolted coupling and outboard bearing to a 25-kw. compound wound, direct-current generator. The engine is designed for a steam pressure of 90 pounds per sq. in., and operated at a speed of 350 revs. per minute.

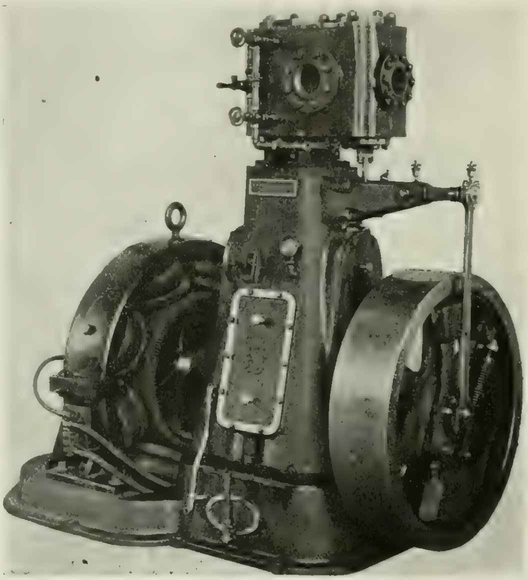


FIG. 1.—DIRECT-CONNECTED GENERATOR.

The engine is equipped with an inertia governor of the Rites type, which regulates the speed within two per cent from no load to full load. The cylinder is raised from the frame, and a stuffing box for the piston rod is fitted in the top. By this construction the oil is prevented from being carried into the cylinder on the rod, and the cylinder condensation cannot reach the oil in the frame: at the same

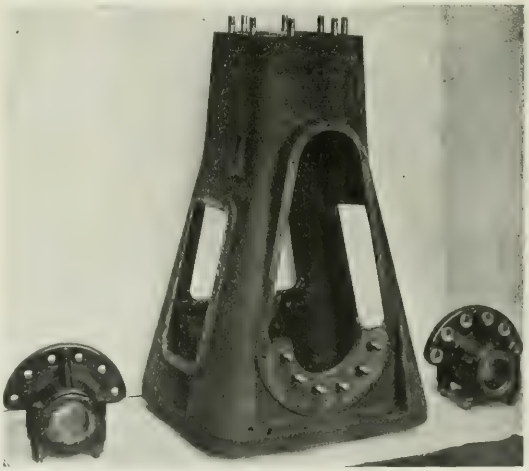


FIG. 2.—DETAILS OF MAIN BEARINGS OF ENGINE.

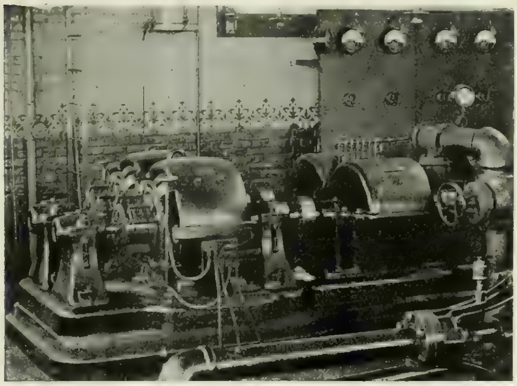
time, this arrangement gives ready access to the stuffing boxes while running.

The lubrication is of the type known as forced. An oil pump, operated from the main crank shaft, forces oil at a pressure of from 10 to 20 pounds per square inch into the main bearings, through the crank shaft, web, crank-pin, through the connecting-rod to the crosshead pin. Connection is also made from the oil pump to the main cross-head guides. This system of oiling serves not only to deliver oil to all bearings, but also to maintain under pressure a film of oil between the two bearing surfaces, thereby greatly reducing the friction and increasing the mechanical efficiency of the engine.

The generator is of the best mechanical and electrical construction. It is capable of carrying 100 per cent momentary overload without flashing at the commutator, with fixed brushes. An overload of 25 per cent can be carried for a period of two hours, without a temperature rise exceeding 50° C. above the surrounding air. The insulation is subjected to a test of 1,500 effective alternating volts for one minute, although the normal working e.m.f. may be only 500 volts.

The Durability of Steam Turbines.

An interesting test made upon a De Laval steam turbine which had been in use for two years was recently reported by Professors E. F. Miller and B. B. Lawrence of the Massachusetts Institute of Technology. The machine was built in the spring of 1903 at the Trenton shops of the De Laval Steam Turbine Company, and it has been constantly in service furnishing power and light for the New England Structural Company, East Everett, Mass. The installation is shown in the accompanying illustration.



150-HP TURBO-DYNAMO.

An examination of the turbine wheel, buckets and pinions just previous to the test showed that there is no trace of appreciable wear. Many of the buckets still have some part of the original scale made during the process of drop forging.

Under a steam pressure of 152.0 pounds per sq. in. at the boiler, and 145.9 pounds below the governor valve, and a vacuum of 25.47 in. with the barometer at 29.0 in., the steam consumption was found to be 17.62 pounds per brake-horsepower per hour at an output of 160.4 hp. The guarantee under which the turbine was ordered stated that with a steam pressure of 150 pounds at the governor valve and a vacuum of 26 inches at the turbine, the steam consumption should not exceed 18.7 pounds per brake-horsepower per hour at full load of 150 hp.

It is to be noted that the turbine is still within the original guarantee, thus proving that the slight depreciation has apparently not affected the steam consumption.

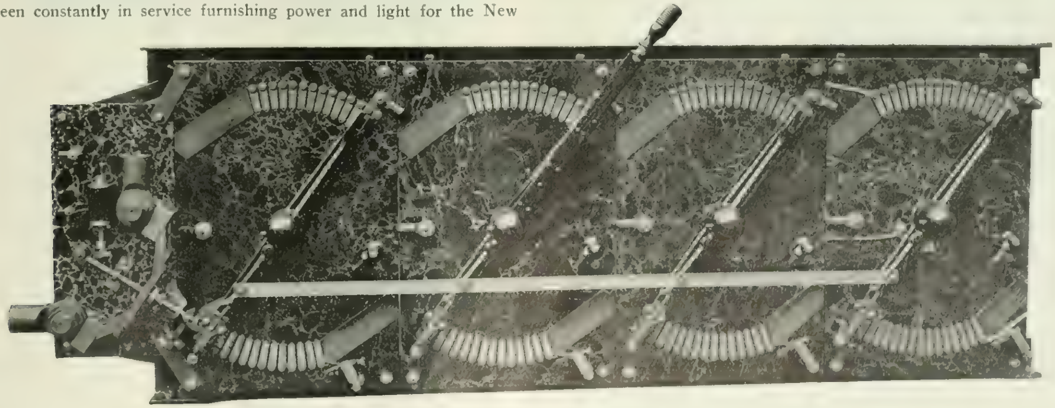
"No-Voltage" Release Motor-Starter.

The cut herewith shows a 200 hp. 125 volt, automatic, "no voltage" release motor-starter manufactured by the Ward Leonard Electric Company, of Bronxville, N. Y. This machine is made up of four 50-hp starters, which are connected in parallel, and controlled by one master lever. Each starter is complete with its own resistance and switch. If at any future time changes of equipment demand it, an ordinary mechanic can readily increase or decrease the number of unit starters so as to adapt the starters to the exact condition of service. There are no magnets on any of the individual starters.

The starting levers are held at the short-circuit position by a latch which is tripped by the solenoid plunger upon the occurrence of "no voltage." This solenoid plunger is responsive solely to the line voltage and is entirely independent of the field or armature currents. At the short-circuit end of the starter there are two laminated contacts which short-circuit the lever, etc., and reduce the "watt" loss in the starter circuit to a minimum.

The material of the resistance is non-corrosive and not damageable by heating to a temperature of 150° C. or by salt air or salt water and does not materially change its resistance with rise of temperature. The starter will stand without injury a current of 50 per cent in excess of the full load motor current when passed through the entire resistance when cold for one minute. The starter will stand without injury or alteration a current which is double the full load motor current when passed through the entire resistance when cold for 20 seconds. The starter will not smoke or smell or deteriorate when tested as above.

To prevent arcing upon the circuit-closing contacts, there is furnished an auxiliary, independent, spring-operated, renewable circuit-closing switch, which makes the circuit with a quick make, and breaks the circuit with a quick break and magnetic blowout. All the stationary contacts are of segmental form, readily renewable and removable.



"NO-VOLTAGE" RELEASE MOTOR-STARTER.

The movable contacts are easily renewable and of the self-adjusting type, and able to ride over any projection standing 1/16 in. above the contact segments.

The resistance conductor is entirely enclosed in a solid fire-proof, non-absorbent, insulating material. If the resistive conductor be fused by excessive current or otherwise, the arc is quickly and quietly extinguished without any attendant fire risk. The starter occupies but very little floor space, it being not more than 15 in. deep.

The d'Arsonval-Fulmen Storage Battery.

The different lead accumulator systems may be reduced, by careful elimination, to two: the Faure system of oxides pasted on a support and the Planté system of active matter formed at the expense of the support. Nearly all large manufacturers have adopted the Faure system and have condemned that of Planté (except in certain cases where lightness of construction is not essential) because of the difficulties of its formation and of its small specific capacity.

Within the past few years there has appeared a tendency to replace the Faure system by a mixed system by constructing the accumulator with Faure negatives and Planté positives. This change has been made because the duration of the Planté positive plates is incomparably longer than that of the oxide plates, while the principal reason of their systematic abandonment—their small specific capacity—can no longer be objected to after the progress made in France by Messrs. d'Arsonval and Vaugeois, who have obtained with the Planté plates the same specific capacities as those of the Faure plates.

The most conclusive proof on the duration of the d'Arsonval positive plates is found in the industrial working of the Parisian tramway services, where they have remained three years in service. On one of these lines it is specified that the batteries shall have a capacity of 50 ampere-hours at the average output of 50 amp.; the charging of the batteries is accomplished in about an hour. The positive plates of such an element weigh a total of 6 kg. Under these conditions they make easily 2,000 to 2,500 discharges before being put out of service. Such results have never previously been obtained.

The principles utilized by Messrs. d'Arsonval and Vaugeois to construct and form their electrodes are drawn from the following observations: When active matter is formed rapidly it falls; if, on the contrary, it is formed slowly, it becomes adherent, but the dimensions of the electrodes change, due to the change of volume that the lead undergoes in passing to the PbO_2 state. It will, therefore, be understood that in order to prevent the active matter from falling it is necessary to realize such a mechanical structure of the plate that this change in volume can take place freely. If two plates of lead having the same surface be compared, one non-formed and the other formed, it will be found that there is an increase of 5 to 10 per cent in the dimensions of that plate which has PbO_2 formed at the rate of 10 to 20 gr. per dm_2. If the dimensions of the plate had not changed it is evident that the active matter would not have formed or that it would have partially fallen. This observation is fundamental both for the construction as well as for the formation of the Planté plates. To profit by this the electrodes must be given a shape such that the changes of dimensions are provided for and controlled.

With the d'Arsonval electrodes, there are taken certain precautions that render the formed matter compact and impermeable to the sulphuric liquid, and this protects the underlying lead against an ulterior attack; when the lead has taken its definite form and is covered with a hard and dense coat of PbO_2 it has become almost proof against any attack of anodic products of electrolysis, or at any rate, much less so than would be the case with naked lead.

These ideas, of which the accuracy has been verified by industrial practice, resulted in the adoption of the Planté positive plates instead of oxide plates, and have been the origin of a real progress in the accumulator industry.

Below is given an outline of the process of manufacture of the Planté plates such as Messrs. d'Arsonval and Vaugeois have described it in comparing it with the processes in use up to the present time.

The problem to be solved for constructing a rational accumulator proposes itself in the following terms: Obtain with a given weight of lead the maximum surface, taking into account that the plate should present great mechanical solidity, and be easy to manufacture.

Two processes have been employed up to the present time to increase the apparent surface of a plate in creating thereon grooves and projections. The first process is by the fusion of lead in an appropriate mould. This process has numerous drawbacks: the unmoulding, if the grooves are narrow and deep, becomes difficult; the very delicate moulds necessary do not last long; the fineness of the projections being limited by difficulties of unmoulding, the maximum specific surface susceptible of being obtained by this process is soon attained. It is with great difficulty that a developed surface 15 times greater than the apparent surface of a plate 12 mm. thick can be obtained. The principal inconvenience of plates manufactured by fusion, however, is found in the fact that they carry in themselves the real cause of their destruction. Lead cast in moulds is, in fact, far from being homogeneous. It contains air bubbles in its mass and naturally deteriorates rapidly under the action of the peroxidation and the successive infiltrations of electrolyte; the plate is eaten through and through before the projections are completely worn, and thus put out of service before all the lead has been utilized. In melting down one of the disused plates, the fact that it still contains more than 60 per cent of primitive unoxidized lead may easily be verified.

The second process employed to make plates of large active surface is based on the use of a special cutting tool which, in cutting in on one side of the plate almost to its center, raises and bends the slips, which remain fast to the plate at one side, so that they stand out almost perpendicular to the surface of the plate. The action of the tool is very much like that of a plow. By this process there can be obtained a developed surface thirty-five times the apparent surface, and it is only in this respect that any progress has been made. The cast lead being always crystalline and not homogeneous, cannot be worked in this way, so that there had to be employed laminated lead of which the molecular cohesion is much greater and more regular. The use of laminated lead was believed to be of great advantage, because when subjected to electrolytic actions it wears out less rapidly and more regularly than the cast lead. But that which is true for lead in plates coming from the rolling mill is not true for the slips bent up on edge, as in this second process, for during the process the metal is bent and strained so as to destroy completely its original texture. This is especially true at the junction of the slip to the core of the plate; that is, at the point where it should have the greatest strength and uniformity. It is attacked very quickly at this point by the electrolysis, so that the body becomes worn through before the projections are completely peroxided. The result is that the plate is put out of service before all the metal in the raised slip has been used, and practically the life of this plate is not much superior to that of the cast plates.

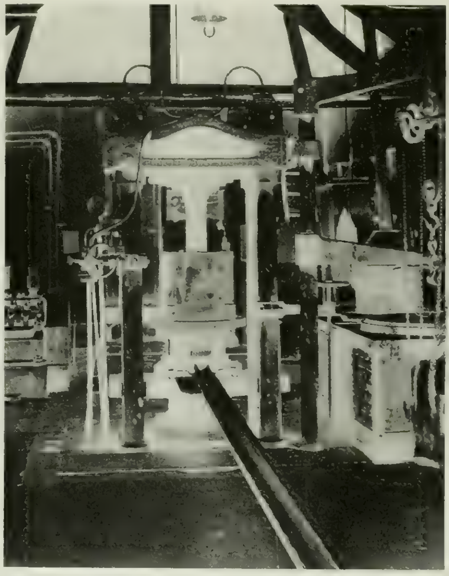


FIG. 1.—MANUFACTURE OF LEAD PLATES.

The process employed by Messrs. d'Arsonval and Vaugeois produces electrodes of perfectly homogeneous lead, exempt from airholes, very dense, and presenting developed surfaces attaining more than forty times the apparent surfaces. This process (Fig. 1) consists in principle of forcing the lead at a temperature approaching that of its point of fusion, through a special draw-plate under a pressure which may attain 2,000 kg. per sq. cm. This process is very similar to that used for making extended metal.

The draw-plates which are used in this manufacture are constructed by very simple mechanical processes, and are of such precision that grooves and slips as fine as can be wished for may be obtained. (For instance, 1/10 of a millimeter.)

The lead comes from the draw-plates in its definite form (Fig. 2) without any supplementary handwork being necessary; it does not, therefore, lose any of the qualities given it by its manufacture at high pressure and heat.

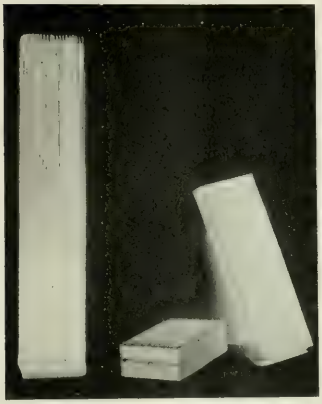


FIG. 2.—LEAD FROM THE DRAW-PLATES.

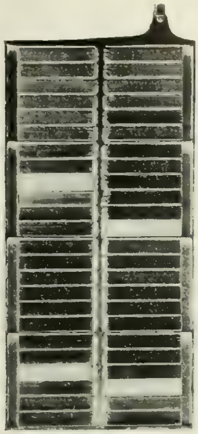


FIG. 3.—PLATE FOR SUBMARINE WORK.

The grooved bar which comes from the draw-plates is sawed into pieces of equal length which are soldered in frames of appropriate shape, by an autogen electric welding process (Fig. 3). The plate is then ready for the formation.

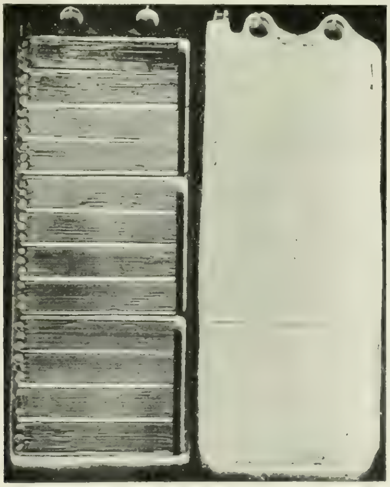


FIG. 4.—NEW PLATE FOR TRAMWAY WORK, AND SAME PLATE AFTER 2160 DISCHARGES.

Although permitting the production of a plate perfect in every way, this process can compete, it is said, with any other, as to cost. In the manufacture of large surface electrodes it is claimed that no other is so rapid, so simple, and at the same time so cheap. The cost of a plate ready to be formed differs but slightly from that of the lead it contains.

Electrical Compressor Plant of the Chicago and Northwestern Railway Terminal at Chicago.

The air power plant at the terminal station of the Chicago & Northwestern Railway in Chicago is a fine example of the best modern practice in the application of electric power to the compression of air for the many purposes so characteristic of railway yard work.

The plant is located in a small brick building in the rear of the main terminal station, close to the river and adjacent to the extensive passenger yards of the company. This building comprises two rooms, in one of which are the steam boilers for the heating system of the station. In the other section is located the electrical and pneumatic apparatus.

Alternating current is taken from the city mains of the Chicago Edison Company and passed through transformers reducing it to the working voltage. Part of it is used directly on low-voltage alternating circuits. The remainder is passed through rotary converters or motor generators and delivered as direct-current for power purposes.

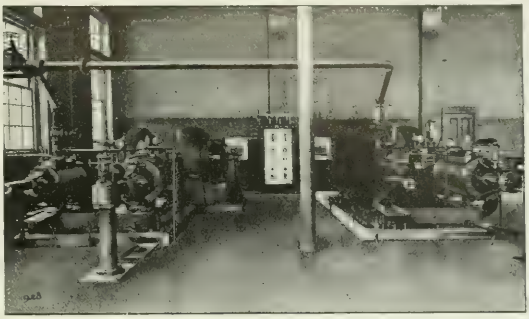


FIG. 1.—VIEW OF INTERIOR OF POWER PLANT.

The air compressor plant is made up of two Ingersoll-Sergeant standard power-driven compressors. They are duplex, two-stage machines, with air cylinders, frames and bearings, mounted on a solid cast-iron bed-plate which encloses the horizontal inter-cooler between the cylinders. Both high and low-pressure cylinders are fitted with the standard Ingersoll-Sergeant piston inlet valve, and regulation is secured by the maker's standard choking controller on the low-pressure intake. This device, acting to throttle the air intake passage, is controlled by receiver pressure and automatically regulates the volume of air compressed and consequently the amount of power consumed to the demand for air from the power system. The compressors run at constant speed, the controller simply varying the effective piston displacement with varying load. The machines have, at their speed of 130 r.p.m., a free air capacity of each unit of 455 cu. ft. per minute. The pressure used in this plant is 70 to 80 lbs. gauge.

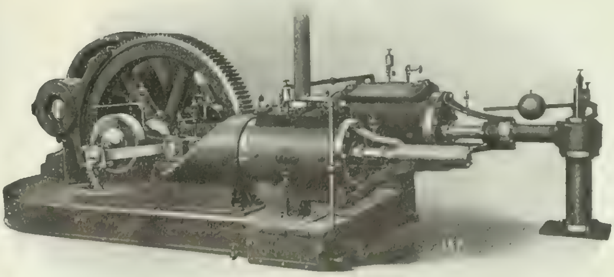


FIG. 2.—AIR COMPRESSOR.

The sub-base is extended in each compressor to support the driving motors, which are General Electric direct-current machines, rated at 80 hp and 510 r.p.m., on 220 volts. A pinion on the motor shaft gears directly with the teeth on the compressor flywheel, which is of standard weight for machines of this capacity. The gears are protected by proper guards. The units run with a remarkable freedom from vibration and noise.

The illustration shows the arrangement of the air plant. The machines are side by side; the switch-board, rheostats, meters, etc., mounted in front of and between them. An intake duct, supplying both compressors, leads under the floor to the open air and rises beside the power house, terminating in a screen cover for the exclusion of dust and cinders from the yards.

The discharge pipes from the two unite in an air main leading to the primary receiver outside the plant. Secondary air receivers are also located at suitable places. The air is used almost entirely in this system of switches and signals, but a small portion is diverted to the boiler room, where it is applied in a small air lift pumping outfit which supplies water to the terminal. The engineers in charge report an excellent performance of this equipment, which has been in severe and continuous service for several years.

Small High-Speed Engines.

It may be stated as broadly true that improvements in small high-speed engines have not kept pace with those in the larger types, possibly because of the lower economy in small units, and because equal inventive and engineering effort has not been concentrated on the problems. The American Blower Company, of Detroit, Mich., seeing the opportunity, put competent designers to the task of producing a line of small engines equal in all respects to the larger machines. These engines embody the following constructional features: They are self-contained, enclosed, self-oiling, and are built for heavy duty, high speeds, high steam pressure and continuous service, without shutting down, for weeks at a time if need be. These features make this type of engine peculiarly adapted for direct-connected work of any character which demands a thoroughly high-grade engine.

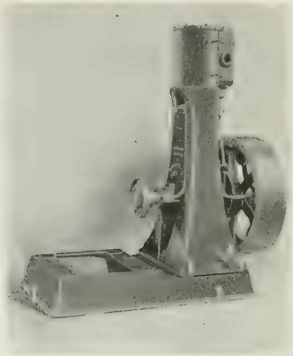


FIG. 1.—VERTICAL ENGINE.

Fig. 1 shows the engine mounted on a sub-base ready for attachment to the electrical generator. It will be seen that the engine has easy curves and graceful lines, giving it a handsome appearance. As has been noted, it is fully enclosed, preventing foreign matter from getting into the working parts, yet the latter are easily accessible by simply turning a milled hand nut and lifting out the enclosing plates.

The most remarkable feature of the engine is the oiling system, to which reference has been made above. Automatic lubrication of engines has been one of the details very slow in development. Such attention as this detail has received had previously been given to only the large horizontal engines, which are less likely to prove annoying through defective lubrication than are the small, high-speed, vertical engines.

The oiling system embodied in this engine is something entirely different from any of the usual methods, and has proven successful far beyond the most sanguine expectations of its designers. Every frictional surface is covered with oil, there being no positive contact between metals, with the effect of practically eliminating wear. The oiling is done by the engine itself, and instead of a drop or two a minute each bearing has a stream of oil. By referring to Fig. 2 the operation can easily be traced. A worm, *K*, on the shaft actuates a geared pump at *A* and through shaft *L*, forcing the oil up through the tube *B* into the small strainer *C*. From *C* it drops into an oil box through the bottom of which four tubes project. In one side of each of these tubes there is a slot, so that when the oil box contains only a small amount of oil, each tube can take only its proper proportion. In case the box is full all the tubes get more oil in proportion to the increased height.

One of these tubes, *F*, and one on the opposite side, not lettered, apply oil to the guides, the oil dropping into a small oil trough, *G*, from which it runs into the bearing through an oil hole. The crosshead pin is supplied by the tube marked *E*; the oil drops into the cup, *H*, and fills the cavity between the bolt and inside of the crosshead pin and the oil grooves. The oil dropping from the crosshead is caught in two pans attached to the inside of the covers. From these oil pans it runs down the inside of the cover, dropping into a cup in the top of the main bearing cap. Instead of using oil grooves at the top and bottom of the main bearing, in this system the oil is supplied at the sides where the bearing is cut away at the joints. When the strain from the connecting rod is up, the oil is carried to the bottom of the bearing, but when the load is reversed, there are no oil grooves to carry away this oil. The crank pin is oiled through the tube marked *D*. This tube discharges into a crank oil ring inside the eccentric, which in turn discharges into the crank pin oil tube and flows across the crank pin bearing. The crank pin oil ring, in addition to its independent supply, catches the drip from one end of the main bearing. The eccentric is oiled by the drip which it catches from the other end. Not the least difficulty has been experienced in catching the oil thrown off from the eccentric strap, and the splash from the crosshead has been equally easy to take care of, the outside of the engine being absolutely free from oil. A portion of the oil, as it drops back into the bottom of the frame drops upon an oil filter throughly cleaned and purified. The large base gives the oil an excellent opportunity to cool and settle.

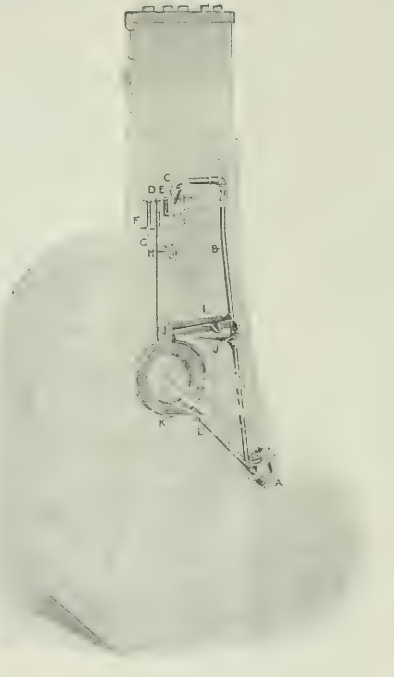


FIG. 2.—PHANTOM PERSPECTIVE OF VERTICAL ENGINE

It is stated that a certain engine which had been operated from fourteen to sixteen hours per day driving a blower, after the lapse of over four months, really needed no adjustment or fresh lubricant, running almost as noiselessly as at first.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—There was an unusually brisk duplicate order business in wholesale and jobbing circles, and confidence in the future remains unabated. Structural steel and all forms of railway equipment were the prominent features of the iron industry, but quiet conditions prevail. Building material of all kinds reflects the demands of a record year in this respect. Pig iron has been dull and moved lower, but heavy finished products have been in good call. Iron ore shipments exceed those of last year by 42 per cent, and of 1902 by 12 per cent. New contracts for iron and steel are still confined to the few departments that have been overcrowded for months, especially rail mills and the plants producing structural shapes. Transporting lines are now busily engaged in improving facilities, and, while new mileage has not equaled some earlier records, the tonnage required for repairs is enormous and traction demands are considerable. Sensational soaring of quotations for raw materials threatens the stability of the leading textile markets, although consumption is not yet perceptibly diminished by rapidly rising pricelists. Labor is well employed, and the signing of the new tin plate scale removes the only important threatening feature in industrial lines. Railway earnings continue large, the gain in June being 6 per cent, while May net returns exceeded last year by 8.5 per cent, and the fiscal year will show a gain of 7 per cent. Money is easy, helped by fairly good collections, and despite larger movements to the interior, active stock speculation and gold exports. Crop reports were rather irregular, due to too much rain in widely separated sections, but notably in the spring wheat section of the Northwest and in the cotton belt. Business failures for the week ending July 6, *Bradstreet's* says, are far below the normal for this time of the year, being only 127, against 186 the previous week and 172 in the like week of 1904. There were 5,238 failures for the first six months of the calendar year 1905, a decrease of 2 per cent from the same period of 1904. Liabilities total $60,634,667 for the first half of this year, a sum 27 per cent less than was recorded a year ago, and about the same amount as in 1903. The proportion of assets to liabilities in 1905 was 57.4 per cent, as against 55.1 per cent a year ago, and 49 per cent in 1903.

SALES OF IDEAL ENGINES.—The following large list of recent sales of Ideal engines is reported: One 75-hp, Cleveland Worsted Mills, Cleveland, O.; one 100-hp, Birk Bros. Brewing Company, Chicago; one 100-hp, A. Sanders Packing Company, Cincinnati; one 60-hp, T. J. Noblett, Springfield, Ill.; two 110-hp each, American Warming & Ventilating Company, Pittsburg, Pa.; one 150-hp, Connersville Blower Company, Connersville, Ind.; one 45-hp, General Chemical Company, Chicago; one 110-hp, F. W. Horne, Yokohama, Japan; one 100-hp, A. Neilen & Co., Cincinnati; one 160-hp, John Roth Packing Company, Cincinnati; one 160-hp, Mexican-American Supply Company, Mexico; one 100-hp, City of Lamoore, California; one 25-hp, University of California, San Francisco, Cal.; one 225-hp, Hellmers-Bettman Company, Cincinnati; one 150-hp, D. F. Crilly, Chicago; one 118-hp, Wheeling & Lake Erie Railroad Company, Cleveland, O.; one 248-hp, Wheeling & Lake Erie Railroad Company, Cleveland, O.; one 45-hp, Guinle & Co., Rio de Janeiro, Brazil; one 125-hp, State University of North Dakota, University, N. D.; one 150-hp, North Carolina Granite Corporation, Mt. Airy, N. C.; one 160-hp, Cleveland-Cliffs Iron Mining Company, Negaunee, Mich.; one 80-hp, Chicago, Burlington & Quincy Railroad Company, Havelock, Neb.; one 135-hp, Boston & Colorado Smelting Company, Denver, Colo.; one 230-hp, Dering Coal Company, Chicago; two 160-hp each, National Construction & Supply Company, Danville, Ky.; one 47-hp, Acme Plaster & Cement Company, Grand Rapids, Mich.; one 60-hp, Wilkesbarre Gas & Electric Company, Wilkesbarre, Pa.; one 80-hp, Johnson Gin Company, Wills Point, Tex.; one 90-hp, Higbee Electric Light & Power Plant, Higbee, Mo.; one 215-hp, Utah Fuel Company, Sunnyside, Utah; one 135-hp, I. Gutte, Sinaloa, Mexico; one 160-hp, Linn Coal Company, Bicknell, Ind.; two 25-hp each, American Ship Building Company, Cleveland, O.; two 50-hp each, Angelus Hospital Association, Los Angeles, Cal.; one 25-hp, Angelus Hospital Association, Los Angeles, Cal.; one 324-hp, Alhambra Theatre Company, Milwaukee, Wis.; one 125-hp, city of Walker, Minnesota; one 200-hp, Washington Court House Gas & Electric Company, Washington Court House, O.; one 45-hp, Hackensack Water Company, New Milford, N. J.; one 125-hp, W. J. Whetzel, Eureka, Ill.

TENNESSEE RIVER POWER is to be developed by the Chattanooga & Tennessee River Power Company, in which C. E. James and J. C. Guild, of Chattanooga, are interested, Mr. John Bogart, of New York, being the consulting engineer. The plant is to be one of 30,000 to 40,000 hp. Preliminary plans have been prepared and they show that the power plant will be located some 33 miles from the city by river, but only 12 miles in a direct line from Chattanooga. Therefore, there will be 12 miles of transmission circuit. The lock will be 60 ft. wide and the dam 40 ft. high and 1,200 ft. long. The power house will be laid out for 14 units of 3,000 kw each. There will be a transformer house and other buildings. The Tennessee River at the point located passes through a gorge in the Cumberland Mountains and the United States Government has given its assent to the execution of the proposed work there.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Ardmore, Ind. Ter.; Minneapolis, Minn.; Cleveland, O.; Marion, O.; Delaware, O.; Furley, Kan.; McLain, Kan.; Idana, Kan.; Corson, S. D.; Brandon, S. D.; Star, Idaho; Ridgeway, Ia.; Lodiburg, Ky.; Bristol, Tenn.; Franklin, Pa.; Granville, N. D.; Bowbells, N. B.; Folsendale, Ky.; East Smithfield, Pa.; Elizabeth, N. C.; Washington, N. C.; Mountain Branch, Tenn.; Berwick, Pa.; Fulton, Kan.; Fenton, Ia.; Pontiac, Ill.; Macon, Ill.; Chicago, Ill., and Fulton, Ia.

CURTIS TURBINES IN BOSTON.—One of the leading officials of the Boston Edison Company is quoted as follows in regard to the Curtis turbines there: "In the case of the Curtis turbines used by the Edison Company, they are giving great satisfaction. The fuel economy is apparently no greater than with engines, but they are effecting a total station economy of 20 per cent, as compared with engines under the same conditions. The economy is in labor and attendance. There is no question as to the success of the Curtis turbine, and in my opinion there will be no further engines sold for electric lighting work."

ELECTRIC LIGHT BIDS.—Bids are wanted August 1 by J. G. Hamilton, Mayor of Durant, Miss., for the construction of an electric light plant for which $10,000 bonds are to be issued. Bids will be received August 10 by the Board of Public Service, Bellefontaine, O., for constructing a new electric light plant at a probable cost of $50,000. Bids will probably be received early in August for the construction of water works and an electric light plant at Bolivar, Tenn., for which bonds to the amount of $20,000 have been sold. Granberry Jackson, Nashville, is the engineer.

LARGE ORDER FOR CARS.—The United Railways & Electric Company, of Baltimore, Md., has ordered 200 new cars to cost about $1,000,000, 15 per cent of which will be paid in cash and the remainder will be paid in 5 per cent car trust notes. Ten per cent of the notes will mature each year until all are paid. Each car will be 42 ft. long and will be of the semi-convertible type. The cars are to be delivered by November 1. The system includes all the trolleys in Baltimore, Md., and its suburbs with 379 miles of electric railway.

BIDS FOR NAVAL SUPPLIES.—Bids will be received until July 25 at the Bureau of Supplies and Accounts, Washington, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., electrical supplies, cable, ventilating sets, reconstructing coaling plant, traveling hoist, sheet copper, pressure gauges, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

NEW ELECTRIC SUPPLY COMPANY.—The Hattiesburg Electric Supply Company has been formed at Hattiesburg, Miss., with an authorized capital of $10,000. It will do a contracting and electrical supply business and will not manufacture any goods. The headquarters are at 204 Main Street, that city. The officers are W. T. Spraney, president; Charles Bynum, vice-president, and John B. [illegible], secretary-treasurer.

APPARATUS FOR CLEVELAND, OHIO.—The Cleveland Electric Railway Company has given orders for new apparatus to [illegible] its [illegible] power station, including a 1,500-kw unit consisting of an Allis-Chalmers engine and a Westinghouse generator, together with [illegible] hp of Sterling boilers and chain grate stokers. Auxiliary equipment will also be installed.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has a large force of men actively at work in Meridian, Miss., installing the conduit system for the Cumberland Telephone & Telegraph Company at that point. The contract was awarded to him last week.

A RULING ON WATER POWERS.—A ruling that would appear likely to have an important and helpful effect on power transmission enterprises has been made at Washington. According to an order issued by the Secretary of War the water power created by Government dams, built as aids to navigation, is the property of riparian owners. The only limitation to the rights of owners of river frontage in using water power is that they must not interfere with navigation or the improvement of a navigable stream. The limitation not only covers the present improvement of a stream, but also precludes the assessment of damages against the Government on account of future improvements of the river. The occasion for issuing this order was the application of H. P. Dilworth, Charles A. Jamison and H. S. Robinson for the right to use the water power created by dam No. 3 in the Allegheny River. Mr. Dilworth and his associates propose to utilize the water power in an electric plant to be located on the north bank of the river. Before rendering his decision the secretary referred the matter to the legal department, which submitted its opinion upon the legal questions involved, and it is upon this that it was decided to give to Mr. Dilworth and his associates the license to use the water power created at the dam. Before installing his plant Mr. Dilworth will be required to submit his plans to Chief Engineer Mackenzie in order to demonstrate to the War Department that his use of the water will not obstruct navigation. It is held by the War Department that the fact that a stream is made a public highway does not divest private ownership in soil to the middle of the river. As long as a riparian does not interfere with navigation he has license to divert the water from a navigable stream. The fact that the Government builds a dam for the purpose of aiding navigation does not necessarily vest in it the water power rights created by the improvement.

BIDS FOR ELECTRIC CABLE.—Following are the bids opened on July 1 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the work complete for underground lead-encased, braid-covered incandescent lighting and power cables for the Navy Yard at League Island: National Conduit & Cable Company, $24,586; John A. Roebling's Sons Co., $22,662; Standard Underground Cable Company, $22,965, and American Steel & Wire Company, $24,716.

MORE NIAGARA POWER.—The Electrical Development Company has entered into a contract to supply the Toronto Railway Company and the Toronto Electric Light Company with electrical energy from Niagara Falls at from $35 to $40 each hp wholesale. The present cost of electrical power generated by steam varies from $60 to $100.

METERS IN CANADA.—The Western Electric Manufacturing Company, of Berlin, Ont., was incorporated recently with a capital of $50,000, and intending to make a specialty of electric meters. These instruments are designed specially for central station purposes. Mr. J. H. Messner is actively interested in the enterprise.

GENERATOR WANTED.—The Telephone Improvement Company, Sweetwater, Tenn., D. L. Smith, manager, is in the market for a 50-kw generator, 1,100 volts pressure. Bids will be received until July 31.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was considerable strength in the speculative market, although the activity was mainly professional. Support and manipulation by large interests was apparent in the behavior of the leading stocks, such as Reading and Union Pacific. St. Paul, the Pennsylvania group and Atchison were also strong, but did not take the lead in the further upward movement. United States Steel shares were somewhat irregular, but at the close of the week developed decided strength. The traction group advanced under the lead of Brooklyn Rapid Transit, which was the object of a bullish sentiment, based upon its increasing traffic. The prices of this stock ranged between 70⅞, the lowest, and 73⅜, the highest, the closing quotation being 71½, a net loss of ¼ point. The number of shares sold was 140,900. There was considerable activity in Metropolitan Street Railway, which ranged between 128 and 131, closing at 130, this being a net gain of 2¼ points. Interborough Rapid Transit closed at 200⅜. The electric stocks are all higher and prices were well maintained. Allis-Chalmers common made a net gain of ¼ point, closing at 51⅞; Westinghouse ½, closing at 168, and General Electric 2½, closing at 178¾. Electric Storage Battery is up 4 points, the last quotation being 82, but the telegraph group is down, Western Union ½, and American Telegraph & Telephone ¼, the closing quotations being 93¼ and 139½, respectively. In a general way the curb market followed the lead of the stock exchange list, closing moderately higher than a week ago. Among the most active stocks was Electric Vehicle. Following are the closing quotations of July 11:

NEW YORK

	July 3	July 11		July 3	July 11
Allis-Chalmers Co.	13⅛	14	Electric Vehicle pfd.	20	27
Allis-Chalmers Co. pfd.	51⅞	52	General Electric	176	176
American Tel. & Cable	90	90	Hudson River Tel.	..	..
American Tel. & Tel.	139	137	Interborough Rap. Tran.	200⅞	200¾
American Dist. Tel.	29	29	Metropolitan St. Ry.	129¾	125⅞
Brooklyn Rapid Transit.	72⅛	69⅛	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	28	20	Western Union Tel.	93¾	93
Electric Boat pfd.	73	60	Westinghouse com.	167	162
Electric Lead Reduction	..	..	Westinghouse pfd.	.	..
Electric Vehicle	16	20			

BOSTON

	July 3	July 11		July 3	July 11
American Tel. & Tel	140	139	Western Tel. & Tel. pfd.	101	99⅛
Cumberland Telephone	117⅝	117	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	*255	*245	New England Telephone	*139	138½
General Electric	175	.	Mass. Elec. Ry.	18	*19
Western Tel. & Tel.	18	18	Mass. Elec. Ry. pfd.	*62	63

PHILADELPHIA

	July 3	July 11		July 3	July 11
American Railways	50½	50	Phila. Traction	..	99¾
Elec. Storage Battery	77	78	Phila. Electric	8¾	8¾
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	28⅝	28
Elec. Co. of America	11¾	11¾			

CHICAGO

	July 3	July 11		July 3	July 11
Central Union Tel.	..	..	National Carbon pfd.	117	118
Chicago Edison	..	159	Metropolitan Elev. com.	24	23⅞
Chicago City Ry.	*190	*190	Union Traction	..	.
Chicago Tel. Co	..		Union Traction pfd.	.	..
National Carbon	65	63			

* Asked.

NEW TELEPHONE OPPOSITION.—A new telephone system composed of the Coast Line Telephone Company organized under the laws of South Dakota, capital $10,000,000, and the Coast Line Telephone Company of New Jersey organized under the laws of that State with a capital of $1,000,000, announces that it will begin business immediately. The former company is to be the construction company and the latter the operating company, which will do business in conjunction with other independent companies throughout the State of New Jersey and will co-operate with the State Line Telephone of New York City and the Atlantic Telephone Company of New York City. Application will be made shortly, it is stated, to the authorities in New Jersey for permission to erect poles and string wires. The president of the Coast Line Company is Elias S. Beach, of New York, and S. M. Conger, also of New York, is treasurer. D. A. Reynolds, of Brooklyn, is president of the $1,000,000 company and manager of the Atlantic Telephone Company, of New York, and E. D. Clark, of Jersey City, is secretary. The directors of both companies are as follows: E. A. Rogers, Eugene H. Brock, W. F. Midlige, John J. Toffey, E. V. Haggerty, T. B. Stolet, W. M. Reynolds, E. T. Burroughs, Daniel E. Cleary, George E. Hall, E. D. Clark, Gustav W. Lembeck, Stephen M. Conger, D. A. Reynolds and J. V. Throckmorton.

HARD RUBBER.—The Hard Rubber Company of America has been incorporated under the laws of New York State with a capital of $7,500,000, of which $2,500,000 is 8 per cent cumulative preferred stock and $5,000,000 common stock. It is the nucleus of a consolidation of several hard rubber manufacturers. The output consists of materials made of vulcanized rubber, such as combs, horns and telephone appurtenances. The American Hard Rubber Company, of No. 9 Mercer Street, is one of the principal concerns in the hard rubber business. It has a capital stock of $2,500,000. Edwin W. Belcher, secretary of the company, stated last week that he knew the purposes for which the Hard Rubber Company was formed, but they did not interest the public.

BELL TELEPHONE WEST.—Advices from Boston quote President Fish, of the American Telephone & Telegraph Company, as follows: "There is now a gap of about 170 miles in the Bell lines from coast to coast. However, even if that gap were built over, I do not believe it would be commercially practicable for telephone communications. Improvements must be made before the voice can be carried so far. There is one very long line in constant daily use now. I refer to the line between Omaha and Boston. The Cudahys have houses in both cities and every day they talk from one to the other over our lines. Conversations between Boston and Milwaukee and between Boston and Atlanta, Ga., are quite frequent."

MEXICAN LIGHTING BONDS.—The $6,000,000 bond issue being made by the Mexican Electric Light Company and guaranteed by the Mexican Light & Power Company, has been subscribed for one and a half times. The allotments are as follows: Bank of Montreal, $1,000,000; London Bankers, $1,000,000; directors of the Mexican Light & Power Company, $1,000,000; E. Mackay Edgar Syndicate, $2,000,000; Sun Life Assurance Company, $500,000; Central Canada Loan & Savings Company, $500,000.

NEW HAVEN RAILROAD TROLLEYS.—The New Haven Railroad has taken up the $300,000 stock of the Branford Light & Water Company, controlling the Branford trolley system, with 4 per cent bonds, the stock being bought at $80 per share.

INTERNATIONAL PUMP REPORT.—In his annual report to the International Steam Pump Company, President John W. Dunn says: "The constantly increasing demand for the products of our company has taxed the various manufacturing plants to their utmost capacity, so that they were unable to reduce the amount of unfilled orders on hand. On March 31, 1905, the unfilled orders on the books of the company amounted to $4,510,000. Considerable time and money have been spent in the development of the centrifugal and turbine pumps, gas engines and water meters and satisfactory progress has been made in the manufacture of these special lines. The engineering and manufacturing departments have made many improvements in the quality and efficiency of the standard pumps, and have applied for letters patent covering a great many new designs and devices which have been made to meet novel conditions. The year just closed has marked the transfer of the Henry R. Worthington plant from Brooklyn and Elizabethport to Harrison, N. J. The moving of these works occupied several months and occasioned a very considerable interruption in the business, so that there was a large falling off in the production and shipments. The loss in production, together with the moving and other expenses incidental to the starting of the new plant, have resulted in a decrease in the profits. The new works at Harrison, N. J., are now practically completed and in full operation. This plant was designed with a view to economy and efficiency, and now stands unsurpassed in its adaptability to the manufacture of pumping and hydraulic machinery. The removal of the operations of the Holly Manufacturing Company from the Lockport plant to the enlarged Snow plant at Buffalo was also finally completed early in the fiscal year, and the Lockport plant is now unoccupied and to a large extent dismantled. The machine tools, etc., belonging to the Holly Company, are, however, independently maintained and segregated within the Snow plant at Buffalo. Since the organization of the company in 1899 there has been paid and distributed in redemption of bonds and in interest and dividends on the securities of the company and its constituent companies a total of $7,113,153 and $6,082,976 for new buildings and improvements, making a total of $13,196,130. The benefits of these improvements are expected to be hereafter reflected in the economy and increase of production." The net earnings for the year ended March 31 were $1,332,935, a decrease of $273,682 from the previous year. The interest on the funded debt was $334,499, leaving a balance of $998,436 available for dividends. The dividends paid on the preferred stock were $709,800 and on the common $306,597, showing a deficit for the year of $17,961, as compared with a surplus of $101,644 the previous year, when a larger amount was paid on the common stock. The surplus, after the deduction of last year's deficit, is $2,252,032.

LARGE ELECTRICAL MORTGAGES have been filed at Buffalo, N. Y. One is from the General Electric Transmission Company of Buffalo to the Buffalo Loan, Trust & Safe Deposit Company as trustee, and for $15,000,000. The mortgage deed covers all of the property and franchise of the electric company in all counties of the State. The mortgage is given to secure bonds of the company to the amount stated. These bonds are to run forty years at the rate of 5 per cent per annum, payable half yearly. Another large mortgage was filed for $25,000,000 from the United Message Company of Albany to the Knickerbocker Trust Company of New York as trustee. The trust mortgage covers all the property and franchises of the Message Company in all the States through which its lines may be extended. The company is incorporated for the purpose of maintaining lines of electric telephone and telegraph in the States of New York, Vermont, Connecticut, Massachusetts, Rhode Island, New Hampshire, Maine and the Dominion of Canada. The mortgage is given to secure bonds of the company to the amount stated. These bonds are to run thirty years at the rate of 5 per cent per annum. These mortgages go on file only a little ahead of the time when the mortgage tax act of the last New York Legislature becomes effective. That act went into effect on July 1, and had these two mortgages been held for record until after that date they would have been subject to a tax of one-half of 1 per cent on the aggregate amount ($40,000,000), which would have netted to the State $200,000. This sum the companies saved.

SAN FRANCISCO TROLLEYS.—It is said that the earnings of the United Railroads of San Francisco, all of the stock of which is held by the United Railways Investment Company, are showing such satisfactory progress that banking interests identified with the property express the opinion that the dividend on the preferred stock of the investment company will soon be raised from the 4 per cent to the full 5 per cent rate. Moreover, there has accumulated on the preferred about 5 per cent in back dividends, and the same interests are authority for the statement that consideration will soon be given to the question of paying off this accumulation. Last year the company paid 4 per cent on its preferred stock in addition to spending a considerable amount on improvements, and at the close of the fiscal year on March 1 showed above these expenditures a surplus of $904,710 for the year. Since the beginning of March the gross earnings have increased at the rate of about $28,000 a month, and it is stated that there has been no increase in operating expenses, so that at the present rate the net earnings for the current fiscal year will be larger by about $300,000 than they were last year. If the actual result justifies this estimate the earnings for the year ended March 1, 1906, will be sufficient to pay the full 5 per cent on the preferred for the current year, to distribute the 5 per cent of accumulated dividends, and to leave a substantial sum to add to the surplus. During the past three years the company has spent $3,000,000 in improving its property and has reduced its outstanding indebtedness by $1,300,000.

CUMBERLAND TELEPHONE CO.—The Cumberland Telephone & Telegraph Company has issued the following report of its May earnings:

	1905	1904	Increase.
May gross	$373,836	$322,137	$51,699
Expenses	242,669	197,683	44,986
May net	$131,167	$124,454	6,713
Charges	22,805	21,833	972
May surplus	$108,362	$102,621	$5,741
Five months' gross	1,870,308	1,616,702	253,606
Expenses	1,139,380	945,968	193,412
Five months' net			
Charges	106,512	106,212	300
Five months' surplus	$624,416	$564,522	$59,894

TROLLEY FOR MISSOURI VALLEY.—According to advices from Kansas City, Mo., the Missouri Valley Electric Railway Company has been incorporated, with a capital stock of $650,000. Geo. B. Blanchard, a civil engineer, representing Nevins & Co., of New York, is pushing the road. The plan of the company is to construct and operate an electric railway from Kansas City to St. Joseph, with spurs to Leavenworth, Kan., and Atchison, Kan. The length of the main line will be 65 miles. The stockholders, who also comprise the board of directors, are Mr. Blanchard, C. P. Breen, G. B. Tuggle, S. Facker, Wilson McAfee and Howard McAfee, all of Parkville, Mo. The route of the proposed electric railway will follow the river as closely as possible, the idea being to parallel the Burlington tracks.

DIVIDENDS.—The directors of Electric Company of America have declared the regular semi-annual dividend of 3½ per cent, payable July 31. The directors of the United States Rubber Company have declared a regular quarterly dividend of 2 per cent upon the preferred stock from the net earnings of the company and its subsidiary companies for the three months ending June 30, 1905. The dividend is payable August 15. J. G. White & Co., Inc., have declared a quarterly dividend of 1½ per cent on the preferred stock, payable August 1. The El Paso (Tex.) Electric Company, a Stone & Webster property, has declared a semi-annual dividend of $3 per share on its preferred stock.

EARNINGS IN SAN FRANCISCO.—The comparative statement of earnings of the California Gas & Electric Corporation for the months of May, 1904 and 1905, is as follows:

	1904	1905.	Changes.
Gross earnings	$329,077.41	$447,631.80	$118,554.39
Operating expenses, taxes, ins. and int. sub. cos.	246,434.36	333,727.38	87,293.02
Profit	82,643.05	113,904.42	31,261.37
Corporation bond interest	36,458.34	36,829.17	370.83
Balance	46,184.71	77,075.25	30,890.54
Sinking fund	12,500.00	12,500.00	
Net surplus	33,684.71	64,575.25	30,890.54

APRIL TELEPHONE EARNINGS.—Following are the earnings of the United States Telephone Company for April, compared with April, 1904:

	April, '05.	April, '04.
Gross earnings	$38,787.10	$35,709.70
Expenses and taxes	23,802.14	20,013.36
Net earnings	$14,984.96	$15,696.34
Deductions	9,146.61	7,892.87
Surplus for period	$5,838.35	$7,803.47

KINGS COUNTY STOCK.—The stockholders of the Kings County Electric Light & Power Company have voted in favor of the proposition to increase the capital stock from $5,000,000 to $10,000,000. The new stock is to be used in part for extensions.

ELECTRIC VEHICLE.—It is reported that a readjustment of the securities of the Electric Vehicle Company is to take place.

General News of the Week

The Telephone.

NOME, ALASKA.—The Chicago Telephone Supply Company has sent R. L. Goudy to Nome, Alaska, to install a central energy telephone system of several hundred telephones.

SAN FRANCISCO, CAL.—J. S. Torrance and T. W. Torrance, who are interested in the Home Telephone Company, recently arrived in this city on business connected with the new system projected here.

HARTFORD, CONN.—The Southern New England Telephone Company has increased its capital stock to $10,000,000.

COLLINSVILLE, CONN.—The Farmington Valley Telephone Company has raised its capital from $27,000 to $54,000.

LOS ANGELES, CAL.—The Home Telephone & Telegraph Company has created the offices of assistant general manager and second assistant general manager. The first has been filled by the appointment of C. L. Swain, formerly assistant superintendent of the Southern Pacific, and the second by C. C. Craig, who has been in the employ of the Home Telephone Company since it began business. The new offices were made necessary by the company's increased business. The business of the company has grown to such an extent that official action has been taken looking toward doubling its capitalization and its bonded indebtedness. The company is said to have 19,000 subscribers in Los Angeles, with 2000 waiting orders.

BOISE, IDAHO.—The Idaho Independent Telephone Company will build a modern 3-story building for telephone purposes, at a cost of about $35,000.

CHICAGO, ILL.—The Chicago Telephone Company's gain for June was 2212 subscribers, making a total of 130,316.

PATRIOT, ILL.—The Farmers' Mutual Telephone Company has been incorporated, with a capital of $25,000. Incorporated by James Mead and F. H. Groeve.

LIVINGSTON, ILL.—At the annual meeting of the Reddick Mutual Telephone Company it was voted to increase the capital of the company from $5000 to $10,000.

ALBION, ILL.—The Board of Directors of the Edwards County Mutual Telephone Company has organized by electing Charles Clark, president; O. A. Bunting, secretary, and Moses Gumbrell, treasurer. The company incorporated with a capital stock of $4000.

ELDORA, ILL.—The Hardin County telephone system, formerly known as the Cedar Valley, has passed into the possession of the Iowa Telephone Company, of Des Moines. The sale includes the Eldora, Steamboat Rock, Ackley and other exchanges in the smaller towns of the county other than the Mutual Company exchanges in Eldora and Iowa Falls.

SYRACUSE, IND.—The Syracuse Home Telephone Company has decided to sell its plant.

FRANKFORT, IND.—The local independent telephone company has been sold to the Bell Company for $125,000.

FLORA, IND.—The Central Union Telephone Company is making a strong fight to invade the local field and from this point secure every co-operative telephone plant in Carroll County.

CONVERSE, IND.—The Central Union Telephone Company is installing a new switchboard and making other changes and improvements in the plant recently acquired from Amboy Home Telephone Company.

KOKOMO, IND.—There is a fight between the New Long Distance Telephone Company and the Bell Telephone Company for control of the plant of the Citizens' Telephone Company of the city. The Council has introduced an ordinance, at the instance of the Citizens' Company, repealing the clause in its franchise which prohibits it from entering into a contract with the Bell company for long-distance connections.

RICHMOND, IND.—The Central Union Telephone Company is now ready to begin the work of placing its wires underground and is urging the City Council to permit it to construct a conduit system. The committee has been instructed to prepare the ordinance. If the permission for the construction of an exclusive underground system is not granted the Central Union Company will proceed at once to spend $7000 in improving its pole line system. The company complains of the trouble with its lines on account of the close proximity of its wires to the high tension wires and is anxious to remedy it.

PORTLAND, IND.—It is believed here that the Bell telephone interests have entered upon a systematic campaign against the independents in Jay County. It is rumored that the slight lead gained some months ago in the purchase of a controlling interest of the United Telephone Company has been followed by the purchase of the independent exchanges at Dunkirk and Redkey. Attempts were also made to secure independent exchanges at Bryant and Salamonia, but the owners refused to sell at any price, and the latter are preparing to cover the county with a complete toll line system of their own.

GREENFIELD, IND.—The mayor and city council have locked horns with the Morrison Telephone Company over a peculiar question of right and the forfeiture of the company's franchise is threatened in consequence. A false alarm of fire was recently sent in over the company's wire and during the run one of the department's horses was permanently injured. When the fire chief requested the number of the telephone responsible for the run, the operator declined to give it, saying it was against the rules of the company. A meeting of the city council was called and Manager Earley was asked to explain, the mayor taking the view that the telephone is a part of the fire department system. Mr. Earley would do nothing more than promise to investigate, and up to the present has declined to make any report to the authorities as to the responsibility of the false alarm.

VENTURA, IA.—The citizens have organized a telephone company, with Frank Wheeler as president, and Walter Leonard, secretary.

ELDORA, IA.—The Hardin County telephone system, formerly known as the Cedar Valley, has passed into the possession of the Iowa Telephone Company.

DES MOINES, IA.—The Mutual Telephone Company has announced an increase of $6 per year in its charge for residence telephones.

BLOOMFIELD, IA.—John M. Lain, M. D. Sprout, O. S. Reed and Henry Utt have purchased the Steckel telephone line, running from Bloomfield to the Lain and Sprout farms at Shunem. The purchase covers the entire Shunem line and the wires will be connected with the Farmers' Mutual switchboard at this place.

TABOR, IA.—The City Telephone Company has held a special meeting of stockholders and officers to arrange for the dissolution of the company and its reorganization into two companies, one for Fremont and one for Mills County. The former will have its headquarters here and continue under the old name of "City Telephone Company." The Mills County company will have its principal offices at Malvern.

OSBORNE, KAN.—The Bloomington Mutual Telephone Company has been organized with a capital of $3000.

ATCHISON, KAN.—The directors of the Atchison Telephone Company have authorized the increase of the bonded indebtedness of the company from $75,000 to $150,000. It is the intention to construct a number of country lines to connect with the smaller towns and also to connect the farms along the way.

IOLA, KAN.—The Missouri & Kansas Telephone Company has purchased the local telephone system from Arnet & Hobart, and will begin at once to rebuild the plant and make a thoroughly modern system. The central emergency system will be put in and many miles of cable installed. In addition a two-story brick building will be put up especially equipped for the central station. In addition to the local plant, the Gas City system has been purchased by the long-distance lines between the two towns.

PADUCAH, KY.—The People's Independent Telephone Company has been absorbed by the Paducah Home Telephone Company, a new concern recently organized, which is virtually the Louisville Home Telephone Company. The new company is capitalized at $250,000.

BATON ROUGE, LA.—The Louisiana Railroad Commission has given notice to the Cumberland Telephone & Telegraph Company that at the next session it will take up for the purpose of adopting a rule providing that deductions shall be made from telephone charges whenever telephones are out of use for a period longer than 24 hours in a city or 48 hours in the country except for causes beyond the control of the company, and in such cases rules will be fixed for deduction to be made after certain delays.

BALTIMORE, MD.—The Highways Commission has granted permission to the Chesapeake & Potomac Telephone Company to build a line from White Hall to Bluemont, and from Herford to Mount Carmel.

WINDOM, MINN.—The Windom Mutual Telephone Company has just made long-distance connections with Dundee, Fulda and Kimbrae.

EXCELSIOR, MINN.—The farmers on the upper lake have formed a new telephone company, to be known as the Lakeside Rural Telephone Company. A line will be built which will complete direct communication with the Twin City.

PARIS, MO.—The Paris Telephone Exchange has been sold to the Buffum Telephone Company.

CENTERVILLE, MO.—The Centerville Telephone Company, of Centerville, has been incorporated for $2,000. The incorporators are J. J. Jamison, W. S. Carter, Z. C. Smith, C. M. Buford, Wm. H. George, Wm. Rayfield and others.

ST. LOUIS, MO.—The City Council has made arrangements with the Kinloch Telephone Company to place telephones in various parts of the city for the exclusive use of the police and fire department.

CARTHAGE, MO.—The Home Telephone Company has filed a certificate showing that the company has increased its capital stock from $200,000 to $750,000. The company expects to invest the extra capital in improvements and extensions. It has voted $100,000 of the extra capital to be used at once.

LOUNSBERRY, MONT.—Articles of incorporation have been filed by the Lounsberry-Bradley Telephone Company, with a capital of $2,600. Incorporated by E. T. Megna and F. J. Faehn.

AURORA, NEB.—The Hamilton County Telephone Association has purchased the interests of the Bell Telephone Company in this city.

OMAHA, NEB.—The Nebraska Telephone Company has purchased a lot in South Omaha on which a brick block will soon be built. It is stated that the company proposes to expend from $75,000 to $100,000 in the way of improvements in its system in South Omaha this year.

TRENTON, N. J.—The Coast Line Telephone Company, capital $1,000,000, was incorporated here June 28. The incorporators are D. A. Reynolds and E. H. Brock, of New York, and E. P. Clark, of Jersey City.

FREEHOLD, N. J.—The franchises and property of the Freehold Telephone & Telegraph Company, which suspended operations last fall, have been sold at public auction by George H. Atkinson, trustee. They were purchased by George W. Eggert, of Perth Amboy, for $1550. Mr. Atkinson also sold the property of the Red Bank Telephone Company to Henry C. McLean, of Red Bank, for $2550.

ALBANY, N. Y.—The Cobleskill Telephone Company certified that it has increased its capital stock from $6000 to $15,000.

JAMESTOWN, N. Y.—Fire in Panama, Chautauqua County, on July 7, destroyed every business place in the village, including the exchanges of the Bell and Independent telephone companies.

SYRACUSE, N. Y.—The Independent Telephone Company has been incorporated with a capital stock of $1,000,000. The directors are Jacob Ames, Baldwinsville; A. K. Hiscock, C. M. Warner, Syracuse, and C. F. Lamb, Rochester.

BUFFALO, N. Y.—The Consolidated Telephone Company, which recently purchased the stock of the Frontier Telephone Company, at a meeting of its directors voted to increase its directorate and these men were elected: John Markle, Wilkesbarre; J. Sloat Fassett, Elmira; E. Frank Brewster, Rochester; George W. Thayer, Rochester; V. Moreau Smith, Rochester, and Charles W. Goodyear, Buffalo.

HUNTER, N. D.—The Hunter Telephone Company's stock has been increased from $5,000 to $15,000.

CINCINNATI, OHIO.—A new exchange has been opened by the Cincinnati & Suburban Bell Telephone Company at 2422 Gilbert Ave.

MORGANSVILLE, OHIO.—The Morgansvillle Telephone Company has been incorporated, with a capital stock of $50,000. The incorporators are Jackson Jones, W. J. Warne; J. C. Glass.

CLEVELAND, OHIO.—During the last month the Central Union Telephone Company has opened new exchanges as follows: Centerville, O.; Gilman, Ill.; Milan, Ill.; Onarga, Ill.; Pitchin, O.; Spring Valley, O.; West La Fayette, O.

HAMILTON, OHIO.—The Cincinnati & Suburban Bell Telephone Company, which controls the Hamilton Bell Telephone Company, has purchased a site at Hamilton on which will be erected a fine exchange. The building will cost $50,000 and the switchboard $30,000. The capacity of the board will be for 6000 lines.

COLUMBUS, OHIO.—The Central Union Telephone Company has just issued a statement showing the number of Bell instruments in use in Ohio May 1, as compared with January 1. On Jan. 1, 1905, there were 130,011 Bell telephones in Ohio. May 1, there were 142,237, an increase of 12,226. This gain is at the rate of 40,000 a year.

NEW LEXINGTON, OHIO.—The Perry County Telephone Company, recently organized for the purpose of taking over the properties of the Sunday Creek Valley Telephone Company and the Central Union or Bell Company, has elected the following officers: E. S. Martin, president; Wm. A. Allen, vice-president; T. M. Potter, secretary, and C. B. Enlow, treasurer.

CINCINNATI, OHIO.—The Cincinnati & Suburban Telephone Company has made a substantial reduction in the telephone rates for all classes of unlimited service. There will be no five-year contracts hereafter. All contracts will be for one year and the rate will be on the same basis that it was for a five-year contract. The unlimited business service is reduced from $125 to $100; residence telephones, individual lines, from $72 to $60; two-party lines, from $60 to $48; three-party lines, from $48 to $36. four-party lines, from $36 to $30.

OKLAHOMA CITY, OKLA.—The Fort Cobb Telephone Company has been organized with a capital of $2,500. The incorporators are R. A. Woodbridge, John W. Wright and others, of Oklahoma City.

OKLAHOMA CITY, OKLA.—The Lone Wolf Telephone Company, with a capital of $5000, has been organized by D. L. Stromquist, of Mullhall, and R. A. Woolridge, of Oklahoma City.

BENTON, PA.—The Benton Rural Telephone Company has been incorporated. Capital, $5000.

SALADASBURG, PA.—The Saladasburg & Linden Telephone Company has been formed with a capital of $5000.

NASHVILLE, TENN.—The Cumberland Telephone Co. will erect an $8000 branch exchange in this city.

NASHVILLE, TENN.—Ernest T. Mitchell and C. A. Thatcher are the latest applicants for a Nashville telephone franchise, with conduits. Messrs. Mitchell and Thatcher are said to represent the Automatic Telephone Company, of Chicago.

LERO, VA.—The North Frederick Telephone Company has been chartered; capital, $1,000. Incorporated by S. E. Brown, president; E. Jackson, secretary.

BELOIT, WIS.—The Beloit Telephone Company has been organized with a capital of $20,000.

BALDWIN, WIS.—The Baldwin Telephone Exchange, of Baldwin, has amended its charter, increasing its capital to $15,000.

GREEN BAY, WIS.—The stockholders of the Manitowoc & Western Telephone Company have decided to extend the company's line from Greenleaf to Green Bay. The company is capitalized at $12,000.

MILWAUKEE, WIS.—The Chicago & St. Paul Telegraph Company has been incorporated to build and operate telegraph and telephone lines from Hudson to Milwaukee and other cities in this State, between St. Paul and Stillwater, Minn., and other places in that State, and to Chicago and other places in the State of Illinois. The capital stock is $100,000. The incorporators are A. G. Zimmerman, County Judge of Dane County, and Attorneys Rufus B. Smith and Alfred T. Rogers.

APPLETON, WIS.—Representatives of the Fox River Valley Telephone Company, of Appleton, and the Valley Telephone & Telegraph Company, of Green Bay, have effected a consolidation of the two companies. The former company operates an exchange of 1500 telephones at Appleton, with toll lines and local exchanges at 45 other points in the valley and eastern Wisconsin. The Green Bay Company is building exchanges at Green Bay and Depere [illegible] will be in operation by Aug. 1 and work will begin at once on a line from Kaukauna to Depere, which will connect its lines with those of the Fox River Valley Company.

Electric Light and Power.

ARGENTA, ARK.—The citizens have petitioned Council to establish water works and an electric light plant.

TEXARKANA, ARK.—The Texarkana Gas & Electric Light Co. has changed its name to the Texarkana Gas & Electric Co. and reduced its capital stock from $2[illegible] to $1[illegible].

CHINO, CAL.—The Chino Land & Water Company will construct an electric light plant for Chino.

EUREKA, CAL.—Bids are wanted until July 17 for the purchase of an electric power franchise. J. S. Brown is chairman of the committee.

SANTA BARBARA, CAL.—The stockholders of the Merchants' Electric Company have decided to proceed at once with the construction of an independent plant.

LOS ANGELES, CAL.—The Ciy Council has been asked by the Municipal League to consider the matter of a municipal lighting plant. The present cost of lighting is about $133,000 annually.

SAN FRANCISCO, CAL.—The Sierra Nevada Water & Power Company has been incorporated, with a capital of $5,000,000, by G. B. Crittenden, W. L. Stowell, R. M. Kreiser, and others.

LOS ANGELES.—A new city ordinance has gone into effect, providing that electric energy supplied by the lighting company shall not vary more than 3 per cent. from the standard; also for tests of electric meters to be made by the city electrician.

LOS ANGELES, CAL.—The City Council has passed a new ordinance under which corporations will be obliged to submit a complete financial statement annually to the city after Jan. 1, 1906. The Council is empowered to fix a price for the service provided.

ANAHEIM, CAL.—The City Trustees of Anaheim are considering the advisability of leasing the city electric light plant to the Edison Electric Company. This company claims that it can operate the plant cheaper than the city. It offers to pay the city 12 per cent. of the gross receipts of the lighting service, with an agreement to give the city the right to terminate the contract in a year.

LOS ANGELES, CAL.—Various interested companies have been holding meetings for the purpose of devising plans whereby telegraph, telephone, electric lighting and trolley poles shall be removed throughout the city and consolidated systems erected in their place down alleys and back streets.

LOS ANGELES, CAL.—Broadway, in this city, which is over a mile long, is one of the best lighted thoroughfares in the world. Electroliers stand on either side of the street, having been erected at an expense of about $15,000 by abutting property owners. These poles display 1600 ornamental incandscent lights, effectively softened by milk-white globes. This system, recently installed, is lighted by the municipality at a monthly cost approximating $900.

SAN FRANCISCO, CAL.—The Reno Power, Light & Water Co.'s plant at Reno, Nev., was shut down for ten days while the armature of the main generator was being rewound. The company's circuits were temporarily supplied from the Truckee River General Electric Company's plant at Floriston. The burn-out was caused by a cat, which climbed a pole on the high-tension line in Reno and produced a short circuit.

WASHINGTON, D. C.—A report made by Gen. George H. Harries, as vice-president of the Potomac Electric Power Company, is to the effect that all overhead wires on Seventh St. have been removed. Gen. Harries also reports that during the past fiscal year his company has taken down wires and put them underground to an aggregate length of 19,560 ft.

WILMINGTON, DEL.—The question of constructing a municipal electric lighting plant, in conjunction with the pumping station, for street and public lighting only, is under discussion here. Theo. A. Leisen is chief engineer of the water department.

CALHOUN, GA.—Geo. C. Chambers, of Calhoun, will construct an electric light plant to cost from $3,500 to $4,000, and operate it with water power.

OTTAWA, ILL.—The Ottawa Power Company has been incorporated with a capital of $5000. The incorporators are: Jas. A. Sedden, Chas. W. Hadley, and others.

QUINCY, ILL.—At the annual meeting of the Quincy Gas & Electric Company it was voted to increase the capital of the company from $600,000 to $2,000,000. K. J. Lynn is president, and M. G. Borgman, treasurer.

CHICAGO, ILL.—Plans have been filed by the Commonwealth Electric Company for a [illegible]-story power house, to be constructed at 22d and Fisk Sts., to cost $[illegible], also for a one and two-story brick power house, to cost $[illegible].

CHICAGO, ILL.—The Chicago & Suburban Water & Light Co. has accepted the offer suggested by Mayor Dunne that the city purchase its plant in Austin for $[illegible], and an ordinance for the purchase of the system at this price has been introduced in the council.

MURPHYSBORO, ILL.—The Carbondale Water, Light & Power Company has been placed in the hands of Attorney Otis Glenn as receiver, on application of the American Trust and Savings Bank of Chicago, which holds a trust deed to all the property, as trustee to secure payment of bonds and interest.

COLUMBUS, IND.—The Columbus Street Railway & Light Company is to build a new power house and steam heating plant.

TELL CITY, IND.—Bids will be received by Frank Hinkle, City Clerk, for [illegible] to be installed at the electric light plant.

EVANSVILLE, IND.—The Evansville Gas & Electric Light Company will [illegible] in the city to supply electric power to the various traction [illegible] here.

INDIANAPOLIS, IND.—The Cheney Electrical Co. has secured the contract for the electric wiring and fitting for the new State Industrial School for Girls, to be located on Crawfordsville Pike, for $9,178.

WATERLOO, IND.—The Waterloo Electric Light Company has experienced considerable annoyance from the burning out of transformers by lightning. The repairs have to be made in Fort Wayne, often causing considerable delay. The company will solicit bids for putting up lightning arresters.

WASHINGTON, IA.—The Iowa Gas & Electric Company has been incorporated, with a capital of $100,000.

NEWTON, IA.—The Council will purchase a storage battery equipment for the electric light plant, at a cost of $8000.

WATERVILLE, ME.—The Fort Halifax Power Company, of Waterville, has voted to reduce the amount of its capital stock from $250,000 to $100,000.

COTTONWOOD FALLS, KAN.—The Smith Light & Power Company, of Bolivar, Mo., has received a franchise from this town and is installing a plant here.

CHETOPA, KAN.—Burns & McDonnell, Kansas City, Mo., are preparing plans and specifications for water works and an electric light plant, to cost about $30,000.

ABBEVILLE, LA.—Bonds to the amount of $40,000 have been sold, to be used for water works, sewerage and electric lights.

PORTLAND, ME.—The Green River Power & Development Company has been organized at Portland with $5,000,000 capital stock, of which $800 is paid in. The officers are: President, H. P. Sweetser, of Portland; treasurer, L. L. Hight, of Portland.

HOLYOKE, MASS.—Contracts for the buildings, water wheels and electrical and steam apparatus for the Holyoke Water Power Co. have not yet been let.

ANN ARBOR, MICH.—The stock of the Washtenaw Light & Power Company is reported to have been purchased by Alex Dow, of Detroit; R. W. Hemphill, Jr., of Ypsilanti, and others. The directors are reported to have decided to develop the Huron River power, manufacture gas and extend the power service in Ann Arbor and Ypsilanti.

LEWISTON, MONT. — John L. Bright, of the Citizens' Electric Company, who recently purchased the stock of the Livingston Electric Light Company, has perfected all plans for installing a new plant throughout.

MISSOULA, MONT.—Owing to the increased demand upon the light and water company for lighting facilities in this city, additions to the power plant at Bonner have been decided upon, which will cost when completed in the neighborhood of $30,000. A Westinghouse-Parsons turbine will be installed It will be the first steam turbine to be placed in the State of Montana.

WEBB CITY, MO.—J. C. Harrison and Robt. Holt, of Carthage, have petitioned for a franchise and contract to light Webb City.

CAMDEN, MO.—The Camden Water, Light & Power Company of Missouri has filed a certificate designating Daniel Davies, of Camden, as agent for Arkansas, and that $30,000 of its $50,000 capital is in use in Arkansas.

ST. LOUIS, MO.—The West Cabanne Improvement Co. has filed an application for articles of incorporation for the purpose of furnishing light, heat and power in the city of St. Louis and St. Louis County. The capital is to be $25,000, half of which is paid. Thomas C. Henning owns a majority of the stock. Among the other stockholders are W. W. Colver, Arthur E. Ewing, Montague Punch, William Yule, Jesse P. Baker, George Kingsland, W. F. Funsten and Charles E. Ware.

TECUMSEH, NEB.—An election will probably soon be held to vote on issuing $9500 for a new electric light plant. P. H. Hopkins is Mayor.

PORTSMOUTH, N. H.—The Rockingham Light & Power Company is putting in a new large fan to be used for induced draft in the boilers and chimney at the power plant at Portsmouth, N. H. The company has also contracted with the Hodge Boiler Works, of East Boston, for the erection of a large tank to hold 135,000 gallons of feed water for the boilers. This will be taken directly from Beverly Springs.

NEWARK, N. J.—The Licking Light & Power Company, of Newark, has ben incorporated. The concern has been reorganized by Melville Gillett, of Newark, and Congressman Beman J. Dawes, of Marietta. The capital is $300,000, one third of which is preferred stock. In addition to Gillett, the incorporators are Henry G. Bohl, John P. Maynard, W. G. Bathalow and J. W. Danford.

PAUL SMITH'S, N. Y.—The Paul Smith's Electric Light & Power Company has been incorporated with a capital stock of $100,000. The directors are Paul Smith, Phelps Smith and Paul Smith, Jr.

NEWBURGH, N. Y.—It is reported that the Cornwall Electric Light & Power Company will sell out to the Newburgh Electric Light, Heat & Power Company. Capt. Thomas Taft is at the head of the Cornwall company.

ALMA, N. C.—The Carolina Electric Company has moved its plant from Maxton to Alma, where fuel is cheaper.

ALBEMARLE, N. C. The Albemarle Light & Water Company is in the market for an outfit for a small electric light plant. R. Smith is secretary.

SPENCER, N. C.—The citizens have voted to issue $15,000 bonds to be used for water works, sewerage, electric lights, street improvements and graded schools.

FAYETTEVILLE, N. C.—Bids are wanted until July 20 for additional improvements to the municipal electric light plant, at a probable outlay of $10,000. W. Thomas Jones is the superintendent. The Finance Committee of the Board of Aldermen has been instructed to sell $30,000 of 5 per cent., 30-year electric light bonds.

FAYETTEVILLE, N. C.—The Cape Fear Power Company, at Buckhorn Shoals, near Fayetteville, will develop about 4,000 horse-power and have the same ready for transmission about August 1.

ASHEVILLE, N. C.—A meeting of the water and light commission will be held to consider the issuing of water bonds, and also $40,000 electric light bonds for constructing a plant on Swannanoa River.

CHARLOTTE, N. C.—The Southern Power Company has been organized in New York City with a capital stock of $7,500,000, to develop large water powers on the Catawba River in North Carolina and upper South Carolina. The new company is organized under the laws of New Jersey, and Dr. W. Gil Wylie, of New York, is president; B. N. Duke, of Durham, N. C., first vice-president; W. S. Lee, of Charlotte, second vice-president and chief engineer. The offices of the company will be in Charlotte, N. C. The first power to be developed will be at the Great Falls of the Catawba, where a plant will be erected costing about $1,500,000.

TOLEDO, OHIO.—The City Council has authorized Frank Consaul, city engineer, to prepare estimates for an electric light plant.

BELLEVUE, OHIO.—The Mutual Light & Power Company has been incorporation by R. F. Bell, C. W. Bell, W. H. Bell, Peter Brady and E. C. Crocker. Capital, $50,000.

CANTON, OHIO.—The Merchants' Heat, Light & Power Company has been formed. Incorporators: T. F. Turner, W. L. Stolzenbach, John Kommel, B. T. Steiner, Charles T. Austin, W. S. Shertzger. Capital stock, $500,000.

KENTON, OHIO.—The Kerlin Brothers Company, Toledo, Ohio, has purchased the plant of the Kenton Gas & Electric Light Company, and is securing estimates on new electrical and steam equipment to cost $50,000, for the improvement and extension of the system.

COLUMBUS, OHIO.—The municipal light plant has commenced to furnish electric current for the lighting of nearly the whole city. Under the new plan, there will be only one stretch in the city not lighted by the municipal plant, this being the distance between the court house and the Union Station in High St., where the arches are still lighted by the merger company. It is the intention to permit the company to continue the lighting of the arches under yearly contract. A number of additional lights will be added to the municipal service, the plan contemplating eventually the use of 1950 lamps.

WAMPUM, PA.—An election will be held in August to vote on issuing $12,000 bonds for a gravity water system, and to equip the borough with electric light, power to be obtained from the Ellwood Power Co., of Elwood, 5 miles distant.

GREENCASTLE, PA.—The Borough Council has passed the ordinance granting Isaac I. Wingert, of Chambersburg, representing the Greencastle Light, Heat, Fuel & Power Co., a franchise to establish in Greencastle an electric light and gas plant.

LANSDALE, PA.—Contracts for rebuilding the electric light plant have been awarded as follows: To the Elm City Iron Works, Erie, Pa., for the steam equipment including one boiler and two engines and all connections; and the Fort Wayne Electric Works, Fort Wayne, Ind., for two dynamos of 125-kw. capacity and switchboard with all equipment and 60 enclosed arc lamps.

CENTRAL FALLS, R. I.—The matter of constructing a municipal electric light plant is to be decided in joint special convention. The probable cost of the plant is $75,000.

GREENVILLE, S. C.—The Council has granted a franchise to the Saluda River Power Co. to string wires and supply electricity in this city for a period of 40 years.

CLARKSVILLE, TENN.—The Consumers Electric Light, Power, Heating & Refrigerating Company has been formed here to construct an electric light plant.

CHATTANOOGA, TENN.—Plans are about completed for the proposed dam and power plant for the Chattanooga-Tennessee River Power Company, to be constructed under the supervision of Maj. Henry C. Newcomer. Work will begin about Sept. 1.

KNOXVILLE, TENN. — In regard to the proposed power plant of the Knoxville Power Co. on Tennessee River, Engineer Jas. B. Cahoon, of New York, states that it will probably not be financed before fall and nothing will be done until then.

LLANO, TEX.—Engineer John W. Maxcy, of Houston, is reported to be investigating the feasibility of constructing a power plant on Llano River, also the construction of an irrigation system.

BRISTOL, VT.—The Lake Dunmore Power & Traction Company, which recently absorbed the Bristol Electric Company, is constructing a steam auxiliary plant and has completed surveys for a large dam to be built about a mile above its present plant on New Haven River. H. W. McIntosh, of Burlington, is the engineer.

RICHMOND, VA.—The Water Commission has adopted the report of the subcommittee endorsing the proposed new electric light plant at the old pump house, to cost, for building, $12,000; for electric pumps, motors, transformers, switchboard, transmission line, etc., $25,000, and for a main between pump house and new reservoir, $52,000.

PORT TOWNSEND, WASH.—John Seiderbaum has petitioned Council for a franchise for a gas, electric light and heating plant.

TACOMA, WASH.—The Fire and Water Committee has recommended the passage of a resolution, authorizing the City Clerk to call for bids, to be submitted by Oct. 1, for the construction of a water-power generating plant of not less than 5000 horse-power and not more than 10,000 horse-power.

NAPANEE, ONT.—The citizens have voted to issue $35,000 bonds for a municipal electric light plant.

ROSSLAND, B. C.—In regard to the development of Upper Bonnington Falls, Ross & Holgate, of Montreal, Que., are the hydraulic engineers in charge. S. A. Campbell, of Rossland, is supervising the electric installation. The contracts for apparatus have been awarded as follows: To the I. P. Morris Company, of Philadelphia, Pa., for water wheels; to the Canadian General Electric Company, of Toronto, for generators and switchboard apparatus, and to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. for the transformers.

The Electric Railway.

BRANFORD, CONN.—The New York, New Haven & Hartford Railroad has acquired the Branford Lighting & Power Company. This company controls the Branford Railway Company, which lines are used from East Haven to Branford by the Consolidated Railway Company. The Branford Lighting & Power Company is capitalized at $600,000, of which only $300,000 has been issued. It has authority to furnish lighting and power, to construct water works and railways. The officers of the company are: President, A. E. Hammer; W. G. Bushnell, of New Haven, vice-president; A. M. Young, A. O. Shepardson, of Waterbury; F. F. Brewster, of New Haven, and F. H. Golding, of Branford.

TAYLORSVILLE, ILL.—Articles of incorporation have been issued to the United States Construction Company to construct an electric railway from Decatur to Quincy. The incorporators and first board of directors are George M. Skelley, John E. Melick, James S. Sutton, Charles F. Bisch and Cyrus Farrow.

PORTLAND, IND.—The City Council has granted a franchise to the Fort Wayne & Springfield Traction Company, to extend its line from Decatur to Portland.

SHELBYVILLE, IND.—The City Council has granted a franchise to Charles L. Henry, president of the Indianapolis & Cincinnati Traction Company, to continue his line through this city to Greensburg.

NORTH MANCHESTER, IND.—The City Council has granted a franchise to the Indiana Northern Traction Company, the choice of three routes into the city being given. The company proposes to build from Wabash to North Manchester, as an extension of its line now in operation between Marion and Wabash.

LAPORTE, IND.—The South Bend Western Railway Company and the Laporte & Michigan City Traction Company, capitalized at $500,000 and $400,000 respectively, have been merged into the South Bend, Laporte & Michigan City Traction Company, with a capital stock of $1,000,000. The South Bend Western Company is now building an interurban line between Laporte and South Bend. The intention is to extend the line northwest to Chicago and east to Cleveland, Ohio.

COALGATE, I. T.—Mr. C. S. Young, representing Eastern capital, has asked the city for a franchise for the construction of an electric railway, to run from here to Atoka, via Lehigh, Phillips and Midway.

SOUTH McALESTER, I. T.—The Choctaw Railway & Light Company was chartered June 27 with a capital stock of $500,000. It will take over the Indian Territory Traction Company's properties, thus preventing the appointment of a receiver asked for by the minority stockholders some time ago. The new concern is controlled by Chicago capital.

BANGOR, ME.—Negotiations are now pending between the bondholders, who recently acquired control of the Penobscot Central Railroad, a 25-mile trolley line from Bangor to Charleston, and the Bangor Railway & Electric Company, which will probably result in the sale of the road within a few days to the Bangor corporation, which owns all the other electric roads in this city and vicinity. The Penobscot Central cost $450,000. It is said the property can now be secured for $75,000.

BALTIMORE, MD.—The contract for the erection of the power house for the United Railways & Electric Company, on Harford Ave., near North Ave., has been awarded to J. Henry Miller.

NEW ORLEANS, LA.—All of the physical property of the New Orleans Railways Company, under recently adopted reorganization plans, was sold at auction July 8 for $3,500,000. Mortimer Buckner, representing the New York Security & Trust Company, was the only bidder. This is the last technicality in the reorganization which reduced the capitalization from $80,000,000 to $60,000,000. The property is an amalgamation of all the street railroads in the city and of the electric light and gas plants.

KALAMAZOO, MICH.—At a meeting of the directors of the new Kalamazoo, Lake Shore & Chicago Railroad the following officers were elected: S. J. Dunkley, president; George E. Bardeen, vice-president; W. R. Beebe, treasurer, and James Grant, secretary.

BENTON HARBOR, MICH.—The Indiana & Michigan Electric Company, of South Bend, has contracted to furnish the Benton Harbor & St. Joseph Electric Railway & Lighting Company 3000 hp of electric energy for operating the street railway and street lighting system of the twin cities.

SAGINAW, MICH.—Articles of incorporation have been filed of the Saginaw & Southwestern Railway Company. The capital stock is $50,000. The line is to extend from Saginaw to St. Johns, a distance of 50 miles. At St. Johns it will connect with the Lansing Suburban Company's line. The directors of the new company are Albert S. Courtright, Lansing; W. G. Emerick, W. S. Linton, Edwin P. Waldron and Charles E. Linton, Saginaw. The business office will be in Saginaw.

GRAND RAPIDS, MICH.—A Grand Rapids Alderman has introduced into the Common Council an ordinance providing for a tax of 50 cents per annum on every street railway pole, electric lighting pole, telephone pole and telegraph pole in the streets of Grand Rapids. He proposes that all the poles in the city shall be painted green, and that stripes of distinctive hues should distinguished the poles of the different corporations. Each pole is to have a separate license, and each is to wear its license number.

BENTON HARBOR, MICH.—Articles of association have been filed by the Kalamazoo, Lake Shore & Chicago Traction Company, heretofore known as the Dunkley-Williams Company. The capital stock is $500,000, and the incorporators are: S. J. Dunkley, E. C. Dayton, W. R. Beebe, Kalamazoo; C. W. Williams, South Haven; George E. Bardeen, Otsego; A. W. Norton, Chicago; George L. Craig, Toledo; J. W. Thompson, Detroit; George F. Arnold, Mackinac Island; Joseph E. Lockwood, Detroit, and James Grant, Kalamazoo.

BENTON HARBOR, MICH.—The Michigan Cold Storage Company, which was to build an electric railway between Benton Harbor and South Haven and erect a cold storage and ice making plant in this city, is tied up because of a break between President Fred M. Steele, formerly owner of the South Haven & Eastern, and Edmund F. Bard, his confidential agent and owner of the property on which the plants were to be built in this city. Work has been stopped and contractors ordered to render an accounting. Suit for $50,000 has been begun against Bard on a note endorsed by Steele, and other suits may follow.

NATCHEZ, MISS.—There is a movement on foot to construct an electric railway through Pike County, connecting Summit and Magnolia.

JEFFERSON CITY, MO.—The Mississippi Valley Electric Railway has been incorporated, with a capital of $650,000. The road will run from Kansas City to St. Joseph, with spurs extending to Leavenworth and Atchison. The length of the road will be about 65 miles. The board of directors will be composed of Charles P. Breen, George B. Tuggle, S. F. Wilson and H. B. McAfee, of Parkville, Mo., and George B. Blanchard, of New York City.

ST. LOUIS, MO.—Business men of St. Louis County have applied for a charter for an electric railway to connect Jefferson City with Valley Park, the route of which will pass through Eureka, Allenton, Pacific and intervening towns. J. F. Sensenbrenner, of Viola Heights, is one of those interested in the movement. M. D. Lewis, of Crescent Station, Dr. I. R. Monroe, of Eureka, and F. Merrylex, of Allenton, are also connected with the enterprise. It is planned to have the line connect with those already existing in St. Louis, while an extension to Kansas City is also proposed.

ST. LOUIS, MO.—The Chicago & Alton Railroad has installed in several of its stations on the St. Louis-Chicago lines an automatic electric device known as the train bulletin. It has the appearance of a large clock, a hand or pointer being moved on a dial, indicating whether the train is on time, or, if not, the number of hours or minutes late. These bulletins are placed in waiting rooms of stations and in the principal hotels of towns through which the company's trains are run. They are controlled by an operator in the depot. All bulletins register precisely similar records at the same instant. Considerable trouble is saved patrons and employes of the road by their use.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has opened a new trolley line from Ridgewood to the Manhattan end of the Williamsburg bridge.

ALBANY, N. Y.—The Auburn & Ithaca Traction Company, of Ithaca, has been incorporated to operate an electric street railway, 40 miles long, from Auburn to Ithaca. The capital stock is $400,000, and the directors are: Sherman Collins, Ithaca; E. B. Mosher and I. P. Hazard, Poplar Ridge.

TICONDEROGA, N. Y.—The Ticonderoga Union Terminal Railroad Company has been incorporated, with a capital stock of $50,000, to operate a street surface road five miles long from the Rutland Railroad at Addison Junction to Ticonderoga. The directors are I. Rothschild, A. B. Adkins and A. H. Weed, Ticonderoga.

NEW YORK, N. Y.—The Interborough Railway Company has filed with the Bureau of Franchises in the Finance Department applications for large extensions of its original routes in Bronx Borough. The action of the Aldermen temporarily prevents the Board of Estimate and Apportionment from acting, but it is probable that in time the company's applications will be granted. The lines are to be operated by the overhead trolley system. The Union Railway Company also has filed applications for extensions covering about 22 miles.

GLEN COVE, L. I., N. Y.—The Glen Cove Railroad Company, which operates a short line, has announced that it proposes to extend its line through several streets in Glen Cove and will also purchase a right of way from private owners for a trolley line to Sea Cliff, which is taken as an indication that the line will eventually reach Mineola and connect with the present system of the New York & Long Island Traction Company, now jointly owned by the Long Island Railroad Company and the Interborough Rapid Transit Company, of New York. Frank L. Fuller, manager of the New York & Queens County Railway Company, with offices in Long Island City, and also manager of the Belmont-Long Island trolley lines, is studying the situation in Nassau County, with the view of developing some of the franchises owned by the company and securing others. It is stated that the New York & Queens County Railway Company will begin this fall to build a line from College Point to Whitestone and Willets Point.

HICKORY, N. C.—The capital of the Hickory Railroad & Power Company has been increased from $125,000 to $300,000.

ASHEVILLE, N. C.—The Asheville & Craggy Mountain Railway Company will soon change from steam to electric power for the operation of the line from Asheville to a point on the French Broad River.

OBERLIN, OHIO.—The Oberlin & Lorain Railway Company has organized, with M. D. Skeels president, W. F. Stanley vice-president, C. R. Summers secretary and W. A. Donaldson treasurer.

NEWARK, OHIO.—A syndicate headed by B. G. Dawes, of Marietta, and M. G. Gillette, of this city, has taken over the property of the Citizens' Electric Light & Power Company of this city.

TOLEDO, OHIO.—The Toledo Railways & Light Company has purchased control of the Toledo & Point Place Electric Railway, which was opened a short time ago. The line is about two and a half miles long.

COLUMBUS, OHIO.—Officials of the Columbus, New Albany & Johnstown Interurban Line will soon award contracts for the extension of the line to Johnstown from its present terminus, Gahanna.

CLEVELAND, OHIO.—The reorganization committee of the Eastern Ohio Traction Company has recommended the sale of the property under foreclosure of the consolidated mortgage and the organization of the Cleveland & Mahoning Valley Traction Company to take over the properties.

COLUMBUS, OHIO.—It is announced that Tucker, Anthony & Co. are working on a plan for the consolidation of the Columbus, Buckeye Lake & Newark Traction Company and the Columbus, Newark & Zanesville Electric Railway. Both properties are owned by the same people and are under practically the same management.

STEUBENVILLE, OHIO.—The Steubenville & Wheeling Traction Company has increased its capital stock from $400,000 to $650,000. The additional capital will be used in changing the route of its line from Steubenville to Mingo Junction so as to avoid heavy grades, and possibly for the extension of the line south from Brilliant.

CINCINNATI, OHIO.—F. E. Seagrave, of Toledo; W. A. Calhoun, T. R. Smith and J. N. Gardner, of New York, are interested in a project to buy the Cincinnati, Georgetown & Portsmouth Railway and the Ohio River & Columbus Railway, the latter a steam road, and then build from Ripley to Aberdeen, where connection would be made with Maysville, Ky. From Maysville they propose to build to Mt. Olivet, Millersburg, Blue Lick Springs, connecting at Paris with the system of the Blue Grass Traction Company, making a continuous line from Lexington, Ky., to Cincinnati.

TOLEDO, OHIO.—The Patrick Hirsh Company, of this city, which is financing the Toledo, Ann Arbor & Detroit Railway, will shortly place contracts for the entire equipment. Contracts for the overhead work and grading have already been closed with the Fidelity Construction Company, of Detroit. The main power station will be located at Petersburg, Mich., for which the following equipment will be purchased: Two 750-hp cross-compound condensing engines with jet condensers, two 550-kw, 370-volt alternating current generators, four 300-h.p. boilers, a self-supporting steel stack, two 40-kw. exciters, and four 300 to 400-kw. rotary converter outfits, with other main station and sub-station equipment. There will also be purchased poles, ties and rails for 42 miles of track, seven passenger coaches, two express cars, one large steel bridge and fifteen to eighteen smaller ones, also equipment for a repair shop.

PITTSBURG, PA.—A charter has been requested for the Peters Creek Street Railway Company. W. G. Weimer, J. E. White and others are the incorporators.

CHAMBERSBURG, PA.—The Chambersburg & Gettysburg Electric Railway Company has decided to extend its system from this place to Greencastle, Middleburg and the state line; also to New Franklin and to Brown's Mills.

New Industrial Companies.

THE BEACON ELECTRIC COMPANY, of Boston, Mass., has been formed; capital, $25,000; president, Bradford L. Ames; treasurer, Fred S. Ashley.

THE SEASIDE ELECTRIC COMPANY, of Seaside, Ore., has been formed, with a capital of $1000. Dan J. Moore, A. S. Froslid and others are incorporators.

THE MERCHANTS' MOTOR COMPANY has been formed in Jersey City; capital stock, $200,000. The incorporators are: Albert H. Overman, Ward B. Chamberlain, Jr., and Albert B. Chamberlain.

THE AUTOMATIC TELEPHONE MANUFACTURING COMPANY has been formed at Augusta, Me., to manufacture telephones, etc.; capital, $200,000. President, L. J. Coleman, Gardiner; treasurer, W. S. Lee, Augusta.

THE ELECTRIC SALES CORPORATION, New York City, has been incorporated, with a capital stock of $10,000. The directors are, H. L. Ferndon, Bergenfield, N. J.; F. H. Cordman and F. P. Reeve, of Brooklyn.

THE AMALGAMATED GAS FIXTURE COMPANY, of New York City, has been incorporated, with a capital of $45,000. The directors are R. R. Allen, Rockaway Beach; Bernard Sobely and Alfred Sear, New York.

THE AMERICAN NON-METALLIC STORAGE BATTERY COMPANY, of Jersey City, has been incorporated, with a capital stock of $125,000. The incorporators are, Edward J. Burt, E. S. Cauldwell and James N. Davis.

THE ESSEX MOTOR CAR COMPANY, of Boston, Mass., has been incorporated with a capital of $100,000. President, Arthur Lovering; treasurer, Lawrence W. Cushman, both of Brookline; clerk, Frank D. Brannon, Cambridge.

THE CRESTMOOR MANUFACTURING & SUPPLY COMPANY, of New York, has been formed to develop mechanical and electrical appliances; capital, $50,000. Directors: R. L. Woolen, W. J. Robinson, New York, and Emma K. Chettle, Brooklyn.

THE NEW YORK COIL COMPANY, of New York City, has been incorporated to manufacture mechanical and electrical devices. The capital stock is $6,000. The directors are H. G. Mears, New York; A. A. Dittmar and William Roche, Jersey City.

THE CENTRAL ELECTRIC LAMP COMPANY has been incorporated at St. Louis; capital stock, $6,000. The incorporators are: Joseph Davey, George S. Johnson and L. A. Davey. The object of the corporation is to manufacture and deal in all kinds of electrical goods.

THE CANADIAN VALLEY ELECTRIC & REFRIGERATING COMPANY, of Holdenville and Weleetka, Okla., with a $100,000 capital stock, has been formed. Charles De Watterville, of Holdenville; M. D. Owen, of Chandler, and C. Porter Johnson, of Oklahoma City, are the incorporators.

THE SCHWAHN ALUMINUM COMPANY, of Belleville, Ill., has been incorporated with a capital stock of $2,500 to carry on a business of manufacturing, smelting, engineering and contracting. The incorporators are H. E. D. Schwahn, William Struthers and Gustave Schwahn.

THE MUNICIPAL OWNERSHIP LEAGUE OF NEW YORK, with principal offices in New York City, was incorporated with the Secretary of State July 8. The directors are J. G. Phelps Stokes, Samuel Seabury, Thomas A. Gilleran, John Palmieri, M. G. Palliser and M. F. Ihmsen, New York.

THE PALMER ELECTRICAL COMPANY, of Bangor, Me., has been organized to transact a general electrical business in the manufacture and sale of the Dyno-battery, etc., with $500,000 capital stock, of which $40 is paid in. The officers are: President, Charles D. Shaw, of Greenville; treasurer, R. M. Palmer, of Cambridge, Mass.

THE NORMAN MANUFACTURING COMPANY, of Hartford, Conn., has been formed by Harry L. McGregor-Norman, Jessie E. McGregor-Norman and Leroy S. Lewis. The capital stock is $25,000. The company will manufacture a new kind of machinery for lighting, heat and power. This will include both electrical and gas apparatus and machinery. Motors will be an important part of the products turned out.

Legal.

CHICAGO LEASES VALID. Judge Julian W. Mack, in the Circuit Court at Chicago, has decided that the leases by which the Union Traction Company controls the street car lines of underlying companies are valid.

NEW JERSEY CORPORATION LAWS.—It has been decided by the New Jersey Court of Errors and Appeals that under the New Jersey corporation laws a company extending its corporate existence beyond the time specified by its original charter must pay the same fees as a new company. The decision was reached in the suit brought by the National Lead Company against Samuel D. Dickinson as Secretary of State, who refused to extend the company's charter for a nominal fee of $20, which, it is claimed, was all that was required. The company deposited $6,000 under protest. The money will be retained by the state.

FIXING TELEPHONE RATES.—The Supreme Court, sitting at Columbus, Ohio, on June 29, in the case of Farmer & Getz and the City of Salem against the Columbiana County Telephone Company, holds that a city cannot demand free telephones for itself nor fix rates. The State, under Sections 3454 to 2471-8, give power to construct lines in streets and public ways and not municipalities. The latter have only the power to agree as to the mode of use, and upon compensation for such use, but not beyond what may be necessary to restore the streets to former usefulness. Where such power to obtain free service and fix rates is attempted the company will not be required to adhere to them by a court of equity by mandatory injunction, even though it be shown that the rates agreed upon and incorporated in the ordinance were so fixed at the solicitation of the company.

Personal.

MR. A. F. RAMSEY, of Crawfordsville, Ind., has been elected vice-president of the New Long Distance Telephone Company, of Indianapolis.

MR. FRANCIS RAYMOND has resigned from the Stanley-G. I. Electric Manufacturing Company, at Chicago, to again engage as a manufacturer's agent.

MR. LOUIS HOLLWEG has been elected president of the Indianapolis Telephone Company and of the New Long Distance Telephone Company, to fill the vacancies caused by the recent death of S. P. Sheerin.

MR. GEORGE R. SELDEN, of Rochester, N. Y., has imported a radium clock from Europe that is receiving a good deal of attention from the press. It is guaranteed to run for 2,000 years, or the money will be refunded.

MR. H. B. SALE, secretary-treasurer of the Indianpolis Telephone Company, has been elected to the position of vice-president and general manager of the same company. Mr. Sale was also elected secretary of the New Long Distance Telephone Company.

MR. ARTHUR WILLIAMS, of the New York Edison Company and first vice-president of the National Electric Light Association, sails this week for Europe for a few months' rest and recreation. While abroad, however, he will look into the municipal ownership situation, a subject in which he is very much interested.

MR. M. B. BEATTIE has resigned his position with the General Electric Company and accepted a position with the Chicago office of the Crocker-Wheeler Co. Mr. Beattie was formerly connected with the power and mining department of the General Electric and had been stationed in its Detroit office.

MR. A. W. PROCTOR has become associated with Rosenbaum & Stockbridge, of New York City, in the practice of patent and trade-mark law. Mr. Proctor is an electrical engineer and an attorney-at-law. For the past seven years he has been an examiner in the U. S. Patent Office, at Washington, and is familiar with the electrical and other arts.

DR. ALBERTO PIRELLI, a member of the well-known house of that name, manufacturers of insulated wires and cables, etc., at Milan, Italy, is now on a visit to this country. Dr. Pirelli was over here last year as a member of the Italian delegation to the electrical congress and made a host of friends. He will spend about a month on this side.

MR. J. C. SLIPPY, of Waterloo, Ia., informs us that he has been placed in charge of the reconstruction of the plant of the Corn Belt Telephone Company (formerly under the United States Telephone Company) and that they will put in a thoroughly modern plant, with an ultimate capacity of 2400. A new building for the exchange will be erected, and about 30,000 feet of cable will be used.

MR. R. D. McGONIGLE, well known as a writer, philanthropist, clubman, lecturer, financier and promoter of sports, was found dead last week in the

Hotel Lincoln, at Pittsburg. He had killed himself with a dose of chloral. He was 53 years old, and a few years ago his fortune was estimated at several million dollars, but he had suffered big losses lately in speculation. He was the founder of the Allegheny Light Company, and was intimately connected with local illuminating interests.

REV. FATHER MURGAS.—An illustrated article appears elsewhere in this issue, describing the Murgas wireless telegraph system. Its inventor, the Rev. Father Murgas, was born in Tajo, Hungary, Feb. 17, 1864. After attending public school for six years, he went to college at Banska Bystrica for four years; then to Pressburg for two years, and Ostrihom for four years. In the latter two years of this he studied theology. He then went back to the first college, Banska Bystrica, for two more years, taking up theology again, and was ordained Nov. 10, 1888. Owing to his great artistic abilities, the Bishop sent him to Buda-Pesth to develop his talent for painting, and then to Munich, Bavaria, in 1889 and 1890. While in Vienna he became a member of the Electrotechnisches Verein, as during all his college life he had taken a great interest in electricity. He came to America in 1896, and has since been able to work to better advantage.

◆

Trade Publications.

EARTHQUAKES. The *Edinburgh Review's* learned and timely article on "Earthquakes and the New Seismology" is reprinted in *The Living Age* for June 24.

HABIRSHAW WIRES AND CABLES.—The India Rubber & Gutta Percha Insulating Company, Yonkers, N. Y., has just issued price-lists for White Core and Red Core wires.

OTTO GAS ENGINE WORKS, Philadelphia, Pa., are issuing excellent trade literature in the shape of a handsome reprint of "Some Reasons Why," being the brochure compiled for visitors to the St. Louis Exposition. It is admirably illustrated and full of good text, briefly put.

THE AITON MACHINE COMPANY has just issued its Bulletin No. 20, showing the three types of vertical stranding machines, for the manufacturing of small wire ropes and light cords. Copies of this bulletin can be obtained at the offices of the company, 126 Liberty St., New York City.

PROGRESS REPORTER.—The last issue of this publication contains an elaborate description of the Angus shops of the Canadian Pacific Railway. Practically all of the large machines were built by the Niles-Bement-Pond Company. Many of these are illustrated and discussed in detail.

MOTOR-CONTROLLING DEVICES.—The J. L. Schureman Company, 70 W. Jackson Boulevard, Chicago, is issuing a comprehensive loose-leaf catalogue devoted to automatic motor-controlling devices. These devices include self-starters, pressure regulators, tank switches, elevator controllers and requisite accessories.

ELECTRICAL SUPPLIES.—The Brode Electric Company, Los Angeles, Cal., has issued a comprehensive general catalogue No. 6, devoted to electrical apparatus and appliances, lighting, railway, house wiring, fire alarm, telephone and telegraph supplies. The catalogue contains 377 pages and is profusely illustrated throughout.

LIGHTING SPECIALTIES.—In a remarkably neat bulletin now being issued the Yost Electric Manufacturing Company, Toledo, Ohio, describes its line of electric lighting specialties, consisting of sockets, rosettes, bushings, shades, etc. The characteristic feature of these specialties is their high quality, which is a little beyond the standard required.

CIRCUIT BREAKERS.—In a well-written bulletin, the Cutter Company, Nineteenth and Hamilton Streets, Philadelphia, presents the arguments from a financial standpoint for the use of a circuit breaker. The advantageous features of circuit breakers in general and the "I. T. E." breaker in particular are pointed out, numerous illustrations serving to make the statements more emphatic.

HIGH-SPEED ENGINES.—In a miniature catalogue recently issued, A. L. Ide & Sons, Springfield, Ill., describe in detail the constructional features of the "Ideal" high-speed engine. The single-expansion engines are made in sizes from 8 to 400 horse-power, and the compound engines from 45 to 450 horse-power. The average efficiency of these engines is stated to be about 97 per cent.

FUSES.—The American Electric Fuse Company, Chicago, has issued a neat little folder containing a report by Prof. J. C. Kelsey, of Purdue University, on the satisfactory performance of a bank of arresters and Kaisling coils. The report states that the uniformity of action, completeness of operation, no sticking at all, ease of handling operated coils and convenience in getting at parts made a good impression.

THE LAMPOON. Under the above title the Sterling Electric Manufacturing Company, Warren, Ohio, is publishing monthly an entertaining little magazine as the "Official Megaphone of the Society for the Prevention of Lost Candle Power and the Promotion of Real, Live, Honest Sterling Light." The publication is filled with well written short stories dealing for the most part with the subject of illumination.

CALCULAGRAPH. One of the most interesting mechanical devices for assisting in the accurate determination of the time spent upon piece work in factories is found in the "calculagraph," which serves to record both the time of beginning work and the elapsed time when the work is completed. The features of this valuable little instrument are outlined in a pamphlet recently issued by the Calculagraph Company, 1425 Jewelers' Building, New York City.

LARGE GAS ENGINES. In an attractive catalogue, the De La Vergne Machine Company, East 138th St., New York, outlines the constructional features and operating characteristics of the Koerting two-cycle gas engine. The catalogue is well illustrated. One of the interesting views shows [illegible] sixteen 2000-h.p. two-cycle gas engines operating blowing engines at the Buffalo works of the Lackawanna Steel Company. These engines operate on blast-furnace gas. A valuable feature of the catalogue is found in the technical discussion of the advantages to be derived from the utilization of blast-furnace gas. In discussing the performance of the gas engine it is stated that under the most favorable conditions the thermal efficiency obtained by the Koerting engine is 38 per cent., based on the indicated horse-power.

ELECTRIC GRINDERS AND BUFFERS. The Northern Electrical Manufacturing Company, Madison, Wis., has recently issued a well illustrated catalogue, designated as Bulletin No. 48, which is devoted to electric grinders and buffers. Each machine consists of an enclosed electric motor on the extended shaft at each end of which is mounted an emery grinder or buffer. The grinders are of special design and construction, including heavy, crucible, tool-steel, armature shafts, liberal bearings and dust-proof covers. The motors are equipped with speed-regulating devices, so that the speed of the grinding and buffing wheels can be varied to compensate for the varying diameters of the wheels.

THE PARKER BOILER. The Parker Boiler Company, Philadelphia, Pa., has issued a descriptive catalogue devoted to its water-tube boiler. The characteristic feature of this boiler resides in the use of tubes without bends, so that any scale which forms can be readily removed. The flow of water is so arranged that the scale is carried downward automatically until the upcast is reached, where the flow is so rapid that it sweeps all before it. The coolest water enters the upper end of the element, where it comes in contact with the coolest gases, and since there is a considerable difference in temperature between the two, there is obtained a transfer of heat which insures a high efficiency.

◆

News of the Trade.

MR. J. B. WILSON, formerly with the Woodill & Hulse Electric Company, Los Angeles, Cal., has opened an establishment in Canton, Ohio, where he will conduct a business of electric wiring, etc.

THE CHANDLER & TAYLOR MANUFACTURING COMPANY, of Indianapolis, Ind., has secured the contract to build and install the 150-hp, high-speed, self-oiling engine in the new power plant in the department store of Mandel Bros., in Chicago.

THE LAFAYETTE ELECTRIC MANUFACTURING COMPANY, Lafayette, Ind., recently incorporated to manufacture transformers under the management of Mr. William H. Hornberger, is about ready for business. The company will manufacture the Hornberger transformer in various sizes for electric lighting and electric railway work. The company has installed its machinery in a large three-story brick building and will have its products on the markets in a few days.

FRANKLIN LAMP CONFERENCE. The usual annual conference of the selling organization of the Franklin Electric Mfg. Co., of Hartford, Conn., was held in that city on June 27, 28, 29, 30, when an enjoyable and useful meeting was had. The list of conferees included C. I. Hills, J. Camp, E. D. Redfield, J. W. Morrell, E. B. Hatch, J. A. Butler, P. S. Klees, G. O. Curtis, C. N. Thorpe, F. E. Wilson, C. Leonard, H. A. Truitt, T. G. Truitt, I. M. Johanson, J. D. Morrell, D. S. Morrell. A banquet was given on the last night, and the regular proceedings were interspersed with sundry entertainments.

FIRE IN DALE FACTORY. A very destructive fire occurred a few days ago in the large building at Ninth Avenue and West Thirteenth Street, in which the factory of the Dale Electrical Company was located. Before the fire could be subdued some forty firemen were badly incapacitated by smoke and back draft. Mr. John Dale had just been taking inventory of his large stock, on which the loss is estimated to have run as high as $100,000. Fortunately, the insurance is ample, and Mr. H. S. Salt, the manager, informs us that the manufacturing plant is already in such shape that they will be turning out goods again in ten days. Of course, they are not yet in shape to make deliveries of orders on hand, but every effort is being made to cope with the situation.

CRANE COMPANY'S FIFTIETH ANNIVERSARY. The Crane Company, Chicago, celebrated its fiftieth anniversary July 4. All of the company's branch house managers took part in the celebration. On Monday the branch house managers went through the Crane Company's factories. In the evening at 7 o'clock they were given a dinner and taken to the "White City." Tuesday morning the managers went to Lake Geneva, Wis., where they were entertained by Mr. R. T. Crane at his summer residence then and the following day. Thursday, July 6, the company gave to all its employes and their families a picnic at Northwestern Park. About [illegible] people attended this picnic. As a souvenir of the anniversary the company is furnishing to any one in the trade a metal elephant, to be used as a paper weight. These elephants may be obtained upon application at any of the branch houses or to the general offices in Chicago.

LIGHTING AND POWER UNITS FOR EXPORT. Even at the present time there are comparatively few concerns in America that build both the engine and the generator. Prominent among these is the B. F. Sturtevant Co., of Boston, Mass., U. S. A. It is certainly a misfortune that its world-wide reputation as blower manufacturer has partially obscured the magnitude of its business in engines, motors and generating sets. In fact, however, the B. F. Sturtevant Co. has for years made a specialty of high speed generating sets, with the engine and generator designed each for the other, and combining maximum efficiency with minimum space and weight; compactness and lightness are particularly essential in machinery built for export. This company now offers the trade no less than thirty-six different sizes and types of such sets, ranging from [illegible] to [illegible] kilowatts. Each is absolutely complete in itself, having engine and dynamo on a bedplate which is common to both. The size and weight of all but the larger sizes are such as to permit of export shipment without separating of parts, so that the machine stands ready for [illegible] as soon as it is unpacked.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 4, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

793,647. CAPACITY; Reginald A. Fessenden, Washington, D. C. App. filed Dec. 14, 1904. (See page 90.)

793,648. RECEIVER FOR ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Washington, D. C. App. filed Dec. 14, 1904. (See page 90.)

793,649. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Washington, D. C. App. filed March 30, 1905. (See page 90.)

793,650. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Washington, D. C. App. filed March 30, 1905. (See page 90.)

793,651. AERIAL FOR WIRELESS SIGNALING; Reginald A. Fessenden, Washington, D. C. App. filed March 30, 1905. (See page 90.)

793,652. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Washington, D. C. (App. filed April 6, 1905. (See page 90.)

793,671. ELECTRIC AUTOMATIC BLOCK SYSTEM FOR RAILWAYS; George H. Lower, Robert H. Lower, Edward P. Lower, Winfrey W. Lee, William B. Lee and Herbert Walker, Hot Springs, Ark. App. filed July 23, 1904. A tappet adjacent to one of the track rails is moved laterally by the passage of a train, and closes a circuit to energize a solenoid and set semaphore to danger. A release magnet is operated by contacts closed at the succeeding tappet in the next block section.

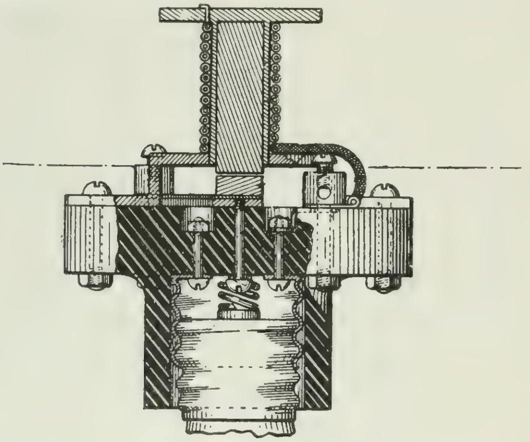
793,718. WIRELESS TELEGRAPHY; Reginald A. Fessenden, Washington, D. C. App. filed March 30, 1905. (See page 90.)

793,754. INSULATION. George A. Weber, New York, N. Y. App. filed Feb. 10, 1903. An insulating bushing for bolts comprising a pair of sheet metal cups which are nested concentrically with one another and include an insulating substance between them.

793,760. ART OF TELEGRAPHY. Marcus O. Anthony, Barberton, O. App. filed Nov. 22, 1902. A transmitting induction coil has windings by which currents are induced in both directions by the make-and-break action of the transmitting key. The alternating impulses pass over a single line wire and are received in a second "step-down" coil of special construction.

793,768. MOTOR CONTROL; Eugene R. Carichoff, East Orange, N. J. App. filed Dec. 8, 1903. An operating circuit produces movements of a main switch operating solenoid core. At one position of the main switch the motor is connected to the supply mains, and at the other position the armature windings are short-circuited through the field coils to energize them with normal polarity so as to produce a magnetic brake.

793,774. MULTIPLE ELECTRIC LAMP HOLDER. Elias L. Elliott, New York, N. Y. App. filed June 5, 1903. A hemispherical cup of insulating material has an annular ring therein to which is attached a pair of the lamp sockets. The third socket is specially connected so that all are in series in normal operation.



793,935.—Lamp Socket.

793,775. FIRE AND BURGLAR ALARM. Peter M. Esser, Chicago, Ill. App. filed Aug. 29, 1904. A cord is led to various points around the dwelling to be protected, and lateral extensions to various points serve to pull the cord and close an alarm circuit when windows or doors are opened. In case of fire the cord burns and another alarm circuit is closed.

793,777. CONDENSER; Reginald A. Fessenden, Washington, D. C. App. filed March 30, 1905. (See page 90.)

793,802. ELECTRIC PROTECTIVE APPARATUS. Frederick R. Parker, Chicago, Ill. App. filed July 9, 1904. A combined lightning arrester and "sneak current" protector in which carbon blocks are included in the circuit and slightly separated so as to leave a jump gap for lightning discharges. A pair of spring circuit closing blades are normally held apart by a thermal protector and serve to short-circuit the line conductors under the action of the sneak currents on the thermal protectors.

793,845. AUTOMATIC TAKE-UP DEVICE FOR TELEPHONE CONNECTIONS. Frank B. Long, Los Angeles, Cal. App. filed Oct. 15, 1904. The telephone receiver is hung on a flexible strap or band in which is embedded the conductor. When released the band is automatically wound on a spring reel. The circuit is made through conducting rings and brushes.

793,848. ELECTRIC CONTROLLER. Charles S. Reno, Covington, Ky. App. filed March 11, 1905. The controller arm contains two cams thereon, one of which closes the motor circuit in either direction, and in such a way as to give a quick make-and-break thereof, while the other cam is effective to cut resistance coils gradually in and out of the circuit.

793,872. SPARK TIGHT BOX FOR ARC LAMPS. Harry Bissing, New York, N. Y. App. filed May 23, 1904. Comprises a sheet metal casing having a wire gauze transparent front, and lateral doors for the inspection of the arc. Switches are provided so that the arc cannot be struck until all of the doors are tightly closed.

793,881. SECONDARY BATTERY; Isidor Kitsee, Philadelphia, Pa. App. filed March 17, 1893.

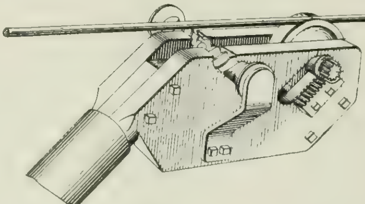
793,897. ELECTRIC SWITCH SYSTEM FOR BLAST FURACES; Robert G. McFarland, Newcastle, Pa. App. filed Nov. 10, 1904.

793,904. INDUCTION MOTOR; William D. Pomeroy, Norwood, O. App. filed Nov. 24, 1903. The rotary windings are initially connected to conductor rings from which the induced current is led through resistances in order to increase the starting torque of the motor. When the motor arrives at full speed a cam is thrown into action which short-circuits the conductor rings.

793,928. TELEPHONE TRANSMITTER; William E. Harkness. Elyria, Ohio. App. filed March 18, 1904.

793,935. LAMP SOCKET; Walter J. Jones, Newark, N. J. App. filed May 24, 1904. A lamp socket for series incandescent lamps in which an exceedingly minute spark-gap normally opens a shunt circuit. When the filament breaks the rise in potential causes the current to jump the gap and energizes a cut-out magnet.

793,936. ELECTRIC PUSH BUTTON; Henry F. Keil, Bronxville, N. Y. App. filed Feb. 27, 1905. A floor push button having certain detail features of construction relating to the cup-shaped casing of sheet metal and the disposition of the contact plates in an insulating plug at the bottom thereof.



794,020. -Trolley Head.

793,941. TELEPHONE EXCHANGE SYSTEM; Edmund Land, Grand Rapids, Mich. App. filed Jan. 23, 1903.

793,952. ELECTRICAL LAMP FIXTURE; Benjamin W. Perrigo, Auburn, N. Y. App. filed Nov. 3, 1904. The insulating ring between the canopy and the ceiling is formed of overlapping sections, any one of which may be replaced when broken or injured without removing the central fixtures.

793,965. TROLLEY; William F. Thompson, Corapolis, Pa. App. filed Dec. 28, 1904. The trolley harp carries a pair of rubber-coated spring hooks which close over the trolley wire, but are displaced laterally to pass an obstruction. The trolley wheel is vertically movable in the harp.

793,969. SWITCH; Ferdinand Volk, Pittsburg, Pa. App. filed Nov. 25, 1904. The trolley wire is supported from a frame which also carries a revolvable commutator or switch. A tappet in the path of the trolley wheel operates a ratchet pawl to step around the commutator and close the switch-operating circuits.

793,971. TELEPHONE EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed April 17, 1903.

793,972. TELEPHONE EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed March 25, 1903.

794,011. ATTACHMENT FOR EXPLOSIVE ENGINES; William B. Hayden, New York, N. Y. App. filed Oct. 22, 1904. The magneto generator is driven from a coil spring which is wound up by a ratchet pawl operated from the engine. A centrifugal governor disconnects the rewinding means when sufficient speed of the generator is attained. The generator may be initially rotated by its spring before the engine starts so as to furnish the starting ignition of the engine.

794,012. ELECTRIC TEMPERATURE ALARM; Cowan P. Hepler, Smithton, Pa. App. filed Feb. 6, 1905. A mercury thermometer has platinum electrodes fused into the glass so that an alarm circuit may be made for any desired temperature in the usual way. A mercury jacket surrounds the platinum to prevent oxidization thereof by the chemicals treated.

794,016. TELEPHONE ATTACHMENT; Frank F. Howe, Marietta, Ohio. App. filed March 2, 1905.

794,020. TROLLEY HEAD; Harry I. Jeffers, Tuscaloosa, Ala. App. filed August 20, 1903. The trolley harp has laterally projecting spirally grooved inclined rollers to guide the wire to central position, and the trolley wheel drops when freed from the wire so that it is in position to again receive the wire when guided thereto by the spiral rollers.

794,022. DRAFT-DRIVEN GENERATOR; William Henry Jordan, Hays, Kan. App. filed March 8, 1905. (See Current News and Notes.)

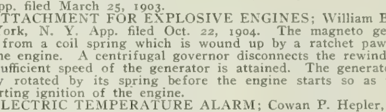
794,086. LIFTING MAGNET; Arthur C. Eastwood, Cleveland, O. App. filed Dec. 27, 1904. Specially adapted for scrap and small cast-iron articles. The magnet is very flat and as widely separated annular pole faces so as to produce a field which extends deeply into the mass to be lifted. The energizing coil is of triangular section for a special purpose.

794,084. METER; Frederick Darlington, Great Barrington, Mass. App. filed Oct. 14, 1904. A copper disc is rotated by clockwork and attains a certain speed under no-current conditions. Series and shunt damping magnets in the circuit to be measured slow down the rotation of the disc and the current is calculated from the amount that its rotation is arrested.

794,116. TELEPHONE ATTACHMENT; Valentin Rebhun, Schaghticoke, N. Y. App. filed Oct. 17, 1904.

794,125. SERVICE METER FOR TELEPHONE LINES; Charles E. Scribner and James L. McQuarrie, Chicago, Ill. App. filed July 16, 1900.

794,134. TELEPHONE SWITCH; Klas Weman and Henry Melvin Bascom, New York, N. Y. App. filed Oct. 16, 1903.



794,086.—Lighting Magnet.

794,135. INDUCTION MOTOR; Edwin C. Wright, Newport, Ky. App. filed Nov. 24, 1903. A form of induction motor in which the windings are short-circuited after the motor arrives at normal speed by means of three brushes which are moved into short-circuiting relation by three sprocket wheels operated by a single sprocket chain and cam.

794,137. TELEPHONE RECEIVER; Theodore C. Brecht, Washington, D. C. App. filed Sept. 22, 1902.

794,142. TELEPHONE SWITCHBOARD; Eugene Darnell, Carrollton, Mo. App. filed April 30, 1904.

794,140. SOCKET OR RECEPTACLE PLUG; Louis J. Costa, Philadelphia, Pa. App. filed April 16, 1904. A lamp socket for exposed positions in which a rubber packing washer is clamped into packing relation when the socket parts are screwed together so as to exclude damp and moisture from the metallic surfaces.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, JULY 22, 1905 No. 4.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................1139 Monadnock Block
PHILADELPHIA OFFICE....................929 Chestnut Street
CLEVELAND OFFICE....................402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for 1905 to date,* **404,500.**

NEW YORK, SATURDAY, JULY 22, 1905.

CONTENTS.

Editorial 125
Electrical Contractors' Convention in Boston.................... 128
The Electrical Engineer in Heavy Electric Traction.................... 128
Feed Water, Heaters and Pumps.................... 128
An Engineering Congress at the Portland Exposition.................... 129
Indiana Telephone Associations Merge.................... 129
Tesla on the Peary North Pole Expedition.................... 130
Dealing with Travel Problems in London.................... 130
Steam Consumption of Curtis Turbines.................... 131
Western Union and Racing Service.................... 131
A Westinghouse Denial 131
Calcium Carbide in France.................... 131
Current News and Notes.................... 132
Electrical Engineers of the Times.—XIX. Prof. C. P. Matthews.................... 134
A Norwegian Hydro-Electric Plant. By C. Smith.................... 135
Design of the Telefunken System. By A. Frederick Collins.................... 136
Electrical Features of the Portland Exposition.................... 138
Terminals and Distribution Boards in Telephone Exchanges. By Arthur V. Abbott, C. E. 140
Electrical Features of the Elks' Carnival at Buffalo.................... 144
New Telephone Patents.................... 144
LETTERS TO THE EDITORS:
Scott on Single-Phase Traction. By John Whitehouse.................... 144
Electrolytic Wave Detectors in Wireless Telegraphy. By W. R. Carroll 145
Digest of Current Electrical Literature.................... 146
Book Review 148
Opening of the International Electrical Exhibition at Boston.................... 149
Equipment for New Plant of the New York Edison System [illegible]
Radial Arm Crane Controllers.................... 154
Railway Type Circuit Breaker for Direct Current Uses.................... [illegible]
Water-Tight Floor Outlet.................... 155
Industrial and Commercial News.................... [illegible]
General News of the Week.................... [illegible]

DIRECTED WIRELESS IMPULSES.

At brief intervals the secular press brings reports of sensational improvements in wireless telegraphy which we usually pigeonhole as "important, if true," a category which still lurks in our sanctum in spite of the all-pervading tendency to publish as fact and deny afterward if necessary. This time it is a report from abroad laid at the door of Dr. Braun, and charging him with a device to secure directive action in wireless sending so that the message goes to its intended destination and nowhere else. If such action could be secured it would be of great importance both in preventing interference and in economizing energy. But until the modus operandi is made public we can form very little idea as to the probable truth of the report. Of course, electric waves of all lengths can conceivably be reflected so as to produce the effect of a searchlight streaming invisible rays into space. But one cannot produce directed reflection save from surfaces of dimensions large compared with the wave length, and up to the present time the wave lengths required in wireless telegraphy over any considerable distance have been so long as to make reflection practically out of the question. Moreover, even could one conveniently reflect waves many meters in length, it is a question whether the concentrated beam thus formed would be effective at distances so great as to make the curvature of the earth an important element of difficulty. It is possible also to check by absorption waves in undesirable directions, but even so there would be rather waste than saving of energy, and the shielding would be only partial at best. Directive action, like syntonism, may perhaps be attained in time. At present both these desiderata are difficult of attainment. Syntonism depends on securing closely selected wave lengths and using receivers capable of very close tuning. Inasmuch as for long-distance work it seems desirable to use waves as long as the practicable length of antenna permits, the working limits of wave length are too narrow to make syntonic selection within them easy. So far, syntonism is generally claimed and very little applied. If a receiver of extraordinarily great sensitiveness to short waves is devised, it will greatly assist both directive and syntonic working, unless difficulties of wave absorption should develop seriously as the wave lengths are diminished.

THE ELECTRICAL PROPERTIES OF AIR.

Much interesting and valuable information concerning the behavior of air when subjected to electrical stress has been brought forward as a result of relatively recent investigations. It will be recalled that up to within the last few years the resistance of air to rupture under the stress produced by electromotive force was tacitly assumed to be dependent upon the distance apart of the electrodes, and the shape of the terminals. In fact, the striking distance in air between needle points furnishes to-day, perhaps, the most reliable method for determining the maximum value of high electromotive forces for testing purposes. A modifying condition upon which due emphasis has only recently been placed is found in the fact that for a given voltage and a certain shape of terminals the striking distance varies largely with the pressure and temperature of the air. Experimental investigations have shown that the dielectric strength of air is closely proportioned directly to the absolute pressure and inversely to the absolute temperature; that is, it varies directly with the density. The knowledge of this fact has led to the belief that compressed air would serve as an excellent insulator for transformers. The numerous disadvantages attending the use of air under pressure in a transformer case are well pointed out by Prof. H. J. Ryan in an article which appears in abstract in the Digest for this issue.

An instructive deduction can be obtained from the facts reported by Prof. Ryan. If one assumes a cylinder with insulating walls in which travel two conducting pistons so arranged as to be gas-tight with the side walls, then the electromotive force which can be applied between the two pistons, when there is a certain amount of air in the cylinder, is in all respects independent of the distance separating the pistons. This relation holds true even when the cylinder is subjected to extremes of temperature. It appears that the real dielectric strength resides in the particles of air confined within the cylinder. Since, under otherwise similar conditions, the capacity of a plate condenser varies inversely with the distance separating the plates, it would seem that by using compressed air as an insulator the plates can be brought correspondingly closer together and the capacity thereby increased. As indicated on page 90 of our issue for July 15, Prof. R. A. Fessenden has made use of this fact in the construction of condensers for wireless telegraphy. A valuable property of air under pressure is reported by Prof. Fessenden, who states that above a certain pressure, apparently varying with the structure (but generally above 60 pounds per square inch), all static discharges with accompanying loss of energy, which may amount to 50 per cent in air at ordinary pressures, seem to disappear entirely, and that there is no dielectric hysteresis. No statement is made by Prof. Fessenden as to any variation in the specific inductive capacity of the dielectric with change in pressure of the air, and one is led to assume that the value remains unity under all conditions, as has previously been held. If this latter assumption is correct, then that property of the dielectric which is referred to as the capacity is not a function of the density or arrangement of the particles of the air, but is a function merely of the dimensions of the space between and around the electrodes. That is to say, the evidence at hand would seem to indicate that the so-called specific inductive capacity of air is in reality a property of the ether, while the dielectric strength is a property of the air itself. The evidence on these points is far from conclusive, and further experimentation is desirable. No satisfactory explanation has as yet been offered for the existence of the relatively increased dielectric strength of the surface films of air, nor for the relative decrease in the dielectric strength with abnormal increase in the density of the air, which facts have been ascertained experimentally. At the Asheville meeting of the American Institute of Electrical Engineers, Dr. Steinmetz stated his intention to present later a paper dealing with the dielectric strength of air at various densities and for exceedingly high voltages, and giving a discussion of the source of the strength of air. We look forward with much pleasure to the appearance of this paper, and hope that a similar paper dealing with the specific inductive capacity of gaseous media will soon be forthcoming.

SURGING IN ALTERNATING SYSTEMS.

We cordially advise our readers to make a prayerful study of Dr. Steinmetz's Institute paper on the destructive surges encountered some two years ago on the Manhattan Railway system. The damage done was so serious and the possible damage to successful operation so formidable that nothing short of a complete understanding of the situation could produce any feeling of future security. Fortunately the case came up to Dr. Steinmetz, and he has gone so thoroughly into the theory of the matter as to leave little more to be desired. It is the first time within our knowledge that the theory of a concrete case of formidable surging has been worked out in detail. The general theory of resonance has been more or less often discussed, but generally upon the incorrect assumption that it is to be regarded as occurring upon a circuit in substantially normal condition. Surging, which may be regarded as a special case of impelled resonance, has been studied mainly in its altogether minor effects at switches and the like. We have repeatedly called attention to the primary importance of grounding, and accidental crosses, upon this class of phenomena, and of such action the instance studied by Dr. Steinmetz furnishes emphatic confirmation. Broadly, the accident was the grounding of a large cable in a system of large capacity and enormous output. The result was a tremendous surging of relatively low frequency accompanying the periodic arc from the damaged cable, with dangerous rises of potential that broke down insulation and turned over new parts of the system to destruction.

The most important thing to which Dr. Steinmetz calls attention is the independent existence of three co-operating frequencies in case of trouble on a transmission system. First is the generator frequency providing the impressed e.m.f. This includes, of course, the usual odd harmonics. Second comes the natural period of the circuit, depending on its constants, also with its harmonics, sometimes of considerable amplitude. And third, comes the frequency of the circuit disturbance itself, which depends strictly upon the character of the disturbance and may have a very high value with correspondingly great power to break through insulation. Its importance arises mainly from the fact that it may break the way for dangerous accessions of energy. A very abrupt wave front traveling along a circuit may pile up potential enough to jump long air-gaps and the like, and then the trouble begins. These impulsive e.m.f.'s form what is popularly known as "static," which may also include resonance of higher harmonics and the like. In this Manhattan accident the fundamental frequency of the final surge in the system as a whole was determined to be 270. The instantaneous short-circuit value of the surging current was as great as 9,000 amperes, and the pressure of the oscillation was 68,800 volts per phase, or 119,000 volts between lines, a pressure of itself quite capable of most disastrous effects. A surge like this once started with the whole power of the station behind it was quite certain to wreck things extensively, as it indeed did. It produced a voltage rise to more than ten times the normal value, and had something like 70,000 kw to draw upon for destructive energy.

Phenomena like this are to be sharply distinguished from all ordinary resonance in circuits, for they depend not upon the normal frequency of its harmonics, but upon conditions impressed upon the circuit by casualties. In this instance the trouble started with sparking between a cable conductor and ground, followed by arcing, with the phenomena of surging in its train. Similar occurrences on a much smaller scale are familiar on power transmission circuits, resulting in considerable accessions of potential, the destruction of lightning arresters and other protective devices, and occasionally in injuries to larger apparatus. The larger the capacity of the system, the greater the chance for a surge of low frequency that is not easily damped out of mischief. The lower the resistance, too, the less the surges will be checked, and finally the greater the volume of the surge the higher the e.m.f. of oscillation, so that we are here dealing with conditions which are especially severe in case of very large stations. And it is generally true of such electrical oscillations that systems dealing with currents of large volume at relatively moderate voltage are in greater danger of encountering serious conditions than are high voltage stations in which the volume of current is small and insulation strength is of necessity planned to withstand normally large pressures. It does not take a sensational arc to ground to start mischief from surging—the blowing of a fuse, the sudden opening of a circuit-breaker, the failure of a lightning arrester, may all induce violent electrical oscillations, the result of which may be disastrous. On overhead systems there is far less likelihood of trouble than on underground ones, fortunately, and the cushioning effect of long lines of relatively large resistance and inductance is very great. But there are many stations in which there is abundant opportunity for trouble, and surging often unrecognized is doubtless the cause of numerous unexplained troubles. Dr. Steinmetz has done an excellent work in putting on record the complete discussion of so striking a case, and we hope that it will lead to a more careful and systematic study of these abnormal oscillations, and to means for their amelioration.

Discussion on the St. Louis Congress.

The June number of the *Journal* of the Institution of Electrical Engineers recently issued contains a full record of the discussion in that body of the report by Mr. W. Duddell upon the International Electrical Congress of St. Louis. This discussion had previously been published in this country in abstract only. The views elicited from such prominent physicists as Lord Rayleigh, Profs. Ayrton, Thompson, Glazebrook and others are of great value. They also reveal the great difference in mental attitude of the physicist and the engineer toward a large subject like electrical units and standards, as discussed at St. Louis. The physicist aims to have the standard concrete units as nearly correct as possible, according to their theoretical definition, and leaves the details of the mechanism for issuing reliable working copies of those standards to competent electricians in laboratories. The physicist seeks to know the precise length of a square millimeter mercury wire which shall embody the ohm, considered as one hundred millions of c.g.s. units of resistance in electromagnetic measure. Or he seeks to know as nearly as possible the electrochemical equivalent of silver. Or, again, he seeks to know the precise value of the e.m.f. of a standard cell in absolute electromagnetic units, when the cell has been constructed of chemically pure materials according to definite specifications. But he prefers that the standardization of such knowledge, and its application to the issue of secondary standards by national laboratories should be taken up by other persons. From the physical standpoint this is all eminently correct. The precise values of standard voltages, currents and resistances in absolute measure are of the greatest scientific importance.

On the other hand, the engineer is indifferent to any reasonably small discrepancy in the assigned value of these physical magnitudes. He cares but little whether the e.m.f. of a standard Clark cell at 15° C. is 1.433 or 1.434 international volts. He is almost indifferent whether the electrochemical equivalent of silver is 1.118 milligrams per coulomb, or 1.119. Again, he is not much concerned as to whether the length of a square millimeter mercury column at 0° C., embodying one billion c.g.s. units of resistance, is 106.28 centimeters or 106.29. But he is vitally interested in the uniformity of standards, and he is likely to be much concerned if a certain Clark standard cell at 15° C. is declared to be 1.4328 international volts in Berlin and 1.434 international volts in Washington. He is likely to complain if the electrochemical equivalent of silver is accepted at 1.118 with one kind of coulombmeter in London and with another kind in Paris if the two kinds lead to slightly different values on a certificate of calibration. He is likely to be perplexed if the standard ohms of two different countries differ appreciably. As regards the standard ohm, everyone admits that there is no sensible difference between the values maintained in the principal standard laboratories of the world, and consequently the engineer is content with his ohm. If it should be found that the concrete standard ohm is slightly inaccurate, considered as one billion absohms, the engineer would prefer that the concrete primary standards should not be changed; but that the small correction should be made numerically by physicists when making measurements of high precision. The international ohm should be kept as it is, if possible.

As regards the electrolytically measured ampere, the engineer does not care, for he never makes such electrolytic determinations. That is in his judgment a matter for the physicist. If the standard ampere of the national laboratories is based on electrolytic equivalent, then he asks that the same value shall be used everywhere. The device which the engineer uses, in common with standardized resistance coils, is the standard cell. At present, if he sends that to one national laboratory, he is likely to have its numerical value in volts reported slightly different from that at other national laboratories. This discrepancy actually exists. The engineer does not care which value is right; but he does care if that value differ by an amount which, although small, is capable of producing a commercially appreciable difference in dealing with high-efficiency incandescent lamps. It was to overcome this difficulty and to establish, if possible, complete accord between the working concrete standards of the different countries, that the St. Louis Congress voted in favor of the appointment of an international commission.

It is a matter for some surprise that several speakers in London eulogized the Giorgi system as a solution of the hiatus between the theoretical and practical electrical units. The Giorgi system virtually makes the practical ampere-volt-ohm system into a fundamental system after first modifying the values of the dielectric and magnetic constants of the ether. This displaces the c.g.s. system from use in electromagnetics. Before we can do this, we need new textbooks restating the laws of electromagnetics in the m.k.s.o. (metre-kilogramme-second-ohm) system. This change would have to be made internationally, either by definite promulgation, or by tacit common consent, in order that the change might become effective. If this were done, however, the plan might succeed, and the hiatus between theory and practice in the matter of electrical units would thus disappear. The disadvantages would be that the density of a substance would no longer be equal to its specific gravity in terms of water, and also that electromagnetism would be divorced, as a quantitative branch of science, from other branches, which would continue to work in the c.g.s. system. In other words, unless other branches of science also join in the m.k.s.o. system the hiatus which now exists exclusively in electromagnetics between theory and practice, will be merely shifted from this locality to the boundary between electromagnetism and the rest of the scientific world. For example, the electric resistivity of copper is today expressed in ohm-centimetres among practicians. In electrical theory it is expressed in absohm-centimetres; i. e., in the c.g.s. system. The thermal resistivity of copper is also expressed in the c.g.s. system as a matter within the science of heat. If, however, electricians could all adopt the m.k.s.o. system, the electric resistivity of copper would be measured and expressed in ohm-centimetres, both as a matter of practice and as a matter of theory. But the thermal resistivity would probably go on being expressed in the c.g.s. system. If there were no crossing between the departments of heat and electricity, if there were a permanent barrier between these two branches of science, it would not be a serious matter to have the c.g.s. system in general science, and the m.k.s.o. system in electromagnetism. But all science must be one and the same, fundamentally. Every year makes one branch depend more upon others, and it is against the spirit of the age to make artificial difficulties by incursions or excursions among the different branches. The need for complete uniformity of methods, treatment and measurement is likely to be felt more and more as progress continues.

Electrical Contractors' Convention in Boston.

The National Association of Electrical Contractors held its annual convention in Boston this week, beginning Wednesday, July 19. The convention was accompanied by a large exhibition in Mechanics' Building, where also the sessions were held. As the proceedings are conducted with closed doors and the convention is in session at this writing there is nothing of interest to report as to what was done. The intense heat has interfered with a very large attendance, but there were 173 delegates registered and 263 guests—supply men, exhibitors, etc. The New York contingent arrived on a special train under the conduct of Mr. Alec Henderson, master of transportation, some thirty being on board and a very pleasant trip being made. The dinner of the association was given on Wednesday night, but the attendance was limited to members of the association only. On Thursday the association and registered guests go on a trip to Nantasket Beach by boat and dine at Wade's Nantasket Point Hotel.

Elsewhere a very full and complete illustrated account is given of the exhibit, with the names of the participants and their representatives.

The Electrical Engineer in Heavy Electric Traction.

The July issue of the Proceedings of The Engineers' Club, of Philadelphia, contains an interesting paper by Mr. William McClellan, on the subject indicated by the title above, which discusses the engineering features involved in the substitution of electricity for steam on railroads. The author calls attention to the fundamental difference between steam and electric systems, with reference to power conditions. The steam unit is well contained and independent of the other units. In the electric system, however, the power which must be available at each point depends upon the maximum units which may be massed at that locality. This condition dictates that before construction begins, the required capacity of the road, its train service, etc., must be more or less accurately determined. With steam traction, it is possible to transfer locomotives in any number desired to points where the traffic becomes congested. In this respect the steam road has a flexibility not possessed by the electric system. To this fact may be attributed the conservatism that has prevailed in advising a change. In the selection of the electric equipment for a given road careful consideration must be made of the question of motor temperature. This is a feature that is entirely absent from steam railroad practice. If the locomotive will give the required tractive effort at the required speed, it will do the work. If it is overloaded, even to being stalled, no harm is done. Not so with the car motors. Continued overloads, or even what is called normal load, if the gear-ratio be improperly chosen, will cause the temperature in the coils to rise to a point at which the insulation chars.

The paper contains descriptions of the dynamometer cars of the Pennsylvania and Illinois Central railroads and of the air-resistance car used by the Louisiana Purchase Test Commission. Only by means of such cars can there be obtained reliable data upon which to base calculations for the electric equipment required for a given service. The author discusses the various factors which enter into the determination of the power required, under the heads of grades, curves, braking, mechanical friction, wind resistance, translational and relational inertia. There are available innumerable formulas for expressing the value of the train resistance. Each formula is subject to the criticism that it has been derived from special conditions of some sort, and it will not answer for general work. Our definite knowledge seems to be that with properly shaped cars, the train resistance for single cars up to nearly 100 miles per hour will not greatly exceed 30 pounds per ton, and that a comprehensive formula, when found, will be of the form:

$$R = A + BV + CV^2$$

where A is a factor depending chiefly on journal conditions, B is a factor depending chiefly on rail conditions, and C is a function of train weight and formation.

The striking point in connection with the discussion of this whole problem is the great lack of data. With increase of acceleration, especially with frequent stops, many features of train problems become relatively more important. The limit to acceleration is the comfort of the passenger. A passenger does not complain much of a little jolting at the beginning and end of an hour's run, but the occurrence of the same thing every five minutes is likely to be resented. The criticism has been made that steam roads and locomotive builders never did have, and have not yet the facilities for the same kind of elaborate experimental work that has been done by the great electrical companies. This is probably true, but they had not previously needed the information in the same way that it is now needed. The fact is that no real progress will be made until adequate data have been collected. The cry is now going up for data in central station work, in lighting, everywhere, but nowhere is the need greater than in electric railway work.

Feed Water, Heaters and Pumps.

The request, "Please give a formula for boiler compound for water in which there is a heavy lime deposit," in the "Question Box" of the N. E. L. A., received three responses. Two of these advocate the use of washing soda in conjunction with kerosene oil, the proportion being a bucketful of soda to two gallons of oil for a 100-hp boiler. The third suggests 40 pounds caustic soda, 40 pounds soda ash, 35 pounds liquid hemlock, 15 pounds gambier dissolved in hot water to make one barrel of dissolvent. Of the thirteen replies received to the query, "Which is preferable—to treat the water before it enters the boilers, or to use a high-fire kerosene and mechanical cleaner?" twelve indicate that the former method is preferable, while one recommends that, if the plant is large enough to warrant the expense of a chemical purifier, one should be installed. The replies to the question, "Does not kerosene oil, being itself a condensation from a still, vaporize before any benefit is derived when fed into working boilers to prevent scale?" are seemingly contradictory. The consensus of opinion, however, is that while the use of oil is attended with fair success other and better methods can be found. Ten replies to a question concerning the location of the heaviest deposit of magnesia within a boiler, are common in that all agree that the greatest precipitation is produced at the point of highest temperature. Of the three remedies proposed for keeping feed water pipes clear of scale where the water is exceptionally full of magnesia carbonate, two involve the treatment of the feed water, while the third would allow the scale to form and remove it from time to time.

The answers to a question concerning the advisability of using a heater between the engine and the condenser would leave one in great doubt as to the proper plan to adopt, there being nine positive, five negative and four neutral replies. To the query, "Is it good practice to turn exhaust from station auxiliaries into an open-type, feed-water heater?" the 12 replies would indicate that an open-type heater accumulates the oil, thus making poor water to feed to the boilers and, therefore, if the practice is followed, an oil separator should be used. The advantages of the open type of heater for large plates are stated to be that it returns the condensation to the boiler, thus saving water and lessening the deposit of scale, and it is easy to keep clean, thus insuring good efficiency, while the advantage of the closed type of heater is that it avoids the possibility of oil being carried into the boilers. Two replies to the query, "What is the life of a hot water meter when run continuously in full capacity?" indicate that the meter develops an error of five per cent within ten days, and that the life is about eight months. Although two of the replies to a question concerning the benefit of an air chamber on a boiler feed pump express doubt as to any benefit, the others agree that the air acts as a cushion for the surging water due to the action of the pump, and prevents a water hammer in the feed pipes. In regard to the method of driving auxiliaries a correspondent states that "in a non-condensing plant the motor-driven boiler feed pump is doubtless the most economical form that can be employed. Centrifugal feed pumps have hardly had sufficient use to demonstrate their reliability. If motor-driven pumps are used one steam-driven pump or injector should be installed for use when the generators are all shut down. In turbine plants steam-driven auxiliaries will be the more economical up to the point where all the exhaust steam can be condensed in heating the feed water. Beyond that point motor-driven auxiliaries should be used." The eleven replies to the query "We have a heater, purifier and feed pump which delivers the water to the boilers at 206° F. Is this fairly economical?" agree that the performance is very good.

An Engineering Congress at the Portland Exposition.

Pacific Coast and Northwest electrical development has received a marked impetus from a congress of Pacific Coast electrical and mechanical engineers just held in Portland. It is the first meeting of this kind, and will probably be followed by other congresses on occasions of inter-state importance like the Lewis and Clark Fair. The first congress was originated by Milnor Roberts, professor of civil engineering in the University of Washington. The participants were members of the Pacific Northwest Society of Engineers, Seattle; the Technical Society of the Pacific Coast, San Francisco; the Pacific Coast Electrical Transmission Association; the Montana Society of Engineers; the Washington Chapter of the American Institute of Electrical Engineers; delegates numbering in all over 200. There were large delegations from Seattle, Spokane, Tacoma, Los Angeles and San Francisco. Oregon has a rapidly growing colony of electrical engineers, and all were active in assisting to make the first Portland congress a success. Geo. Perley Low, of San Francisco, who is a Portland man, and was elected president of the Pacific Coast Electrical Transmission Association at this meeting, came from California with an excursion party of delegates that filled three Pullman cars.

The convention was called to order at 10 o'clock a.m., Thursday, June 29, by H. W. Goode, president of the Lewis and Clark Exposition, who is also president of the Portland General Electric. For permanent chairman the congress elected Geo. W. Dickie, of San Francisco, president of the Technical Society of the Pacific Coast; and Prof. M. Roberts for secretary. The business affairs of the congress were placed in charge of an executive committee composed of Messrs. Low and Roberts, and Franklin Riffle, of San Francisco.

The congress met in two sections, a general congress section and an electrical transmission section, and meetings were held in the parlors of the American Inn, in the exposition grounds. There were addresses of welcome by Mr. Goode, Geo. P. Low, Frank W. Hibbs, president of the Northwest Society of Engineers, and Geo. W. Dickie. Before the joint session Thursday morning papers were read as follows: "The System of the Portland General Electric Company," by F. G. Sykes, general superintendent; "Water Power as a Factor in Industrial Development," by Charles H. Baker. member Pacific Northwest Society of Engineers.

The electrical transmission session, Thursday afternoon, listened to the following papers: "The Engineering Features of the Exposition," by J. R. Thompson, electrical engineer Lewis and Clark Exposition; "Engineering and Commercial Features of the Lewiston-Clarkston System," by Allen E. Ransom, electrical engineer of the Lewiston-Clarkston Company, Clarkston, Wash.; "Expositions as Engineering Educators," by G. H. Patten, of the General Electric Company, Portland headquarters; "Single-Phase Railways," by M. P. Randolph, of the Westinghouse Electric & Manufacturing Company, Seattle.

On Friday the electrical transmission section heard papers on these topics: "The Value of Sawdust as Fuel," by O. B. Caldwell, operating Superintendent Portland General Electric; "On the Cost of Irrigation by Electrically Driven Pumps, from Transmission Service," by W. W. Wheeler, superintendent of the Northern California Power Company, Redding, Cal.; "The Cedar River Plant of the City of Seattle," by J. D. Ross, assistant engineer, Seattle; "Report of Progress Editor," by F. A. C. Perrine, New York; "Wrinkles," by R. W. Van Norden, superintendent Central California Electric Company, Sacramento; "The Question Box," by C. A. Copeland, consulting electrical and mechanical engineer, Los Angeles, Cal. The association elected the following officers for the ensuing year: President, Geo. P. Low, editor Journal of Electricity, Power and Gas, San Francisco; vice-president, H. H. Sinclair, of the Edison Electric Co., Los Angeles; secretary, S. G. Reed, treasurer Portland General Electric Company.

On Saturday the congress went on an excursion to The Dalles of the Columbia River, accompanied by Portland engineers and officers of the U. S. engineering corps in charge of river improvements. Sunday the delegates attended a steamer excursion on the Willamette River to the falls at Oregon City, to inspect the hydro-electric plants of the Portland General Electric. Monday they went in a special train furnished by the Oregon Water Power & Railway Company to Cazadero, to examine the dam on the Clackamas River under construction by that company. The Californians in attendance at the congress went to Seattle, Tacoma, Snoqualmie and Electron, Washington, to look at power and lighting plants. At Snoqualmie they were unfavorably received, the general superintendent of the company refusing them admission to the plant. They were compensated for the trip to Washington by the reception given them by H. F. Grant, manager of the Seattle Electric Company. He took them over the lines about Seattle, and over the interurban to Tacoma, in a special palace car, and entertained them with luncheon at the Rainier Club. The tourists were eloquent in praise of Mr. Grant's hospitality

Indiana Telephone Associations Merge.

An important meeting of telephone men representing the independent telephone interests of Indiana was held July 12 at Winona, at which was formed the "Indiana Independent Telephone Association." It is the purpose to merge the Indiana Mutual Telephone Association and the Southern Indiana Telephone Association into the new association. About seventy-five telephone men attended the meeting, which was called to order by Theadore Thorward, president of the Indiana Mutual Telephone Association, to devise ways and means to best protect the independent properties against the new plan of attack by the Bell Company. He said the necessity was present for a closer organization; that the organizations they now have are nothing more than social gatherings with nothing in them but good fellowship and a good time. He suggested a plan for a close district organization all over the state that would combine all the independent companies in the districts with iron-bound contracts calculated to protect large and small companies against the common enemy as well as against each other. He also suggested the formation of a strong financial state institution to look after small or struggling companies to avoid their falling into the hands of the Bell company.

A committee on organization reported back to the meeting a preamble, constitution and by-laws for the new organization, which were adopted. The plan includes the formation of district associations, which are to be represented in state meetings by delegates. Each district president will be a vice-president in the state organization. The organization was perfected by electing George W. Beers, of Fort Wayne, president, and C. S. Norton, of Indianapolis, secretary-treasurer, and the following district vice-presidents: First district, Theadore Thorward, South Bend; second district, W. L. Moellering, Fort Wayne; third district, W. J. Uhle, Logansport; fourth district, O. P. Frerbing, Lafayette; fifth district, Thos. A. Bromley, Jr., Muncie; sixth district, Charles R. Duffin, Terre Haute; seventh district, W. W. Mendenhall, Indianapolis; eighth district, A. C. Lindermuth, Richmond; ninth district, W. C. Curil, Petersburg; tenth district, C. D. Knoefel, New Albany; eleventh district, W. R. Swarthout, Rising Sun. Following the organization a warm discussion was had concerning the eligibility to membership of companies that have entered into toll line arrangement with the Bell Company. It was generally insisted that such companies should not be admitted, but the matter was deferred until the next meeting.

President J. B. Hoge, of the National Independent Association, was present and rendered material assistance in organizing the new association. Mr. Hoge said he was gratified over the movement in Indiana, for it meant that the fighters of the telephone "trust" were thus brought into a more compact body in this State, but let the Indiana men join hands with the independent associations of Ohio, Michigan and Wisconsin and other States, as well as get into closer relation with the National Association.

Mr. Charles S. Norton said there was no cause for alarm; that independent telephony was never so prosperous as at present. He said independent companies were in favor everywhere, and that only two or three had passed to the control of the Bell Company. The total of Indiana independent telephones is 166,255, and 100,333 of them have connection with independent toll lines.

Other speakers said that their business is growing faster than they could provide for it. They also commended the new association and said its aggressive membership would be the means of still greater expansion of the independent telephone business in Indiana. At the close of the meeting the delegates became the guests of Walter Scott, superintendent of the Warsaw Commercial Telephone Company, in a boat ride around the lake.

Tesla on the Peary North Pole Expedition.

The New York *Sun* of July 16 prints the following letter from Mr. Nikola Tesla:

Everybody must have been pleased to learn that Commodore Peary has finally obtained the financial assistance which will enable him to start without further delay on his important journey. Let us wish the bold navigator the most complete success in his perilous undertaking, in the interest of humanity as well as for his own and his companions' sake and the gratification of the generous donors who have aided him. But, while voicing these sentiments, let us hope that Peary's will be the last attempt to reach the pole in this slow, penible and hazardous way.

We have already sufficiently advanced in the knowledge of electricity and its applications to avail ourselves of better means of transportation, enabling us to reach and to explore without difficulty and in a more perfect manner not only the North, but also the South Pole, and any other still unknown regions of the earth's surface. I refer to the facilities afforded in this respect by the transmission of electrical energy without wires and aerial navigation, which has found in this novel art its ideal solution.

Many of your readers will, no doubt, be under the impression that I am speaking merely of possibilities. As a matter of fact, from the principles involved and the experiments which I have actually performed, not only is the practical success of such distribution of power reduced to a degree of mathematical certitude, but the transmission can be effected with an economy much greater than possible by the present method involving the use of wires.

It would not take long to build a plant for purposes of aerial navigation and geographical research, nor would it cost as much as might be supposed. Its location would be perfectly immaterial. It might be at the Niagara, or at the Victorian Falls in Africa, without any appreciable difference in the power collected in a flying machine or other apparatus.

A popular error, which I have often opportunity to correct, is to believe that the energy of such a plant would dissipate itself in all directions. This is not so, as I have pointed out in my technical publications. Electricity is displaced by the transmitter in all directions, equally through the earth and the air; that is true, but energy is expended only at the place where it is collected and used to perform some work. To illustrate, a plant of 10,000 hp, such as I have been planning, might be running full blast at Niagara, and there might be but one flying machine, of, say, 50 hp operating in some distant place, the location being of absolutely no consequence. In this case 50 hp would be all the power furnished by the plant to the rest of the universe. Although the electrical oscillations would manifest themselves all over the earth, at the surface as well as high in the air, virtually no power would be consumed. My experiments have shown that the entire electrical movement which keeps the whole globe a-tremble can be maintained with but a few horsepower. Apart from the transmitting and receiving apparatus, the only loss incurred is the energy radiated in the form of Hertzian or electro-magnetic waves, which can be reduced to an entirely insignificant quantity.

I appreciate the difficulty which your non-technical readers must experience in comprehending the working of this system. To gain a rough idea, let them imagine the transmitter and the earth to be two elastic bags, one very small and the other immense, both being connected by a tube and filled with some incompressible fluid. A pump is provided for forcing the fluid from one into the other, alternately and in rapid succession. Now, to produce a great movement of the fluid in a bag of such enormous size as the earth would require a pump so large that it would be a greater task to construct it than to build a thousand Egyptian pyramids. But there is a way of accomplishing this with a pump of very small dimensions. The bag connected to the earth is elastic, and when suddenly struck vibrates at a certain rate. The first artifice consists in so designing and adjusting the parts that the natural vibrations of the bag are in synchronism with the strokes of the pump. Under such conditions the bag is set into violent vibrations, and the fluid is made to rush in and out with terrific force. But the immense bag—the earth, is still comparatively undisturbed. Its size, however, does not exempt it from the laws of nature, and just as the small bag, so too the earth, responds to certain impulses. This fact I discovered in 1899.

The second artifice is to so adjust the transmitter that it will furnish these particular impulses. When all is properly done the large bag is thrown into spasms of vibration, and the effects are bewildering. But no power is yet transmitted, and all this colossal movement requires little energy to maintain. It is like an engine running without load.

Next let your readers imagine that at any place where it may be desired to deliver energy a small elastic bag, not unlike the first, is connected to the large one through a tube. The third artifice consists in so proportioning the parts that the attachment will be responsive to the impulses transmitted, this resulting in a great intensification of the vibration of the bag. Still the pump will not furnish power until these vibrations are made to do work of some kind.

To conduce to an understanding of the fourth artifice, that of "individualization," let your readers follow me a step further, and conceive that the flow of energy to any point can be controlled from the place where the pump is located at will, and with equal facility and precision, regardless of distance, and, furthermore, through a device such as the combination lock of a safe, they will then have a crude idea of the processes involved. But only when they realize that all these and many other processes not mentioned, and related to one another like the links of a chain, are completed in a fraction of a second, will your readers be able to appreciate the magical potencies of electrical vibrations and form a conception of the miracles which a skilled electrician can perform by the use of these appliances.

I earnestly hope that in the near future the conditions will be favorable for the construction of a plant such as I have proposed. As soon as this is done it will be possible to adapt electrical motors to flying machines of the type popularized by Santos Dumont. There will be no necessity of carrying a generator or store of motive energy and consequently the machine will be much lighter and smaller. Owing to this and also to the greater power available for propulsion, the speed will be considerably increased. But a few of such machines, properly equipped with photographic and other appliances, will be sufficient to give us in a short time an exact knowledge of the entire earth's surface. It should be borne in mind, however, that for the ordinary uses of a single person a very small machine of not more than one-quarter horse-power, corresponding to the work of two men, would be amply sufficient so that when the first plant of 10,000 hp is installed, the commodity of aerial flight can be offered to a great many individuals all the world over. I can conceive of no improvement which would be more efficient in the furtherance of civilization than this.

Dealing with Travel Problems in London.

Dispatches from England state that the royal commission appointed in February, 1903, to inquire into the means of locomotion and transport in London has issued its report. It declares that everybody knows that the existing means are seriously defective. It adds that improvement is imperatively necessary in the interests of public health and convenience, for the prompt transaction of business, and to render decent housing possible.

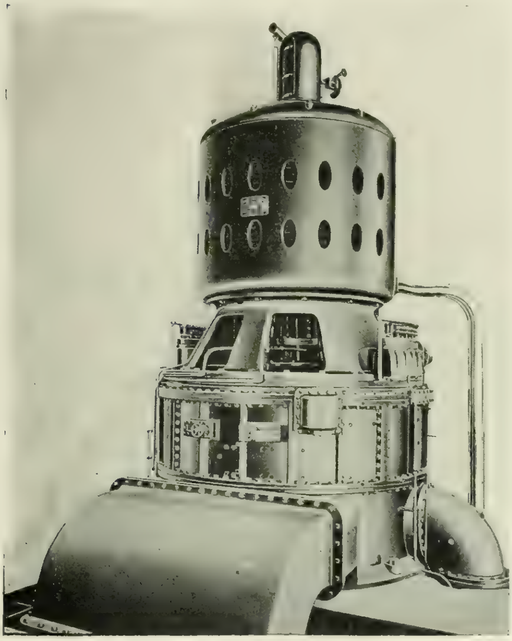
The narrowness of the streets lies at the root of the problem of surface locomotion. The commissioners recommend the widening of many important thoroughfares, and what is one of the most striking points of their whole report is the construction of two great avenues, one running east and west, four and three-quarters miles long, and the other running north and south, four and a quarter miles long. Each avenue would be 140 feet wide, with four tramway tracks on the surface and four electric railway tracks underground. The commissioners apparently regard this somewhat as the counsel of perfection, at any rate for the present, for the estimated cost is from £25,000,000 to £30,000,000. Nevertheless, they strongly urge this plan if it is found to be financially practicable.

In dealing with tramways the report remarks that the existing tramway mileage is quite insufficient and is conspicuously inferior to that of American, European and provincial English cities. It recommends a large extension and the linking of various systems. More railways also are needed, and they should be, if necessary, aided by the local authorities. Shallow subways are regarded as preferable to deep laid tubes, although the former in some cases are admitted to be impracticable. The opinion is expressed that motor omnibuses will never take the place of tramways.

The construction of the two avenues and the carrying out of the commission's other recommendations would be enormously expensive. The commissioners recognize that this will prevent the adoption of an ideal scheme, but in view of the apparent fact that the metropolitan population will reach 11,000,000 in the near future they declare that the utmost possible ought to be done, and they urge the creation of a permanent body to deal with the question.

Steam Consumption of Curtis Turbines.

The accompanying table gives results of tests made by Mr. Frederick Sargent and Mr. Louis A. Ferguson on a 2,000-kw steam turbine generating unit of the Curtis type. The turbine is a four-stage machine designed in 1903, and recently changed in a few particulars as a result of experiments conducted during the past year. The machine as tested conforms as nearly as possible to the standard four-stage machines now being produced, but is less efficient because the changes which have been made have been confined to the buckets, while several other important changes, which are now known to be desirable, could not be made in this case without entirely rebuilding the machine.



TURBO-GENERATOR.

TESTS OF CURTIS TURBO-GENERATOR.

Load, ratio to full value	4/4	3/4	1/4	0/4
Duration of tests, hours	1.250	0.916	1.000	1.33
Steam pressure (gauge), lbs	163.3	170.2	155.5	154.5
Back pressure (absolute) in. of hg	1.40	1.40	1.45	1.85
Superheat, deg. F.	207.	120.	204.	156.
Load in kilowatts	2023.7	1060.7	555.	00.
Steam consumption per kw.-hour	15.02	16.31	18.09	1510.5*

*Total pounds of steam per hour.

All of the instruments were carefully tested and standardized during the trials, the electrical instruments being checked at the New York Testing Laboratory. The surface condenser showed practically no leakage. Every precaution was taken to make the tests reliable and accurate.

Western Union and Racing Service.

After a meeting last week of the executive committee of the Western Union Telegraph Co. the following statement was issued:

Whereas, this company under an order issued by its president on the 18th day of May, 1904, has directed the cessation of the collection of horse-race reports; and, whereas, it is claimed that the distribution of horse-race reports still continues notwithstanding the action of this company first referred to,

Be is resolved, that it be recommended to the board of directors that the officers of the Western Union Telegraph Company be directed to cease the transmission of any messages containing horse-race reports, except where such messages are delivered to a regular office of the company for transmission to and delivery through a regular office of the company, or for delivery in such other manner as the president of the company shall authorize over his signature.

A Westinghouse Denial.

Mr. George Westinghouse issued last week the following denial of a statement that the Westinghouse interests were going extensively into the operation of trolley lines in competition with some of the large railroad systems:

"Mr. Westinghouse's attention having been called to an article in one of the morning papers, he said that he deemed it important to at once deny the statement that there was any Westinghouse scheme to go into the business of building electric railways parallel to or in opposition to steam railways, which statement he characterized as an attempt of unfriendly interests to prejudice the managers of railways against the Westinghouse interests. As to the other statements in the article in question, Mr. Westinghouse sees no occasion to comment on them."

The "other statements" had it that John F. Wallace, who recently resigned as Chief Engineer of the Panama Canal to accept a "$65,000 offer" from somebody whose identity is still undisclosed, was going to be identified hereafter with the Westinghouse interests. Mr. Westinghouse, when pressed for an answer on this point, would make no comment. A friend of his said, however: "Mr. Wallace has been named for almost everything, and it isn't strange that they are coupling him up with Mr. Westinghouse now. Mr. Westinghouse could deny it, but he won't. He prefers not to say anything on the subject."

Calcium Carbide in France.

Mr. Robert T. Skinner, U. S. Consul General at Marseilles, makes an interesting report to the Department of Commerce and Labor on calcium carbide and acetylene in France. He says: "The principal centers of the calcium carbide industry in France are in the Alps and the Pyrenees, particularly in the environs of Bellgarde, Grenoble, Nice and Toulouse. At present there are 11 manufactories capable of producing 40,000 tons of calcium carbide annually. The demand is far from corresponding to the means of production, and the total output sold during 1904 may be closely estimated at 18,000 tons.

"The average yield of gas per unit of weight of carbide is 300 liters (79.25 gallons) per kilogram (2.2 pounds). There appears to be no market rate, properly speaking. The French manufacturers are completely protected against importations by the Bullier patent, and manufacturers of carbide and acetylene have reached an understanding whereby an average price has been established which enables both industries to exist. The manufacturers of carbide are said to lower their prices every time they are able to do so without inconveniencing themselves.

"The merchandise is packed, according to the wish of the buyer, in metallic cans of 100, 65 or 50 kilos (220, 143, or 110 pounds) capacity, or, in case of shipment for exportation, in wooden cases lined with tin. Sales are controlled by the Société Commerciale du Carbure de Calcium, with headquarters at 2 rue Blanche, Place de la Trinité, Paris. This company has a capital of 2,200,000 francs ($424,600) and has been chosen by the eleven producing concerns as the selling agent for the entire country.

"The cost price of a ton of calcium carbide in Europe was estimated by Professor Lefevre, professor at the School of Sciences at Nantes, in 1897, at from 200 to 250 francs ($38.60 to $48.25). There was nothing then, so he stated, to indicate the probability of these figures being sensibly modified. M. Pictet, however, in the same year thought that the product might be made at a price of 82 francs ($15.82) by the use of a new furnace.

"It is said, however, that in 1904 the production was disposed of at $38.60 per ton."

CURRENT NEWS AND NOTES.

MILAN EDISON COMPANY'S LOST BONDS.—According to a Milan, Italy, dispatch dated July 13, the Edison Company has discovered that bonds have been stolen from it to the value of $240,000. A former clerk is under arrest, charged with the robbery.

COLORADO CONVENTION.—The annual convention of the Colorado Electric Light, Power & Railway Association will be held at Glenwood Springs, Col., September 18, 19 and 20. Mr. George B. Tripp, of Colorado Springs, is secretary, and expects a large gathering. Action may be taken to include States surrounding Colorado.

MORE NEWFOUNDLAND CABLE.—The Commercial Cable Company has agreed to lay 200 miles of deep sea cable for the colonial government, to connect the island with Canso, Nova Scotia, where the Commercial Cable Company's cables and land lines will afford communication with the rest of the world. The new cable is to be laid by September.

UNIDIRECTION WIRELESS.—A special cable dispatch from Berlin, Germany, of July 12 says: "An important improvement in wireless telegraphy is announced by Prof. Braun, of Strassburg, the inventor of the system which bears his name. The professor has succeeded in sending wireless electrical waves in a single direction. Up to now it has been possible only to transmit waves in all directions. Much energy is saved by the new invention." We make editorial reference to this dispatch on page 126.

ELECTRIFYING LAKE SHORE.—A special dispatch from Toledo, Ohio, of July 17, says: "Officials of the Lake Shore & Michigan Southern Railway say that the visit of W. K. Vanderbilt to this city recently was in regard to the advisability of installing an electric service on the Detroit & Toledo division of the line. It is said that Mr. Vanderbilt has decided the plan is feasible and that it will be put in operation at once. The initial steps in this plan will be confined to the freight business at first. It is impossible for the steam roads to compete with the electrics on short hauls in this region owing to the cheapness of electricity for motive power."

LIGHTING AT COLUMBUS, O.—The report of the sub-committee of the committee which is investigating the municipal electric light plant cost of operation shows that the lamps of the municipal plant have cost the city $98 a year. The city pays $74.50 for lamps lit by private lighting companies. The report covers a period of four and a half years, and the plant is branded as a "monstrous extravagance." In the time covering the report the committee shows that the total cost of maintenance was $75,360.52, interest on bonds $18,171.13, and the estimated depreciation is placed at $40,000, making a total expenditure of $133,531.65. At this price it cost the city $98.91 a year for the maintenance of each lamp. The report does not cover the new system in operation, but an investigation of this also is expected to follow.

WAGES FOR BEGINNERS.—The General Electric Company, which is looking for apprentices at its West Lynn factory, in response to inquiry, announces the following salaries: To graduates of high schools only—drawing office apprenticeship course, $5.33 per week for first six months, $6.30 per week for second six months, $7.28 per week for third six months, $8.25 per week for fourth six months, $9.22 per week for fifth six months, $10.67 per week for sixth six months. There will also be a bonus of $75 distributed if the three years of service have been satisfactory. Shop apprenticeship course, $4.48 per week for first six months, $5.60 per week for second six months, $5.72 per week for second year, $7.84 per week for third year, $9.24 per week for fourth year; bonus of $100 at expiration of term if services have been satisfactory. For high school students and grammar school graduates—shop apprenticeship course—$3.36 per week for first six months, $4.48 per week for second six months, $5.60 per week for second year, $7.00 per week for third year, $8.40 per week for fourth year; bonus of $100 at expiration of term if services are satisfactory.

THE CHICAGO TUNNEL.—Messrs. E. C. Shankland, John M. Ewen and Louis Ritter are the three engineers who have been appointed by Commissioner of Public Works Patterson, of Chicago, to investigate the Illinois Tunnel Company's undermining of the city's streets and to determine the danger to the downtown structures and the sinking of the streets reported to be due to the tunnel company's bores. The engineering commission will begin its work at once. The expense of the investigation is to be borne by the corporation under the provisions of the ordinance which requires that the company shall pay for all examinations of its work.

SIERRAS POWER PLANT.—A statement has been published that the Southern Pacific Company has an engineering force at work investigating sites along the Truckee River, between Truckee and Verdi, for the purpose of installing a monster electric power plant. The plant, it was said, would furnish power for boring a five-mile tunnel through the Sierra Nevada Mountains. General Manager Calvin says: "Nothing is being done on the tunnel project at present, and the company is not looking for any site for the power plant on the Truckee River or elsewhere. I understand that other interests are at work on a power project up there, planning to supply electrical power to some of the big Nevada mines. The Southern Pacific has no interest in it whatever."

LONG ISLAND ELECTRIC TRAINS.—The first electric train on the Long Island Railroad was run on July 18 from Woodhaven Junction to Flatbush and back. Two round trips were made for the purpose of testing the clearances of the contact shoes on the third rail. This is the first practical test of the new electric equipment, on which the road is spending $40,000,000. This week also a train of five cars will make a trial trip to Rockaway Beach, and it is expected that by the first of next week electricity will take the place of steam on the whole Rockaway Beach division. General Superintendent C. L. Addison and Electrical Superintendent L. S. Wells were in charge of the trial run, which was considered a very satisfactory one. A speed of thirty-five to forty miles an hour was maintained without difficulty on the elevated portions of the track.

TELEPHONY IN CANADA.—The Canadian Parliamentary Telephone Committee last week heard the evidence of A. L. Tetu, Nashville, Tenn., secretary of the National and the Interstate Telephone Associations. He testified as to the competition between the independent and Bell systems. He did not think the time had come for government ownership of telephones and telegraphs, but did think the government should impose restrictions in franchises forbidding competing companies to self out to one another. A local system with antiquated equipment should bring its apparatus up-to-date before being admitted to a long-distance service. He knew of any number of cases where farmers enjoyed telephone service at $15 a year. In a city of 20,000 a fair rate would be $30 for business and $18 for residence. Mr. Ware also testified as to independent conditions in Michigan. He believed in government ownership of long-distance lines, but not of local exchanges.

PREVENTION OF SPARKING IN DIRECT-CURRENT MACHINES.—Having observed that in order to neutralize the demagnetizing effect of the armature current upon the field it is necessary to place the brushes on one side of the neutral point, while for non-sparking conditions it is necessary to place the brushes on the opposite side of the neutral point, D. Balachowsky and P. Caire have devised a scheme involving the use of brushes in both positions, for which a patent was granted on July 11. Thus, for a two-pole armature there would be four brushes, two positive and two negative. One positive brush is placed ahead of the positive neutral point, while the other is placed behind the positive neutral point, these two brushes being joined directly together. A similar disposal is made of the two negative brushes. The positions of the brushes are so chosen that the e.m.f. in the coils in front of the neutral line is greater than that of the coils behind. The magnetizing action of the current which flows in the local brush circuit due to the difference of these e.m.f's is in a direction simultaneously to strengthen the field magnetism and to assist in the prevention of sparking. The inventors state that it is possible thus to render the machine compound or overcompound, or even to obtain a machine operating without windings on the field magnets.

FREIGHT IN CHICAGO.—The Chicago City Council has granted to the Metropolitan Elevated electric road the right to carry freight and express, for ten years.

AUTOMOBILE SHOW IN MILAN.—An interesting show, largely made up of national exhibits of automobiles, cycles, etc., is being held in Milan, Italy. There are three exhibits of American cars.

A CITY ELECTRICIAN.—The office of city electrician has been created for Bath, Me. This functionary is to have very full powers over all electrical work done in the vicinity, under the guidance of a joint committee on electrical appliances, consisting of the mayor, president of council, two aldermen and three members of the common council.

DR. GISBERT KAPP has accepted a professorship in electrical engineering at the University of Birmingham and has resigned as general secretary of the German Association of Electrical Engineers and as editor of the *Elektrotechnische Zeitschrift.* His successor as general secretary is chief engineer Georg Dettmar, and his successor as editor of the *Elektrotechnische Zeitschrift* is Mr. E. C. Zehme.

LONG DISTANCE TRANSMITTER.—A Sioux City dispatch says: M. L. Marrett and E. W. Preston, two Sioux City electricians, after years of work, have applied for a patent upon a telephone transmitter that will enable persons to talk 3,000 miles without the necessity of having messages repeated every 500 to 600 miles. Two electric magnets are placed quite close to the disc of the ordinary telephone and this magnifies the sound, and extra wire around the induction coils beside the magnets does away with sputtering. In several trials the voice was heard perfectly over a resistance equal to 3,000 miles of wire.

INSTEAD OF THE BARBER.—Advices from Paterson, N. J., state that telephones on barber chairs are the latest innovation there and so popular is the plan that before long it is expected other barbers in the city will have telephones installed. The barber shop in the Romaine Building is the only one, it is believed, in the United States which can boast of having telephones on its chairs. Through them it is possible for a business man, while being shaved, to hold constant communication with his office. The barber in charge says that he put in the telephones as an experiment, and he has been congratulated by several of his customers, who are unanimous in their opinion that, while the plan is a novel one, it is soon to become popular in other places.

ELECTRICAL EXHIBITION AT KIEV, RUSSIA.—United States Consul Thomas E. Heenan, Odessa, Russia, reports that an electrotechnical exhibition will be held at Kiev in 1906. The ministry of finance will permit the importation of the latest appliances and inventions in the realm of electrotechnical science for purposes of exhibit under the following rules: (1) The exhibition committee must deposit security to the amount of customs duty according to the tariff, which will be returned when the goods are re-exported, which must take place not later than three months after the closing of the exhibition; (2) the goods are to be exported by way of the same custom houses through which they entered Russia. It is probable that this exhibition will take place at Easter, 1906.

VOLTAGE REGULATOR.—A simple form of regulator for governing the field strength of generators is disclosed in a patent granted July 11 to Mr. P. M. Lincoln. In series with the field coil of the generator is connected a resistance which is periodically short-circuited. The novel features of the present patent reside in the means employed for varying the relative time when the resistance is in circuit and when it is shunted. There is provided a continuously rotating cylinder formed in two segments connected separately to the ends of the resistance, and separated by insulation, the form of which is such that an arm makes contact with one or the other segment throughout a definite proportion of each revolution of the cylinder according to the position of the arm. The arm is governed in position by an electromagnet whose strength depends upon the voltage of the generator. By means of this device the time-average amount of resistance in series with the field magnet winding of the generator may be maintained such as to insure a substantially constant voltage on the line.

OPERATING WITHOUT GOVERNORS.—The entire great network of transmission lines in the vicinity of Salt Lake City, operated by the Utah Light, Power & Railway Company, in parallel with the Telluride Power Transmission Company, is now being operated without governors on the water wheels. This is made possible by the great fly-wheel effect of the armatures of the generators, motors and rotary converters connected with the system and the great size of the system. Fluctuations of load at any one point are so small compared with the total load of the system and the combined fly-wheel effect is so large that governors have apparently been rendered unnecessary.

STUDYING FOREIGN CONDITIONS.—Chairman Barker, of the Massachusetts Gas and Electric Commission; Commissioner George and Special Commissioner Cotter will sail from Boston for England August 1 for the purpose of investigating the sliding scale of gas prices as operated in London with a view to having the same introduced in the Boston gas field. The three commissioners will be abroad about five weeks and will also undoubtedly visit the municipal plant at Glasgow as well as those at Sheffield, Liverpool and other cities. The special commission must report its findings to next year's legislature. Expenses of the trip amounting to $1,800 have been approved by Governor Douglas and his council.

DETECTOR FOR ELECTROMAGNETIC WAVES.—A patent issued July 11 to W. S. Hogg relates to a sensitive decohering detector for use in wireless telegraphy. The detector employs the thermo-electric power changes which occur between microphonic contacts of dissimilar thermo-electric materials. There is used a comminuted mixture of nickel and zinc with selenium between terminals consisting of a fine platinum wire and a steel plug. The selenited material forms a strong thermo-electric couple with the platinum wire; the platinum wire has a small capacity for heat, so that its temperature changes quickly with the oscillating currents. The detector is placed together with a telephone receiver in one of the arms of a Wheatstone bridge.

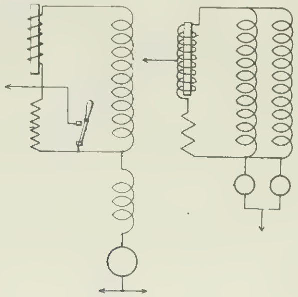
WIRELESS TELEGRAPH STATIONS.—One of the Stone wireless telegraph stations has been set up at Appledore Island, Isles of Shoals, off the New England coast. Appledore has been connected with the main land at Portsmouth, N. H., some ten miles distant, by cable, but the cable has never, it is said, worked satisfactorily and hence for the last two or three years the Island has been cut off from communication with the shore. Some little time ago, the proprietors of one of the Appledore hotels made overtures for the erection of a Stone plant, so that they could get into touch with the Government system at the Portsmouth Navy Yard. The plant was put up accordingly by the Stone Telegraph & Telephone Company, and is now working very satisfactorily. On July 11, for example, one press message of 295 words and another of 87 words went through very nicely. The Stone system is now to be installed at the Portsmouth Yard, and also on the collier *Lebanon,* which when in readiness will be sent out from the yard as a "derelict destroyer."

LAWSON ON MUNICIPALISM.—Mr. Thomas W. Lawson has now given out his views on and against municipal ownership. At a Jefferson Club dinner in Chicago he said: "You think, some of you, that the solution of our troubles is in municipal and federal ownership of our public utilities," said Mr. Lawson. "I hate to oppose your optimistic impression that in the people's administration of the railroads and gas companies lies the panacea for our deep-rooted troubles. Before I left home I was asked not to disturb the nation's new, glowing hope that in this way safety lies. I was asked to take the presidency of a national league for political ownership which is being organized, but I must be true to my convictions and I must not temporize with the facts as I know them. Municipal ownership is a will-o'-the-wisp. The idea it is circulated among the people to keep them out of mischief. It is a rattle and a rubber ring for the country to play with. If Rogers and Rockefeller and other frenzied financiers were starting over again they would ask nothing better than to begin in a world in which all the banks, railroads and manufactories were in the hands of the government, because they could steal them easier, quicker, cheaper and more safely from elected authorities than from individual owners."

IN MEMORY OF THURSTON.—Students of Sibley College, Cornell University, have ordered designs made for a $1,500 bronze tablet, which they will erect in memory of the late Dr. R. H. Thurston, formerly Director of Sibley. The tablet is being designed by Prof. H. S. Gutsall, of the College of Architecture, and will be erected in a stone niche of the new Thurston Hall of Engineering, now in process of construction.

POLARIZED ELECTROMAGNETIC WAVES.—A solution of the problem of limiting the direction of transmission of waves from a wireless telegraph station is proposed by A. Artom, of Turin, Italy, in a patent issued July 11, 1905. To obtain the desired result the inventor employs aerial conductors arranged symmetrically with respect to the predetermined direction in which the electrical transmission is to take place, so that they form a downwardly open angle with one another of 90°, each of them being inclined 45° to the horizontal. These aerials consist of lattices of parallel conducting wires. At the rear edge of the aerials are placed secondary pieces that act as screens and prevent the backward transmission of the waves and cause the waves for the greater part to radiate in the desired direction of transmission. It is stated that this form of aerial reinforces circularly and elliptically polarized electromagnetic waves, at the same time radiating these waves in only the desired direction, and thus produce a narrow bundle of rays. The production of the polarized waves is not explained.

ALTERNATING-CURRENT MOTOR USED ON DIRECT-CURRENT CIRCUITS.—When a series-wound motor is operated by alternating current, it is desirable that the ampere-turns in the field winding should be relatively low, but when it is operated by direct current the magnetomotive force of the field current should be much higher in value. In order to provide means for automatically changing the value of the ampere-turns in the field magnet winding of a motor when a change in the supply of energy is made from direct current to alternating current, and vice versa, Mr. B. G. Lamme, according to two patents issued July 11, would place in combination with the field coils suitable arrangements of resistances and reactances so as to allow a greater value for the ampere-turns in the field magnet winding when the motor is operated by direct currents than when it is operated by alternating currents. The methods employed are indicated in the accompanying illustration.



In one of these methods the field winding is divided into two parts, in parallel with one of which is placed a series circuit containing resistance and reactance. The current is introduced in the series circuit at such a point that when the current is unidirectional the major portion of it flows through both field windings, while when it is alternating only a small part of it flows through the shunted section of the field coil, as shown in the illustration. According to another method the inventor places in parallel with the whole of the field winding a series circuit containing a resistance and an inductive winding. The current is introduced at a point along the inductive winding so chosen that the proper proportion of alternating current is forced to pass through the resistance and directly to the armature, while the greater relative value of the resistance allows only a small part of any unidirectional current to flow therethrough and forces the greater portion to pass through the field coil. The diagram indicates this arrangement when two motors are operated simultaneously, the field windings being connected in parallel with each other, and the armatures being also connected in parallel with each other.

Electrical Engineers of the Times.—XIX.

PROF. C. P. MATTHEWS.

Charles Philo Matthews was born at Fort Covington, N. Y., Sept. 18, 1867. He received his primary education in the schools of his native town and entered St. Johnsbury Academy, St. Johnsbury, Vt., in 1885, from which he was graduated in 1887. After a year in business he entered Sibley College, Cornell University, and was graduated with the degree of M. E. in 1892. In 1901 he received the degree of Ph. D. from Cornell, the subject of his Doctor's thesis being "On Certain Photometric Apparatus and the Results Therewith Obtained."

Since 1892 Prof. Matthews has been engaged chiefly in teaching physics and electrical engineering, but during vacation periods, and to some extent during term time, has engaged in various kinds of engineering work. The summer of 1892 was passed at the works of the Rockford, Ill., Manufacturing Company; the summer of 1902 in the National Bureau of Standards at Washington, and the winter of 1903-1904 in the Electrical Testing Laboratories of New York City. From time to time he has acted as consulting engineer, chiefly on matters in connection with electric lighting. From 1892 to 1896 he was instructor in physics and applied electricity at Cornell University, and in the latter year went to Purdue University, Lafayette, Ind., as associate professor of electrical engineering. In 1902 he became professor of electrical engineering at Purdue, and upon the resignation of Professor W. E. Goldsborough was made director of the School of Electrical Engineering of that university.

PROF. C. P. MATTHEWS.

Prof. Matthews was for four years photometrist for the committee of the National Electric Light Association, appointed to determine the photometric values of arc lamps, during which time he directed all the experimental work and designed the apparatus wherewith to carry it on. These reports, which cover over 200 pages and represent a vast amount of labor, appear in the transactions and contain the most valuable collection of data on the subject of arc lamp photometry in existence. Prof. Matthews is the patentee of an integrating photometer for determining the candle power of incandescent lamps and other sources of artificial light, which instrument is largely used in laboratories and received a gold medal from the Louisiana Purchase Exposition. He is joint author of several books, as follows: "A Laboratory Manual of Physics and Applied Chemistry," written in collaboration with Prof. Edward J. Nichols; "Problems and Questions in Physics," in collaboration with Prof. J. S. Shearer; "Electrical Laboratory Notes," in collaboration with Prof. J. W. Esterline. He has contributed a number of papers to the Transactions of the American Institute of Electrical Engineers as follows: "The Action of Continuous and Alternating Currents on Fuse Metals" (1893); "Standard of Light" (Nichols, Sharp and Matthews, 1896); "The Photometry of the Enclosed Arc Light" (1898); "Improved Apparatus for Arc Light Photometry" (1901); "The Integrating Photometer for Glow Lamps and Sources of Like Intensity" (1902). He has also contributed articles to the *Physical Review* and to technical journals. Prof. Matthews is an associate member of the A. I. E. E. and a member of the Society for the Promotion of Engineering Education.

A Norwegian Hydro-Electric Plant.

By C. Smith.

NORWAY abounds in waterfalls, the hydro-electric power available being extremely large, and numerous small water power plants have been installed. By far the most important of these is the Glommen, which is not only the largest power station in Norway, but also one of the most important installations in Europe.

The River Glommen, the largest in Norway, which has its source in the northern part of the country, at an altitude of 8,400 ft., flowing from a chain of small lakes south toward Frederickstad, where it empties into Christiania Fjord. The River Vormen, which drains the Lakes Mjosen and Oejeren, also unites with the Glommen, thus increasing the output to a considerable extent. There are on the river a series of falls which have been utilized by private industries, the Glommen power plant taking advantage of the highest falls at Kykkelsrud, about 63 km. from Christiania, which it supplies with electrical energy for power and lighting purposes.

The German engineers, Siemens & Schuckert, of Berlin, who have had entire charge of the construction and equipment of this plant, encountered many engineering difficulties during their work, especially with the canal construction and embankment work, but they have now practically completed the installation, which was commenced in 1900.

From a small island in the center of the stream dams are thrown across the river to both banks. The intake, which is separated into two parts, each 41 ft. square, by a central pier, leads to the open canal, which was constructed with much difficulty, the ground being particularly unfavorable. It is slightly over a kilometer in length, with a width at the bottom of 7.5 meters, the gradient being 1 in 660.

At its lower end there has been constructed a reservoir 420 ft. in length by 66 ft. in width, the water passing from it to the turbines. The effective head is 19 meters and the flow 260 cubic meters per second, the power available amounting to about 30,000 hp. In dry weather, however, the output is somewhat lower.

Fig. 1 shows the exterior of this plant, while Fig. 2 is a view of the interior. So far there have been installed two 3,000-hp turbines and two 280-hp turbines. One of the large vertical-shaft Francis-type turbines was constructed by Escher, Wyss & Co., of Zurich, Switzerland, while the other 3,000-hp turbines, as well as the two smaller ones, were made by the firm of J. M. Voith, of Heidenheim-am-Brenz. The latter Voith turbine is 6 ft. in diameter and is enclosed in a wrought-iron casing. The shafts of both of the larger turbines are of Siemens steel with a diameter of one foot, their lengths being 25 and 27 ft., respectively.

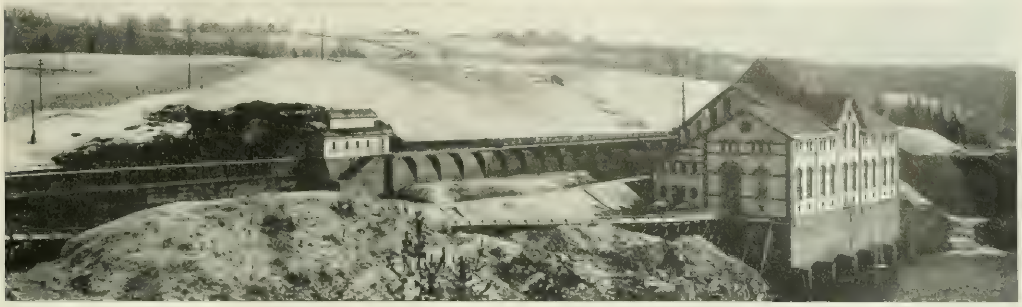


Fig. 1.—Exterior View of Glommen Power Station.

When completed the plant will contain in all four 3,000-hp turbines, three 280-hp turbines and eight 5,000-hp turbines. The turbines of 3,000 hp capacity already installed have a speed of 150 r.p.m. and an efficiency of 75 per cent at a head of 52 ft.

The two large turbines are direct-connected to three-phase, alternating-current generators, while the smaller ones drive 180-kw, direct-current machines which supply current for excitation of the alternators and for lighting the station.

The three-phase alternators are of the rotating field type, and each has a capacity of 2,500 kw. The magnet wheel carries 40 poles and revolves at a speed of 150 r.p.m. The current has a frequency of 50 periods per second and a potential of 5,000 volts. The efficiency of these alternators is 96 per cent. The shaft of the turbine, revolving portions and rotating field weigh in all about 32 tons.

The current supplied by the alternators is raised to a potential of 20,000 volts by step-up transformers of 1,050 kw capacity each. Fig. 3 shows these oil-cooled transformers, which are of a new German design. The windings are traversed with numerous passages for the oil, the insulation between the winding and the core as

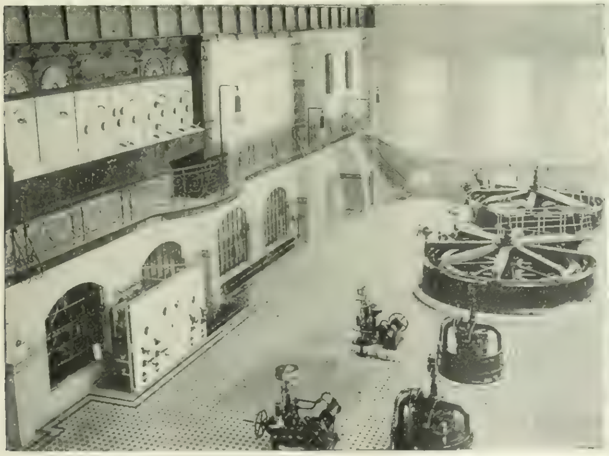


Fig. 2.—Interior of Station, Showing Alternators and Exciters.

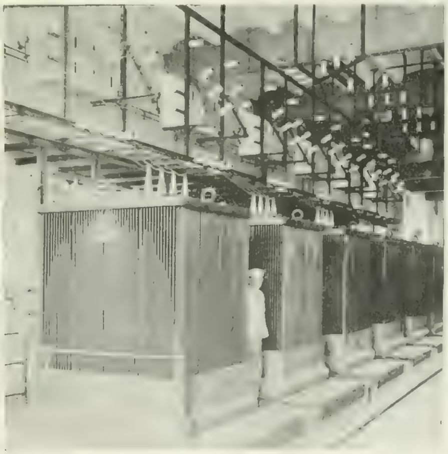


Fig. 3.—Transformer Room, 20,000-Volt Transformers.

well as the insulation between the individual coils is very efficient. Cooling is also obtained more readily and easily with this kind of transformer.

Five transmission lines, four to the north, and one to the south, convey the current to seven sub-stations along the route, the last station being located at Slemmestad, about 87 km. from the hydro-electric plant. One line also leads to Christiania, 63 km. distant. Oil-cooled transformers similar to those used at Glommen, reduce the potential from 20,000 to 5,000 volts at these stations. The power is then either used at this pressure or stepped down still further, to either 220 or 110 volts by smaller transformers.

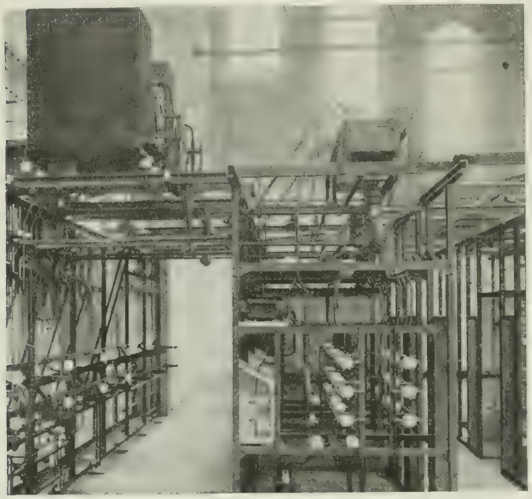


FIG. 4.—ROOM BELOW THE SWITCHBOARD. HIGH-TENSION APPARATUS.

The illustration, Fig. 4, shows the high-tension apparatus, etc., in the room under the switchboard, which can be seen on the left in Fig. 1, mounted on a gallery. The switchboard is constructed of white marble and carries the low-tension apparatus. All of the six panels are not in use at present, but they will be placed in service in the near future when the installation has been completed.

Design of the Telefunken System.

By A. Frederick Collins.

IN a recent article published in the columns of this journal, the amalgamation and subsequent rise of the Gesellschaft für Drahtlose Telegraphie, or the Wireless Telegraphy Company, in the province of space transmission and its immediate possibilities were described in detail.

There are several additional interesting features relating to the system proper as developed by this corporation, and these include a new arrangement of the oscillating circuits, diagrams of the apparatus that embody both the Braun and the Slaby-Arco ideas, a multiple spark-gap and other devices, all of which have been combined to form the "Telefunken" system.

In the beginning of the art the effort to obtain increased distances consisted chiefly in enlarging the induction coil, improving the coherers and adding to the electrical dimensions of the aerials. In 1900 the principle of electrical resonance which offered a theoretical promise of selectivity was then taken up and nearly all the workers in wireless concentrated their attention on its practical consummation until a year ago, when every possible combination of tuned and syntonized circuits had seemingly been evolved.

During the past year a new line of research engaged the busy brain of the wireless physicist and inventor, with the result that much new data have been adduced and information made available concerning the damping of the spark-gap and oscillator circuits. It is well known that when striking distance of the disruptive discharge is increased beyond a certain critical length the potential energy stored up in the oscillator system is equalized through the spark as a direct current due to the resistance of the intervening medium.

With a single spark-gap there was usually a very great loss of energy, but it has been found that by segregating the spark this untoward effect is eliminated. The investigations along this line by the electricians of the Telefunken system have been due very largely to the measurements made with the odometer, and hence the radical departure from the hide-bound notions that have hitherto prevailed, and with the result that new types of instruments have been constructed.

Upon this knowledge the above company has found it feasible to completely change the dimensions of the oscillator system and hence modify the resulting period of oscillation without sacrificing to the slightest extent the range of effective signaling. In the equipments under consideration a net of wires is utilized for the emission and reception of electric waves, and as in other wireless stations the same aerial serves both purposes, the simultaneous throwing in of secondary and out of the sender, and vice versa, being accomplished through the medium of a switch.

The necessity of a properly proportioned aerial has been recognized for several years where the best results are to be expected in the matter of accuracy and distance. The equipping of no less than 300 stations, both land and marine, by the experts engaged in the furtherance of this particular system, has naturally taught them many facts that can only be learned in the school of actual experience. Among these may be cited the most suitable length of aerials from the earth and the distances between the wires of the same aerial, the differences in the frequency of oscillation permissible, the opposing elements produced by extraneous conductors in the field of force, etc.

A great deal of time has also been bestowed in the past two years on the best methods for earthing a terminal of the oscillator and resonator circuits. Prof. Ferdinand Braun was the first, I believe, to make use of an artificial earth, and then followed a long line of experiments participated in by almost everyone interested in the improvement of the apparatus, and these finally led to the use of conducting substances distributed about the base of the earthed wire.

In the Telefunken system in so far as floating stations are concerned, the original scheme of earthing is adhered to, for the surface of the ship's bottom presents an ideal connection with the earth, the resistance amounting to only a few ohms. Permanent stations where they are not in close proximity with the sea offer a different and more difficult proposition, and for this reason a cross between the original Marconi plan of earthing and the artificial areas of Braun is used.

This device, termed an electric counterpoise, consists of a large, flat, circular conducting surface placed horizontally upon the ground and insulated from it. It is evident that the electric counterpoise acts as the opposite of the aerial system and that the earth acts inductively upon the former instead of by conduction, as it does where a direct contact is made. An inductance is connected between the aerial and the counterpoise, and by this method two oscillatory circuits are formed.

To better understand the nature of these circuits, let it be remembered that in the oscillator as originally designed the lower end of the aerial was connected to one side of the spark-gap, while the other side led to earth, and in this system the aerial wire and the earth itself act like the opposite coatings of a condenser. It is stated by Count Arco that it is impossible to convert large amounts of energy into electric waves by this method, for in the first place the capacity of the aerial is limited and an increase of energy can be had only by augmenting the charging current.

In order to fulfill this condition a long spark was requisite, but when the length of the spark was increased to 5 cm. or more, and was directly connected with a 60-meter aerial, the disruptive discharge took the form of an arc. To obviate this serious defect the primary of the induction coil used for energizing the secondary, which in turn charges the oscillator circuits, is tuned to the period of alternation, for in this case a single-phase current is required. With this arrangement a spark of 30 cm. can be obtained with an aerial wire 60 meters in height. The only limitation imposed in using these long spark lengths lies in the matter of properly insulating the aerial for the high potential.

The difficulty of the conversion of high potentials and large current strengths into radiant enermy may in this way be overcome, while it has been shown that in the ordinary spark-gap the increase in range does not rise in nearly the same ratio as the increase of the charging energy, due to the losses occasioned by lengthening the spark, and again the increase in potential at the beginning of the discharge is more than exceeded by the damping factor, but these faults may be circumvented by the application of the segregated or multiple spark-gap.

That the heat losses may be reduced to a minimum, there is employed a method of distribution in which either small capacities in the form of condensers or inductances in the form of coils are introduced in multiple, so that the potential is proportionate to the length of the spark-gap. The invention of this new spark-gap is credited to Herr Randahl, and by its means the effective range rises proportionately to the length of the disruptive discharge. With this new emitter it has been found possible to bridge a distance of 250 km. with an initial energy of 90 watts and an aerial 32 meters in height.

In connection with a simple open-circuit oscillator the multiplex discharge, as it is termed, it is claimed to be possible to obtain a much higher degree of accuracy in tuning the receiver, as will be subsequently shown. The company, however, desires it to be understood that it is still pinning its faith to the compound system energized by Leyden jars as designed by Prof. Braun and patented by him October 14, 1898, and this arrangement has been further improved by the application of Braun's new current distributors.

The two types of compound oscillators employed in the telefunken apparatus are indicated in Figs. 1 and 2. The first is recommended for floating equipments, because it is simple, easily adjusted for varying wave lengths and on account of the slight tensions to which the aerial is subjected. The closed circuit includes a non-adjustable condenser, C_1, the segregated spark-gap, *F*, and a variable inductance coil, *L*. One terminal of this coil is earthed, while the opposite end encloses contact with the aerial, *A*, through the tuning inductance, *I*, and the condenser, *C*.

In Fig. 2 is shown a portable transmitter in which an aerial composed of a single wire is elevated either by means of a kite or a balloon, and in this way two wave lengths are available, the first being that emitted by its natural period and the second that of its first upper octave. It is in this apparatus that the wire gauze counterpoise is used.

This type of oscillator comprises a condenser, *C*, having a capacity of fixed value which is charged by the secondary of the transformer through the segregated spark-gap, *F*, and the tuning coil, *L*; when it is desired to emit short wave lengths it is only necessary to insert a plug at *P*, or if, on the other hand, the long wave length is required all the turns of the inductance are brought into action by pushing the plug home at P_2.

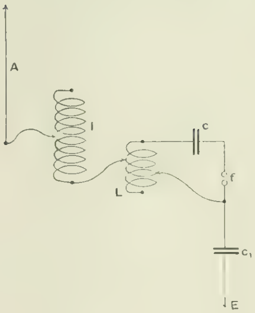


FIG. 1.—TRANSMITTING CIRCUITS FOR FLOATING EQUIPMENTS.

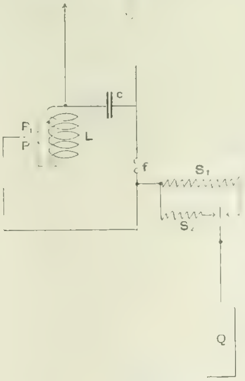


FIG. 2.—TRANSMITTER CIRCUITS FOR PORTABLE EQUIPMENTS.

One side of the gap is connected direct to the aerial through the condenser, *C*, while the opposite side leads to the counterpoise through the inductance coils, S_1 and S_2. Where the natural period of the oscillator is used the tuning coil, S_1 and S_2, is used with its overtone. By varying these plugs the periods of the circuits are changed and hence give rise to the two different wave lengths employed.

Highly tuned receiving circuits are of greater importance in the military and naval arts than in the merchant marine, as in the former sharp tuning may effectually prevent the agglomeration or annihilation of the telegram by the enemy's waves, even if these are of superior intensity, while on transoceanic steamers all vessels must be able to receive from any ship or shore station.

In Fig. 3 the granular detector is shown at *F*, while the condenser, *C*, having a capacity of large and fixed value, compared with that of the detector, is included in the circuit with the latter. The inductance coil, I, has three adjustable contacts, *a*, *b* and *c*, and by shifting the position of *b* the coherer circuit may be tuned without difficulty. The contact, *c*, permits the turns of the inductance to be short-circuited, thus preventing the oscillations from wasting their energy in the turns that are not used. From the contact *b* a wire leads to earth through an adjustable condenser, C_1, and from the point *a* a wire leads to and connects with the aerial.

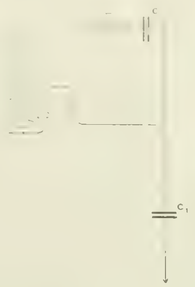


FIG. 3.—TIGHTLY COUPLED RECEIVER CIRCUITS.

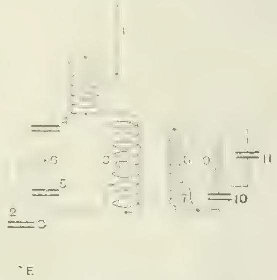


FIG. 4.—LOOSELY COUPLED RECEIVER CIRCUITS.

To tune the latter the number of turns of the inductance, *a* and *b*, are varied until the right value is had, and then the proper proportion of capacity is obtained by adjusting the condenser, *C*; hence the greater the number of turns between the points *a*, *b*, per given wave length, the smaller may be the value of *C*, and the closer the coupling of the open and closed circuits the less the instrument will be in tune. This is the type of receiver the German writers mean when they speak of a "tight coupling."

A "loosely coupled" oscillator, to use their terminology, is shown in Fig. 4, and consists of two closed circuits inductively connected by a small oscillation transformer coil. In this type the antenna is designated by 1, an adjustable condenser by which the aerial is tuned to earth by 2, and by carefully choosing the condensers 4 and 5, which have a permanent value, the closed primary resonator circuit is coupled to the antenna. The secondary resonator circuit, 8, in which the coherer is placed, is thus "loosely coupled" to the primary by the transformer coils, 3 and 8. The term "loosely coupled" is taken to mean in this case that there is a large intervening space of air between the primary and secondary coils so that any deformation of the primary wave cannot appreciably affect the secondary circuit.

A sliding contact, 7, renders the inductance of the secondary of the oscillation transformer adjustable within certain limits. The terminals of this winding lead to the coherer, 9, through an adjustable condenser, 10, for tuning, while paralleling the devices 9 and 10 is the condenser, 11, the capacity of which is infinitely greater than that of the detector. The aerial need not be connected to earth, but an electric counterpoise can be employed instead with equally good results. Where a transformer is used, as shown in the diagram, Fig. 4, instead of combining the resonator systems, as in Fig. 3, the untoward influences of atmospheric electricity may be further diminished.

With inductively associated resonators a greater degree of perfection in tuning may be approached, and with this type of receiver it has been found possible to tune the receiver to about 1 per cent, and it is stated that such tuning suffices absolutely to discriminate between the waves intended for it and the counter action set up by the enemy's emitter, assuming that the intensity of the opposing instrument is practically the same, and that there is a 4 per cent difference in the waves. This striking achievement is largely the result of using the segregated spark gap and is due somewhat to the reduction of the damping of the circuits.

Still more remarkable is the simultaneous reception of two messages from different stations having a wave difference of 30 per cent by the use of two distinct antennæ, and it is even possible to connect both receptors to a common aerial and receive the dual telegram. Where a single vertical wire is employed for the reception of two different wave lengths simultaneously, the tuning of the receiving systems is attended with much difficulty, and the resonator circuits must be connected with the antenna by means of oscillation transformers, the primary and secondary windings of which are differentially associated.

Electrical Features of the Portland Exposition.

The Lewis and Clark Exposition at Portland, Ore., departing from the precedent set by the St. Louis Exposition in the matter of illuminations, has no separate power station on the grounds. After estimates had been obtained, showing that it would cost $400,000 to install an adequate power plant, a proposition was accepted from the Portland General Electric Company for a service of about 100,000 lights for the entire exposition season at an aggregate cost of about $80,000.

For the purpose of supplying the Exposition with illuminations, and with a view to increasing the capacity of its public service to meet prospective growth and increased demand for light and power in the city and its environs, the Portland General Electric built a steam power plant situated one-third of a mile from the Exposition grounds, and installed 12,000 hp in addition to the 12,000 hp at its water power plant at Willamette Falls, 15 miles from Portland. The illumination of the Exposition requires about 4,000 hp.

FIG. 3.—THE "TRAIL."

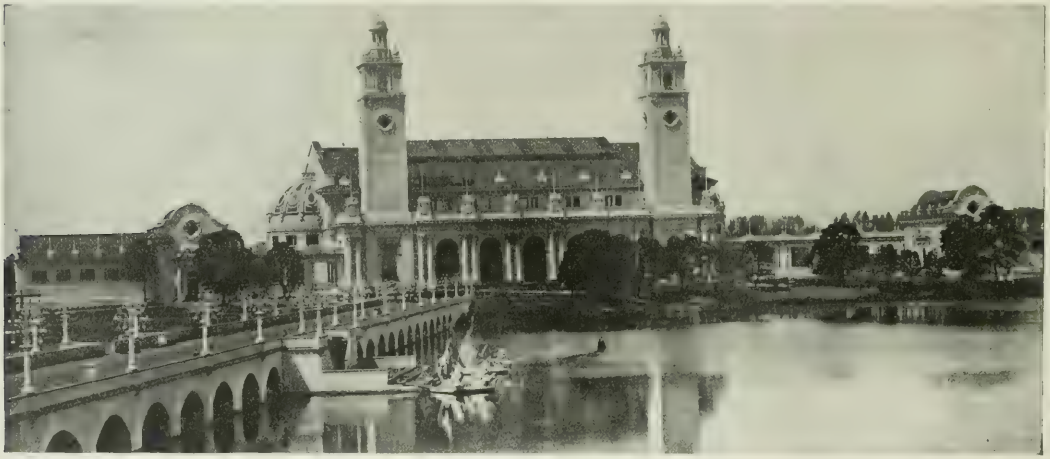


FIG. 1.—GOVERNMENT BUILDING.

FIG. 2.—GENERAL VIEW OF BUILDINGS

The service is fed to the fair on 2,200-volt circuits, and is distributed to various transformer pits located just outside the buildings. The secondary wire distribution is at 117 volts. There is not an arc light on the grounds. Every lamp is a frosted incandescent. The general plan of illumination is that of outlining the buildings, courts, sunken gardens and esplanades with 8-cp frosted lamps. About 100,000 of these are used, and in addition 5,000 50-cp Meridian lamps are used in electroliers on the Bridge of Nations connecting the government peninsula with the mainland; the lake shore esplanade, following the shore line nearly a mile, and the walks and avenues throughout the grounds. For supplying these lights the Portland General Electric installed two 1,500-kw turbines. For driving machinery in the fair the company supplies 500 hp of current.

There are about seven miles of underground conduits, in wooden troughs, for the 117-volt distribution. Weather-proof wires and porcelain knobs are used. The 2,500 and 500-volt distribution circuits consist of about two miles of conduits, placed in wooden boxes and on insulators.

The standing lights throughout the grounds are electroliers, fixed on iron posts. There are 140 posts bearing 27 lamp electroliers, in spray effects. There are 400 six-light fixtures of similar style. The park illumination consists of 6,000 frosted lamps placed in the trees and shrubbery, and among the vast gardens of roses that bloom here continually. Clusters of twenty-seven 50-cp lamps are placed around the sunken gardens of Columbia Court, alternating with large urns filled with gorgeous flowering plants. Other similar electroliers occupy pedestals on the grand stairway, and smaller fixtures made up of six lamps are used around groups of statuary and along main walks.

Mr. James R. Thompson, the electrical engineer who designed the illumination scheme, and has charge of it, conceived something new in the submarine illumination of Guild's Lake, around and across which body of water the Exposition is built. The Exposition's main array of buildings stands along the gently rising slope of an eminence at the south bank of the lake, and the government buildings are in the form of a crescent on an island in the middle of the lake. They are connected by a "Bridge of Nations," 2,000 ft. long. The spans and arches of this bridge are outlined with frosted incandescent lamps, as is also the government group of buildings. Viewed from either side of the axis of the fair formed by this bridge, the electrical display is the same. The water feature is 220 acres in extent, the largest ever enclosed within an Exposition fence. Along the lake shore esplanade, and on either side of the Bridge of Nations for its entire length, Mr. Thompson has placed, at intervals of three feet, 50-cp lamps in marine receptacles, on the bottom of the lake. The lake is about 8 ft. deep. The illumination is sufficient to enable spectators on the bridge and along the esplanade to see objects at the bottom. The government fish hatcheries have stocked the lake with carp, salmon and bass, and these may be seen swimming to the lights and examining them with fish-like curiosity that does not diminish. An element quite unexpected by the electrician, and occasioning his growing dissatisfaction, is the increase of organic matter in the water of the lake since its natural outlet and inlet from the river were closed to deepen it during the Exposition season. The pumping of 30,000,000 gallons of water daily into the lake from the Willamette River, a clear river rising in the Cascade Mountains, has the effect of retarding, however, in a degree, the growth of the objectionable matter.

FIG. 4.—FORESTRY BUILDING.

The architecture of the fair is brilliantly displayed by the scheme of illumination, and the effect at night is very beautiful. Every building on the grounds, including large and small exhibit buildings, State buildings, Government and fair administration buildings, the Trail, the Bridge of Nations, the American Inn and the grand stairway, and the long esplanade stretching a mile along the shore of the lake, are outlined with the soft glow of the frosted incandescents. Searchlights are operated nightly from two towers, one on each side of the lake, and from the roof of the Agricultural Palace.

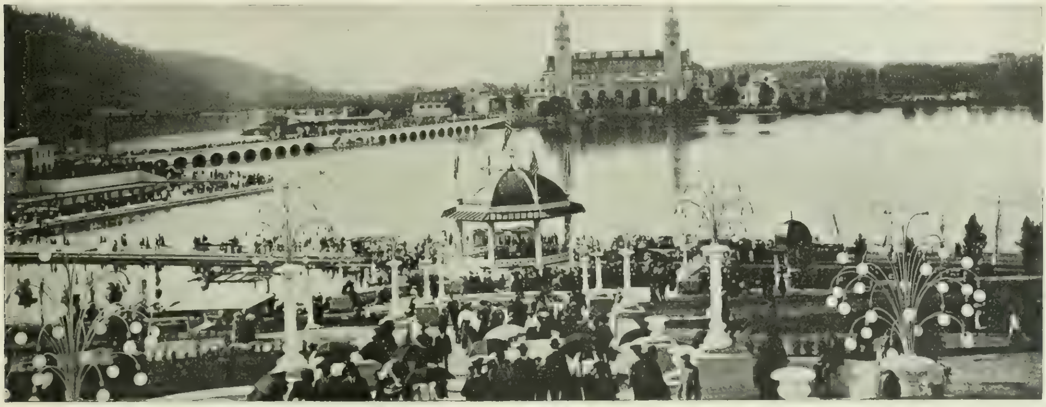


FIG. 5.—GENERAL VIEW ACROSS GUILD'S LAKE, SHOWING BRIDGE OF NATIONS.

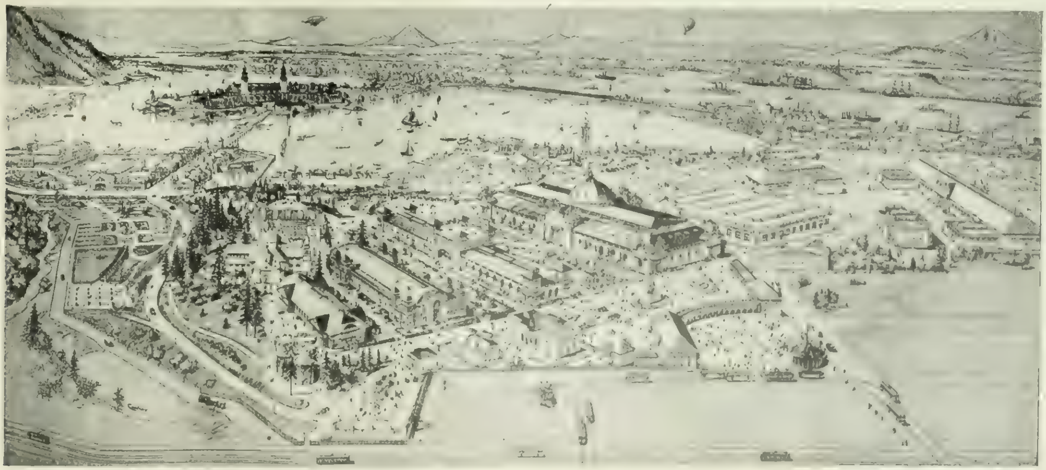


FIG. 6.—BIRD'S-EYE [illegible] GROUNDS.

Terminals and Distribution Boards in Telephone Exchanges.

By Arthur V. Abbott, C.E.

TIME was when the problem of bringing the various lines into the telephone exchange taxed the invention of the telephonist, for when all lines were aerial they naturally converged to the roof of the building, and to place thereon a structure capable of resisting the stress of some thousands of lines, so designed as to maintain each in electrical isolation was a herculean task. All vestiges of such practice have vanished with the adoption of the aerial cable and the development of the conduit, for it is essentially true to state that now no open wires are carried into exchange buildings.

Even in the smallest installations the open wire is gathered into a cable a few poles away from the office, thus compacting the lines into a small compass and rendering their introduction into the building through a convenient hole in the wall an easy matter. In the larger cities exchanges are located in the more crowded portions and the circuits are universally under ground. Hence, it is usual to build in the street what is frequently called an "office manhole," to which all conduits converge and in which they end. From this manhole to the basement of the exchange building the cables are carried either in an open tunnel, the method almost universally adopted in the older offices, or by means of series of short ducts, now the prevalent practice.

The tunnel is usually a passageway some 4 ft. wide and 6½ ft. high, excavated beneath the street, and lined and arched with brick, providing a structure of ample strength to carry the heaviest traffic of a busy street. Into the masonry of the side walls iron supports are built, thus furnishing a series of shelves or racks on which the cables may rest. So far as ease in installing or rearranging cables is concerned, nothing can be more desirable, as there is ample space to do anything one pleases. To find room among street structures for such a tunnel is a difficult, often impossible matter, to say nothing of its expense, so by building a short subway of ducts connecting the office basement with the street manhole, both of these objections are avoided. In many cases such a conduit must provide for a very large number of cables, and in order to render all accessible much ingenuity must be displayed. Usually a broad flat conduit lends itself most readily to cable installation, and by fanning out the separate ducts at the basement wall sufficient room to handle cables can be secured.

There is some difference of opinion as to the best method to adopt after the cables reach the inside of the building. It was formerly the custom to end the cables in iron cable heads carried in a rack attached to the building wall. Such cable heads carried the protective devices, and house cables from them extended to the distributing boards. The iron cable heads are expensive to install, and even when carefully connected to the cable they can by no means be considered moisture-proof, and they take up so large an amount of space as often to require a room by themselves. As the protector forms the most convenient point at which to test for trouble, the cable heads should be placed as near as possible to the switchboard or else much time will be expended in going to and fro. For these reasons it is becoming customary to place the switchboard and distributing board close together on the same floor, as is shown in Fig. 1; then the street cables are carried as near as possible to the distributing board and terminated in potheads.

From the potheads twenty-pair switchboard cables are run to the distributing frame. In some cases the street cables have been carried to and laid on the shelves of the distribution board, the individual circuits being extended to the terminals of board by means of okonite, but the pothead when placed on the shelf of the distributing board takes up so much room as to make this method inadvisable. The nearest arrangement is to set the potheads on a floor below that occupied by the distributing board, and directly beneath it. Then by means of a slot in the floor the cables from the head can run directly to the terminals on the frame. It is usual to place the operating rooms of large offices on the top floors. In many cases this necessitates a long vertical run in the building. It is impractical to suspend the cables from one end as the lead sheath is so soft that the weight of but a few feet would pull the sheath apart. So a shaft must be designed to provide a cable support every few feet. Where one wall of the building is free from windows it is convenient to build the shaft only deep enough to take one cable, and as wide as may be necessary to accommodate the desired number. Fire-proof doors are provided on each floor to give access to the shaft, and as often as every ten feet the cables are supported by clamps in the wall.

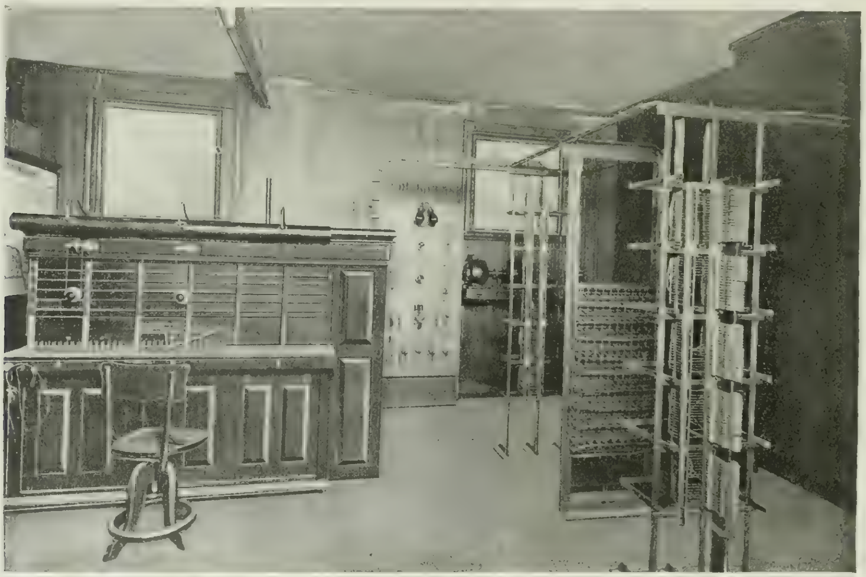


Fig. 1.—General Arrangement of Exchange Apparatus.

When potheads are used protectors must be provided for, and it is now usual to place them on the switchboard side of the distributing frame. The advocates of the pothead claim that its use affords a surer protection against the entrance of moisture than the cable head, that it takes up much less space, costs less to install, and that less protection of a cheaper and more accessible form can be used on the distributing board. Those who favor cable heads, while admitting the advantages cited for the pothead, believe that the difference in cost is more than repaid by the better opportunity that the cable head affords for testing and rearranging circuits when a cable is spliced, and by the fact that protection on the heads guards *all* the wiring inside the building, while if it be placed on the switchboard side of the distributing frame the jumpers in the frame are entirely unprotected, thus leaving unguarded a spot where a little fire may do much injury. This objection, which was weighty in the days of wooden boards, and parafined wire, now loses much of its force with the employment of iron frames and flame-proof, wool-covered jumpers, and so the pothead is on the whole the favorite method. In order to combine the merits and omit the defects of both, the plan of using potheads for the street cables and placing the protection on a special frame in cabinet set between the pothead and the distributing board is sometimes adopted. Where this method is adopted it is usual to place the protectors on long strips, so mounted as to be easily accessible from all sides, and enclose a sufficient number of strips in a cabinet, as shown in Fig. 2.

From the end of the street cable, however terminated, the circuits must be extended through a longer or shorter run to the distributing board. As such a run is inside the office building and may be kept reasonable dry, house cable is adopted. When potheads were employed, it was considered necessary to splice a length of rubber-covered wire to the street cable. This idea was founded on the theory that all the fibrous materials (cotton, etc.) used as insulators are composed of microscopic tubes which it is impossible to seal hermetically; hence if such cable were used, moisture would sooner or later reach and destroy the paper cable. Prolonged experience has shown that such fear is largely unfounded, for there are many hundreds of potheaded cables to which silk and cotton switchboard cable, either leaded or unleaded, have been spliced, and in which no deterioration of insulation has been noticed. Lead-covered, wool-insulated cable has also been used, because wool is both less hygroscopic and less inflammable.

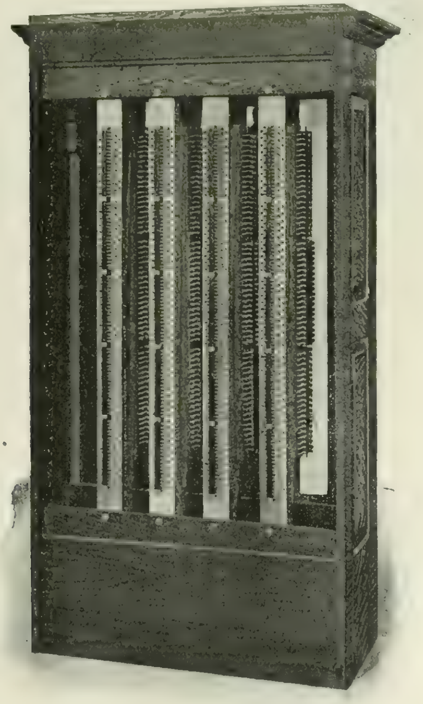


FIG. 2.—PROTECTOR CABINET.

The distributing board is one of the most important, yet often least comprehended piece of apparatus; its object is to afford an easy method of changing the relation of the wire plant circuits and the switchboard circuits; in theory it is exceedingly simple, in practice somewhat complicated. Referring to Fig. 3, suppose *A B* to be a street cable, having its ends fanned out and each circuit connected directly to the line signals in the switchboard. Such a diagram illustrates an office without a distributing board. It is easy to imagine a thousand causes that will render it desirable to change a cable circuit from one line signal to another. According to the arrangement of Fig. 3, it would be necessary to cut the wires from the cable to the board and splice in new pieces. Such a practice would in a short time destroy the best installed plant. Now suppose that in Fig. 4 the street cable wires be extended to a strip on which a number of binding posts are placed, and that each wire be soldered permanently to its post. Also that the switchboard circuits be similarly extended to and terminated on a second strip supplied with binding posts, placed a short distance away from the first. Evidently any line in the cable can be at once connected to any one in the switchboard, by simply running a piece of flexible wire between the respective binding posts to which the wires are attached. Neither cable or switchboard circuits are disturbed, there is no cutting or patching, simply the loosening and tightening of a couple of screws, and neither line need be open more than a few seconds. Such is the distributing board. In very small offices the *"cross-connecting board,"* as it is often called, is nothing but a strip of varnished wood, carrying two rows of binding posts, or even two rows of metal pins to which the subscribers' circuits and switchboard circuits are attached, and between which the flexible wire jumpers run.

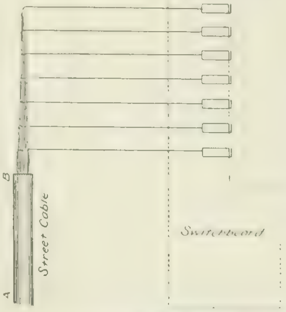


FIG. 3.—DISTRIBUTING BOARD OMITTED.

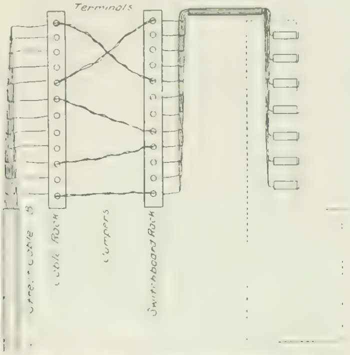


FIG. 4.—DISTRIBUTING BOARD INSTALLED.

When a telephone line becomes inoperative the difficulty may lie either in the wire plant between the office and the subscribers' premises, or in the switchboard apparatus and its circuits. As the distributing board forms a temporary connection between these two, it logically becomes the point from which the inspector seeks to locate trouble, by opening the jumper and testing out toward the sub-station, and in toward the switchboard.

As the distributing board is placed at the end of street cables, it becomes the natural location for protective devices. The distributing board, therefore, must provide for three functions: It must enable a temporary connection to be made rapidly and easily between any wire plant and any switchboard circuit; it must lend itself readily to the operations of testing for protection. Consider now how the various boards fulfill these requisites. The simplest distributing board is literally a "board," usually from 8 in. to 12 in. wide, and 5 ft. to 8 ft. long, made of hard wood, preferably maple, and thoroughly dried and varnished. Along one edge is a strip of wood carrying binding posts, while on the other edges the protective devices are arranged in a row on about the same spacing as the binding posts.

The cable from the switchboard is usually either in the space formed by the strip carrying the posts and the main board, or else directly on the back of the board, each of its wires being soldered to the end of the binding post within the strip, or if the post is supplied with two nuts, held under the lower one. In a similar manner the wire plant cable is attached to the back of the board on the protector side, each wire being attached to a post or screw that may be seen between the carbon plates and the fuses or heat coils. To connect any wire plant wire to any switchboard circuit it is only necessary to insert one end of a flexible wire under the screw at the inner end of the fuse, run it longitudinally along the board to the binding post of the desired switchboard circuit and clamp it. Pins are driven into the board about every 6 in., around which the jumpers may be bent, and thus carried nearly longitudinally throughout their entire course. Fig. 5 shows a view of a distributing board designed on this general plan, though the details are slightly different, in the arrangement of the protectors and use of a ring to guide the jumpers instead of a wood pin.

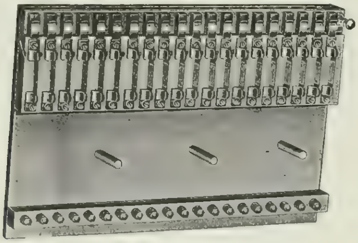


FIG. 5.—VIEW OF DISTRIBUTING BOARD.

Supposing the protectors to be set on half-inch centers, a hundred lines will need a board 50 in. long; a very convenient size, but for 200 lines a length of more than 8 ft. would be needed, making the board inaccessible. It is impractical to use two boards and connect from one to the other. To secure greater capacity the most obvious design is to bring all the switchboard cables to a series of strips either vertical or horizontal, and all the wire plant cables to a similar set placed a short distance away, say 2 ft. to 3 ft., with an open space between them, through which the jumpers can be run.

The modern iron frame distributing board presents a very neat solution of the problem. As now built, distributing boards consist of a number of panels built of angle iron. Fig. 6 shows a single panel of an approved design. The height is usually regulated by the room in which it is to be placed or by the convenience to the wire chief in reaching the terminals. The length, as will be presently shown, depends only on the desired capacity, while the width or distance between opposite sides is also a function of the capacity. The base is a piece of light 2.5 in. by 2.5 in. in angle, the uprights are 1.5-in. or 2.25-in. angles, the horizontals are supported by a strip of 4-in. by ½-in. flat set vertically, as shown on the left hand. Theoretically, boards of different sizes could be proportioned of different sized shapes, but practically the saving in iron would not pay the expense of a new design and the cost of stocking a great variety of shapes. For a 5,000-line board the base would be about 33 in. long. The distance from the face of the arrester strip to the center of the vertical bar 9 in. from the center of the vertical to the face of the horizontal runs 20 in., with a clear space between shelves 9 in. Horizontal spacing of arrester bars 8 in., spacing of horizontals runs 9 in.

As the board is formed of single bays like Fig. 6, any capacity may be secured by changing the number of bays. A complete board is shown in Fig. 7. Fig. 8 is a section through a shelf of such a board. The street cable enters along the horizontal run and is attached to clips. The switchboard cables extend vertically along each upright and are fanned out into one side of the protectors. From the other side the jumpers run to the cable conductors. From this arrangement the cables side is usually called the horizontal side and the switchboard side the vertical run.

The method of calculating a distributing board is as follows:

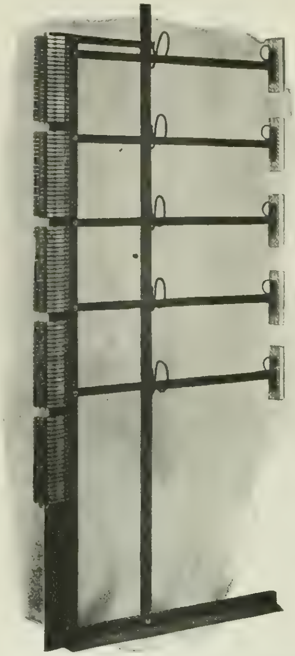


FIG. 6.—SINGLE PANEL OF DISTRIBUTING FRAME.

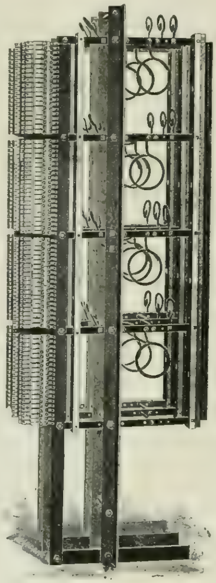


FIG. 7.—COMPLETE DISTRIBUTING BOARD.

Assume a 4,000-line board required; on account of dust it is inexpedient to set arresters nearer than a foot to the floor; without a step ladder a man cannot work on an arrester over 6 ft. from the floor. Hence, the available vertical space is 5 ft. If arresters are set on ½-in. centers, there will be 120 pairs on a vertical; the number of verticals will be 4,000/120, say 34 strips, to which must be added an allowance for private lines, trunk-line call wires, etc., or say from 40 to 45 strips for the entire frame. With verticals on 8-in. centers, the frame would be from 27 ft. to 30 ft. in length. As the frame is 6 ft. high, there will be room for eight horizontal strips on 9-in. centers. As there are no arresters, less space is required, ⅜-in. centers being ample; thus the horizontal runs give space for 7,600 pairs. Usually the cable wire is about 30 per cent

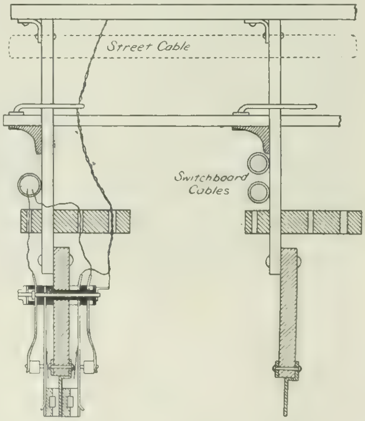


FIG. 8.—SECTION OF DISTRIBUTING BOARD.

in excess of the switchboard, so space for say 5,500 lines must be equipped, which will need about six runs.

The clips for the horizontal or street cable side are simple. A base block of maple is provided long enough to carry twenty pairs. On this a strip of hard rubber is fastened, and the terminals proper, consisting of pins or narrow strips of metal with a slot or groove in each end, are driven through the rubber. To the ends of the metal connector thus provided the cable wire and corresponding jumper is attached by thrusting the wire into the slot and touching it with a hot soldering iron.

The original form of distributing board protector devised by the American Bell Company is shown in Fig. 9. One side of the line enters by Spring *A,* traverses this spring to the heat coil, *B,* thence through the heat coil in the direction of the arrows to spring *H* and bolt *C,* through bolt to terminal *D,* and thence to switchboard. The return wire enters the switchboard terminal, *E,* passes in the direction of the arrow to heat coil *B′*, thence to the line spring *F.* It will be seen that the springs *F* and *G* bear upon carbon plates that form an open space cut-out. Each heat coil contains a small pin which bears upon a thin spring that is attached underneath the main springs, *F* and *G.* In case of an abnormal current the solder which holds this pin is melted by the heat developed inside the coil. The springs, *H* and *I,* then force the pin inward, and ground it upon the ironwork.

For common battery installations it is necessary to ground the outside line, and to open the switchboard side, or otherwise the grounding of the common battery may produce disastrous results, and in order to avoid prolonged injury to the service it is desirable that an alarm should be given whenever a protective device operates. This is accomplished by placing an alarm bell and battery in circuit with all protectors and ground. When any one fails the bell rings. In the Cooke protector (Fig. 10) the heat coil is inserted in a small carbon block placed between the line springs. In the center of this block there is a metal stud which carries a resistance coil and to which a copper rivet is soldered. The carbon and the contained heat coil are warmed by the passage of an abnormal current, and this unsolders the metal pin. In the older forms of heat coils the repairing was a difficult matter, requiring an expert mechanic and special tools. All modern protectors afford great facility to make tests at the distributing board. In each case there is supplied a peculiarly formed test block (Fig. 10), which may be at once inserted between line springs, and when in place extends each side of the subscribers' line through a flexible cord to any form of test apparatus that the wire chief may desire to employ.

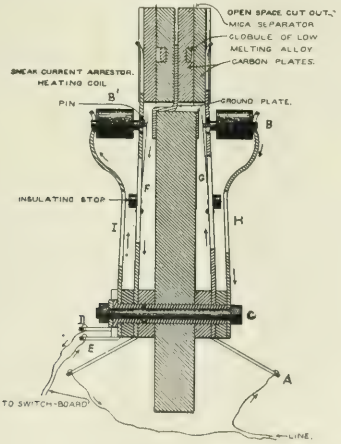


FIG. 9.—DISTRIBUTING BOARD PROTECTOR.

The distributing boards so far described are usually called "*Main distributing boards,*" because they are used to enable a rearrangement between *all* the cable plant and *all* the switchboard. But in the case of multiple switchboards any set of multiple jack could be associated with any line signal and answering jack, and cases might arise where it would become advisable quickly to change the mutual relations of multiple and answering jack. Hence, it is customary to carry the switchboard cables from the protected side of the main distributing board to the horizontal side of a second distributing board called the *"intermediate distributing board."* The answering jacks are connected to cables which run through the horizontal side of this latter board, while the multiple jacks are carried to the vertical side of this board. Then by means of jumpers any multiple jack can be connected to any answering jack. In many of the modern switchboards more than two wires are needed for each circuit, hence the distributing board terminal becomes correspondingly complex.

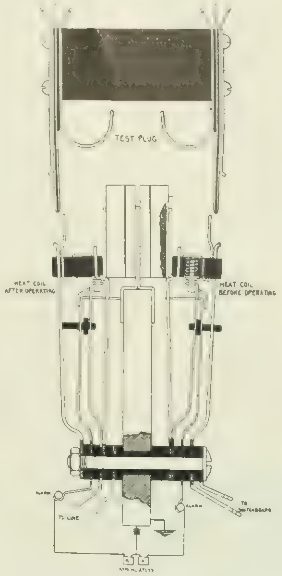


FIG. 10.—DISTRIBUTING BOARD PROTECTOR.

One of the important, oftentimes least understood, and seldom employed functions of the distributing boards, is the opportunity that it offers easily to rearrange and adjust the load on the various operators. Suppose a new office to be opened and a hundred lines placed before each operator. The data available allow of making only the roughest kind of a guess as to the amount of traffic each line will originate. Operator A may get 2,000 messages per day and operator B 1,000. A will be overloaded and B underloaded; nothing is more destructive of good service. After a short experience subscribers can be classified as to the quantity of business they originate, and then by the change of a few jumpers the lines may be reapportioned among the operators in such a manner as to give to each approximately 1,500 messages per day, without any change either in the apparatus or the numbering; in fact, no one but the wire chief and the traffic manager need be aware that a change has occurred. Unfortunately, the adjustment of the load line is a factor in operating to which but scant attention is paid, for, surprising as it may seem, some large boards are installed without the important feature of an intermediate board.

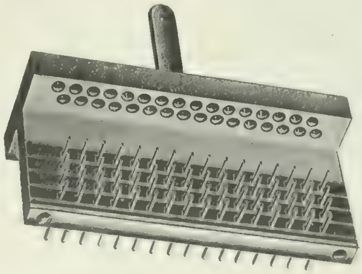


FIG. 11.—DISTRIBUTING BOARD TERMINAL.

Electrical Features of the Elks' Carnival at Buffalo.

The entire business part of Buffalo was in gala attire last week in honor of the nineteenth reunion of the Order of Elks. Bunting of many colors—purple, the Elks' color, predominating—was draped everywhere. But if the daylight scene was gorgeous, it was far excelled by the electrical decorations at night. Through the energy and resourcefulness of Mr. Charles R. Huntley, general manager of the Buffalo General Electric Co., the city streets presented a night scene probably never before equalled in similar celebrations. Niagara electric power was freely drawn upon, and was everywhere in evidence through incandescent lamps festooned across the fronts of buildings in "Welcome" signs, and in elaborate special designs embodying the characteristic Elk emblem.

The unique feature of this festival of light was a "Mercury Arc Tower," located in Shelton Square. This was a fluted column of "staff" 75 feet high, studded with 100 mercury arc lamps. Standing alone, this tower produced a most startling effect, due largely to the characteristic greenish light of the mercury arcs. It stood out conspicuously in the mass of many colored incandescents covering the fronts of the buildings on the Square and the radiating streets. The natural curiosity of the people regarding its peculiar color caused a constant dense crowd about its base. Inasmuch as the tower was visible for a long distance up the streets leading from the Square it received a great deal of attention, and was generally spoken of as the most original feature of the Carnival.

The mercury arc lamps were operated in two series of 50 lights each from 4-amp. Brush arc machines located in the Wilkison Street Station of the Buffalo lighting system. As each lamp consumed only 160 watts, the operating expense was extremely low for so brilliant a spectacle. They were of the standard type for outdoor lighting as developed under the direction of Dr. C. P. Steinmetz, and manufactured by the General Electric Company.

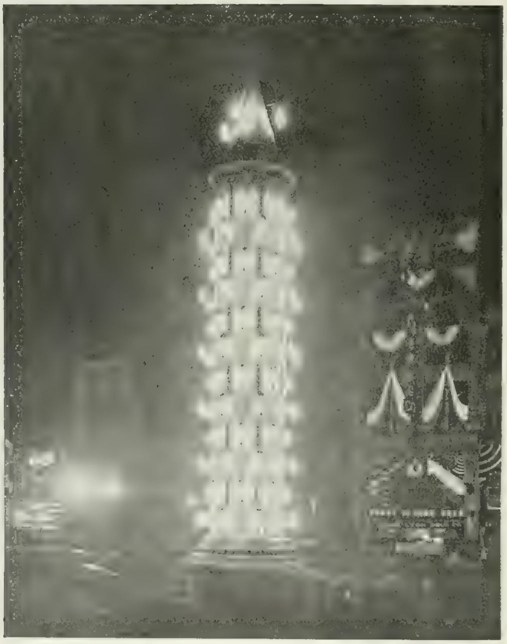


FIG. 1.—MERCURY ARC TOWER.

This new use of the mercury arc lamp on a large scale marks a radical step in electric lighting for decorative purposes. The incandescent lamp reached its climax for general illumination and for decorative effects in the work of the late Luther Stieringer at the Pan-American Exposition four years ago in Buffalo, and it is interesting to note that the most recent development in this branch of the art should be successfully tried in the same city, using also Niagara power. This luminous tower was a special contribution to the Carnival by the Niagara Power Company, the Cataract Power & Conduit Company, and the Buffalo General Electric Company. Mr. Huntley conceived the idea, and designs were prepared by the illuminating engineers of the General Electric Company, which furnished the material and superintended the installation.

The most elaborate decorative feature of the Carnival utilizing incandescent lamps was located at the corner of Main and Seneca Streets. This was a regular cobweb of wires studded with various candle-power incandescent lamps, the whole structure being crowned with four massive elk heads facing the different quarters of the globe. It is understood that 4000 lamps were used in this one feature. Many of the business houses of Buffalo employed experts also to decorate the fronts of their buildings, and the results were decidedly pleasing. On account of the Carnival, many stores increased their window lighting, or added new signs which will remain permanently. Thus the celebration not only increased to a very large extent the temporary lighting of the local company, but has added not a little to its permanent load.

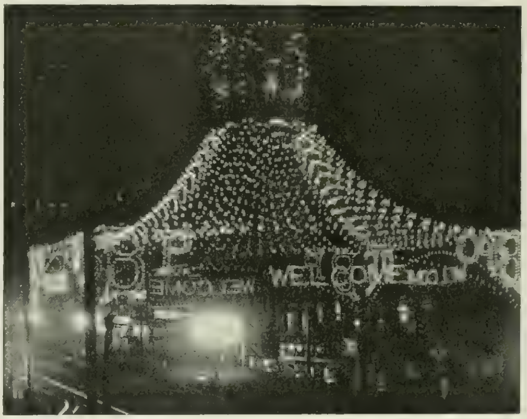


FIG. 2.—AN ILLUMINATION FEATURE.

New Telephone Patents.

AIR-DAMPED DIAPHRAGM.

All transmitters show a tendency to sing, due to the vibration of the diaphragm in one of its many natural periods. Usually the false vibration has been overcome by the use of cushioned damping springs. These work very well, but Mr. D. A. Reynolds has supplemented them by an air damper. In every transmitter there is an air chamber behind the diaphragm and when this is closed almost all energy given up by the diaphragm as it deflects into the chamber compressing the air, is given back by the elastic air as the diaphragm goes forward. It is Mr. Reynolds' idea to make the chamber small and to perforate it so that the air is pumped in and out through the perforations, absorbing energy from the diaphragm in both strokes. He has made his instrument of the two-diaphragm type with the sound tube leading between them.

STEP-BY-STEP PARTY LINE SYSTEM.

Mr. E. A. Buell has obtained three patents for a selective party line system of the step-by-step type. These he has assigned to the Selective Signal & Telephone Manufacturing Company. One of these patents describes the system, one the subscribers' selective device, and one the means at the central office for sending out the required current impulses.

In each case in setting the selectors and indicators the revolving parts move in opposition to a spring which upon the release restores all parts to normal.

Letters to the Editors.

Scott on Single-Phase Traction.

To the Editors of Electrical World and Engineer:

Sirs:—You published on July 8, a very interesting summary by Mr. Scott of the development of a single-phase traction. His view of the subject is most instructive, but I am disposed to think that he takes a somewhat roseate view, not perhaps of its possibilities, but of its existing status. His concluding theses are rather to be proved than to be regarded as demonstrated already. To begin with, the real sine qua non in heavy and long distance railway service is high voltage current upon the working conductor irrespective of its nature so long as it is available for operating a good traction motor. If continuous current were thus available, as at present it is not, it would serve as well as any other. In view of the Zossen work it must be admitted that polyphase current is thoroughly available for such service, albeit, no one is disposed to deny that single-phase current, other things being equal, would be more convenient, and would generally be preferred. But while most gratifying results have been reached in experiments with heavy single-phase motors, I think that it is hardly safe to say that they yet fulfill the ideal requirements.

I earnestly hope that they will do so when tried out upon a large commercial scale, but all results so far reached must be classified as promising rather than decisive. If engineers all over the world are agreed that one form of motor, namely, the series compensated single-phase motor, is best adapted to meet the demands in heavy railway traction, this cosmopolitan agreement is, for the present, jumping at conclusions. For example, if the vapor converter should finally justify the hopes of its friends and become available in large units, I venture to say that the series compensated single-phase motor would rapidly slide into innocuous desuetude. The direct-current traction motor is by no means dead and buried, nor is the induction motor out of the range of possibility. We must need to remember that in spite of all the work that has been done in electric traction, the heavy railway problem has hardly yet been touched, let alone solved. I hope that Mr. Scott's enthusiasm will prove to be well founded, for complete success would mean a revolution in railroading, but I deprecate the dangers that spring from over confidence in a thing just coming into use. Its real value is often diminished by too fervid expectations, and its deserved progress thus impeded.

Boston, Mass. John Whitehouse.

Electrolytic Wave Detectors in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs:—Kindly allow me to present the following data concerning the electrolytic wave detector. Besides the contention for originality, the different claimants disagree as to just how the electrolytic cell acts in performing its work as a wave detector. I believe that I can offer substantial and practical proof on this point. As used by System Telefunken, Fessenden and DeForest, the aerial or antenna is connected to the anode and the ground to the cathode, as shown in Fig. 1. By this arrangement of circuits any action produced by the ethereal wave is over the same identical path as the local action of the cell and might tend to both interrupt the polarization and to heat the solution. As shown in Fig. 2, by bringing the antenna in on a separate and distinct wire from either anode or cathode, we remove the wave path from the path of local action; and the waves can, therefore, no longer interrupt the local action. Yet it has its path to earth through the solution as before and can still continue its heat effects. The result is that no signals are produced, showing conclusively, in my opinion, that the signals must be the result of interruptions in the local action of the cell.

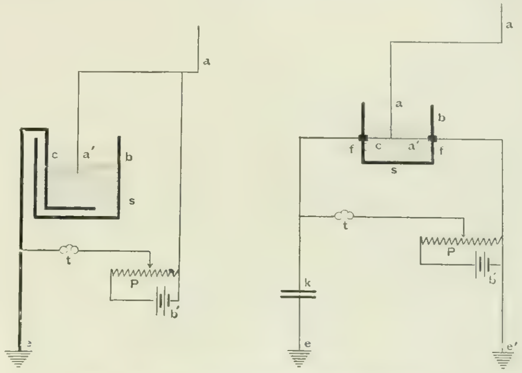
My first use of the electrolytic cell as a wave detector was in May, 1901, being at that time associated with the Inter-Island Wireless Telegraph Service at Honolulu, Hawaii. That company installed the Marconi apparatus in July, 1900, at some seven stations, covering the Hawaiian group.

While setting up and testing the voltage of a number of Bunsen cells at their station at Keomuku, Lanai, in company with Mr. Chris. Wagner, who is now chief operator of the company, we noticed that the galvanometer needle swayed or trembled in unison with the spark from the powerful transmitter at the time in communication with Mahukona, Hawaii, 80 miles distant. The battery was being set up and tested on the front porch of the station and within a few feet of where the antenna entered the building. It was quite puzzling to us at first, but after some investigation the swaying of the needle was attributed to the spark produced within the station.

Some of the carbon and zinc elements having become lost in shipment we were obliged to substitute iron and steel, using strong nitric acid as the sole solution. These latter cells were not a success in connection with the others of the battery; but we noticed that when connected to a galvanometer they were more visibly affected by the spark than had been the regular cell. Efforts were made to receive signals from a distant station by means of the cell, but without any success whatever. It could not have been very sensitive to weak signals coming from a distant station, owing to its crude construction and the fact of depending upon the eye to detect any motion of the galvanometer needle. Then, again, the distant stations were probably not able to send with much strength as they had, like ourselves, been complaining of weak battery and were awaiting their supply of Bunsen cells.

I was soon transferred to the Lahaina, Maui, station, 9 miles distant from Lanai, and thought no more of "our new system" until one day receiving a letter from Mr. Wagner that he had had no further success with the cell even after Mahukona had installed their new battery. He suggested that I try the "wet coherer," as he termed it, at the Lahaina station. Lahaina being but a branch station from the main line, had required no renewal of her original battery of dry cells (O'Bach's) as installed by the Marconi people, and consequently there were no electrolytic cells at hand. This, together with the fact that the Marconi apparatus received perfectly and that I was just nine miles of rough channel, crossed only by Kanaka hollow log canoe from Lanai, the nearest available supply of "wet coherers," caused me to forget the whole matter. In June, 1902, while assisting in the installation of the wireless stations at San Pedro and Avalon, Cal., I was again struck with the idea of trying the "acid coherer," by which name it had then become known. My efforts were not rewarded with success. Since then I have given it a thorough test and find it is a fairly reliable apparatus and capable of great speed, in the latter respect far more rapid than the filings coherer systems. I have no opportunity to try the electrolytic receiver on extremely long range, but I am of the opinion that it is very sensitive and capable of long range. The plan of connections as shown in Fig. 2 can be advantageously employed with any other form of wave detector, being especially meritorious with the carbon and steel microphone and the filings coherer. A [illegible] coil should be used in connection with the carbon and steel microphone. I have chosen to call this plan of wiring "Cole's plan," for it was Mr. R. T. Cole, of the U. S. Navy, who first used it, to the best of my knowledge and belief.

San Francisco, Cal. W. R. Carroll.



Figs. 1 and 2.—Electrolytic Wave Detectors.

a = antenna.
a′ = anode.
c = cathode.
s = acid solution.
t = telephone receivers.
p = potentiometer.
b′ = battery.
b = glass cup.
e and e′ = earth.
k = condenser.

The anode and cathode are sealed in the glass cup at points *f* (Fig. 2); *k* is a small condenser to prevent short circuit of battery.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Starting up Induction Motors.—Lewis.—An article discussing what he calls the "selective winding" method of starting induction motors. The first machine of this kind was designed by Bradley, who used two separate rotors in one machine. The next type was that of Deri, whose rotor winding is shown in Fig. 1, where *a* represents a low-resistance conductor, the ends of which are joined together; and *b* consists of high-resistance connecting pieces. There is the same number of poles on the rotor winding as on the stator. At starting, the number of poles on the stator on each phase is halved by means of a change in the connections. This change has the effect of making the voltages on all the conductors of each of the rotor windings, when added together, produce no pressure, taking the sign and phase into consideration. The current, however, has a path through the high-resistance connections, and each winding is virtually a squirrel cage one, with only two conductors per pole. At full speed, when the machine has the ordinary number of poles, the motor works in the ordinary manner, only a small current passing through the high-resistance connections. This machine was later modified in some respects by Deri. The author then describes a selective winding of his own, which is constructed, for example, in an eight-pole machine, as follows: If with a direct current passed through the winding of one phase the polarity at running were N. S. N. S. N. S. N. S., then at starting the connections would be changed to make the polarity N. S. N. S. S. N. S. N. The voltage on a wave-wound rotor, when each phase of the stator is fed with current with the connections as described, will now oppose one another. Above the wave winding a high-resistance squirrel-cage winding is provided. The machine at starting will be exactly the same as if two portions of the stator at the two opposite points where the current is reversed were not wound; the extent of the portion unwound is the pitch of one pole at each point of opposition. The angular velocity of the rotating field is the same whether the stator is connected for starting or for running. As two poles in this type of machine are always neutralized, and as these two poles are a source of magnetic leakage which lowers the power factor and therefore the starting torque, the greater the number of poles the less is this leakage in proportion. He uses a type of stator which makes this leakage as small as possible.—Lond. *Elec. Rev.*, June 30.

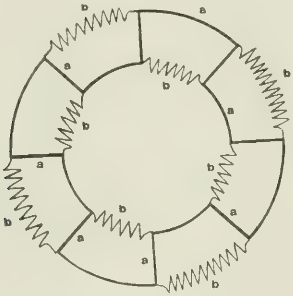


FIG. 1.—STARTING INDUCTION MOTORS.

Separating Losses in Direct-Current Machines.—Linke.—An article illustrated by diagrams on the separation of the losses in direct-current machines by the well-known method in which the machine is run as a motor, the supply current is broken and the decrease of speed is determined as a function of the time. The author discusses especially methods to be applied when the speed decreases to zero in a very short time.—*Elek. Zeit.*, June 29.

Diseases of Electric Machinery.—Crocker and Wheeler.—The final instalment in the series of articles on the diseases of electrical machinery, their causes, symptoms and remedies.—*Am. Elec.*, July.

Armature Windings of Alternators.—Newbury.—A continuation of his serial illustrated by diagrams. In the present instalment he discusses two-phase, open-type windings.—*Elec. Jour.*, July.

Compressed Gases for Transformer Insulation.—See the abstract under "Electrophysics."

Power.

Individual Versus Belt Drive in Electrically Operated Shops.—Bates.—An illustrated article in which the advantages of individual electric drive are pointed out. In a number of establishments where this means of driving machinery has been adopted, it has been demonstrated that the first cost of the motors and their controllers is not greater than the equivalent shafting, hangers and other paraphernalia required with belt driving, so that the installation of anything but individual electric drive, except possibly in some instances where peculiarly special conditions prevail, indicates a lack of familiarity with the full advantages which are to be derived from this method. The writer draws attention to the lack of consideration which is usually given to the question of the correct size and type of motor, the equipment being either too large and costly or too small for the work. He cites the case of a boiler shop in which the machines are driven through shafting and belting by a 25-hp motor. The average consumption is 5.4 kw, while the power which is continually consumed in driving the belting and shafting is 4.4 kw. This represents a yearly waste of $660 with power at 5 cents per kw-hour. The introduction, he says, of electric apparatus in the equipment of shops without fully knowing the reason for doing so is probably the explanation for the easily avoidable mistakes found in many electrically equipped shops.—*Am. Elec.*, July.

Variable Load Loss.—Ashe.—If the load in a transmission line varies, the line loss also varies. The author defines the "cost factor" as the ratio of actual line loss to the ideal line loss which would occur with steady load in place of the variable load. The cost factor equals the mean square current divided by the square of the average current. In two cases taken from actual practice it was found to be 1.29 and 1.22, respectively.—*Eng'ing News*, July 13.

Careless Handling of Direct-Current Motors.—Viall.—A short article on the proper handling of direct-current motors. The author cites a case in which the printed instructions given out by a central station for the purpose of guiding those whose duty it might be to start and stop any of the motors owned by the company and rented to its customers, would, if followed, result in the destruction of the motor.—*Am. Elec.*, July.

Horse-Power Value of Streams.—Church.—A mathematical paper in which the author gives some condensed formulas for the rapid estimate of the discharge value of a given drainage area, and illustrates and simplifies the method of computation of the value of the drainage area in connection with partial storage and steam auxiliary. —*Eng'ing Record*, July 1.

City Refuse as Fuel.—Walsh.—An article showing how city garbage and refuse is utilized to generate electricity in many English cities. In nearly all of these, however, the refuse is not sufficient in calorific value, so that the addition of coal is necessary. The actual destroying capacity of the destructors in operation in England with which electrical generating plants are combined averages nearly 2,000 tons of refuse daily.—*Am. Elec.*, July.

Traction.

Single-Phase Traction.—Scott.—A general discussion giving historical notes on the development of the single-phase railway system, which was referred to editorially in our issue of last week. The use of single-phase current is considered essential for heavy and long-distance railway service. "The verdict of American engineers may be safely taken to be that the compensated series type of motor first used by the Westinghouse Company and finally taken up by the General Electric Company is the one best suited for railway work. Various types have been employed by foreign manufacturers, but there is apparently a strong leaning toward the type which has been adopted in America."—*Elec. Jour.*, July.

Single-Phase Traction in Paris.—Gratzmuller.—An illustrated article on single-phase series motors of the Latour type, made by the French Thomson-Houston Company. The present author is the designer of these motors. Crane motors from 3 to 20 kw, with a frequency of 42 periods, have proven satisfactory in every respect for a year. Motors for frequencies of 77, 60, 50 and 42 have been used for elevators and machine tools during the last 10 months. The author discusses the trial made on a tramway line in Paris which was already dealt with in the Digest last week. He gives the principles of the series motor, the repulsion motor and the compensated series motor which is a combination of the two. He then gives the following data on the traction trial. Single-phase alternating current of 25 periods at 500 volts is used. The two four-pole traction motors give each 37 kw at 300 volts; the increase of temperature of the commutator is 75° C. after an hour of operation, while the other points did not increase in temperature by more than 60°. The efficiency is 84 per cent. The air-gap is 2 mm. and the speed reduction by gearing is from 4.6 to 1. A transformer on the car reduces the voltage from 500 to 300 or less. While it would have been possible to use an auto-transformer, it has been thought preferable to use a double-winding transformer in order to use as much as possible the same equipment as will be required in high-voltage cars. (The government regulations do not permit the use of a higher voltage within the city limits.) "The tests have shown that the air-gap may be enlarged without inconvenience and that the motors can easily be started with a torque three times the normal value. The motors weigh 1,350 kg. and the transformer 1,100 kg.; the latter is, however, far too large." The wiring sketch of car and controller was given in the Digest last week.—*L'Industrie Elec.*, June 25.

Electric Traction in Germany.—Haas.—A paper read before the German Association of Electrical Engineers. The author first sketches the development of electric traction in Germany. Up to the end of 1903 the total length of track was 3,300 miles and the number of motor cars 9,100. The total cost of installation of the electric roads is estimated at about $210,000,000. There are on the whole 174 companies with about 42,000 officials and workingmen. On an average every inhabitant of Germany makes 25 trips on an electric road per year. The total receipts of German electric roads during this year was $37,500,000. All cities with more than 40,000 inhabitants have electric tramways, and it is thought that for smaller cities the installation of electric tramways would generally not pay. Further development of electric traction in cities, therefore, depends on the increase of population or the extension of suburbs. Light suburban electric railways have not proven profitable in Germany compared with Belgium. There are in western Germany only one-fifth as many light railways in the same area as in Belgium, and while in Belgium all the light railways are profitable, they are not so in Germany. It is pointed out that there is in Belgium one official department which governs all light railways, and it is thought that this has done much to make them profitable. The author then speaks of "heavy traction." He first refers to city and suburban roads, for which direct current with the third-rail or single-phase, alternating current with a trolley system are thought to be advisable. The latter system will be used on the city and suburban railways in Hamburg. He then refers to high-speed traction proper, and points out the great commercial advantages of high-speed service between two large cities like Berlin and Hamburg, which would thus become sister cities. A man may read and answer his mail in Hamburg in the morning, take a train to Berlin, go to the Stock Exchange and attend to his business, and may be back in Hamburg in the evening. For such railroads the problem of acceleration is of no account whatever. The three-phase system would have the disadvantages of three overhead wires, so that the single-phase system seems preferable. He points out that the essential superiority of the electric system over the steam locomotive is due to the fact that the electric train does not generate its own energy, but gets it from a central station which, if properly dimensioned, represents an inexhaustible reservoir of power. Further development of interurban roads between important cities is expected. For this purpose either the direct-current system or the single-phase, alternating-current system, or the use of both together (with direct current in the cities and single-phase current outside) will be used. On ordinary railways very little has been done so far to introduce electric traction. If there is no large traffic the cost of the overhead construction and of the electric generation of energy will render the service expensive. In Sweden and Norway, where proper fuel for the locomotive is not available, while there are abundant water powers, the problem of introducing electric traction on the main railroads is now being carefully studied by the government.—*Elek. Zeit.*, June 20

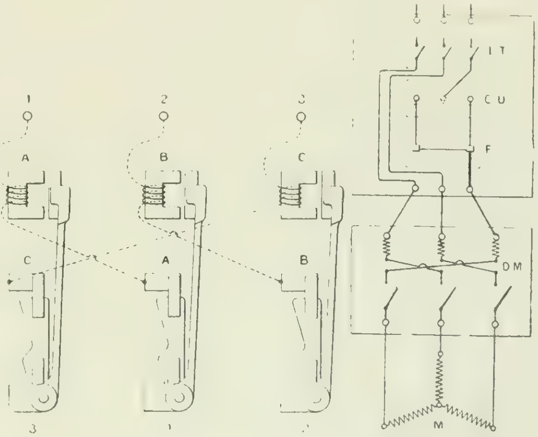
Fields Versus Armatures Nearest Trolley.—Andrews.—It has become standard practice in railway motor work to place the armature in circuit nearer the trolley side of the line and the fields nearest the ground side. The author shows that the most important reason for this method of connection is due to the behavior of the motor when a brush holder or the armature becomes grounded. Otherwise it would probably be better to connect the motor with the fields in the circuit nearer the trolley.—*St. R'y Jour.*, July 1.

Portable Sub-Station.—Hewett.—An illustrated description of a portable sub-station used by the Cincinnati & Columbus Traction Company. It is placed in a standard freight car, which can be hauled about to any point on the line where extra power is needed. The author describes the electric equipment of the car in detail and explains the changes made to adapt the apparatus for operation under the unusual conditions.—*St. R'y Jour.*, July 8.

Railway Braking.—Dawson.—Conclusion of his illustrated serial in which the author discusses automatic pressure governors.—*Elec. Jour.*, July, 1905.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Three-Phase Circuit-Breaker.—An illustrated description of a circuit-breaker for the protection of a three-phase motor, devised by Choulet and built by a French company. It consists of three circuit-breakers as shown in Fig. 2 and connected in such a way that when the current fails in coil *A* then the current in coil *C* is automatically broken so that when there is an accident on one line the three interrupters act automatically in succession. By using this circuit-breaker in connection with a fuse, as shown in Fig. 3, the combination acts in any of the following four cases: accidental failure of the current in the three wires; accidental failure of the current in one of the three wires; dangerous drop of voltage at the motor terminals; overloading of the motor. In Fig. 3 *I T* is a three-pole switch, *C U* a unipolar, double-throw switch (presumably intended to be used, when it is desired to immediately restart the motor, after the fuse has blown and the circuit-breaker has acted; it is then possible to start again at once without first replacing the fuse.) *F* is the fuse; *D M* is the underload circuit-breaker; *M* the motor.—*L'Industrie Elec.*, June 25.



FIGS. 2 AND 3.—THREE-PHASE CIRCUIT-BREAKER.

Starting Rotary Converters.—Wagner.—An article illustrated by diagrams showing in detail all the steps in starting rotary converters in the following three cases. The first case is that of one three-phase rotary converter operating from alternating to two-wire, direct current. The machine is started by a separate starting motor and a synchronizing rheostat. The second case is that of one three-phase rotary converter operating from alternating to two-wire, direct current. The machine is started from the direct-current side as a shunt motor. The third case is that of one two-phase rotary converter operating from alternating to two-wire, direct current. The machine is started with a separate starting motor and a synchronizing rheostat.—*Elec. Jour.*, July, 1905.

ELECTROPHYSICS AND MAGNETISM.

Compressed Gas as an Insulator.—RYAN.—An illustrated account of experimental investigations on the variation of the dielectric strength of gases with varying pressure. Up to pressures of ten to twelve atmospheres the dielectric strength of air varies directly as the density, i. e., directly as the volume and absolute pressure and inversely as the absolute temperature. The rupturing voltage for any given density and distance between terminals, is distinctly affected by the proximity of electrostatic flux-carrying bodies. The material of which the terminals are made has little or no effect upon the rupturing voltage for given conditions. At atmospheric pressure, the rupturing voltage does not vary directly with the distance between terminals, being proportionally higher for shorter distances. Fig. 4 shows the change of the dielectric strength of carbon dioxide with increasing pressure. It has been suggested to use compressed gas for the insulation of underground cables. Experiments have also been made to determine the possibility of using compressed gas as transformer insulation. It has distinct advantages over oil, and it would seem that carbon dioxide or air are about of the same usefulness. However, there are the following disadvantages: Difficulty will be encountered in bringing leads from the case and in keeping the case tight, while the cooling facilities will be poorer. Further, the gas in no way tends to smother an arc once formed as oil does. This has been proved experimentally. In the use of air there is also danger from possible explosions, which the use of an inert gas like CO_2 will avert. The explosions, in air at a pressure of 200 pounds, of volatile matter which might be distilled from the necessary solid insulation of the transformer winding, is a feature well worth examining. It is probable that compressed gas will not prove a formidable rival of oil in the construction of the ordinary transformer, and that any field it may have will be limited to those cases where the essential requirement is enormous insulating strength, for the sake of which, it may be found profitable to overcome the accompanying obstacles.—*Elec. Jour.*, July.

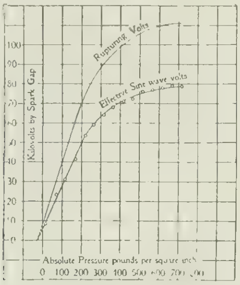


FIG. 4.—CURVES OF DIELECTRIC STRENGTH.

Magnetic Properties of Pyrrhotine.—An account of measurements showed a remarkable dissymmetry in the magnetic structure of pyrrhotine. It is practically ferromagnetic in the magnetic plane and only paramagnetic normal to that plane. The author studied this property by means of a new torsional method, and found that the atomic susceptibility of the iron in pyrrhotine, measured normally to the magnetic plane previously discovered by the author, is very nearly equal to the atomic susceptibility of iron in other paramagnetic compounds.—Lond. *Elec.*, June 30; from *Comptes Rendus*, June 13.

Stationary Electric Oscillations.—GRIMSEHL.—An account of experiments in which he used a modification of the Arons tube in order to make stationary electric oscillations visible. In the Arons tube, two parallel wires are mounted in the interior of an exhausted glass tube. In the author's new form, narrow strips of tin foil are stuck along the outside of the tube, and are connected with the exciter at one end. As in the Arons tube, the gas shines out at the points where high differences of potential exist. The bridges are made of bent copper wires, pressing elastically against the tin foil strips. The latter are easily shortened, and may be lengthened by sticking on further strips. Thus it is possible to get accurate tuning. Several tubes may be placed in series and connected by short wires. For some experiments the author uses serpentine tubes.—Lond. *Elec.*, June 30; from *Phys. Zeit.*, June 15.

ELECTROCHEMISTRY AND BATTERIES.

Cyanide Process for Gold Production.—DAVIS.—A very full discussion of the development and present status of cyanidation in the United States. After some introductory remarks on the history of the process, the subject is discussed under the following headings: Crushing, alkalinity, selection of alkali, treatment of coarse sands, slimes treatment, treatment of high grade ores, precipitation, clean-up and refining. The article is concluded by an interesting discussion of the possibility of regenerating the alkaline cyanides from the double salts. This problem was once considered to be a momentous question, since when solved it would make possible the treatment of all ores by the cyanide process. There are now two known solutions of the problem. But while it has been found in practice that a material saving is accomplished in the cyanide consumption; yet it has also been realized that the value of regeneration was overestimated and that by regeneration the treatment of all ores has not been made possible. These two methods are those by Orr and by Davis. The latter uses a peculiar method of alternating-current electrolysis. It has been used successfully on a commercial scale for some six months, but the theory of the process is not yet understood.—*Electrochem. and Met. Ind.*, July.

Concentration Cells.—CADY.—An account of an experimental investigation in which the author studied concentration cells with liquid ammonia as solvent. From the striking similarity in the behavior of aqueous and ammonia solutions, so far as investigated, it was expected that the laws that hold in water solutions would also apply to ammonia solutions. This was indeed found to be the case.—*Jour. Phys. Chemistry*, June.

Lead Soldering.—SCHOOP.—An illustrated discussion of those methods of antozenous lead soldering, which are of special value for storage battery factories. The first method is the air-hydrogen flame; the hydrogen is either producted from zinc and sulphuric acid, or is taken from steel bottles, in which the hydrogen is compressed up to 125 atmospheres. The second method is the oxy-hydrogen flame; both gases are obtained by electrolytic decomposition of water, and are used in the factory at a pressure of 500 to 600 mm. water column, while for installing batteries outside the factory, the gases are compressed in steel bottles. The author points out the inherent advantages of this method. The third method is the oxygen-illuminating gas flame; according to the circumstances this method may often be used in factories as a substitute for the second method, although the heat of the flame is considerably less. The fourth method is electric welding, which has developed and is in use especially in French storage battery factories; it may be learned by unskilled workingmen in one or two days, while the use of the air-hydrogen flame or of the oxy-hydrogen flame requires considerable experience. Two types of burners, suitable for either the oxy-hydrogen or the air-hydrogen flame are described and illustrated.—*Electrochem. and Met. Ind.*, July.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Capacity of Cables.—DEVAUX-CHARBONNEL.—A description of a new method for measuring the capacity of submarine cables. The author claims that it gives more accurate results than the methods generally employed, and is simple in theory and working. It consists essentially in charging at the same time as the cable a condenser of known capacity connected in series. The capacity of the cable is deduced from the charge taken up by the condenser. If C is the capacity of the condenser and X that of the cable, E the potential of the battery and V that of the common coating, then, if the charges taken up are equal, we have

$$C\,(E - V) = XV.$$

If the condenser is detached and the coating at potential V is earthed, it will take up an additional charge, $Q_1 = CV$, measured by a ballistic galvanometer. With the battery only, the condenser takes a charge $Q_2 = CE$, and the capacity of the cable is given by

$$X = C\,\frac{Q_2 - Q_1}{Q_1}.$$

The author found in the Brest-Dakar cable a capacity always confined between 1,085.8 and 1,087.4. Earth currents and residual charges are eliminated. A serious fault in the insulation does not sensibly affect the result. The author has found that the capacities of cables increase 0.3 to 0.4 per cent. after laying, probably owing to the enormous pressure on the insulation.—Lond. *Elec.*, June 30; from *Comptes Rendus*, June 13.

New Platinum Contact.—GILDEMEISTER AND WEISS.—In physiological experiments with short electric currents it is usual to employ a Helmholtz pendulum for breaking the circuit. It is desirable to use the same means for closing it, but it is much more difficult to obtain an instantaneous make than an instantaneous break, since the terminals suddenly thrown into contact are liable to vibrate and lead to several breaks before the circuit is finally closed. The present authors have worked out a successful contact, which, with care, works accurately to within one-millionth of a second. It is an improved form of that devised by Edelmann, and consists of a lever, *b* (see Fig. 5), which is hit vertically by the arm of the pendulum advancing in the direction of the arrow. This releases the contact screw *m* and breaks the circuit. After a short interval, the stay *n* is withdrawn from the lever *p*, and the spring *s* draws it into contact with *q*, thereby closing the circuit. By gradually reducing the interval the authors obtained a zero point, and judged by its steadiness whether there was any vibration. Finding that there was, they covered the spring *s* with thin rubber tubing, stuck a steel pencil on the lever *p* with wax and wound it with iron wire. This damped the oscillations effectively. The contact sounds "leaden" if it is good.—Lond. *Elec.*, June 30; from *Ann. der Physik.*, No. 6.

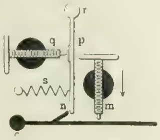


FIG. 5.—PLATINUM CONTACT.

Comparison of the Mutual Induction of a Pair of Coils with the Self-Inductance of One of Them.—HERDEGAN.—An abstract of a paper presented at the Chicago meeting of the American Physical Society. Maxwell's method is modified so as to permit the use of the differential transformer as a measuring instrument. The balance condition being equality of amplitude and phase of the two currents in the differential transformer simplifies the expression for the ratio of L to M. The sharpness of the balance makes it possible to determine this ratio to an accuracy of one-tenth of one per cent for a single observation.—*Phys. Review*, July.

BOOK REVIEW.

LE TURBINE. (Steam Turbines.) By Giuseppe Belluzzo. Milan: Ulrico Hoepli. 413 pages, 300 illustrations.

The steam turbine has so recently sprung into active service on a large scale that there has been but little opportunity to develop its engineering theory. This volume is one of the most complete textbooks on the steam turbine that has yet appeared in the Italian language. It employs principally graphic methods in its theoretical treatment.

The book is divided into four sections. The first deals with the elementary principles of the subject. The second applies graphic methods to the quantitative properties of steam and gas turbines. The third treats of the various forms of turbine in practical use and compares their properties. The fourth deals with the use of the steam turbine in marine service. The types of turbine described are those of De Laval, Seger, Riedler-Stumf, Rateau-Elektra, Zoelly and Curtis.

The book is excellently illustrated and clearly written. It will be of great interest to students of engineering acquainted with the Italian language.

Opening of the International Electrical Exhibition at Boston.

THE International Electrical Exhibition, held in connection with the convention of the National Electrical Contractors' Association, was opened at Mechanics Hall, Boston, Saturday evening, July 15. About 3,000 persons were present, and from the electrical standpoint it is safe to say that no exhibition of recent years in Boston has presented so many features of interest. The entire upper floor of the building and part of the basement were devoted to attractive displays, and the halls and booths were tastefully decorated with the national colors in flags and bunting. The widespread use of decorative lamps added brilliancy to the scene.

The entire platform at the west end of the main hall was occupied

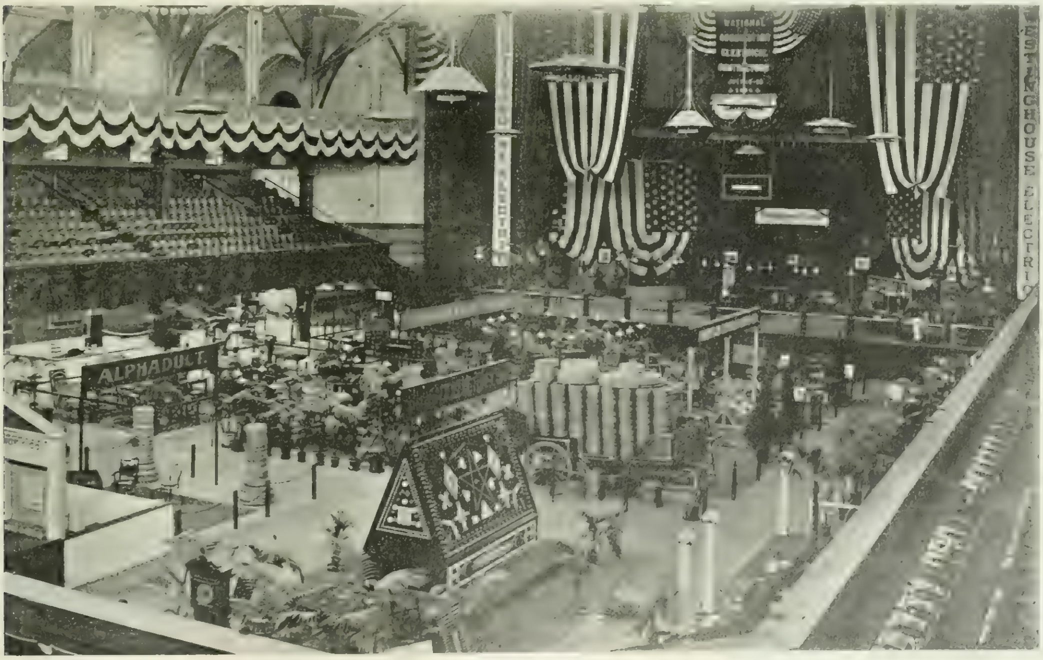


FIG. 1.—GENERAL VIEW OF MAIN HALL.

by the Westinghouse Electric & Manufacturing Company. Over the center of the exhibit was a large high-potential electric sign bearing the word "Westinghouse" in porcelain letters on a dark background. The letters were backed with tin-foil, and alternating discharges at 30,000 volts between the backs produced striking effects. Various types of Sawyer-Man lamps were displayed in a glass case on the platform, including colored, pear-shaped and circular bulbs, frosted and plain types, silvered reflectors, etc., from 4 cp to 50 cp. Along the front of the platform vertical standards carried a fine display of Nernst lamps, consisting of the single-glower, 50-cp, the double-glower, 100-cp and the triple-glower, 170-cp types. A 42-in. Stafford fine yarn cotton loom was shown in full operation, being geardriven by a ½-hp, three-phase, 200-volt, 25-cycle induction motor with automatic stopping devices actuated by the breaking of a thread in the weaving process or other mishaps in the loom proper. Another prominent exhibit of this company was composed of a large table of central station and portable testing instruments. These included a portable polyphase wattmeter, portable series transformer adjustable from 10 to 50 amp., an alternating-current ammeter adjustable from 5 to 10 amp., which can be used with the preceding instrument to cover a scale range of 5 to 50 amp., always working at the accurate points of the scale; a portable voltage transformer, portable precision voltmeter and a portable indicating wattmeter independent of power factor effects. A single-phase synchroscope was shown, also a frequency meter, series incandescent shunt coil and a prepayment wattmeter with a capacity of $2.50 in quarters. Four Cooper Hewitt mercury-vapor lamps were exhibited, and a prominent place was occupied by a 50-lamp arc circuit regulator with a new woven-wire screen for coil protection. An alternating-current arc switchboard panel with an oil switch was shown, together with a 50-kw, 25 or 60-cycle oil-insulated, self-cooling transformer for the high-potential sign mentioned above. Fuses of the enclosed type were shown, ranging from 250 to 20,000 volts in potential rating and up to 400 amp. at 1,500 volts in capacity. Series and multiple arc lamps for direct and alternating circuits were displayed, together with a high-tension oil switch for pole service up to 6,600 volts, fan motors and a 5-hp single-phase, 110-volt, 60-cycle induction motor with automatic centrifugal clutch for taking up the load. In the audience room on the second floor a biograph exhibition comprising a trip through the Westinghouse factory at East Pittsburg was given nightly to interested audiences.

The General Electric Company exhibited in its space in the main hall an interesting group of apparatus. Foremost came the new 2.5-watt incandescent lamp of the company, called "a high-efficiency lighting unit," fitted with a metallized carbon filament. Sixteen of these lamps in the 50-cp, 110-volt size were hung in a square above the easterly group of palms and floral pieces which attractively surrounded the exhibit space, current being supplied by a 30-amp. mercury arc rectifier mounted on a switchboard panel in the middle of the floor. The rectifier received 220-volt, single-phase, alternating current and supplied the lamps with 110 volts direct current. The 2.5-watt lamps were shown in operation and separately on tables in the 50-cp and 100-cp sizes with frosted bulbs and both concentrating and diffusing Holophane reflectors. At the west end of the exhibit the 100-cp size was shown in operation, surrounding a large enclosure. Half a dozen 1905 fan motors were shown and several small alternating-current and direct-current motors for automobile and general power service were displayed, together with a 1-kw motor-generator set, 500 to 10 volts for storage battery charging. Two biographs of electric locomotives and trains were in frequent operation.

An operating exhibit of the Gray National Telautograph Company, of Boston, was shown in the main hall. Two stations were fitted up with improved equipment noticeably more compact than the earlier types of apparatus displayed by the company.

Two wireless telegraph stations were fitted up in the hall by the Marconi Wireless Telegraph Company for the transmission of messages, and many visitors availed themselves of the privilege. The messages were automatically printed in the Continental Morse code on a paper strip and given away as souvenirs.

Pass & Seymour, Inc., of Solvay, N. Y., displayed a large number of specialties in the way of double-pole brass sockets, wall sockets, attachment plugs, porcelain cleats, wiring tubes, primary cut-outs, all styles of regular and special equipment for wood and metal signs, and temporary cut-outs.

The Couch & Seeley Co., of Boston, showed a complete line of telephones and supplies, including central energy and magneto switchboards for central offices and private branch exchanges, interior and intercommunicating systems of the non-interfering and common return types, portable street railway and linemen's sets.

Inter-pole motors received attention at the hands of the Electro-Dynamic Company, of Bayonne, N. J. A working exhibit with a 4 to 1 speed variation was shown by belting a 5-hp motor to a generator which could be loaded up to 100 per cent overload on the motor. An ammeter of large size and a similar speed-calibrated voltmeter were mounted prominently to show the speed and load changes. Reversals were also made to show the absence of sparking under severe conditions of service.

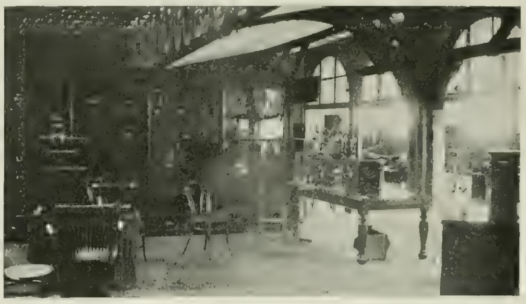


FIG. 2.—COUCH & SEELEY CO.'S EXHIBIT.

G. M. Gest, conduit expert, of New York, exhibited a large number of photographs showing construction work performed by him in different cities of the United States, also in Montreal, Toronto and Mexico City.

Trolley maps, the "Trolley Wayfinder," timetables, information and guides were supplied from a booth occupied by the New England Street Railway Club's "Bulletin."

The Bryant Electric Co., of Bridgeport, Conn., and the Perkins Electric Switch Manufacturing Company, of that city, had a main exhibit installed artistically on the sides and ends of an A-shaped wooden tent 14 ft. high and 12 ft. long; 9,000 screws were used in installing the switches, cut-outs, fuses, sockets, bases, etc., which made up this exhibit. Prominent in the exhibit was the Perkins push button switch, designed for easy connection and alignment, and built in sizes up to 250-volt rating for incandescent and power service. The Perkins panel switch was also shown, built with all its terminals concealed, with two double-pole switches for two and three-wire service, indicating features, porcelain bases, covers, keys and with plug fuse cut-outs. These switches are especially adapted to grouping. A full line of Bryant enclosed fuses was shown, 250 to 1,500 volts and 400 amp. maximum capacity at the latter potential.

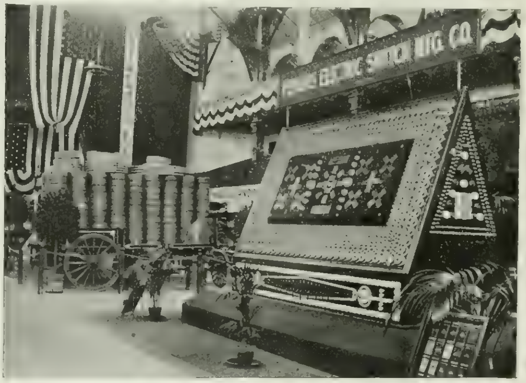


FIG. 3.—EXHIBITS OF AMERICAN CIRCULAR LOOM CO. AND PERKINS ELECTRIC SWITCH MFG. CO.

Two large wagon loads of equipment were shown by the American

Circular Loom Company, of Chelsea, Mass. One of these contained 75,000 ft. of circular loom conduit varying in internal diameter from ¼ in. to 2½ in., and the other six tons of "electro duct" enameled conduit and fittings varying from ½ in. to 4 in. in diameter. Various sizes of circular loom conduit were also shown in a circular design mounted on a large standard.

The contract department of the Edison Electric Illuminating Company, of Boston, had an attractive exhibit space, showing photographs of the company's power stations and inviting visitors to their permanent exhibition of electrical appliances at Head Place, Boston.

The Chase-Shawmut Company, of Boston, displayed a complete line of rail bonds, outlet bushings, enclosed fuses up to 600 amp. capacity, open fuses and porcelain fittings.

The Ridgway Dynamo & Engine Company, of 53 State Street, Boston, and Ridgway, Pa., exhibited a 6-hp, 250-volt motor with a 6 to 1 speed variation, 300 to 1,800 r.p.m. Of these machines 3,215 have been placed in service, averaging 16¼ hp each. The company also showed a compact direct-connected, engine-driven, 25-kw, direct-current generating set for general lighting and power service. The engine was of the 9-in. by 10-in. size, making 325 r.p.m., with a guaranteed regulation of 1 per cent. The cross-head shoes are designed so that lost motion can readily be taken up.

A large assortment of enclosed fuses, varying from .3 amp. to 600 amp., and up to 6,000 volts, was shown by the D. & W. Fuse Company, of Providence, R. I. Substantially designed cast-iron service switch boxes were also displayed. This company also displayed field coils made of Deltabeston wire, in all stages of construction. Among the special coils exhibited were: One from a railway motor in which the outer cotton insulation had been roasted off, while the asbestos wire covering had remained uninjured, leaving the coil suitable for rewinding; and another which had been kept at 900° F. for 97 hours and then showing over 400 megohms insulation resistance after being immersed in water. Comparative tests of cotton-covered and Deltabeston wire for charring and red heat were made in the exhibit.

Armature varnishes, P. & B. tapes and insulating paints were shown by the Standard Paint Company, of New York.

The Okonite Company, Limited, showed a large assortment of wire and tape, a large rubber biscuit cut in half to exhibit the inside of fine rubber and a submarine cable which had been tied in hard knots by a tub boat anchor. The Osburn Flexible Conduit Company, of New York, exhibited 40,000 ft. of ¼-in. to 1½-in. conduit, laying special stress upon the toughness, flexibility and interweaving of the component parts. Associated with these three latter companies the Pettingell-Andrews Company, of Boston, exhibited Peerless electric fans, supplies, a 20-cp, 110-volt, 2-watt tantalum lamp in operation and also an alcove space showing illuminated gas and electric fixtures, fancy shades and patterns, mosaic glassware, etc.

A large assortment of heating appliances was displayed by the Simplex Electric Heating Company, of Boston. These included, in part, electric flatirons varying from a 3-pound traveling iron to a 25-pound goose iron, with and without automatic handles and stand switches. Domestic heaters, milk warmers and traveling cups, coffee percolaters, small kitchen stoves, broilers, griddles, a waffle iron, plate warmer, ovens, radiators, glue pots, soldering irons, treeing iron, curling iron and grease paint theatrical heaters, instrument sterilizer and heating pads were also shown. The Simplex Electrical Company, of Boston, exhibited in the same booth armored and lead-covered aerial and submarine cables for general signaling and power work.

The R. M. Cornwell Co., of Syracuse, N. Y., showed universal switch boxes, the "Wonder alternator," weighing 4½ pounds, height 4½ in., length of shaft 6¼ in., output 12 watts, and the "Wonder" dynamo-motor, weighing 4 pounds. There was also exhibited a 3-hp, two-cylinder gasoline engine and a 1½-hp single-cylinder engine.

The Condit Electrical Manufacturing Company, of Boston, exhibited a three-panel Alberene stone switchboard equipped with automatic and non-automatic oil switches, laminated circuit-breakers for alternating-current and direct-current capacities up to 3,000 amp. at 500 volts, an electrical remote control oil switch, knife type of circuit-breakers and samples of "loricated armorduct" from ½ in. to 4½ in. diameter.

A number of specialties were shown by the American Electric Novelty Company, of New York. Among these were the "Noscru" type of screwless push button for street car and telephone or other similar work, the "Ever-Ready Cigar Lighter," aluminum two-light reflectors for incandescent lamp candle-power increase, the "Ever-Ready" keyless clocks and dry battery, flash lamps, miniature lamps, pocket ammeters and surgical lamps.

The Wireless Electric Railway Company, of Philadelphia, showed a model car in operation on a narrow-gauge track with contact buttons in the center, between the rails. The car shoe spans 1½ buttons, which are alive only when the car is directly above, the current being thrown on by an electromagnet in the car which operates a loose armature switch in the button beneath. The wireless electric battery was also shown in this exhibit.

The Bossert Electrical Construction Company, of Utica, N. Y., exhibited outlet boxes, "New Imperial" switches, made up of single pieces of flat copper with no solder or broken contacts, "Monitor" bushings, Erickson insulators and bushings for Greenfield flexible conduit and Sprague armored conduit.

The Electric Gas Lighting Company, of Boston, exhibited an automatic interior system for house or desk installation in which the calling plug releases automatically when the receiver is returned to its hook after a conversation is finished. But one button is required to be pushed in ringing and talking. This is a new feature in a metallic system and was shown for the first time. This company also exhibited for the first time its "Rotokoll" central energy switchboard with 300 lines, all accessible from one position. Each drop occupies no more vertical space than its corresponding jack, which is located beneath the drop instead of at the bottom of the board as in former practice. A general line of house goods and hotel equipment was shown, including a 100-line "annunciphone" associated with a safeguard fire alarm attachment. A marine telephone set of robust design was exhibited; also the "Ever-Sure" automatic vestibule apartment house telephone system, which is non-interfering. A new distributing box for telephone connections was shown, the principal feature being connections on each side for the main cable and two separate toes.

The Thompson-Bonney Co., of New York, showed for the first time an electrically driven revolving window display case equipped with plate glass trays and miniature lamps. The motor for driving was rated 1-20 hp. There was also shown a small motor for musical instrument or sewing machine work. Railway fittings and insulating material were exhibited, together with a jeweler's and optician's motor driven drill 10 in. high.

Herbert W. Smith, Boston, representing the Teater-Heany Development Company, the Chicago Mica Company, Rhode Island Electric Works, Swazey & Smith, Inc., the Waterbury Co., Prometheus Electric Co. and United Copper Foundry Co., showed fire-proof magnet wire, "mica bond" insulating material in various forms, magnet wire, a corrugated trolley pole, low and high-tension bracket arms, self-lubricating trolley wheel, wire and marine ropes, lead-covered cables, panel and switchboards, rubber covered wire, and "Process" copper, 4-in. and 6-in. trolley wheels. A test piece of "Process" copper was exhibited; it had broken at a tensile stress of 46,540 lbs. per sq. in.

The S. H. Couch Co., of Boston, exhibited a large assortment of telephone apparatus, including an intercommunicating combination automatic telephone and annunciator for apartment house service, flush automatic telephones for residences, a 100-line visual target exchange board, new automatic desk set containing 26 stations, stated to be the highest number of stations thus far built for such service, and a full line of hand and wall instruments for common and individual battery service. The casting on the apartment house sets is in one piece, with cleanable celluloid strips for names and numbers. Special attention was paid in the exhibit to automatic service.

The Ovington Mfg. Co., of Boston, exhibited its "Ovington Electro-Therapeutic and High Frequency Apparatus," which supplies every form of current that a physician requires, which means 10 currents besides a high-frequency discharge. Numerous interesting and spectacular high-voltage experiments were frequently performed in this exhibit.

The American Steel & Wire Company maintained headquarters in the main hall.

A working model of the Automatic Electric Train & Station Annunciator Company's system was shown in an exhibit, the headquarters of the company being at Lexington, Mass. The E. R. Brown Beer Pump Co., of Boston, showed a beer pump driven by a 1-7 hp motor.

The Renim Specialty Co., of Boston, exhibited switch and outlet boxes, cut-out cabinets and quartered oak trims. "Ideal" floor treads were also shown. A new cast-iron cut-out cabinet adapted for a combination cut-out and switch was shown, the device being adapted to either flexible or iron conduit.

The Stuart-Howland Co., of Boston, in a large space, showed Helios-Upton enclosed arc lamps, magnetos and interrupters for automobiles and power boat service, gongs, bells, fans, spark coils, gas lighting supplies, "Pagoda" shades and telephone apparatus, besides other general supplies.

The Dale Co., of New York, occupied an exhibit including electric lighting specialties, sockets, standards, wireless clusters, fittings, portable lamps, shades, fixtures and brackets.

Watchmen's clocks were shown by Simplex Time Recording Co., of Gardner, Mass., and by the E. Howard Clock Co., of Boston. The latter company showed a regulator master clock driving a 4-ft. secondary, an electric watchman's clock with unlimited station capacity, a recording watchman's clock, and the 150 station magneto-watchman's clock recently completed for Jordan, Marsh & Co., of Boston. The latter is the largest clock of the magneto type ever built.

The Alphaduct Mfg. Co., of New York, displayed about 15,000 feet of flexible interior conduit varying in size from ¼ in. to 1½ in. The interior of this conduit is cotton duck finish dusted with powdered soapstone. The Addressograph Co., of Boston, also exhibited its product.

The McKenney & Waterbury Co., of Boston, showed an artistic grouping of art glass and portable lamp fixtures to match in the Elizabethan, Art Nouveau, Renaissance, Rococo and Flemish Dutch styles. A ball-bearing adjustable bracket was also exhibited. It was the object of the exhibit to show what could be done in harmonizing color schemes and lighting effects, and this was notably accomplished.

The National Carbon Co., of Cleveland, Ohio, exhibited arc light carbons for open and enclosed service, an electric furnace carbon 6 in. in diameter and 52 in. high, carbon brushes and dry batteries. This company also brought out a new battery for railway signal and fire alarm service, called the "Columbia closed circuit battery." The elements are zinc, copper, oxide and caustic soda dissolved in water. A 300-ampere hour discharge is guaranteed at about .7 volt. A new line of flash lights for household use was also shown.

C. S. Knowles, of Boston, displayed high-tension porcelain insulators for voltages of 10,000 to 60,000, and glass insulators for potentials up to 40,000 volts. Samples of enamel duct from ½ in. to 4 in. diameter were shown, with porcelain fittings for wiring installations, steel insulator pins and angle iron transmission cross-arm braces. The Worcester Polytechnic Institute's 200,000-300,000 volt transformer was in service in the Knowles exhibit for insulator testing and high-tension experiments. The current supply for this transformer was provided by a motor-generator set furnished by the Frank Ridlon Co., of Boston.

John A. Roebling's Sons Co., of New York, maintained headquarters at the exhibition.

The Marshall Electric Mfg. Co., of Boston, exhibited baby knife switches, Dow lamp adjusters, snap switches, and indicating snap switches in which the lettered plate is held from slipping by a small rivet.

Peter Forg, of Somerville, Mass., exhibited a variety of adjustable electric light fixtures with telescopic arms and ball and socket joints. Special designs for students' use, doctors, architects and draftsmen were shown, together with shop fixtures. A feature of the exhibit was the Forg steel drop forged automobile sprocket wheel.

The Benjamin Electric Mfg. Co., of New York, exhibited wireless clusters approved by the National Board of Fire Underwriters up to 650 volts; the "arc burst" cluster composed of 6 Meridian frosted lamps in a horizontal plane and one in a vertical plane; and the "Daylight" cluster composed of 6 Meridian lamps fitted with diffusing reflectors. These wireless clusters are built up to 50 lights capacity and present an interesting example of advanced illumination. The "arc burst" cluster was rated at 205 cp and equipped with two inverted top shades and a Prismo shade on the bottom; the Daylight cluster gave better effects with only 150 cp and diffusing reflectors.

The Miniwax Co., of New York, supplied the exhibition with fire extinguishers and also had an exhibit of these devices.

The Worcester Electric Mfg. Co., of Worcester, Mass., exhibited a handsome panel board mounted in antique oak, knife and quick break switches, fuse blocks and an isolated plant switchboard complete in one panel.

The H. T. Paiste Co., of Philadelphia, exhibited a full line of sockets, P. K. rosettes, panel boxes, attachment plugs, cut-outs and switches.

Five triplex, duplex and differential chain blocks, hand hoists varying from 1 ton to 20 tons capacity were shown by the Yale & Towne Mfg. Co., of New York. The 20-ton hoist can be handled by one man at a pull of 140 lbs. on the hand chain; the full load rises .6 ft. per minute with 79.5 per cent mechanical efficiency. There was also one 2-ton electric hoist driven by a 3-hp motor. This outfit had a single upper hook, making it portable for use on any suitable overhead support or trolley.

The Albert Champion Co., of Boston, exhibited electric specialties for automobile service, including battery sets, small lamps, spark plugs, rubber-covered wire and gauges. The Manhattan Electrical Supply Co., of New York, maintained headquarters and showed flush plug receptacles and "Sarco" combined outlet and junction boxes.

Samples of wire and rubber were shown by the Eastern Electric Cable Co., of Boston.

The Heinze Electric Co., of Boston, showed a large assortment of X-ray and wireless telegraph apparatus, automobile spark coils, a motor-driven mechanical interrupter for induction coil or theatre dimming service, and a 50-in. induction coil for experimental and spectacular purposes.

The Shelby Electric Co., of Shelby, Ohio, had a lamp testing room fitted up with a Queen photometer and a compartment divided for comparative tests of different commercial lamps.

The O. C. White Co., of Worcester, Mass., displayed a large variety of adjustable fixtures for machine shops, desks, drafting rooms, studios, libraries and banks.

Dossert & Co., of New York, showed joints for connecting wires or cables without the use of solder, ranging from 12-wire to 2,000,000 cm cable, trolley splicers, top joints, top hooks and aluminum connectors. Lugs for panel boards and switches were also displayed.

Automatic electric pianos were shown by the Wood Piano Co., of Boston, and visible typewriters by the Wellington Mfg. Co., of Boston.

Johnson & Morton, of Utica, N. Y., exhibited their "Universal" direct connection panel, style BD distributing cabinet, storage battery charging switchboard and knife switches.

The exhibit of the Valentine Electric Sign Company, of Atlantic City, showed the manner of applying the stock letter to various uses, such as in panel signs for either grooved or black letters or in skeleton frame signs. The stock letters are made of galvanized-iron finished in red and white enamel, and they are practically waterproof. A sign built for small first cost and operating expense was shown in a drug store unit lighted by four 8-cp lamps. Colored lamp signs were also exhibited.

The Trumbull Electric Manufacturing Company, of Plainville, Conn., exhibited panel boxes, switches, cut-outs and porcelain fittings. Two Baker electric automobiles were shown and the Electric Vehicle Company, of Hartford, also exhibited an attractive carriage.

The American Electric Sign Company, of New York, furnished practically all the illuminated signs in the general exhibit work and in its own booth the company showed an interesting variety of signs, flashing mechanisms, time switches and an advertising mirrorgraph.

The International Instrument Company, of Cambridge, Mass., exhibited a laboratory clock, laboratory accessories, an electric centrifuge for rapid precipitation, used in testing for solid matter in milk and other liquids, a 10-hp absorption brake and an electric chronograph.

The H. W. Johns-Manville Co. displayed Sachs Noark and National Code standard fuses up to 10,000 volts, 50 amp., and 600 volts, 600 amp., subway cable and fuse boxes, "Electrobestos" and "Transite" conduits for car wiring, Manville fire extinguishers and trolley line material.

"Eastern" dry batteries, No. 3 and Atlantic types, carbon brushes, plates and cylinders showing the steps in brush manufacture were exhibited by the Eastern Carbon Works, of Jersey City.

The Steel City Electric Company, of Pittsburg, Pa., showed Fullman bushings, locknuts and floor outlets, "Universal" insulator supports and beam straps, conduit benders and Thompson reamer attachments.

The Holtzer-Cabot Electric Company, of Brookline, Mass., showed a large number of small motors for varied service, gongs, telephone supplies, annunciators, motor-generators and experimental equipment.

Charles A. Cotton, of Boston, exhibited a line of Triumph motors from ½ hp to 15 hp, and Century self-starting, single-phase motors from 3 to 5 hp, 60 cycles. Charles L. Garrison, of Boston, exhibited a 1-kw De Laval steam turbine, speed 25,000 r.p.m., and steam pressure 150 pounds.

The Blake Electric Company, of Boston, showed a line of cut-out tablets, starting boxes, fan motors and general supplies; the Holophane Glass Company, of Chicago, displayed a great variety of shades and globes, and the Economical Lamp Company, of New York, exhibited a turn-down incandescent lamp. Booth & Co., engineers and contractors, Boston, maintained headquarters in the building and John L. Gleason, of Boston, exhibited universal moulding boxes, junction and reduction boxes for 2 and 3-wire circuits, from ¼ in. to 1 in. groove.

The A. C. & M. L. Felkin Co., of Boston, exhibited "Imperial" electric signs adapted for day and night service, internally lighted, with inside reflectors of galvanized iron. The Little & Emerson Co., of Boston, showed an electric calendar; the Olds (Boston) Gasoline Engine Works a gasoline engine exhibit; the Cooley General Development Company, of Boston, a rotary engine installation, and Dunton & Field, of Cambridge, Mass., tree insulators.

The following were the concerns interested and their representatives:

Electrical World and Engineer. J. M. Wakeman, George W. Elliott, T. C. Martin, H. S. Knowlton.

Westinghouse Electric & Manufacturing Company. B. L. Warren, J. C. McQuiston, D. E. Manson, C. B. Humphrey, G. B. Griffin, G. C. Ewing, C. Wahn, G. L. Osborn, G. M. Bates, L. Watts, P. Bond, G. Gibbs, L. W. Reed, M. H. Merrill, H. M. Young.

Nernst Lamp Company. E. W. Clark, Mr. Holbrook.

General Electric Company. F. H. Gale, J. P. Felton, R. B. Hanson, O. F. Brastow, W. M. Wright, C. B. Davis, Mr. Kinney.

Dossert & Co. J. L. Holland, H. A. Bristol, M. R. Jarvis.

Renim Specialty Company. M. Robinson.

Sprague Electric Company. Alex. Henderson, H. C. Farnsworth, H. H. Hornsby.

I. P. Frink. Frank Stout.

Osburn Flexible Conduit Company. C. E. Corrigan.

American Electric Lamp Company. C. J. Purdy, general manager.

Munder Electric Company. C. F. Munder.

Improved Moulding Manufacturing Company. W. T. McDowell.

Marshall Electric Manufacturing Company. Norman Marshall.

Holtzer-Cabot Company. A. W. Waterman, E. F. McCobb, T. W. Ness.

Holophane Glass Company. I. W. Farquharson, H. C. Jones.

H. T. Paiste Company. E. A. Jenkns, C. I. Hills, George MacElwee.

R. M. Cornwell Manufacturing Company. Hiram Cornwell, F. S. Baldwin.

Condit Electric Manufacturing Company. S. B. Condit, Jr., F. W. Nason, J. Fisher.

Johnson & Morton. W. H. Morton, M. H. Johnson, J. H. Cramphorn.

American Electric Sign Company. C. I. Wetmore, J. L. Russell, C. M. Borden.

H. W. Johns-Manville Company. A. D. Newton, J. W. Perry, Joseph Humphreys, W. R. Walsh, E. L. Cameron. E. B. Hatch, Joseph Sachs, Johns-Pratt Company.

Chase-Shawmut Company. H. P. Moore, J. J. Miley, F. D. Masterson, J. T. G. Nichols, Jr.

Worcester Electric Manufacturing Company. James McGrady.

Electric-Gas Lighting Company of Boston. H. C. Thomson, C. E. Lee, A. F. Boardman, C. R. Sherman, C. F. Howes, C. H. Young.

O. C. White Company. O. C. White, Jr., F. M. Pond.

Eastern Electric Cable Company. H. M. Daggett, C. W. Knight.

Trumbull Electric Manufacturing Company. J. H. Henry, Frank Trumbull, G. W. Edge, T. D. Watson.

Simplex Electrical Company. Mr. Davis.

Yale & Towne Manufacturing Company. C. W. Beaver, William Hazleton, John T. Boyd.

Eastern Carbon Works. George W. Mills, Williams Mills, O. L. Turgeon.

National Carbon Company. A. C. Henry, J. C. Irvine.

Manhattan Electrical Supply Company. J. W. McDowell.

Harvey Hubbell. H. W. Bliven, Joseph Rogers.

Pettingell-Andrews Company. C. B. Price, F. W. Cramphorn, W. J. Keenan, Messrs. Peterson, Palmer and Jones.

S. H. Couch Company. S. H. Couch, W. Couch, C. E. Monroe.

Stuart-Howland Company. G. M. Stuart, A. Howland, J. W. McNair, C. B. Wetmore, A. E. Payne, R. M. Merritt, Harry De Steese, J. B. Bailey, C. R. Fish, J. E. Wilson, J. T. Hessel, H. C. Dalton.

Simplex Electric Heating Company. J. I. Ayer, C. W. Richards.

Amer. Circular Loom Company. A. T. Clark, H. B. Kirkland, T. H. Bibber, M. W. King, R. B. Corey, H. C. Adams, Jr.

D. & W. Fuse Company. C. E. Harmon, W. S. Sissons, L. W. Downs.

American Electric & Novelty Manufacturing Company. F. J. Alvin, S. S. Shepard.

Sarco Company. Ralph A. Schoenberg.

G. M. Gest. W. T. Jackson.

Dale Company. J. H. Dale, O. J. Bryan, H. S. Ransford.

Electro-Dynamic Company. G. H. Condict, Messrs. Bell, Mitchell and Warner.

Couch & Seeley Company. E. B. Seeley, F. C. Redfield.

Alphaduct Manufacturing Company. Russell Dart.

Gilmore Electic Company. William Gilmore, E. L. Brown, E. E. Fernald.

Diehl Manufacturing Company. B. C. Kenyon, H. S. Miller.

John A. Roebling's Sons Co. H. L. Shippy, F. W. Harrington, Messrs. Mann and Van Ortwick.

Bossert Electric Construction Company. F. T. Foxenberger, F. B. Smith, W. P. Crockett, R. B. Corey, C. W. Bongard.

Hart Manufacturing Company. H. A. Hart, F. B. Smith, W. P. Crockett, C. W. Bongard.

Pass & Seymour. John W. Brooks, W. B. Hall, A. M. Little.

De Veau & Co. A. S. De Veau.

Bryant Electric Company. V. C. Gilpin, E. R. Grier, Ed. Patton, W. C. Bryant.

Automatic Electric Train & Station Annunciator Company. Henry T. Goold.

Equipment for New Plant of the New York Edison System.

Work is being pushed actively on the new plant of the New York Edison Company, adjoining immediately the well-known Waterside station, on the East River at Thirty-ninth Street. The older plant is running to its full capacity, and the current from the new will be needed this fall. The order for the initial equipment has fallen to the Westinghouse interests, which met the requirements and guarantees as to delivery, etc., it being imperative that current should be available in view of the rising demand due to the reduction in price of current and the enormous peak of the load at the Christmas holiday season. Waterside station No. 1, it will be remembered, is equipped with Westinghouse vertical, three-cylinder, compound reciprocating engines which, although installed only a few years ago as then representing the highest type of large engine construction, have apparently been outclassed through the rapid advance of the steam turbine system. No less than eleven of these large engine type units are now in service in this station, each rated at about 6,500 horse-power capacity and direct connected to a 3,500-kw generator. The next step in the acquisition of larger units resulted in the installation of 5,000-kw turbine units of the Curtis type. In the equipment of the new Waterside station with two Westinghouse turbine units of 7,500 kilowatt capacity, over twice that of the original engine type units, there will here exist a striking example of the extremely rapid development in power station construction that has taken place since 1900.

The extreme compactness of the new generating unit is evidenced by the small space it requires in the new power station arrangement. Its over-all dimensions are approximately: Length, 50 feet; width, 17 feet; height, 15 feet; floor space, 850 sq. ft. per unit net, or .113 sq. ft. per kilowatt capacity. This is less than one-half the space occupied by the engine type units which are the most compact type yet built for central station work. A condenser of the surface type will be located beneath the turbine in the foundations proper. This arrangement is in all respects equivalent to that claimed to be incidental only to the vertical type of turbine which requires much extra space for condenser and turbine auxiliaries.

The new turbines will operate under 175 lb. steam pressure, approximately 28-in. vacuum and 100 degrees superheat, the normal speed of the unit being 750 r.p.m. Under these conditions the consumption of the complete unit will be in the neighborhood of 16 lb. per kw-hour at full rated load. Each unit will have an overload capacity of at least 50 per cent, or will be capable of developing full rated load without the use of a condenser. A distinctive feature of this design is that the turbine gives its best economy around full rated load, although a large overload capacity is at all times instantly available when required without material sacrifice of efficiency. At this maximum load each turbine will be developing over 15,000 horse-power at the shaft, which is by far the greatest amount of power ever developed in a single prime mover in stationary service.

The direct connected turbo-generators will be of standard Westinghouse construction, delivering 6,600-volt, three-phase current to the high tension network at a frequency of 25 cycles per second. The generators will embody the new enclosed construction which constitutes an important advantage in the entire elimination of the hum peculiar to high-speed turbine generators. They will have an efficiency approximating 97½ per cent at full rated load. Each generator will be able to sustain for several hours an overload of 50 per cent within reasonable temperature rise.

It is of interest in connection with this important installation that, almost simultaneously, three Westinghouse turbine units of the same size have been ordered for two large Brooklyn power stations, one for railway and the other for lighting service, making a total of over 50,000 horse-power in turbine machinery of this size. Two units will go to the Brooklyn Heights Railway Company, and the third to the Brooklyn Edison Company. Such orders reflect the prosperous condition particularly of the electric lighting business, and the expansion of the industry for producing current.

Radial Arm Crane Controllers.

The illustrations herewith show a new type of crane controller, known as the radial arm, which is being placed upon the market by the Cutler-Hammer Manufacturing Company, of Milwaukee. In designing these controllers the purpose was to overcome the difficulties met with in former types and to attain, with the most simple construction possible, proper control with the minimum number of points at which arcing could occur as the controller deteriorated in service, and to make certain that when arcing did occur it would be under predetermined conditions and with ample protection. In addition, provision was made for ease of operation, adaptability to all conditions of service, ease of renewals and interchangeability of parts.

In types B and C these ends were achieved by mounting the front above the resistance, thus giving free accessibility to the connections on the back of the slate. The front itself consists of four sets of segments, the connections of which are so arranged that no reversing sector is necessary. The resistance is also arranged in four sections, each connected to its respective set of segments, making the wiring simple and eliminating all crowding. The lever is in three pieces, insulated from one another by large pieces of insulating material, sufficiently massive to withstand any mechanical strain to which they may be subjected in use.

The blow-out consists of a coil surrounding and embracing the controller shaft on the front of the controller, and the iron of the framework is so disposed as to complete the magnetic circuit and give a powerful blow-out action at each of the four points at which the circuit is broken. The provision of a multiple protected break for the circuit reduces destructive arcing to a minimum. A reliable center indicating device is provided at the "off" position, which enables the operator to feel the central or "off" position, but which will in no way prevent his reversing quickly.

The type A controller differs from the above only in the mounting of the resistance, which is of iron-enclosed tube porcelain-insulated construction, and is carried directly by the front. The resistance may, therefore, be removed from the enclosing case and mounted directly in a recess provided, should this be desirable, as is frequently the case in applying it to small trolley hoist work, etc. Or it may be rotated within the case so as to permit it being placed in any desired position, as on the sides or top of crane cab. It may also be arranged for rope operation from the floor, in which case a centering spring is provided.

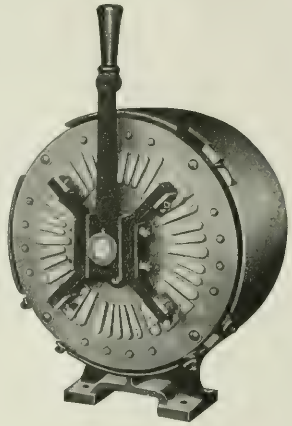


FIG. 1.—CRANE CONTROLLER.

Types B, C and D may be provided with bell crank and link to permit of installation at the back of the cab by levers at the front. Resistance is provided which will give a speed reduction of 50 per cent under the average load conditions on the crane.

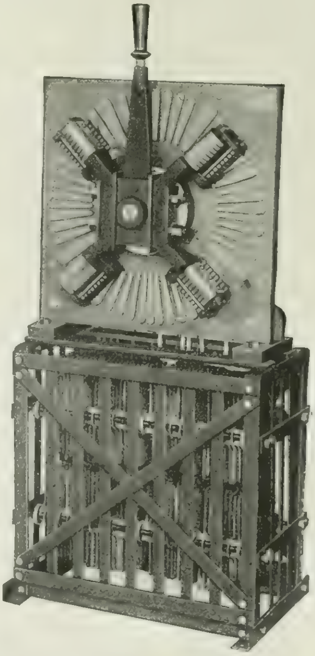


FIG. 2.—CRANE CONTROLLER.

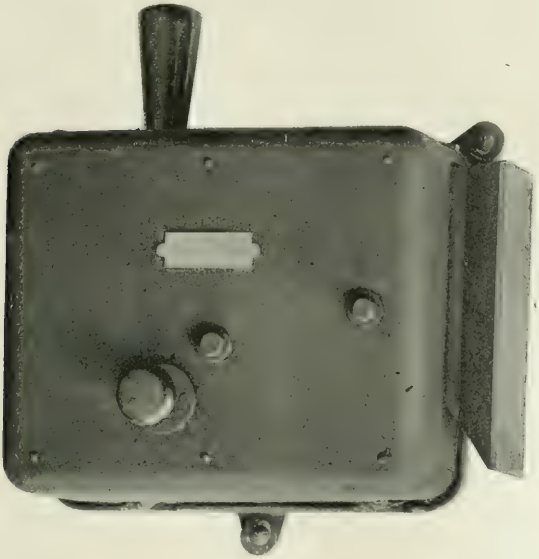
The controllers are designed to occupy the minimum space consistent with the duty they are required to perform, and their arrangement is such that the operator's view is practically unobstructed. Arrangements for slow speed control may be obtained in types B and C.

Railway Type Circuit-Breaker for Direct-Current Uses.

The street railway circuit-breaker shown in the illustration combines in one piece of apparatus a safety device and main switch, as it automatically opens the circuit on overload or short circuit, and can be operated by hand to disconnect the car from the trolley circuit. It is intended to be installed over the motorman's head, in the place usually occupied by the canopy switch, but may be placed elsewhere if desired. It can be quickly closed, thus avoiding the inconvenience and delay incident to replacing a fuse.

This circuit-breaker is intended for direct-current use, and is made for capacities of 60, 100, 150 and 200 amp., with a range from 90 to 225 per cent of normal rating. The mechanism is mounted on a cast-iron base and enclosed by a pressed-metal cover. The handle for resetting projects conveniently from the side of the case and the plunger for tripping by hand extends through the cover and is provided with a composition handle for the hand to strike against. The resetting handle is connected to the switch lever through a compression spring, which insures a firm pressure and good contact, regardless of the natural wear to which the parts may be subjected in service.

The arc is broken in a powerful magnetic field, which effectually opens the circuit under the most severe conditions. The contacts on which the arc occurs are surrounded by a shield of insulating and arc-resisting material, which prevents the arc from being communicated to any other part of the breaker. The contact is made up of copper strips separated by spaces, each acting independently of the others, and in this way a slight irregularity or burr will affect the individual strip only without disturbing the other strips, as would be the case in a brush made in the usual way with laminations without spaces. An auxiliary contact at the end of the switch lever, which can easily be removed and replaced by a new one, serves as an arcing pit. A feature of this breaker is the accessibility when the cover is removed.



RAILWAY CIRCUIT BREAKER.

The current adjustment is made by means of a knurled head screw, which engages a nut attached to a coiled spring, which in turn opposes the pull of the magnet on the armature. A trigger holds the switch in the closed position, and is in range with a projection on the armature of the tripping magnet. When the armature is drawn down by an excessive current in the coil this projection strikes the trigger and releases the switch lever, which is opened instantly by a coiled spring.

The new breaker, improving upon the former type made by the Westinghouse Electric & Mfg. Co., has a cast-iron base, with a sheet-metal cover, a lighter construction than in the former type of cast-iron circuit-breaker, and one giving greater accessibility to the parts for repair, upon the removal of the cover. The contact is made of copper strips, giving a better connection in the event of a burr or any irregularity. The entire construction is lighter and more compact than that of former practice.

◆

Water-Tight Floor Outlet.

The outlet box which is shown in the accompanying illustration was designed with a determination to meet all the conditions encountered in actual practice. It will be appreciated by practical men that there is almost inevitably a disturbance in the accurate and level setting of the box body after being installed. The conduits being rigidly secured to the box every disturbance of the conduit disturbs the box, and it is the exception to find boxes that are not considerably out of level when the finishing work is to be done. The Fullman universal adjustment outlet affords a simple and practical remedy.

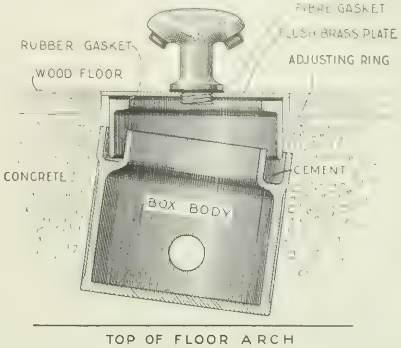


FIG. 1.—SECTIONAL VIEW, SHOWING HOW THE CROOKED SETTING OF BOX BODY IS TAKEN CARE OF.

By reference to the illustrations the method of adjustment will be made clear. The box body is placed in position when the conduits are run, and nothing else is done toward finishing until the flooring is laid. The completion is as follows: The wooden flooring is neatly trimmed to the size of the plate and the ring is suspended in the groove in the upper edge of the box body by means of a template resting on the floor, and while suspended in this position the groove is filled with melted cement, which is of special composition and sets immediately; the template is removed, the rubber gasket applied and the cover plate fastened down by the screws.

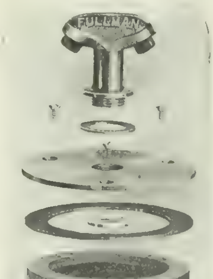


FIG. 2. VIEW, SHOWING PARTS READY FOR ASSEMBLING.

FIG. 3. BRASS FLANGE RINGS.

These floor outlets are manufactured by the Steel City Electric Company, Third Street and Penn Avenue, Pittsburg.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—General trade and industry are, to a large extent, still governed by midsummer influences, but better weather and better crop reports have had a stimulating effect on trade in the surplus cereal-producing sections of the West. Very favorable reports as to fall trade orders come from nearly all points west of the Alleghanies, north of the Ohio River and thence westward to the Pacific. Large—though, except in a few cases, not record-breaking—crop yields now appear reasonably assured in that region, and there is a general agreement that fall business already booked exceeds that for a year ago at this date. Less assurance is found in the reports from the western half of the South, where considerable damage is reported done by heavy rains to cotton, wheat and other crops, this partially offsetting the favorable influences of the recent heavy advance in cotton prices. There is evidence of cross currents in iron and steel, the latter being active and strong, while crude iron, though displaying more activity, is still weak or lower in most markets. Pig-iron production decreased slightly in June, but for the first half of 1905 the output was slightly in excess of 11,000,000 tons, a gain of 34 per cent over the first half of 1904 and of 13 per cent over the record six months' production in the first half of 1903. It exceeded that of the last half of 1904 by 32 per cent. Stocks of unsold iron increased slightly during June. For the week pig iron has been more active, but prices have been shaded 25 to 50 cents per ton to get business. Northern foundry iron has been cut 25 cents, with good sales reported at eastern points and large inquiries pending. Furnaces are piling iron in the Pittsburg district, and coke is lower, though shutdowns of ovens are expected to right this later. Structural material is active and good sales of rails have been made. The rail mills are sold ahead to 1906. Reports as to the first half of the year's operations point to an enormous turnover, far exceeding corresponding periods of previous years. Iron production was unprecedented in that period, railway earnings show 6.5 per cent gain over a year ago, and are, therefore, the best ever recorded in a first half year, and foreign trade, mainly owing to enormous cotton shipments, increased exports of manufactured goods, and record imports of materials for manufacture will surpass the best of previous years. Copper during the week was active, and there was a good demand both for home trade and for export. Producers are busy. Lake is quoted at 14⅞c. to 15c., electrolytic at 14¾c. to 14⅞c., and casting stock at 14⅜c. to 14½c. *Bradstreet's* reports 166 business failures during the week ended July 13, as compared with 127 the week previous and 203 in the corresponding week last year.

ELECTRICAL EXPORTS.—Attention was called a couple of weeks ago to the excellent figures of electrical exports. It was noted that the exports of electrical machinery for the ten months ending April were $5,854,974, a gain of one million over 1903, and of at least $1,250,000 over 1904. The figures for April itself were $564,883, or nearly $35,000 better than in 1904. The exports of electrical instruments, additional to the above, also continue large. While a little less than in 1904, the total is nearly $500,000 better for the ten months than in 1903, being $3,060,126, while for April it was $443,478, as compared with $311,440 in April a year ago. The detailed figures for May are now out and make a good showing again. The export of electrical machinery in May, 1904, was $517,961; for May this year it was $806,702. For the eleven months including May it was $5,047,268, in 1904, where for the eleven months of this year it is no less than $6,661,676, a splendid gain well distributed in the demand from all parts of the world. The export of electrical instruments for the month is also excellent. In May, 1904, it was $292,997; this May it was $430,092. For the eleven months the showing is equally good, being $4,490,818, as compared with $4,486,647 last year, both years being much in excess of 1903. At the present rate, therefore, the total export of electrical machinery and instruments for the year will reach well over $12,000,000.

ELECTRIFYING WEST SHORE.—The *Wall Street Journal* says that work for the electrification of the West Shore Railroad is under way and the Vanderbilt management has practically let contracts for all the construction necessary for the electrification of that portion of the West Shore road between Syracuse and Utica. It is understood that all the contracts are to go to the Oneida, New York, Railway Company. This company has already built west as far as Canastota. Because of a change in its plans the Vanderbilt management will not have the electric cars on the West Shore go entirely through Syracuse. They will run to Eastwood, near Syracuse, where connections will be made with the Eastwood branch of the Syracuse Rapid Transit Company. The reason for the change is the present intention of the management to elevate all the tracks through Syracuse and abolish grade crossings. It is stated that Syracuse is to be the dividing point between the zones using Niagara and Hudson River power.

PANAMA TROLLEY CONTRACT.—The terms of the proposed trolley contract for Panama City have just been made public in the bulletin of the United States Department of Commerce and Labor. Bids are to be opened July 24. The successful bidder undertakes to construct, operate and keep in active service a street tramway for the streets of Panama propelled by electricity. The line will have as a starting point the Plaza de Armas, following a course along Carreras Nacional, Ricaurte, Bolivar, Constitucion and Istmo up to the new station of the Panama Railroad Company, the public market, and the cemeteries. The contractor will be at liberty to construct other branch lines at such a time as the requirements of the traffic shall require it, to pass through the most convenient streets for the construction, operation and rapid service of the tramway. The contractor likewise undertakes to arrange with whom it may concern to secure the privilege of extending the principal line to the "sabanas" of the city and up to La Boca, the branch line passing by the cemeteries. A five-cent fare is specified.

MISSOURI RIVER POWER.—Some articles have already appeared in these pages as to power development in Montana from the Missouri River. The Helena (Mont.) Power Transmission Company, a subsidiary company of the Missouri River Power Company, is now to undertake the construction of a new dam and power plant on the Missouri River, about 15 miles below its present plant. The plant will have a head of about 60 feet and a capacity of about 20,000 horse-power, which will be transmitted to Helena, Butte and Anaconda. The Missouri River Power Company's transmission lines will be extended from Butte to Anaconda, making a total distance of transmission from the new plant to Anaconda of about 100 miles. This transmission will be operated at 70,000 volts. Mr. M. H. Gerry, Jr., is, as is well known, general manager of the Helena company.

THE CHILIAN CONTRACTING COMPANY has been formed in this city with Mr. J. G. White at its head as president, and Messrs. F. H. Reed and H. U. Wallace, of the J. G. White Co., as directors, associated with such men as E. C. Converse, president of the Liberty National Bank; C. C. Cuyler, of Cuyler, Morgan & Company; G. L. Duval, of Beecher Duval & Company; E. Hewitt, of Cooper Hewitt & Company; F. Strauss, of J. & W. Seligman & Co.; C. Lewis, of W. Salomon & Co.; T. H. Newberry, of Detroit; F. S. Smithers, of that named firm, and C. M. Swift, of Detroit. Information as to the plans of the company are not yet given out, but one project is said to be a harbor for the port of Valparaiso. Mr. White's energy, persistence and ability promise success for this as for his other domestic and international enterprises.

RECENT STURTEVANT ORDERS.—Among recent orders for marine generating sets taken by the B. F. Sturtevant Co., of Boston, Mass., are included those for F. B. Pulson's and Timothy Eaton's private yachts, building at Toronto, Ont., for the tug *Menasket*, and through the Portsmouth Navy Yard, for shops of the United States Navy. Contracts for complete heating and ventilating systems have recently been taken by the B. F. Sturtevant Co. for the Fall River Iron Works Co., Fall River, Mass.; Nashua Manufacturing Co., Nashua, N. H.; Bemis Bros. Bag Co., Kansas City, Mo.; Fore River Shipbuilding Co., Fore River, Mass.; Lewis A. Crossett, North Abington, Mass., and Trenton Brass & Machine Co., Trenton, N. J.

NEW HYDRO-ELECTRIC EQUIPMENT FOR IDAHO.—The Abner Doble Company, engineer, of San Francisco, has recently secured the contract for the machinery to be installed in an addition to the hydro-electric plant of the Cramer Electric Company, successor to the Idaho Electric Supply Company, at Hailey, Idaho. This contract covers the entire water power and electrical apparatus and includes a 400-kw alternator directly driven by an 800-hp set of water wheels, exciter and governor; three-panel marble switchboard, two 25-light arc transformers and 50 arc lamps with regulators, switchboards and other accessories; 14 transformers and other supplies for the distribution system.

TROLLEY RAILS.—The Philadelphia Rapid Transit Company has placed a second order for 8,000 tons of steel with the American Bridge Company.

THE AUTOMATIC ELECTRIC COMPANY has recently closed three contracts of considerable interest to telephone men. The largest is for a 15,000-line automatic telephone system for Havana, Cuba. This is to displace the old "Red Telefonica System" of Havana, formerly owned by a Spanish company, but now a part of the properties of the Cuban Telephone & Telegraph Company. The latter company at the same time contracted for a 600-line automatic system for the town of Marianao, Cuba, a suburb of Havana. The initial installation at Havana will be 5,000 lines. The Cuban Telephone & Telegraph Company will soon erect a new building and lay a new conduit and cable system for the new plant. The officials of the Cuban Telephone & Telegraph Company who went to Chicago late in June to close the contract were President Roland R. Conklin, Vice-President S. L. Jarvis and General Manager W. M. Talbott. The other two contracts recently granted the Automatic Electric Company were for a 250-line exchange at Miamisburg, Ohio, for the Montgomery County Telephone Company, and a 1,200-line exchange for the Dakota Central Telephone Company at Aberdeen, S. D. These two latter exchanges will be the first to have the new automatic four-party-lines with selective ringing and lock-out recently worked out by the Automatic Electric Company's engineers. This new development of the automatic system attracted much attention at the recent Independent Telephone Convention in Chicago, where it was exhibited for the first time. Only a portion of the Miamisburg and Aberdeen plants will be for party line service.

IDEAL ENGINES.—Recent sales of Ideal engines are reported as follows: One 90-hp. Kingan Provision Company, Baltimore, Md.; one 160-hp. Connersville Blower Company, Connersville, Ind.; one 110-hp. Northern Commercial Company, Fairbanks, Alaska; one 160-hp. Northern Commercial Company, Fairbanks, Alaska; one 70-hp. Edward Mauner, New York City; one 55-hp. City Hospital, Minneapolis, Minn.; one 110-hp, Nixon & Kimmel, Harrington, Wash.; one 119-hp, Charles F. Loudon, Terre Haute, Ind.; one 85-hp, Southern Indiana Railway Company, Terre Haute, Ind.; one 182-hp, The Ohio Coal Company, Cambridge, O.; two 150-hp each, Board of Public Works, St. Louis, Mo.; one 125-hp, Vertin Bros., Calumet, Mich.; one 75-hp, Wilkesbarre Gas & Electric Company, Wilkesbarre, Pa.; one 70-hp, James P. Wood Heating Company, Philadelphia, Pa.; one 85-hp, Atchison, Topeka & Santa Fe Railroad Company, Shawnee, O. T.; one 150-hp, Ralph J. F. Gerstle Company, New York City; two 310-hp each, Ralph J. F. Gerstle Company, New York City; one 80-hp, O. M. Carter, Houston, Tex.; one 65-hp, Standard Brewing Company, Cleveland, Ohio; one 125-hp, city of Warren, Minn.; one 250-hp, Stratford Hotel, Chicago; one 75-hp, Guinle & Co., Rio de Janeiro, Brazil; one 125-hp, South Dakota Hospital for the Insane, Yankton, S. D.; one 50-hp, Anglo-Chilean Nitrate & Railway Company, Tocopilla, Chile; one 75-hp, Perkins Hotel, Portland, Ore.; one 110-hp, Great Western Sugar Company, Denver, Colo.

GREATEST FOREIGN TRADE.—American foreign trade maintains its high level, the domestic exports for June being $118,727,467 and the imports $90,435,674. The country's foreign trade in the fiscal year ended June 30, 1905, is in many respects remarkable. In both export and import of merchandise all records are broken. In exports the fiscal year 1901 stands next to 1905, but fell $30,000,000 short of it; in imports the next highest fiscal year was 1903, which did not, however, come within $81,000,000 of the past twelve months' record. Exports were more than double those of 1889; imports were more than double those of 1885. In the past few years, however, imports have been increasing more rapidly than exports. The excess of exports over imports in the past fiscal year is $68,784,000 below the similar excess in 1904, $77,443,000 below 1902 and $263,637,000 below 1901, when the largest excess of exports in our history was recorded. It is also less than the excess of 1900, 1899 or 1898, but with these exceptions surpasses the showing of all other fiscal years in our history. Exports and imports combined, during the fiscal year 1905, were $2,635,970,333, against $2,451,914,642 in 1904 (the next highest), $2,310,937,156 in 1901 and $1,539,508,130 as lately as 1895. The fact that manufactures should have offset the decline in agricultural exports is significant.

WESTINGHOUSE TURBINE OUTPUT.—That the steam turbine is rapidly increasing its foothold in the power field is evidenced by the remarkable increase in the manufacture of the well-known Westinghouse-Parsons type. During the six months ending June 30, 1905, the Westinghouse Machine Company, exclusive builder of the Westinghouse-Parsons type, has contracted for no less than 82,000 kilowatts in turbo-generating machinery, averaging nearly 1,175 kilowatts capacity per turbine unit. These machines range in size from 200 kilowatts to 7,500 kilowatts. The latter will be the largest turbines in the world, and three units of this [illegible] under contract for Greater New York railway and lighting power stations. In the distribution of these machines among the various industries, the electric railway has claimed the largest number of machines, averaging 1,496 kilowatts in capacity; next in order, industrial plants, averaging 571 kilowatts capacity, and light and power plants, averaging 529 kilowatts capacity. In the order of total capacity, railway plants have required 38,900 kilowatts; lighting plants, 26,300; industrial, 12,000; miscellaneous, 4,800. The equipments represent solely actual sales only, and do not include contemplated business or partially closed contracts.

POWER PLANT FOR NEVADA.—According to the *Wall Street Journal*, Mr. W. Wayne Belvin, president of the British-American Finance Company, who returned to New York last week from a business trip to the new gold fields of Nevada, announced the organization of the Bishop-Nevada Electric Power & Lighting Company, with a capital of $1,000,000. Associated with him in the enterprise is James Butler, the original discoverer of the Mizpah mine at Tonopah; Clay Peters, a capitalist of California; Warner Miller, of New York, and a number of San Francisco capitalists. It is the purpose of the company to build an immense electric plant on the Owens River, near the town of Bishop in Nye County, across the line from Nevada in California and generate the electricity by means of water power to Tonopah, Goldfield and Bullfrog; and also to build and operate electric railways in the State of Nevada. The bonds of the company have been underwritten and the work of construction will begin at once.

TUNNELING THE DETROIT RIVER.—With regard to the announcement made in our pages of the intention of the Michigan Central Railroad to tunnel the Detroit River for electric traction, it is said that the construction and electrification commission, of which Vice-President Wilgus, of the New York Central, is the head, has been given two years in which to complete the tunnel. President Newman, of the New York Central, believes that this is ample time. The exigencies of the situation at Detroit, where in the winter-time the Michigan Central and Canada Southern are at a decided disadvantage, call for haste. The cost of construction, estimated at $10,000,000, will be provided for through the formation of companies subsidiary to the Michigan Central and Canada Southern. The latter will be the holding company for the subsidiary on the Canadian side, while the Michigan Central will look after the subsidiary construction company this side of the river.

CARS FOR HAVANA, CUBA.—The Havana Central Railway Company has placed large orders for electrical equipment and for steel rails in the United States. The electrical equipment will cost about $1,500,000, and the order for steel rails which has been given to the United States Steel Corporation is for 15,000 tons. The Havana Central Railway Company was organized to construct electric railways running from Havana to various points outside of the city which heretofore have been without transportation facilities. The Havana Central is controlled by the interests identified with the Havana Electric Company. Among the directors of the Havana Central Railway Company are W. L. Bull, George P. Hopkins and E. P. Bryan.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has been awarded a contract for the construction of a complete underground conduit system at Washington, D. C., for the Western Union Telegraph Company. This conduit system will be constructed of a specially made steel pipe instead of clay and will connect all of the Western Union Telegraph Company's offices, as well as the department buildings in and around Washington. Work will begin by August 1 and several hundred men will be employed.

MONROE, GA., ELECTRIC PLANT.—Bids will be received until July 31 by the Mayor and council, of Monroe, Ga., for machinery and material and installing complete an electric light plant, embracing two 66x18 high-pressure boilers, a 175-hp Corliss engine, a 120-kw alternating-current generator, 15 arc and 40 50-cp street lights, 900 light transformers and pole line. J. B. McCrary, Senoia, Ga., is the engineer. Address W. H. Nunnally, chairman of council.

THE STROMBERG-CARLSON TELEPHONE COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Auburn, N. Y.; Bird City, Kan.; McDonald, Kan.; Coldwater, Mich.; Hannah City, Ill.; Pitman, N. J.; Lewisport, Ky.; Huntersburg, Ind.; Ormsby, Minn.; Seattle, Wash.; Arcadia, Mich.; Mulkeytown, Ill.; Tonica, Ill.; Lostant, Ill.; Sinclair, Tex.; Center, Kan, and Mexico, Mex.

APPARATUS WANTED.—It is stated that Mr. B. S. Kincart, Lebanon, Ky., engineer in charge of the Campbellsville Electric Light plant, will give contracts about July 25 for the following equipment: One 60-kw, 220-volt, direct-current generator; one 90-hp engine, automatic side crank, speed about 175 rev.; one fire tube boiler, 66 inches diameter and 16 feet long; one inclosed feed water heater; one duplex feed water pump.

PLANS FOR CRESTON, IOWA.—Plans are proposed and in preparation for a $50,000 electric light plant, it is said, and bids are to be asked for shortly.

PLANT FOR GREENWOOD, WIS.—Bids will be received by Elias Peterson, city clerk of Greenwood, Wis., on July 25, for the construction of an electric light plant consisting of dynamos, wiring, pole line and auxiliaries; also frame power house, concrete power dam, turbine water wheel, etc. Oscar Claussen, St. Paul, Minn., is the engineer.

Financial Intelligence.

THE WEEK IN WALL STREET.—At the close of the week the stock market showed strength after an earlier reaction due to speculative profit-taking. Crop prospects are interpreted favorably by Wall Street, and that quarter is also inclined to the belief that money will continue comparatively easy for some time, owing in part to the probability of large amounts of foreign capital being sent here during the crop-moving season. Manipulation of leading issues like Northern Pacific and support by large interests continue, however, to be in evidence. The Steel stocks have been strong on intimations of favorable earnings and reports of increased demands for structural material. The traction group showed strength under the lead of Brooklyn Rapid Transit, the increasing earnings of these properties being a matter of more or less note. This stock reacted, however, and, after touching 72⅛, closed at 69¼, a net loss of 2⅜. Allis-Chalmers, common and preferred, closed at 14¾ and 55, respectively, these figures representing net losses of 1⅛ and 3⅛ points. General Electric is down 1¼ points and closed at 177½, while the net loss on Westinghouse preferred was no less than 6½ points, the closing figure being 194. Common closed at 167½, a net loss of ½ point. Electric Storage Battery lost ½ point, closing at 82½. Metropolitan Street Railway closed at 126, which is a net decline of 2⅞ points, and Interborough Rapid Transit closed at 202. Western Union was very quiet, with a downward tendency, the closing price being 93⅛, a ⅜-point loss. Trading on the curb was a little more active, but prices were irregular. Following are the closing quotations of July 18:

NEW YORK

	July 11	July 18		July 11	July 18
Allis-Chalmers Co.	14	16¼	Electric Vehicle pfd.	27	25½
Allis-Chalmers Co. pfd.	52	56	General Electric	176	174½
American Tel. & Cable	90	90	Hudson River Tel.	..	..
American Tel. & Tel.	137	139	Interborough Rap Tran.	200¾	203¾
American Dist. Tel.	29	29	Metropolitan St. Ry	125⅞	127¼
Brooklyn Rapid Transit	69½	69½	N. Y & N. J. Tel.	.	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	20	20	Western Union Tel.	93	93
Electric Boat pfd.	60	60	Westinghouse com.	162	167
Electric Lead Reduction.	.	..	Westinghouse pfd.	.	.
Electric Vehicle	20	18			

BOSTON

	July 11	July 18		July 11	July 18
American Tel. & Tel	139	139	Western Tel. & Tel. pfd	99⅛	101
Cumberland Telephone	117	117⅝	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	*245	243	New England Telephone.	138½	139
General Electric	.		Mass. Elec. Ry.	*19	18
Western Tel. & Tel.	18	18	Mass. Elec. Ry. pfd	63	63

PHILADELPHIA

	July 11	July 18		July 11	July 18
American Railways.	50	51	Phila. Traction.	99¾	99⅞
Elec. Storage Battery.	78	81	Phila. Electric	8¾	8¾
Elec. Storage Battery pfd.	..	.	Phila. Rapid Trans.	28	27½
Elec. Co. of America	11¾	11¾			

CHICAGO

	July 11	July 18		July 11	July 18
Central Union Tel.	.	..	National Carbon pfd	118	117½
Chicago Edison.	159	..	Metropolitan Elev. com.	23⅞	23⅞
Chicago City Ry	*190		Union Traction	..	..
Chicago Tel. Co.	.		Union Traction pfd.	..	.
National Carbon	63	63½			

* Asked.

DIVIDENDS.—The Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable July 31. The Crocker-Wheeler Company has declared its quarterly dividend of 1½ per cent. The Electric Company of America has declared a regular semi-annual dividend of 3½ per cent, payable July 31. The New Telephone Long Distance Company, of Indianapolis, Ind., has declared the regular quarterly dividend of 1 per cent. The Hudson River Telephone Company has declared the regular quarterly dividend of 1½ per cent. The following dividends, payable August 1, are reported: Jacksonville Electric Company, $3 semi-annual on preferred and $3 on the common; on the Fall River Gas Works Company, $5 semi-annual; semi-annual of $3 on the Minneapolis General Electric. After passing two semi-annual dividends of $3 per share because of strikes and boycotts due to the inauguration of the Jim Crow law, etc., the Houston Electric Company has resumed dividends upon its preferred stock at the regular rate of 6 per cent. The directors have declared a semi-annual dividend of 3 per cent, payable August 1. The Columbus Railway Company's directors have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable August 1.

KINLOCH TELEPHONE CONSOLIDATION.—All details have been completed for the deal by which the Kinloch Long-Distance Telephone Company, of Missouri, absorbs the Kinloch Telephone Company, of St. Louis. The shares of the local company, representing the issued capital stock of $2,000,000, were exchanged July 7, share for share, for stock of the long-distance company. The authorized capital of the latter corporation is $5,000,000, of which $2,800,000 has been issued, including the shares exchanged for the Kinloch Telephone Company stock. The companies, while owned by the same interests, will be conducted as heretofore by separate officers. They will be financed jointly, however, and governed by the same directors. Samuel M. Kennard, president of the Kinloch company, has resigned because of ill health and the press of private business. William F. Nolker, first vice-president, was elected to succeed him. C. Marquard Forster is president of the long-distance company. One of the directors states that the reason for the arrangement was that it would considerably simplify the handling of the properties. The long-distance company is in much better position to finance future needs than the local corporation. He said that the old order of affairs frequently caused awkward situations and friction. The Long-Distance Telephone Company on July 12 filed in St. Louis a mortgage on all its properties for $5,000,000. This is covered by the authorized issue of bonds. The American Trust and Savings Bank of Chicago and George M. Galbreath are trustees for the bondholders.

MICHIGAN STATE TELEPHONE.—N. W. Harris, chairman of the board of directors, has just issued to the stockholders of the Michigan State Company the first annual report of that company. This company is the successor of the old Michigan Telephone Company, a bondholders' committee having reorganized the property somewhat more than a year ago. Since the present management took possession in February, 1904, the number of telephones has been increased from 48,778 to 70,832. The earnings of the company have also been largely increased, the statement for the year ended April 30, 1905, being as follows:

Gross earnings		$2,089,701.51
Operating expenses		1,493,656.87
Net earnings		$596,044.64
Interest on bonds and floating debt	$234,883.23	
Dividends paid on preferred stock	137,100.00—	371,983.23
Net surplus		$224,061.41

The policy of the present management is to use its net surplus for additions and betterments to the company's property, $579,955.03 having been used for maintenance expenses alone for the year ended April 30, 1905.

CROCKER-WHEELER AFFAIRS.—The officers of the Crocker-Wheeler Company have been re-elected for the ensuing year. The regular quarterly dividend of 1½ per cent has been declared, and the affairs of the company are in a flourishing condition. The officers are: Schuyler Skaats Wheeler, president; Gano S. Dunn, vice-president and chief engineer; W. L. Brownell, treasurer; G. W. Bower, assistant treasurer. The directors are Professor Francis B. Crocker, of Columbia University; Dr. Wheeler, Messrs. Dunn and Doremus, A. Foster Higgins, Herbert Noble, Thomas Ewing, Jr., F. L. Eldridge and C. A. Spofford.

NEW YORK EDISON is doing a good business. Its report for the first five months in 1905 to the end of May, including income from associated companies, is as follows:

Gross earnings (all sources)	$5,035,395
Expenses, taxes, contingency and renewal charges	2,566,100
Net	$2,469,295
Fixed charges	826,832
Surplus for this period	$1,642,463

BOSTON EDISON.—The Edison Electric Company of Boston is understood to have earned in the year ended June 30, 1905, $71,000 above all charges and 10 per cent dividends and an allowance of 4 per cent on capital for depreciation. This compares with a surplus of $75,000 the previous year, when the capital was 10 per cent less. The company had on June 30 a floating debt of $825,000, compared with $1,083,000 a year earlier.

THE MACKAY COMPANIES.—The annual meeting of Mackay Companies was held in Boston on July 11. President Clarence H. Mackay presided. There were 529,000 shares of stock represented by proxies, which were used to elect Clarence H. Mackay, William M. Cook, George G. Ward, Dumont Clarke and Edward C. Platt trustees of the Mackay Companies. No other business was transacted.

NEW YORK TROLLEYS.—The summer weather has come in to redress the traction balances of the winter. The effect of the hot weather upon the earnings of the New York City Railway, the Metropolitan Traction system, is shown in the company's gross earnings for June, which amount to $1,887,834, as compared with $1,865,065 for the same month last year, when the subway was not in operation.

GENERAL ELECTRIC SECURITIES.—Last week Harvey Fisk & Sons announced the formation of a $4,000,000 company to hold electric company stocks and bonds for the General Electric Company and offered $500,000 of 5 per cent cumulative preferred stock at 92½ and accrued dividends.

General News of the Week

The Telephone.

MARION JUNCTION, ALA.—S. A. Brice and others have incorporated the Marion Junction Telephone Company.

HARTFORD, CONN.—By a vote of 105 to 99 the bill to admit independent telephone companies to do business in this State has been rejected in the House.

BOISE, IDAHO.—The Independent Telephone Company will install a switchboard, which will cost about $20,000.

CALDWELL, IDAHO.—A franchise has been secured from the city council by the Independent Telephone Company.

TWIN FALLS, IDAHO.—The system of the Twin Falls Telephone Company, Limited, has been purchased by the Rocky Mountain Bell Telephone Company.

POCATELLO, IDAHO.—The franchise recently granted to E. C. Mason and G. D. Aiken, of this city, for the operation of a telephone system, has been acquired by the Rocky Mountain Bell Telephone Company through purchase.

ELKVILLE, ILL.—The Jackson County Telephone Company has increased its capital stock from $2,450 to $21,000.

ATHENS, ILL.—The Menard County Telephone Company has been formed with a capital of $5,000. Incorporated by M. C. Scott, T. W. Kenyon.

NOBLESVILLE, IND.—The Home Telephone Company, of this city, has increased its capital stock from $15,000 to $30,000. The increase is made necessary for the purpose of extending the lines and making other improvements. Thos. Guffin is president and Elihu Hawkins secretary.

KOKOMO, IND.—The city council has decided to table the ordinance designed to so modify the franchise of the Citizens' Telephone Company as to permit it to enter into an arrangement with the Bell Telephone Company for long-distance service. The franchise was originally secured through the influence of the Indianapolis Long Distance Telephone Company and a provision was inserted prohibiting it from entering into any sale or business arrangements with the Bell Company. The Bell people have made an offer for a controlling interest in the local plant so tempting that the owners appealed to the council for a modification of the franchise and the refusal is regarded a victory for the New Long Distance Company, which has a contract with the local company to furnish it long-distance service. The fine point in this question is whether the local company has the right to give a long distance message to the Bell Company, when such message is addressed to a point that the New Long Distance Company does not reach. It is the opinion of good lawyers that the local company can do this notwithstanding the restraining clause in the franchise.

HAVELOCK, IA.—The Havelock Mutual Telephone Company has been formed with a capital of $28,000, by W. E. Pirie and others.

EARLING, IA.—The Earling Telephone & Telegraph Company has been formed with a capital of $10,000. Incorporated by P. J. Korth and others.

ELDORA, IA.—The Iowa Telephone Company has bought the Hardin County Telephone Company's exchange and lines and has sub-leased the plant to the Eldora Mutual, entering into an arrangement with that company which gives the Iowa subscribers the use of both systems and 90 miles of toll lines.

LYNN GROVE, KY.—A new telephone company has been incorporated here with a capital of $2,000.

LOUISVILLE, KY.—The Wing Telephone Company of Graves County has been organized. Capital, $1,500.

ONAWAY, MICH.—The Onaway Telephone Company has entered into an agreement with the Northeastern Telephone & Telegraph Company, which will give its patrons at Onaway, Millersburg and other places in that vicinity toll service with all sections of Michigan. The Onaway Company is contemplating putting in an automatic exchange.

OTO, MINN.—The Farmers' Mutual Telephone Company, capital $10,000, has been incorporated by John Hilfiker and H. P. Simmons.

MISSOULA, MONT.—The extension of its system through the Bitter Root valley is contemplated by the management of the Rocky Mountain Bell Telephone Company.

HAMILTON, MONT.—The proposed grants of a franchise to the Rocky Mountain Bell Telephone Company and one to the Bitter Root Telephone Company were approved at a special election recently held here.

COLUMBIA, MO.—The Columbia Telephone Company has increased its capital stock from $5,000 to $250,000.

AUSTIN, MO.—The Austin Inland Telephone Co., of Austin, has increased its capital stock from $22,000 to $50,000.

HOOPER, NEB.—The Hooper Telephone Company has been installing telephones in the vicinity of Telbasta.

PENN YAN, N. Y.—The following officers of the Friend Telephone Company, an independent line, were elected at the annual meeting: President, Thomas N. Davis; vice-president, Elias F. Pulver; secretary and treasurer, Asahel Bottsford.

KERNERSVILLE, N. C.—The Kernersville Telephone Company has had a new exchange and a 160 drop switchboard installed. [illegible] is president of the company.

HIRAM, OHIO.—The Hiram Telephone Company, capital $10,000, has been incorporated by H. C. [illegible] and Wm. [illegible].

LAFAYETTE, OHIO.—The officers of the Lafayette Telephone Company are making arrangements for the installation of a common multiple system. The Lafayette Company has 2,500 telephones in this city and West Lafayette, and has petitioned the Board of Public Works for permission to lay underground wires in the downtown districts.

NEWPORT, ORE.—The Council has granted a franchise to the Yaquina Bay Mutual Telephone Improvement Company, to build, equip and operate a telephone system in the city of Newport, Ore.

OZONA, TEX.—A new telephone exchange has been installed at Ozona by J. J. Shepperd.

SHERMAN, TEX.—The Grayson County Telephone Company, which has its headquarters at Sherman, will extend its long-distance lines to a number of towns.

TEHUACANA, TEX.—The People's Telephone Company has been organized here with a capital stock of $2,000 for the purpose of installing and operating a local telephone exchange. A. L. Collins is one of the incorporators.

DALLAS, TEX.—The Southwestern Telegraph & Telephone Company has purchased the property of the Granbury Telephone Company, including the exchanges at Granbury and Glenrose and 140 miles of toll line. The company is now building long-distance lines from Fort Worth to Stephenville.

DALLAS, TEX.—The Texas Consolidated Long Distance Telephone Company, which was recently granted a franchise by the City Council of Dallas, will build a line between Dallas and Fort Worth and will tap a number of towns between the two cities. Other important extensions and improvements are contemplated by the company.

AUSTIN, TEX.—The Texas Telephone & Telegraph Company, which has its principal office at Austin, will make important extensions and improvements before the close of the present year. This company is now extending its toll lines to Brady and Georgetown. It recently completed the construction of extensions to Castell and other places. Its lines now aggregate 700 miles. C. C. Gibbs, of San Antonio, is president; W. R. Hamby, of Austin, vice-president, and A. G. Miller, of Llano, superintendent.

CHILDRESS, VA.—The Little Mutual Telephone Company has been organized.

HEATHSVILLE, VA.—The Northern Neck Telegraph & Telephone Company will build a telephone line from Warsaw to Newland. Another line is also to run to Lancaster, in order to improve the service and to establish an office at Ottoman. Extensive improvements are contemplated on the Fredericksburg line with the idea of establishing a number of offices at Colonial Beach.

MILWAUKEE, WIS.—The Walworth Telephone Exchange Company has increased its capital from $2,200 to $4,200.

SOLEDAD, MEX.—A telephone line is being constructed from Soledad to Huatusco, State of Vera Cruz. It will afford communication for a number of ranches with these towns.

CELAYA, MEX.—A new telephone system is to be installed in the city of Celaya by a syndicate of capitalists who have obtained a concession from the State Government for the purpose.

SANTA ROSALIA, MEX.—Antonio Calero has obtained a concession from the Government of the State of Chihuahua for the construction of a new telephone system for Santa Rosalia.

MINACA, MEX.—Miguel Enriquez and Damon Sanz have obtained a concession from the Government of the State of Chihuahua to build and operate a telephone line between Minaca and Guerrero.

CHIHUAHUA, MEX.—Governor Enrique Creel, of the State of Chihuahua, has granted a concession for the construction and operation of an extensive system of telephone lines in the central part of the State.

SILAO, MEX.—La Compania Noruega Mexicana, with headquarters in the City of Mexico, has obtained a concession to establish systems of telephones throughout the State. Christian Schjetnan is manager of the company.

HERMOSILLO, MEX.—The Government of the State of Sonora has granted a concession to E. W. Bristol for the construction and operation of a telephone line from Hermosillo, the capital, to El Colorado. The property and money invested in the enterprise are exempt from all State taxation for a term of years.

CHIHUAHUA, MEX.—Oton Sartorius, general manager of the Mexican General Supply Company of the city of Chihuahua, has obtained a concession from the State Government for the construction and operation of a new telephone system in Chihuahua. He contemplates building long-distance lines to Parral and Jiminez.

COMPOSTELA, MEX.—A telephone line is to be constructed from Compostela, territory of Tepic, to El Rosario, State of Sinaloa. The line is to be built under direction of the Government of the territory of Tepic. It will be used principally for the dispatch of public business relating to affairs of the Territorial Government.

MANILA, P. I.—The Philippine Commission has passed an act granting to John I. Sabin and Louis Glass, of San Francisco, a franchise to construct telephone and telegraph systems throughout the Philippine Islands. Mr. Sabin is the president and Louis Glass, vice-president and general manager of the Pacific States Telephone & Telegraph Company, the head offices of which are located in San Francisco.

Electric Light and Power.

ENSLEY, ALA.—The construction of an electric light plant by the town is probable.

MONTGOMERY, ALA.—The Montgomery Light & Water Power Company has just placed an order for additional machinery for its large plant at Tallassee, which will involve an expenditure of nearly $30,000.

CARBON HILL, ALA.—It is stated that bids will be received until July 24 for bonds to the value of $25,000 for waterworks and an electric light plant. Edgar B. Kay, Tuscaloosa, Ala., is the engineer.

OTTAWA, ILL.—The Ottawa Power Company has been formed with a capital of $5,000. James A. Seddon, Robert Gaylord and others are the incorporators.

LA GRANGE, ILL.—The LaGrange Service Company is building a large power house at Maywood. The LaGrange light and water plant will also be improved, and Sargent & Lundy, of Chicago, will prepare plans for a model power house. The pumps will be operated by electric power. An extra 150 horse-power boiler and engine will be installed to be used in case of accident to the Maywood plant.

EVANSILLE, IND.—The Evansville Gas & Electric Light Company, Evansville, Ind., is planning to erect a plant to supply power to various traction lines.

ACKLEY, IA.—The Ackley electric light and heating plant has been sold by Smith Bros. to John Rath.

BURLINGTON, KAN.—The electric light plant of this city has been purchased by G. H. Webb and G. Webb.

NORTH FAIRFIELD, ME.—The Crosby Mercantile Company is to install an electric light plant which will provide light and power for its large interests here.

HOULTON, ME.—There is a proposition to make a contract with the Maine & New Brunswick Electrical Company to furnish electricity for lighting, heating and power purposes to the town.

PLAINVILLE, MICH.—The Esele Light & Power Company has bought the franchise and the plant of the Brownell Lighting Company.

HOUGHTON, MICH.—The Houghton County Electric Light Company will install an electrically driven, vertical, triplex pump at the Franklin pumping station, capable of supplying 65,000 gallons of water every 24 hours.

TAWAS CITY, MICH.—The Tawas Mfg. Company will operate an electric lighting plant within two months. The plant is being installed by the city and the company will get its revenue out of commercial lighting.

WEST BRANCH, MICH.—W. D. Eddy has been granted a 10-year franchise to operate an electric lighting plant at West Branch. He has bought the interests of W. W. Vaughn and will at once make improvements in the plant.

PORTLAND, MICH.—The municipal lighting plant will be increased in capacity by widening and deepening the race which conveys the water for power. W. D. Fargo, of Kalamazoo, will have charge of the work, which will be completed at a cost of $3,760. The plant will be shut down for at least four weeks.

LANSING, MICH.—The annual report of the municipal lighting plant shows a material gain. The cost of operating the plant in 1905 was $34,037.02, in 1904 it was $32,991.40. The increase in receipts from private consumers was $6,941.69, the total for 1905 being $41,858.12. The total earned receipts exceeded the operating expenses by $22,821.10.

MELROSE, MINN.—Contracts for constructing the electric light plant have been awarded to the American Electric Co. of St. Paul for $6,644. Oscar Claussen, St. Paul, is the engineer.

GRENADA, MISS.—The electric light plant of this city is to be improved.

SPENCER, N. C.—The town of Spencer has voted a bond issue of $70,000 for improvements, including electric lights.

GREENSBORO, N. C.—J. M. Bandy and W. H. Terrell, of Greensboro, are the engineers in charge of the development of water power on South Yadkin River for the Southern Yadkin Development Company. The work contemplated will cost about $1,000,000.

CLEVELAND, OHIO.—C. S. Britton is having plans drawn for the new power block which will be erected on the property he recently leased.

YOUNGSTOWN, OHIO.—The Electric Supply & Construction Company, of Youngstown, has secured the contract for installing an electric light system at the new filter plant for $4,133.

GALION, OHIO.—The Crawford Gas & Electric Company has changed its name to The Crawford County Gas & Electric Company. The capital is $150,000.

OREGON CITY, ORE.—The Clackamas Power Company has been incorporated by J. T. Apperson, H. E. Cross, C. H. Dye, E. G. Canfield and I. B. Sanborn; capital, $25,000, with the object of erecting dams and developing power.

CANTON, OHIO.—The Citizens' Light, Heat & Power Company has sold out to the Merchants' Heat, Light & Power Company. The new company is composed of Canton business men who have selected Thomas F. Turner as their president.

NEWARK, OHIO.—The Citizens' Electric Light & Power Company's plant and business, of Newark, has been sold to Congressman B. G. Dawes, Col. M. M. Gillette and several other local capitalists, who have formed a corporation for the purpose of conducting the business.

PAWTUCKET R. I.—Mayor Higgins has approved the ordinance granting the J. & P. Coates Company permission to lay conduits in certain streets for the transmission of electric power to its plant on Pine Street. The company has plans for the erection of a model electric plant at tidewater.

ANDERSON, S. C.—At the annual meeting of the stockholders of the Anderson Water, Light & Power Company, Dr. S. M. Orr was re-elected president. No dividend was declared on account of the fact that profits have been largely expended in making improvements to the system.

MURFREESBORO, TENN., has granted to the City Gas & Electric Light Company a franchise and a ten-year contract for lights for the city.

CLARKSVILLE, TENN.—A movement has been inaugurated here to organize a new electric light and power company. The company will be known as the Consumers' Electric Light, Power, Heating & Refrigerating Company.

CHATTANOOGA, TENN.—The preliminary surveys for the proposed big water-power electric plant on Little River, near Blanche, Ala., are now being made. H. T. Henderson and Samuel Henderson, of Durango, Col., are the principal promoters of the enterprise. It is expected that the work will cost between $1,000,000 and $1,500,000. The company proposes to develop sufficient power to furnish the industrial plants of Gadsden, Alabama City and Attalla, Ala.; Rome, Ga., and probably Anniston, Ala. The proposed plant will be located 34 miles from Gadsden, 27 miles from Rome, and 72 miles from Anniston.

BONHAM, TEX.—The Bonham Electric Light & Power Company's plant was sold to a Dallas firm, of which J. F. Strickland is president.

CLARENDON, TEX.—The Clarendon Water, Light & Power Company has been organized with a capital stock of $50,000. L. W. Chase is one of the incorporators.

BONHAM, TEX.—The Bonham Gas & Electric Light Company has been organized with a capital stock of $100,000. J. F. Strickland is one of the incorporators.

DEL RIO, TEX.—The Del Rio Electric Light & Ice Company has been organized with a capital stock of $200,000. John M. Gray, of Del Rio, is one of the incorporators.

COLUMBUS, TEX.—The Columbus Light Company has been organized at Columbus for the purpose of operating an electric light and power plant. The company has a capital stock of $10,000.

DENTON, TEX.—The city of Denton has taken possession of the water and light plant which it recently purchased from T. J. Oliver and R. C. Storey, of Dallas, and A. F. Evers, of Denton.

GAINESVILLE, TEX.—J. A. Jones and E. E. Hull, who recently purchased the plant of the Gainesville Light & Fuel Company in Gainesville, will expend about $25,000 in making improvements.

SAN ANTONIO, TEX.—C. A. Zilker, vice-president of the Southern Ice & Cold Storage Company, of San Antonio, is promoting the organization of a company to install an independent electric light and power plant for San Antonio.

AUSTIN, TEX.—Mayor W. E. Shelley, of Austin, is negotiating with the representatives of a syndicate of Boston capitalists for the sale of the ruins of the old dam across the Colorado River here and the sale or lease of the municipal water and light plant. This dam was built about ten years ago at a cost of $1,000,000, but was destroyed by a flood in the river in 1900. It supplied power for operating the water works and electric light plants of the city.

FREDERICKSBURG, VA.—The Rappahannock Electric Light & Power Company has been formed by J. B. Ficklen, president; A. D. Tapscott, secretary. The capital is $10,000.

RURAL RETREAT, VA.—W. C. Lawson contemplates installing an electric light plant at the Rural Retreat Mills, and will probably furnish light and power to the town.

POULTNEY, VA.—The Lake Dunmore Power & Traction Company, which recently absorbed the Bristol Electric Company, is building a steam auxiliary plant and has completed surveys for a large dam to be about a mile above its present plant on the New Haven River near Bristol. The former company operated its plant only a portion of each day, but the new concern proposes to furnish power 24 hours each day.

ST. JOHNSBURY, VT.—An important business deal has just been completed by which the St. Johnsbury Electric Company acquires the Ide water power at Passumpsic, and will erect at once a modern electric light station, using the water power to its fullest capacity. The Electric Company will then have three stations, one at the dam at the Center, which now supplies the village with the arc and commercial arc lights, the station at the Belknap dam, and the new one at Passumpsic.

SAN LUIS POTOSI, MEX.—G. A. Waddil will install a new electric light plant in the city of San Luis Potosi.

SAN LUIS POTOSI, MEX.—The Mexican Government has granted a concession to Manuel Gonzalez to establish an electric power plant on the Abra de Caballeros River, in the State of Luis Potosi.

SOMBRETE, MEX.—An American syndicate, with a capital stock of $500,000, has acquired the waterfalls in the San Pedro River, near Sombrete, and is preparing to construct a large electric power plant on the site.

TEPIC, MEX.—It is stated that the electric power plant which will be erected near Tepic for D. Aguirre & Company will cost about $75,000. It will supply the city of Tepic with lights and power and will afford power for operating the Aguirre cotton factory and other industrial concerns of the section.

TORONTO, ONT.—The Electrical Development Company has entered into contract to supply the Toronto Railway Company and the Toronto Electric Light Company with electrical energy from Niagara Falls at from $35 to $40 per horsepower per year.

The Electric Railway.

DENVER, COL.—A $75,000 electric street car system is planned for Tucson, Ariz., by W. S. Iliff and C. K. Durkin, president and vice-president, respectively, of the United States Light & Traction Company, of Denver.

WILLIMANTIC, CONN.—The Willimantic & Stafford Springs Street Railway Company has been incorporated with a capital stock of $700,000. It is authorized to construct and operate a trolley line in the towns of Windham, Mansfield, Willington and Stafford. The incorporators are Costello Lippitt, Edwin W. Higgins and Llewellyn J. Storrs, of Norwich, and Charles W. Comstock, of Montville.

FORT WAYNE, IND.—The Fort Wayne, Bluffton & Marion Interurban Railroad Company has filed a $400,000, 5 per cent gold bond mortage in favor of the Guarantee Loan & Safe Deposit Company of Philadelphia.

PORTLAND, IND.—The Muncie-Portland Traction Company has filed articles of incorporation, the capital being $100,000. The principal office will be located in Portland. A. E. Smith, Louis A. Clark, W. S. Richey and J. L. McPherson are the incorporators.

SHELBYVILLE, IND.—The Indianapolis & Southeastern Traction Company has filed articles of incorporation with a capital stock of $1,200,000, for the purpose of constructing and operating a traction line between this city and Greensburg and thence to Batesville, and also to construct and operate plants for generating and supplying electricity for heat, light and power. The incorporators are Fletcher M. Durbin, W. J. Alford, C. C. Curtis and J. H. Smith.

SOUTH McALESTER, I. T.—The Indian Territory Traction Company has passed into the hands of the Choctaw Railway & Lighting Company, capitalized at $500,000. The incorporators of the new company are M. M. Lindly, A. E. Pierce, Jr., R. L. Schieg, M. E. Williams and A. U. Thomas, of this city; W. R. Naughton, of Chicago, and E. W. McAlester, of South McAlester. A large sum will be expended in improvements.

WESTMINSTER, MD.—A project has been quietly worked up for the construction of a trolley line from this city to a point between Winfield and Taylorsville, in the southern section of the county, to connect with a line from Gettysburg, Pa., to Washington, D. C. James W. Le Gore, of Legore, Frederick County, is at the head of these projects.

WARE, MASS.—George S. Taft, receiver for the Hampshire & Worcester Street Railway, has petitioned the Superior Court for permission to sell the road.

MARLBORO, MASS.—It is announced here that the Boston & Suburban Street Railway Company, which controls a chain of roads running out of Boston, has acquired control of the Marlboro & Westboro Street Railway.

BOSTON, MASS.—William LaCroix, president of the Nahant & Lynn Street Railway, has petitioned the Railroad Commissioners on behalf of the company for authority to issue original capital stock of $50,000, the proceeds of which issue to be applied to expenses of construction and equipment.

BATTLE CREEK, MICH.—The financing of the Battle Creek & Coldwater Electric Railroad, 40 miles in length, has been arranged with a New York concern, and the construction and equipment of the road with a New York construction company.

GRAND RAPIDS, MICH.—The Grand Rapids Railway Company is to install in its power house coal crushing and conveying apparatus having a capacity of 40 tons an hour. Two or three 350-hp. water-tube boilers and automatic stokers will also be added, and extension made to the car houses.

RED LODGE MONT.—A project for the construction of an electric railway from this city to the Bear Creek coal camp is being favorably considered by Butte capitalists.

MISSOULA, MONT.—G. W. Dougherty, of Hamilton, who, as representative of eastern interests, has secured a franchise for an electric railway system in this city, announces that work will be commenced during the summer months. The line will traverse the Bitter Root valley. It is believed that the system will eventually extend as far as Anaconda and Butte.

ALBANY, N. Y.—The Ticonderoga Union Terminal Railroad Company has been incorporated to operate a street railway from Addison Junction to Ticonderoga. Then length is 5 miles. The capital is $50,000, and the directors are I. Rothschild, Altus B. Adkins, Alexander H. Weed, Frank B. Wickes, Mortimer V. Drake and Frank T. Locke, of Ticonderoga, and Frank B. Gridley and Northrup R. Holmes, of Troy.

SYRACUSE, N. Y.—The Skaneateles Lake Transportation Company has been incorporated at Albany, with a capital of $25,000. The company is controlled largely by the men back of the Auburn & Syracuse Electric Railroad Company. The new incorporation will operate a fleet of passenger boats on Skaneateles Lake in connection with the trolley line.

CATSKILL, N. Y.—The Upper Hudson Electric Railroad Company, of Newburg, was incorporated recently to operate an electric railway 25 miles long from the terminus of the United Traction Company, of Albany, in the town of Bethlehem to the village of Catskill. The capital is $500,000, and the directors are Luke F. Gillespie, J. M. Sheehan, Newburg; Eugene Wolfe, F. W. Titus, Athens; T. M. Sherman, Coxsackie; H. W. Dalton, Thompsonville, Conn.; F. J. Curnick, New York. This company is practically a reorganization of the former Upper Hudson Electric Company, which had a capital stock of $150,000. The new company probably will succeed to the franchises secured several years ago to build an electric railway down the west bank of the Hudson from Kenwood to Catskill.

DAYTON, OHIO.—The Dayton & Irvington Street Railway Company has been incorporated by M. P. Nisewonger, J. W. Bovey, F. M. Stutsman, C. J. Geyer and others.

CLEVELAND, OHIO.—A permit has been issued to the Cleveland Electric Railway Company for the construction of a 2-story power house on Washington and West River Sts.

CLEVELAND, OHIO.—The Pomeroy syndicate announces that the building of the Cleveland, Ashland & Mansfield Railway is now assured. The Roberts & Abbott Company, Cleveland, is engineer for the project.

STEUBENVILLE, OHIO.—T. H. Loomis, promoter of the Canton & Steubenville Traction Company, claims to have arranged for the financing of the project, and the route of the proposed line has been adopted.

CLEVELAND, OHIO.—The proposed electric railway between Kansas City, Leavenworth, Atchison and St. Joseph, in which [illegible], Prior & Co., of Cleveland, have been and are interested, is to be built. Papers of incorporation have been taken out in Missouri. The company's name is the Missouri Valley Electric Railway. The capital named is $650,000. The incorporators are: George P. Blanchard, of New York; Charles P. Breen, George B. Tuggle, S. Wilson and H. B. McAfee, of Parkville, Mo. The road will be 65 miles in length.

SHAMOKIN, PA.—Plans were formulated here last week for the immediate construction of the $1,500,000 trolley line between here and Sunbury, by New York and Philadelphia capitalists, headed by Ex-Congressman M. H. Kulp.

BRADFORD, PA.—Practically all the necessary rights of way for the building of the proposed trolley line from East Bradford up the Kendall Valley to Kew City and thence to Smethford, with a branch from Kew City to Mt. Jewett, have been secured, and prospects for the early construction of this 40-mile system are good.

AUSTIN, TEX.—Articles of incorporation of the Gainesville, Whitesboro & Sherman Electric Railway have been filed. The new company has a capital stock of $500,000, and its purpose is to build an interurban line between Gainesville and Sherman, a distance of 32 miles.

SALT LAKE CITY, UTAH.—A meeting of local promoters and eastern capitalists will be held here at which plans for an electric railway to connect this city with Murray, Bingham Junction, the valley smelters and Bingham will be discussed. The cost of the proposed system is estimated at $2,000,000. The names of the promoters are withheld for the present, but it is known that prominent local mining men are behind the enterprise.

SNOHOMISH, WASH.—All interest in the Snohomish & Cherry Valley Railway has passed from the control of the original promoters of the Snohomish & Cherry Valley Electric Railway Company into that of a new company to be organized among local capitalists. It is understood that the most active backers of the proposed company are Mayor C. S. LaForge, of Snohomish; J. B. Brown and Victor Marshall, also of Snohomish, and Milton Stephens, of the Bank of Monroe. President J. W. Hall, of the old company; W. M. Snyder, of Snohomish; E. Colburn and E. L. Colburn, also of the old company, will probably be identified with the new. E. Colburn will continue as chief engineer.

CORNWALL, ONT.—The motormen and conductors of the Electric Street Railway, of Cornwall, are out on strike. They demand an increase of four cents per hour, or from 13 to 17 cents. Manager Hodge submitted the matter to the directors in Montreal, who declared that it was impossible to comply with the demand of the men. The line is operated by the Sun Life Assurance Company, of Montreal, having passed into the hands of that company as bondholder. This company has also purchased the electric light service of the town, and by combining it with the street railway expect to make the investment profitable.

MONTREAL, QUE.—The officials of the Temiskaming Railway of Ontario, are conferring with the Locomotive & Machine Company, of Montreal, with a view of having an electrical locomotive constructed. It is intended that electric locomotives shall be used on some of the divisions of the railroad.

New Industrial Companies.

THE CENTRAL ELECTRIC COMPANY, of St. Louis, Mo., has been formed with $8,000 capital stock by J. H. Davey and G. S. Johnson.

ERWIN & COMPANY, of Chicago, Ill., will manufacture machinery and electrical supplies. Charles A. Pearson, B. M. Marks, Frederick Duffy are the incorporators.

THE GRAYSON ELECTRICAL CORPORATION, of Grayson, Va., has been formed with $10,000 capital. The incorporators are G. O. Grayson, president, J. H. Grayson, secretary.

THE ELECTRIC ELEVATOR & MILLING COMPANY, of New York, has been incorporated; capital, $25,000. Directors: Yale Kneeland, O. M. Mitchell and F. L. McLean, of New York.

THE BEACON ELECTRIC COMPANY, of Boston, has been formed. Capital, $25,000. President, B. L. Ames, Roxbury; treasurer, F. S. Ashley, Boston; clerk, W. S. Barney, Dorchester.

THE SEACOAST ELECTRIC & MFG. COMPANY, of Lanoka, N. J., has been incorporated with a capital of $10,000. The incorporators are Orian [illegible] Lane, Daniel S. Holme, George M. Lane.

THE BUSHMILLER COMPANY, New York, has been incorporated to manufacture [illegible] and electrical fixtures; capital, $5,000. Directors: Siegfried Bushmiller, Mary C. Bushmiller, P. A. Hatting, New York City.

THE CLARK WIRELESS DEVELOPMENT COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $20,000. The incorporators are Judson W. DePuy, William H. Bearinger and Charles Schlegel.

THE SECURITY AUTOMOBILE SIGNAL COMPANY has been incorporated in New York; capital, $1,200. Directors, U. W. V. Westervelt, Glenridge, N. J.; R. S. Hobbs, New York; Edward Van Winkle, Jersey City.

Legal.

NEW YORK FRANCHISES.—Justice Gildersleeve in the New York Supreme Court has denied the application of Franklin Pettit for an injunction restraining the Board of Estimate and Apportionment from acting on petitions for further franchises made by the Atlantic Telephone Co., N. Y. & Portchester Railroad Company, Nassau Electric Railroad Company, Southern Boulevard Railroad Company and the Union Railway Company. The court at the same time vacated the ex-parte injunction obtained by Pettit. Justice Gildersleeve, however, issued a stay directing the Board of Estimate to do nothing in the matter of petitions except to give them a hearing. The stay is to remain in effect pending a decision by the appellate division of the Supreme Court on the constitutional question raised.

SUBMARINE BOATS.—John P. Holland, inventor of submarine torpedo boats, has filed in the Court of Chancery at Newark, N. J., his formal answer to the suit brought against him by the Electric Boat Company, with which he was associated for the five years from 1899 to 1904. The answer is filed by Vreeland, King, Wilson & Lindabury, and contains besides the answer of the defendant inventor his cross bill to the complainant's allegations, in which he prays that all patents assigned by him to the Electric Boat Company be declared to be improperly held, and that the court order that corporation to reassign the same to him because of its failure to fulfill the specifications and terms of the contract under which they were assigned. He also asks that the complainant company be directed to reassign for the same reason all foreign patents granted to him and by him assigned to the company. The answer and cross bill contain allegations as to the causes leading to the want of success on the part of the company organized to exploit Holland's submarine boats. They assert that after securing the assignments from Holland of fifteen patents covering inventions for controlling the operation of the submarine boat and its armament, he was forced to the background and his advice and experience as a practical submarine engineer were wholly ignored and the management and construction of the vessels were placed in charge of engineers who, he avers, had no knowledge whatever of submarine construction, conditions or requirements.

Educational.

SOUTH DAKOTA STATE SCHOOL OF MINES.—While the school, which is located at Rapid City, S. D., in the mining district of the State, was organized with special reference to the promotion of the mining interests, its scope has been enlarged so that it now offers courses in civil engineering, general science and a preparatory course. The school possesses exceptional advantages for the study of mining engineering. The student has an excellent opportunity to study the milling and smelting processes as they are practiced at Lead City, Deadwood, Rapid City and other points in the Black Hills upon gold, silver and lead ores. The tin district is easily accessible from Rapid City.

WEST VIRGINIA UNIVERSITY.—The University at Morgantown offers four-year courses in civil, mining, electrical and mechanical engineering. The first two of these lead to the degree of Bachelor of Civil Engineering, while the last two lead to the degree of Bachelor of Mechanical Engineering. By devoting an additional year to study at the University, the candidates may receive the degrees of civil engineer and mechanical engineer, respectively. The catalogue of the University shows that during the year 1904-5, no fewer than 91 students were registered in the College of Engineering and Mechanical Arts, the total registration for the University being 1105, exclusive of 307 students in the preparatory schools at Keyser and Montgomery.

NORTH CAROLINA COLLEGE OF AGRICULTURE AND MECHANIC ARTS.—The college offers courses in agriculture, engineering and textile industry, and for four years' work in these courses grants the degrees of Bachelor of Agriculture, Bachelor of Engineering and Bachelor of Science, respectively. The instruction given in the textile department is in the theory and practice of cotton manufacturing. The building occupied by this department is a typical cotton mill fully equipped with all the machinery necessary for manufacturing cotton yarns and fabrics from the bale to the finished product. The student is taught the theory of cotton spinning, weaving, designing and dyeing, and also the practical operation of the cotton machinery used in carrying on the different processes. Each student produces for himself cotton yarns of different numbers, cotton fabrics of different kinds from known designs and choice of colors.

POLYTECHNIC INSTITUTE OF BROOKLYN.—A distinctive feature of the method of instruction at the Institute is a series of evening courses in the departments of chemistry, chemical, civil, electrical and mechanical engineering and in the department of mathematics. These courses are conducted by means of lectures, recitations and discussions given under the direction of members of the regular departments of the Institute, and are open to all persons who are qualified to take them. Students of the courses enjoy the advantage of instruction by a board of consulting professors who are engineers in actual practice and eminent specialists in their respective lines. Their work is an essential part of the course, dealing with actual professional practice. It is similar to the professional instruction given in medical colleges by eminent practising physicians and surgeons. The year 1905-1906 will witness the inauguration of a special course of advanced lectures on the problems of transportation viewed from the standpoint of the civil, the mechanical and the electrical engineer.

ARMOUR INSTITUTE OF TECHNOLOGY.—At few institutions of learning is greater attention given to telephone engineering than at the Armour Institute of Technology, of Chicago. The work in the department of electrical engineering is divided into two courses designated as Course I, Electric Power and Lighting, and Course II, Telephone Engineering. Special efforts have been made to place the latter course on the same basis as the former, which is the equivalent of similar courses offered at other technical colleges. The department of electrical engineering is well supplied with laboratory facilities, there being numerous direct-current, single-phase and polyphase machines and an exceptionally complete equipment for telephone engineering. It is interesting to note that in this department there are registered more students than in any other department of the College of Engineering. The total enrollment of the institute for last year was 1585. In the College of Engineering there were 592 students, 216 being in the department of electrical, 122 in mechanical and 122 in civil engineering.

UNIVERSITY OF TORONTO.—The calendar of the Ontario School of Practical Science, which is affiliated to the University of Toronto, contains some interesting information on the requirements for degrees at the University. The school consists of the usual engineering departments. The regular course in each department is of three years' duration. The instruction is given partly in the lecture rooms and partly in the drafting rooms, laboratories and field. A certain amount of work is laid out for the summer vacation. The course of study in each department is general, and beyond the selection of his department the student has no opportunity to specialize. After the general course is finished the diploma of the school is granted, and the student is at liberty either to enter the active life of his profession or to spend another year in special work. This year is called the fourth or post-graduate year. Graduates electing to proceed with their studies are allowed to select two subjects from an approved list, and are required to confine their whole attention to these subjects during the fourth year. The subjects in this list are such as require a large amount of time to be devoted to laboratory and other practical work. The advanced theoretical instruction is given either at the beginning or the end of the working day in order not to break up the time allotted to practical work. During this year the student is required to prepare a thesis on some subject connected with his work. After complying with all requirements, the candidate receives from the University the degree of Bachelor of Applied Science.

Personal.

MR. C. L. EDGAR, president of the Boston Electric and Boston Edison Companies, is sailing for Europe for three months of rest and recreation.

MR. ROBERT C. REED has been appointed superintendent of the electrical department of the Duquesne steel works of the Carnegie Steel Company. He succeeds Mr. E. Friedlander, who resigned recently.

DR. A. E. KENNELLY, of Harvard University, is sailing from Boston on July 20 for England and the Continent, and he and Mrs. Kennelly will be away on this vacation trip until the end of September.

MR. A. H. WHITESIDE, who has for a considerable time been manager of the Allis-Chalmers Company's district office at Atlanta, Ga., was transferred on July 15 to the Philadelphia district office, where he succeeds as manager Mr. W. A. Wood, resigned.

MR. SAMUEL H. FRESHNEY, of Muskegon, Mich., general manager of the Muskegon Traction & Lighting Company, has been chosen by the Grand Rapids board of public works as the head of the recently organized public service department. He will enter upon the duties of the position September 1.

MR. GEORGE B. TRIPP, general manager of the Colorado Springs Electric Company, has now been made manager of the Colorado Springs Gas Company and of the Colorado Springs Light & Power Company. Large interests are held in common in these concerns, but it is said that no consolidation is intended.

MR. M. W. THOMAS has been appointed manager of the Allis-Chalmers Company's district office at Atlanta, Ga. Mr. Thomas is widely known in the South, where he has been identified for years with electrical and machinery interests. He was until recently manager of the Westinghouse Electric & Mfg. Company's office in New Orleans.

MR. A. M. BELL.—Alexander Melville Bell, the aged father of Prof Alexander Graham Bell, is seriously ill at his summer home, Colonial Beach, Va. Two physicians from Washington were summoned this week, and because of the serious condition of the patient did not wait for the usual means of transportation, but took a Government tug.

MR. CHARLES E. WADDELL, of Asheville, N. C., was a visitor to New York last week, when several members of the American Institute of Electrical Engineers seized the opportunity to reciprocate some of the hospitalities extended during the recent annual meeting in the South. A little dinner was given to Mr. Waddell at Bay Ridge, on New York bay, one evening, and among those present were President Lieb, Secretary Pope and Messrs. F. C. Bates, Calvin Rice and F. H. Gale.

MR. E. R. KNOWLES, C. E., 120 Liberty Street, New York City, has been retained as consulting engineer for the light, power and heat installations for the new factory to be erected in Jersey City for M. Calm & Bro., 41 Warren St., New York City, and also for the new factory to be erected in Brooklyn for the S. S. McClure Publishing Company. He is now making the light and power installations in the North River Insurance Company and the Gibson Buildings, New York City, N. Y.

PROF. G. F. SEVER, of Columbia University, New York, is being kept busy this vacation tallying the honors and recognitions that come his way. He received recently from Columbia an honorary degree as Master of Science, and he has also been made full professor and acting dean of the School of Applied Science at the University. On July 4 he was elected a member of the Massachusetts branch of the Society of the Cincinnati, of which famous Revolutionary body one or two of his ancestors were presidents.

MR. WM. H. BLOOD, the newly elected president of the National Electric Light Association, was in New York, last week, consulting with several of the officers of the Association regarding the policy to be pursued during the coming year. President Blood intends to make a number of appointments of committees, etc., in the near future, with a view of having active work taken up at once, and continued throughout the year, in addition to the routine work of the secretary's office. A number of new members were added to the different classes at the Colorado meeting, and interest in the association was never so keen as at the prsent time.

MR. W. J. BUCKLEY, who has earned a widespread and enviable reputation as a successful salesman of power and electrical machinery in the Southwest, has been appointed manager of the Allis-Chalmers Company's district office at St. Louis. Mr. H. P. Hill, whom he succeeds, goes to the Salt Lake City district office, where he will devote himself to his specialty, the electrical features of the company's business. The Allis-Chalmers Company has never before had its electrical department's products directly represented in that district.

MR. C. T. YERKES.—A cable dispatch from London of July 18 says: "Charles T. Yerkes, who has been seriously ill for the past fortnight, is recovering. His illness considerably alarmed the traction interests of London. The calling in of a prominent specialist gave rise to a rumor that blindness was setting in. A Paris specialist diagnosed Mr. Yerkes's malady as dilation of the stomach and recommended complete rest. Mr. Yerkes was able to do business in his chambers yesterday. Probably he will go to the country in a few days. His condition is not causing any apprehension."

Trade Publications.

RAWHIDE BELTING.—The Shultz Belting Company, 111 Chambers St., New York, has issued a neat booklet devoted to Sable rawhide belting. The characteristic features and the advantages of the rawhide belting are well shown. The booklet contains valuable information concerning the size of belting for various duties.

STEAM TURBINES.—A most interesting bulletin of the De Laval Steam Turbine Company describes its factory and product, and gives a sketch of Dr. De Laval, the inventor. The bulletin is profusely illustrated, the views showing the interior of the shops at Trenton, N. J., and turbines in various stages of construction.

WATER, STEAM AND AMMONIA PACKINGS.—In a well-illustrated catalogue, the Crandall Packing Company, Palmyra, N. Y., gives a complete description of the characteristic features of the numerous styles of packing which it offers to the trade. The faith of the company in its packings is shown by the fact that it expresses its willingness to submit samples for test without cost.

LOCOMOTIVE CRANES.—The Browning Engineering Company, Cleveland, O., recently issued bulletin No. 19, devoted to locomotive cranes. It contains numerous illustrations, showing the cranes at work in stone and lumber yards, in railroad construction, in repair shops, and for handling coal and ashes. A prominent feature of these cranes resides in the fact that they are independent of a locomotive, and can be employed for switching cars.

ALTERNATING-CURRENT MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has issued an illustrated folder, calling attention to the various types of alternating-current motors which it is now manufacturing. In addition to its well-known single-phase constant-speed motors, the company has developed complete lines of single-phase variable-speed motors, and polyphase induction motors of the "squirrel-cage" and "external-resistance" types.

GOLD MILLING.—In its special publication No. 4000, the Allis-Chalmers Company, Milwaukee, Wis., gives an account in detail of gold milling in the Black Hills. The substance of the publication has been taken from a paper read before the American Institute of Mining Engineers by Prof. H. O. Hofman of the South Dakota School of Mines. The paper furnishes a valuable discussion of the processes involved in the extraction of gold from its ores.

WELDLESS CHAINS.—The American Annular Rolling Company, Boston, has issued in pamphlet form a translation of an article by Monsieur Eugene Francois, Professor of Engineering at the Industrial School at Brussels, Belgium, entitled "The Manufacture of Weldless Chains by the Annular Rolling Process." The pamphlet gives an excellent discussion of the relative advantages of the annular rolled chain over the welded chain, and outlines the process involved in the manufacture of the weldless chains.

NICKEL-STEEL.—In a neat booklet recently issued, the International Nickel Company, 43 Exchange Place, New York, gives a long list of the purposes for which nickel steels have been successfully applied in the United States, France, Germany and England. It is stated that the addition of 3 to 4 per cent of nickel to steel increases the proportional elastic limit, adds to the ductility of the steel, increases its resistance to compression, abrasion and shock, and increases its toughness, so that, therefore, nickel-steel is a safer material than carbon-steel.

AN ELECTRIFIED RAILWAY SHOP.—Bulletin No. 58 of the Crocker-Wheeler Company, Ampere, N. J., describes the new shops of the Pittsburg & Lake Erie Railroad at McKees Rocks. These shops are equipped with the Crocker-Wheeler Company's multiple-voltage system. The article, which was written by the mechanical engineer of the shops, shows how the designs for changing the machines to motor drive were worked [illegible] considers in detail some of the changes that were made. The bulletin, in addition to being of general interest, is especially valuable to any [illegible] or engineer contemplating a similar change.

RENOLD ROLLER CHAIN.—The Link-Belt Engineering Company has issued booklet No. 54, devoted to the machine-made roller chain designed by Mr. Hans Renold, of Manchester, England. This chain consists of a series of inside and outside links. The outside link is composed of two light steel plates and two shouldered steel pins, while the inside link is formed of two larger side plates, two solid bushes forming the bearings for both pin and roller, and two anti-friction rollers. It is stated that the steel is the best that the steel makers of Europe can produce, so that the weight is very materially below that of any other chain of equal strength.

MOTOR EQUIPMENT FOR PRINTING PRESSES.—The Sprague Electric Company, 527 West 34th Street, New York, has issued an exceptionally well illustrated bulletin designated as No. [illegible], which serves to show the general application of direct-current motors to printing presses and allied machines. The popularity of motors for this work will be appreciated from a study of a list at the end of the bulletin which contains more than 400 names of prominent engraving and stereotyping plants, equipped with the Sprague Electric Company's motors. The bulletin contains numerous illustrations showing the motors as actually installed with the various machines.

News of the Trade.

REMOVAL.—The Marine Engine & Machine Company, formerly at 80 Broadway, New York, has moved to 136 Liberty Street.

WESTINGHOUSE OFFICE.—The Los Angeles (Cal.) office of the Westinghouse Electric & Mfg. Company, which had heretofore been in the Trust Bldg., has been removed to No. 527 South Main Street.

THE DAYTON HYDRAULIC MACHINERY COMPANY, R. E. Spencer Geare, M. E., sales manager, has opened a New York branch office at 133 Liberty Street. It will carry a line of Brooks' centrifugal pumps, of which it is exclusive manufacturer.

THE ELECTRIC APPLIANCE COMPANY, Chicago and San Francisco, is sending out data descriptive of the Sangamo direct-current wattmeter, for which it is distributing agent. It reports that extensive additions to the factory are keeping pace with the growing demand for this wattmeter.

AMERICAN ELECTRIC FUSE COMPANY.—Contracts have been let by the American Electric Fuse Company for the erection of factory buildings at Muskegon, Mich. One building, 150x50 feet, will contain the brazing, plating, buffing and cleaning rooms and dry kiln. A three-story office building will be erected later.

MR. CHARLES R. UNDERHILL, 55 Liberty Street, New York, announces that he is now in a position to supply the trade with all kinds of small electromagnets, induction coils, spark coils and coil windings of every description and in any quantity, as well as large electromagnets and solenoids, which have heretofore been his specialty.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., has recently opened an office and show room at 156 Pearl St., Boston. This was made necessary because of the increasing business in that section, and renders it more convenient for the company to show its line and submit quotations for its switches, switchboards and panelboards.

WILLARD STORAGE BATTERY.—The Willard Storage Battery Company, of Cleveland, O., informs us that since the fire in its factory, of which note was made in these pages, it has moved into a new factory, and is already turning out one-third of its usual product. This will be steadily and rapidly increased. The new factory is at 27 to 31 Academy Street Cleveland.

SOUVENIR SCARF PIN.—At the recent telephone convention in Chicago, one of the most tasteful and popular souvenirs was the scarf pin representing the trademark of the F. Bissell Company, of Toledo, Ohio. As not every one was present at the convention the company wishes to send pins to those who have not received them and will mail them on request without charge.

THE COOLEY GENERAL DEVELOPMENT COMPANY, Boston, Mass., has just increased its capital stock. This was found necessary on account of the rapidly increasing demand for the engines manufactured by this company. Some months ago it moved into its present quarters at Jamaica Plain from its old factory in Boston and now its plant is quite inadequate to the demand. The increase in capital stock is to provide additional facilities for the output of its product.

CROCKER-WHEELER LOW-SPEED GENERATORS FOR ELECTROLYTIC WORK.—An order just placed with the Crocker-Wheeler Company, of Ampere, N. J., through its New York branch, is for two size 898 Crocker-Wheeler engine-type, direct-current generators, with a capacity of [illegible] amperes and 105 volts, for electrolytic work. These will be special machines with 24 poles. The speed will be 100 r.p.m. They will be installed at Carteret, N. J., in a plant where there are at present four Crocker-Wheeler generators of varying capacity up to 750 kilowatts.

THE LONG ARM SYSTEM.—Among the few American inventions which are on display at the Naval, Shipping and Fisheries Exhibition at Earl's Court, London, this summer, a full size working exhibit of the "Long Arm" system of electrically operated water-tight power doors has attracted great attention. This system, from a central station located at a convenient point on the bridge is to shut or close the doors and hatches of the vessel in time of emergency, providing for the local safety of men involved by a liberty action attached to each door. The device has now been installed on some 30 American men-of war, and the Admiralty departments of numerous foreign governments are interesting themselves in the system with a view to placing it on their own ships. In addition to the exhibition at Earl's Court, there is another full-size working exhibit on display at 39 Victoria St., London.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 11, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attorneys, 140 Nassau St.]

794,161. MEDICAL BATTERY ELECTRODE; Kittie L. Van G. Curry, Chicago, Ill. App. filed Apr. 26, 1905. A spherical electrode for a medical battery in which a pair of hemispherical sections are screwed together and provided with a chamois skin cover.

794,194. ELECTRIC CIRCUITS FOR RAILWAY SIGNALING; Henry W. Spang, New York, N. Y. App. filed July 30, 1902. In order to avoid the drop in potential which occurs when the two rails are made the respective branches of the circuit for a railroad signal, both rails are positively charged and the instruments are included in branch circuits from the rails to the ground.

794,195. ELECTRIC CIRCUITS FOR RAILWAY SIGNALING; Henry W. Spang, New York, N. Y. App. filed Sept. 30, 1902. Relates to modifications of the above in which an alarm apparatus is included in the train and the track is divided into insulated sections so that a circuit is formed between the wheels of one car and those of another.

794,196. ELECTRIC CIRCUITS FOR RAILWAY SIGNALING; Henry W. Spang, N. Y. App. filed Oct. 3, 1903. Relates to modifications of the above and displays signals upon the train by virtue of a pair of relays in the two branches of a balanced or divided circuit, a change in the balance of which actuates one or the other relay.

794,212. METALLURGICAL FURNACE; G. H. Benjamin, New York, N. Y. App. filed March 31, 1903.

794,210. DYNAMO ELECTRIC MACHINE; D. Balachowsky, of Paris, and P. Caire, of Levallois, France. App. filed Nov. 21, 1902. (See Current News and Notes.)

794,218. ELECTRIC SWITCH; Willard E. Dow, Braintree, Mass. App. filed Jan. 9, 1905. Relates to details of construction of a wall switch having two knife blade contacts within a small circular base, and an arm mounted to swing into engagement with either at will. Also includes a removable plug.

794,220. ELECTRIC CIRCUIT CLOSER; Monroe Guett, Hartford, Conn. App. filed Nov. 4, 1903. A battery switch for automobiles in which the usual removable plug is formed with cam surfaces which are adapted to engage different circuit contacts, so that the plug acts as a switch arm when in use.

794,240. ELECTRIC STORAGE BATTERY; A. Meister and A. Junker, New York, N. Y. App. filed Nov. 11, 1901.

794,242. TAPE CONTROLLED TELEGRAPHIC TRANSMITTING APPARATUS; Donald Murray, London, England. App. filed Jan. 5, 1905. A form of Jacquard mechanism in which a continuously reciprocating arm has its lateral position controlled by needles which oscillate toward and from the perforated tape. The arm closes different transmitting circuits according to whether or not the needles enter the perforations.

794,245. ELECTRIC APPARATUS FOR PRODUCING SOUND SIGNALS; Charles H. O'Brien, Augusta, Me. App. filed July 18, 1904. A buzzer or hummer for telephone apparatus in which a sort of microphone transmitter is used as a circuit breaker for a mechanical vibrator. The result is that the buzzer loses its harsh, metallic characteristics.

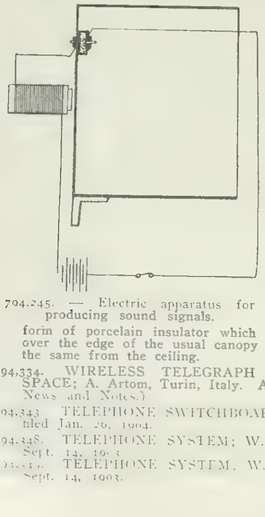
794,255. ELECTRIC FURNACE. C. L. Saunders, Cleveland, Ohio. App. filed Feb. 15, 1901. Renewed Nov. 18, 1903.

794,266. ELECTRIC SIGNALING AND ELECTROPNEUMATIC TRAIN CONTROL SYSTEM; John A. Whyte, Toronto, Can. App. filed Mar. 5, 1904. Within the locomotive cab is a switch box including means for making various circuits through the tracks which indicate whether or not the switches ahead of the train are properly positioned, and in case they are not, a pneumatic apparatus is effective to set the air brakes.

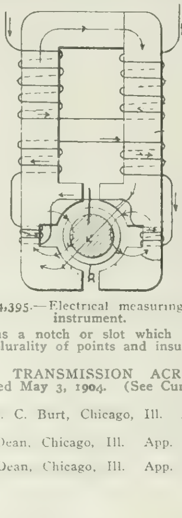
794,269. AUTOMATIC ELECTRIC RAILWAY SWITCH; Walton D. Woolley, Normandy, Mo. App. filed Aug. 3, 1904. Relates to details of construction of a track switch in which a pair of insulated sleeves are placed on the trolley wire and have connections to a pair of solenoids which throw the switch point in opposite directions. The sleeves are preferably of sheet iron, which is bent around the trolley wire and clamped with bolts on the upper side thereof.

794,321. COMBINED GUIDING AND LIGHTING DEVICE FOR CIGARS; Joseph J. Shickluna, Buffalo, N. Y. App. filed Feb. 20, 1905. The turn cock of a gas burner has an arm which makes a contact at the usual gas tip and ignites the gas. The arm also has an eye for guiding the cigar into the flame, which act also causes the operation of the device.

794,309. INSULATING BLOCK FOR ELECTRIC LIGHT CANOPIES; Isaac J. Parker, Boston, Mass. App. filed Nov. 8, 1904. Relates to a form of porcelain insulator which contains a notch or slot which slips over the edge of the usual canopy at a plurality of points and insulates the same from the ceiling.



794,245. — Electric apparatus for producing sound signals.



794,395.—Electrical measuring instrument.

794,334. WIRELESS TELEGRAPH AND TRANSMISSION ACROSS SPACE; A. Artom, Turin, Italy. App. filed May 3, 1904. (See Current News and Notes.)

794,343 TELEPHONE SWITCHBOARD; M. C. Burt, Chicago, Ill. App. filed Jan. 26, 1904.

794,348. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Sept. 14, 1903

794,349. TELEPHONE SYSTEM. W. W. Dean, Chicago, Ill. App. filed Sept. 14, 1903.

794,358. ELECTRICAL CONTROLLER; Ray P. Jackson, Wilkinsburg, Pa. App. filed June 6, 1904. The controller arm has an annular cam groove which normally holds a locking plate for the reverse lever in its locking relation. When the controller arm comes to off position, the plate is released from the groove and the reverse lever can then be actuated.

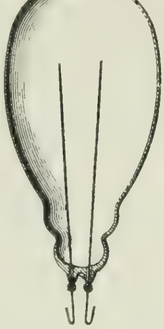
794,362. ELECTRIC MOTOR; B. G. Lamme, Pittsburg, Pa. App. filed May 3, 1904. (See Current News and Notes.)

794,363. ELECTRIC MOTOR AND CONTROLLING MEANS THEREFOR; B. G. Lamme, Pittsburg, Pa. App. filed Jan. 3, 1905. (See Current News and Notes.)

794,365. VOLTAGE REGULATOR; P. M. Lincoln, Pittsburg, Pa. App. filed June 30, 1904. (See Current News and Notes.)

794,370. TELEPHONE LOCK-OUT MECHANISM; T. Matheny and R. C. M. Hastings, Athens, Ohio. App. filed July 22, 1904.

794,395. ELECTRICAL MEASURING INSTRUMENT; Frank Conrad, Edgewood Park, Pa. App. filed Jan. 20, 1904. An alternating-current ammeter in which the torque on a pivoted rotor indicates the strength of the current. In order to avoid the error in current reading due to a change in frequency, additional coils are provided which act as secondary windings of a transformer and exert a neutralizing action as the frequency increases, so that the torque on rotor does not increase unless there is an increase in the actual current.



794,588. — Method of manufacturing incandescent electric lamps.

794,398. ELECTRIC DRILL MOTOR; Francis E. Drake, St. Louis, Mo. App. filed Sept. 30, 1904. The drill is actuated by a pair of alternately acting solenoids in the usual way, and a fan motor forming part of the device delivers a current of air to keep the coils cool.

794,423. APPARATUS FOR CONTROLLING TRAFFIC ON RAILWAYS; Thomas H. Patenall, Wilkinsburg, Pa. App. filed Oct. 18, 1904. In order to avoid excessive wear of the first few staffs in the usual form of staff instrument, the staffs operate in an endless groove, being inserted at one end thereof and taken out at the opposite end continuously. The circuits are arranged to suitably lock the staffs from withdrawal unless duly authorized in the usual manner of staff instruments.

794,435. THERMAL CUT-OUT; Theodore Varney, Pittsburg, Pa. App. filed June 24, 1904. A fuse plug in which the fuse wire is led in a curved path over a projection so that when the fuse is blown the arc will blow directly out of the chamber and will not injure the contact plates.

794,441. COMBINED RAIL JOINT AND BOND; Benjamin Wolhaupter, Chicago, Ill. App. filed Nov. 28, 1904. A form of rail joint in which a base plate has longitudinal grooves to hold and protect the rail bonds. The fish plates have underlying flanges to hold the base plate in position.

794,442. CONTROLLER FOR ELECTRIC MOTORS; Frederick Wright, Fishkill, N. Y. App. filed Feb. 10, 1905. A switch for grouping storage cells into series or multiple arc in order to control the current for any apparatus used.

794,458. INCANDESCENT ELECTRIC LAMP SOCKET; Louis C. Gollatz, Providence, R. I. App. filed Dec. 14, 1904. An adapter for the sockets of an obsolete type of incandescent lamps by which they are made capable of receiving the usual type of incandescent lamp. The device is made to automatically lock in position, so that the adapter will not unscrew and be thrown away with the lamp.

794,459. WIRELESS TELEGRAPHY; W. S. Hogg, Washington, D. C. App. filed May 6, 1905. (See Current News and Notes.)

794,466. EDUCATIONAL TOY; Hanson Robinson, Hanover, Pa. App. filed Aug. 6, 1904. A hollow sphere is partially filled with liquid and has a float therein with a permanent magnet which is adapted to maintain a toy ship upon the upper surface of the sphere, no matter how much the latter is rolled about.

794,497. THERMOSTAT; John D. Gould, New York, N. Y. App. filed Oct. 8, 1904. A circular base plate attached to the ceiling has a pair of spring blade contacts, and a plug at the center of the base is normally effective to keep the contacts separated. When a fusible cap softens, the plug moves to close the alarm circuit.

794,501. STORAGE BATTERY GRID; M. Heisser, Chicago, Ill. App. filed July 5, 1904.

794,518. CIRCUIT BREAKER; John B. Laing, Sun, W. Va. App. filed Mar. 28, 1904. A plate of insulating material has clamps at each end thereof for the attachment of trolley wire sections. The plate also has contact strips on its lower edge which form continuations of the trolley wire sections, and which can be electrically connected by a removable plug in the plate.

794,519. AUTOMATIC BLOCK SIGNAL SYSTEM; Jorg Lanz, Rodaun, near Vienna, Austria-Hungary. App. filed Jan. 21, 1903. An overlapping block signal system in which the semaphore operated by the guard only allows a train to pass out of the section traveled upon when the signal bell and release relays of the next block section are operated by the current of the battery of the next but one block section.

794,565. ELECTRIC ARC LAMP; Marion A. Stogdill, Indianapolis, Ind. App. filed Oct. 26, 1904. Relates to detail improvements in the feeder mechanism for an electrical lamp in which the solenoid acts upon a compound lever system including a toggle joint, so as to secure a more gradual movement of the carbons while the arc is in operation.

794,580. AUTOMATIC ELECTRIC HEAT CONTROL; James I. Ayer, Cambridge, Mass. App. filed Feb. 6, 1905. The holder for a self-heating electric flatiron has a thermostat which automatically opens the circuit when the heat of the iron is sufficient.

794,588. METHOD OF MANUFACTURING INCANDESCENT ELECTRIC LAMPS. Henri Casassa, Milan, Italy. App. filed Jan. 4, 1901. A method of sealing electrodes into an incandescent lamp which avoids the necessity of platinum. The wires are fused into the glass at a red heat by which the air is expelled around the wires and a coat of oxide formed. When the bulb is exhausted a compound of linseed oil and rubber is sucked into the joint, which compensates for the varying coefficients of expansion of the glass and the conducting wires and forms an efficient seal.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, JULY 29, 1905 No. 5.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE	1139 Monadnock Block
PHILADELPHIA OFFICE	929 Chestnut Street
CLEVELAND OFFICE	402 Cuyahoga Building
EUROPEAN OFFICE	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue 13,000 copies are printea. Total circulation for 1905 to date, 417,500.

NEW YORK, SATURDAY, JULY 29, 1905.

CONTENTS.

Editorial ... 165
The Testing of Rubber Insulated Wire ... 168
The Situation in Single-Phase Traction. By C. F. Scott ... 168
The Independent Telephone Situation in St. Louis ... 168
Notes on the Electrical Contractors' Boston Meeting ... 169
Electric Power in Mines ... 169
Detroit Municipal Lighting ... 170
Manufacture of Artificial Abrasives ... 170
Fishing Made Easy ... 170
Success in Electrical Salesmanship ... 170
Current News and Notes ... 171
Electrical Engineers of the Times.—XX. Mr. H. H. Cutler ... 173
Electrical Power Development at Portland, Ore ... 174
Meteorology and the Dynamo. By M. I. Cromack ... 177
Massie System of Wireless Telegraphy. By A. Frederick Collins ... 178
Transfer Systems and the Multiple Board in Telephone Exchanges I. By Arthur V. Abbott, C. E. ... 181
Recent Electrochemical Developments ... 182
Removal of the Diverting Dam of the Ontario Power Company, Niagara Falls ... 184
New Telephone Patents ... 184
LETTER TO THE EDITORS:
The Electrolytic Detector for Electric Waves. By Ernest Merritt ... 185
Digest of Current Electrical Literature ... 185
Book Reviews ... 189
Electric Water Purifier ... 191
Portable Wireless Telegraph Sets ... 191
New Independent Telephone System for Meridian, Miss ... 192
Concentric Diffuser for Incandescent Lamps ... 192
Recent Developments in Induction Motors ...
Types of De Laval Turbine Units ...
National Electrical Code Standard Enclosed Fuses and Cutouts.
New Drilling Machine ...
Industrial and Commercial News ...
General News of the Week ...

OUR UNUSED WATER POWERS.

People are disposed to consider as idle talk the predictions frequently made that the day is coming soon when all the power used in this country will be supplied by hydro-electric plants and that the steam plant will be driven out of existence. With steam plants growing in number and capacity as rapidly as they are at present, hardly any excuse exists for taking these predictions very seriously. There is good reason to suppose, however, that the day will come when a much larger proportion of the total power used will be derived from hydro electric plants. Many low head water powers are being developed each year in the middle and eastern states, as well as high head plants in the mountain districts of the western half of the United States, and there is no justification for supposing that anything more than a beginning has been made. As the price of coal goes up, which it inevitably will do as time passes, the value of water power will increase enough to make investments worth while that could not have safely been made a few years ago. It is not the small rivers alone that are being considered at the present time. Propositions were recently made to utilize no less a stream than the Mississippi near Keokuk, while the Ohio River at certain points has been looked upon favorably from an engineering standpoint. A water power plant using an immense volume of water at a very low head is not regarded as such an unwieldy engineering scheme as it was a few years ago, thanks to the developments in low head turbines. The main questions are those of civil engineering and finance. Electrical engineering has made the utilization of water power at points distant from a market feasible, and on the civil engineer must fall the work of getting these low head water powers harnessed at a reasonable first cost, according to designs which will eliminate dangers from flood waters.

REGULATION OF WIRELESS TELEGRAPHY.

We notice that the German Government has adopted a code of regulations for wireless which will assuredly increase the usefulness of such service. Under this arrangement, shore stations with their great radius of action are given the initiative and take precedence of stations afloat. When a coast station calls, ships unless called keep silence, and ships are not supposed to try for the shore save in emergencies, until fairly within range, here assumed as 75 miles. There are various minor regulations which aim at keeping the ethereal peace. All the coastwise stations use the same wave length in transmitting, the standard taken being 365 meters. Eleven sending stations are available along the German coast, and thirteen liners under the German flag are registered for regular service.

All this is a step in the right direction, and it is a pity that a similar code cannot be made international pending such development in the art as may bring syntonism as a relief from the troubles of interference. To make wireless of great and immediate use some such step is at least temporarily necessary, and while we would be very far from approving restrictions that would impede progress, some concurrent action by the maritime powers is certainly necessary. It will not do to let warring systems defeat by promiscuous interference the one end which it is their common duty to promote. Nor should it be possible for stations of one nation to interfere by accident or design with the stations of another. If wireless is to be pushed to its maximum usefulness, it must cover the seas with an invisible network of communication, and it can do this only when all systems of all nationalities unite in a recognized common policy and obey specified rules. A good beginning was made at the conference two years ago, but united action must follow a common consensus of opinion in order to produce any useful result.

Far Western Development.

Such articles as that which appears in our present issue, relative to the electrical development in the vicinity of Portland, bring again forcibly to mind how large and generous a field for electrical exploitation that Far West and the Pacific Slope have been. The work around Portland is on a large scale and of great importance and interest, and it is evident that Oregon is a splendid territory for electric light, power and transportation. In like manner, California has already shown its leadership and originality in hydroelectric development, while the same state is virtually at the head of the list in the utilization of the telephone by the public. If the Californian ratios prevailed all over the country, the United States would be much farther advanced electrically than it now is. In electric mining the advances have been extraordinary, and yet it would seem that only a beginning has been made, from which the brightest future may be anticipated.

Some Phases of Radiomania.

From time to time we have raised a voice of warning against hasty acceptance of the fervid hypotheses that befog the ascertained facts of radioactivity. The need for sober judgment has been emphasized over and over again by the wild statements which have gone the rounds of the technical as well as the non-technical press. The latest of these has just forced itself upon our notice and calls for pointed comment. It is built around the following thesis: "It is sober fact that radium has shaken the law of gravitation, has set at apparent defiance the law of conservation of energy, has displaced the atomic theory, has rewritten chemistry, and has provided a new account of the ultimate constitution of the universe." Now, in the interest of scientific truth, be it set down that the statement just quoted is largely nonsense in each and every particular. Whatever the investigation of radioactivity may do in the fullness of time, it has not yet done any one of these things. It has in truth produced interesting results which some day will be co-ordinated, but in doing so it has unhappily stimulated the publication of all manner of ill-grounded hypotheses which in turn have befooled the credulous and the superficial. Such psychological phenomena accompany not infrequently new lines of investigation, whether these lead to important results or not. Their acute phase at this particular stage of the study of radioactivity is most unfortunate, since they divert attention from the really important features of the investigation and bring legitimate and sane research to the very verge of charlatanry.

The germ of a great generalization may lie in radioactivity, but it will come to fruition only after years of painstaking labor and weeding out of the rank hypotheses that are growing up around it. Radium is a good thing for the untrained investigator to keep away from, since there are plenty of indications that even the skilled are likely to be led astray by their enthusiasm. The exciting cause of the pseudo-scientific outbreak upon which we are commenting was the recent announcement that Burke, of Cambridge University, England, had succeeded in stimulating the appearance of life in a sterilized medium by means of radium, the omnipotent. Not having seen the experiments, we hesitate to pass judgment upon the actual facts, but we cannot be unmindful that within the past half century similar announcements have several times been made by reputable but mistaken investigators. In each case further research has completely discredited the alleged discovery. There is nothing inherently unbelievable in the production of organized life by purely chemical or physical processes, but on the other hand there has never been adduced evidence sufficient to establish even a remote probability of such an occurrence. The most that can be said from a scientific standpoint of the present case is that Burke has observed certain bodies under circumstances sufficiently unusual to require careful study in order to determine: First, whether they are organic structures; and, second, whether they may have arisen without infection of the culture medium. So far neither of these questions has been answered, and the bodies themselves are so minute as to make them very difficult of determination. But nothing yet has appeared inconsistent with the view that they are crystals and nothing more—and crystals have before this been mistaken for living organisms. That they do not respond like many crystals to polarized light is to be expected of bodies commensurate in size with the wave length of light.

The serious part of the whole matter is that it has resulted in carrying into a perfectly legitimate, even if inconclusive, research, the flamboyant methods of the professional advertising manager. And the same stigma attaches to a great deal of recent scientific and quasi-scientific work. It is shame and dishonor to some institutions of learning that they allow their laboratories to be the prey of sensation mongers. Brilliant and successful research brings fame without recourse to the clap-trap contrivances dear to the advance agent of the circus. And the worst of it all is that such methods bring discredit upon work which might turn out to be of permanent value if it could but escape them. Radioactivity, more's the pity, has been exploited until it is coming to be the very shibboleth of quacks, and the mightiest spell in the conjuring book of pseudo-science. It is high time that the serious and capable workers in that really important field of investigation followed the example of Newton and of Darwin, and wrought patiently and silently until hypothesis has been transmuted into verified fact. One great research well finished is worth more to the world than a hundred hastily published suppositions. We would not condemn, but admonish those who have erred—they are punished enough by seeing their grotesque images in the distorted mirrors held up for all the world to see by bogus savants—and very often they are innocent, as shown by their frenzied protest against statements, ideas and experiments attributed to them wholly without warrant or excuse.

Improvements in the Edison Lamp.

A paper published in the July number of the Journal of the Franklin Institute was read last March before the electrical section of that body by Mr. J. T. Marshall upon the development of the manufacture of the Edison incandescent lamp from 1881 to 1905. The article is interesting in itself and derives new interest from the remarkable improvements in the lamp announced recently by Mr. John W. Howell, before the Institute. In 1881 the average number of Edison incandescent lamps manufactured per working day was about 100. In 1905 the corresponding number was 150,000. The increase in lamp manufacture was thus 1,500 fold in that time. The 16-cp lamps of 1881 had a power consumption of 5.8 watts per mean horizontal candle, or 8 lamps per electrical horse-power. The 16-cp lamps of 1905 were mostly of 3.1 watts per candle or 15 per horse-power. The efficiency of the 16-cp Edison lamp has nearly doubled in the interval. The selling price of the 1881 16-cp lamp was 65 cents and that of the 1905 lamp 16 cents; so that the price has been reduced to one-quarter of the original. Moreover, the lamps of 1881 are stated to have been sold at a loss and the actual cost apiece is stated to have been more than $1.30; so that the manufacturing cost per lamp appears to have been reduced to less than one-eighth.

Nevertheless, the Edison lamp of to-day has the same number of component parts as the lamp of 1881, and to an unskilled eye, the two lamps side by side would look much alike. The principal reduction in the cost of the lamp has been due to the replacement of hand labor by machine labor. Most of the operations involved are effected by machine. The filament is of artificial cellulose, or carbonaceous material, squirted through a small hole, in considerable lengths; whereas the original filament was a hand-cut strip of bamboo fibre. Almost all of the glass-blowing operations are now performed by machinery; whereas the original lamps had all the glass-blowing work done by hand. The glass balls used to be all free-blown by the workman, so that no two bulbs were exactly alike in size. Now they are all molded, so that except for microscopic differences all the bulbs have just the same size. It is curious that the only two operations which have remained hand work, and almost unchanged from the first, are the pasting of the ends of the filament to the terminal wires, and the soldering of the terminal wires to the metal electrodes in the base. It seems unlikely that any machine can compete with a workman in these processes, which call for special selective manipulation. Great interest attaches to the process of exhaustion of the bulbs. A very high degree of vacuum is required. It used to be necessary to exhaust the lamps by Sprengel mercury pumps. Now mechanical pumps, aided by the red phosphorus process, exhaust the lamps much more quickly and conveniently.

The lifetime of a lamp used to be the time of glowing which elapsed under normal conditions until the filament broke; although the candle-power of the lamp might be less than 50 per cent of the original. Now the lifetime is considered the time that it takes while glowing to fall off by 20 per cent in original normal candle-power, or down to 80 per cent of the original. Some figures are given in the paper in tabular form contrasting the lifetime (in the new sense defined above) of 16-cp lamps arranged to work at various efficiencies from one-fifth to one-half of a normal mean horizontal British candle-power per watt. Analyzing these figures, it would appear that the lifetime at the high consumption of five watts per candle is 220 times as long as that at the low consumption of two watts per candle. From this it would appear that the lifetime varies directly as the fifth or sixth power of the consumption. This is a terrible example of the hyperstrenuous life if there be any analogy between lamps and human beings. Between the limits of one-third and one-fifth candle per watt, a formula for the lifetime which fits the results very closely is that the common logarithm of the lifetime in hours equals 5.478 reduced by 8.7 times the illumination expressed in candles per watt. It would be wonderful, indeed, if the next quarter of a century could effect improvements in incandescent lamps comparable to that effected in the quarter century just pasesd. Already, however, remarkable improvements in carbon filaments are foreshadowed, and possibly tantalum, osmium or other filaments may come also into general use. eral use.

THE THEORY OF THE ELECTROLYTIC RECTIFIER.

A recent number of the *Physical Review* contains an account of a research by Mr. S. R. Cook to ascertain the cause of the obstruction offered to electric current by the aluminum electrolytic rectifier. It is manifest that the obstruction must be due either resistance or to c.e.m.f., or to both causes in part. It is someti very difficult to determine how much of an electric obstruction due to resistance, and how much to c.e.m.f. For example, it used to be supposed for many years that the difference of potential between the carbons of an ordinary direct-current arc lamp were due to a c.e.m.f. of 30 or more volts. Now, however, it is generally believed that the maximum value of the c.e.m.f. in an arc is only about 1 volt, and that all the rest of the potential difference is attributable to the resistance of the carbon vapor stream. Practically the only way of clearly deciding between the two rival hypotheses in any given case is by breaking the circuit and ascertaining whether there is any residual e.m.f. in the obstruction. If there be nothing but resistance in the obstruction, then the e.m.f. will vanish instantly with the removal of the current. If, on the other hand, there be a c.e.m.f. present, it will tend to persist and reveal itself after the cessation of the current. The ordinary voltameter, or coulombmeter, is a case in point. In this apparatus the c.e.m.f. of polarization persists after the removal of the polarizing current. In the arc lamp, on the contrary, only traces of c.e.m.f. are discoverable after the removal of the current.

In the case of the aluminum rectifier, the paper shows that if the exciting current be withdrawn there is a relatively large residual c.e.m.f. which gradually disappears. For example, with an applied e.m.f. of 26 volts, and a current of about 26 milliamperes, the apparent resistance of the device was 1,000 ohms; but after shutting off the current the c.e.m.f. after 0.01 second was 24.6 volts, after 1 second 14 volts, after 10 seconds 3 volts and after 50 seconds 2 volts. The c.e.m.f. fell off, therefore, 50 per cent in about 1 second. The actual resistance of the device, as computed on these observations, was approximately 100 ohms, although that figure may be open to discussion.

The conclusions reached from the observations are that the film of hydroxide formed on the aluminum anode acts as a dielectric to the ions swimming in the electrolyte. A condenser is thus virtually formed by the film, between the anode plate on one side and the electrolyte on the other. The condenser yields a c.e.m.f. after the removal of the charging current, subject to loss of charge by leakage through the film. This loss of charge seems to occur more slowly than would take place through a wire joining the plates of the condenser and having a resistance equal to that evaluated from the observations. The percentage loss of charge is more rapid at the outset than at later instants, showing that the loss of charge in the condenser is greatest at the outset; or that the resistance of the dielectric in the condenser continually increases as the pressure falls by leakage. Finally, when the pressure has fallen to 2 volts, the rate of diminution in charge becomes very low.

The size of the aluminum plates used does not appear in the paper; but a capacity of one-seven-hundredth part of a farad would fall to half charge through one thousand ohms in about one second of time. According to Nodon's observations, the capacity of an electrolytic rectifier film may be as high as 10,000 microfarads per square centimeter for very minute areas, and 10 microfarads per square centimeter for plates of ordinary size. On the latter value the size of plate for the seven-hundredth part of a farad would be only about five inches square. It would seem, therefore, as though the electrolytic rectifier formed a dielectric film of hydroxide having extremely small thickness, and extremely large capacity as a condenser. Consequently, such a film holds a relatively large electric bound charge. The removal of the charging e.m.f. permits is charge to leak through the resistance of the dielectric, which, even although only about one megohm per square centimeter, enables the voltage to persist for a very appreciable time as c.e.m.f.

The Testing of Rubber-Insulated Wire.

The Wire Inspection Bureau affiliated with the Underwriters' Laboratories of Chicago and New York has issued an important circular signed by Mr. Hugh T. Wreaks, secretary, as to the testing of rubber-insulated wire. The governing committee whose names are given on the circular are W. H. Merrill, Jr., C. M. Goddard, J. C. Forster, Ira W. Henry, W. M. Habirshaw and G. A. Cragin. We quote the circular in full below, as follows:

On May 22, 1905, a conference was held at the rooms of the National Board of Fire Underwriters, the purpose of the meeting being to devise ways and means of testing all rubber-insulated wire manufactured under the rules of the National Board of Fire Underwriters, and to prevent the introduction into commercial use of any such wire which would prove inferior to the standard demanded by the National Board of Fire Underwriters. This to protect reliable manufacturers against unfair competition, and practically preventing any further use of wire with defective rubber insulation.

At this meeting a joint committee was chosen, consisting of six members, to form the Wire Inspection Bureau, this bureau to draw specifications for testing of rubber-insulated wire manufactured under the rules of the National Board of Fire Underwriters, to decide on such tests, and when and how they are to be made. Also to appoint the necessary electrical inspectors, three being considered sufficient at present, which inspectors shall from time to time visit the testing laboratories of any factories making rubber-insulated wire and make, supervise and verify tests specified by the bureau.

The expenses of these inspectors to be paid by fees collected from the manufacturing companies whose product is tested, each company paying its share in proportion to the amount of wire manufactured.

For the purpose of collecting the money to cover these expenses, stamps will be issued by the Wire Inspection Bureau and sold to the different manufacturers at a charge of one cent per hundred feet of wire tested, these stamps to be attached to the coils of tested wire by the manufacturers themselves, and to serve as a guarantee that wire so stamped has successfully withstood the tests specified by this bureau.

The majority of the rubber-covered wire manufacturers have recently agreed that on and after October 1, 1905, all National Code wire manufactured by their companies will be made up under the new specifications and duly tested, and will bear identification mark of the Wire Inspection Bureau. It is understood that a reasonable time will be allowed after this date for the disposal of code wire not bearing the stamp of approval of the Wire Inspection Bureau, on all such wire manufactured before October 1, 1905, and with this understanding the October list of electrical fittings will contain the names of all rubber-covered wire manufacturers agreeing to the tests of the Wire Inspection Bureau on their products, and to the use of identification stamps of the Wire Inspection Bureau guaranteeing that these tests have been properly made.

The Wire Inspection Bureau will supply identification stamps to the rubber-covered wire manufacturers as may be required by the latter, and on receipt of their order for the same. These stamps will be for 250-ft., 500-ft. and 1,000-ft. coils, and will cost at the rate of one cent per 100 ft. No wire will be considered as having been tested which does not contain an identification stamp (stamps to be of linen paper and to be securely fastened to the shipping tags attached to wire coils). Stamps will have serial numbers and on coils of less than above specified lengths where stamps specify more wire than coil contains, a credit for excess in stamp value can be obtained from the Wire Inspection Bureau on presentation of the facts in writing, giving size of wire, destination, number of feet and serial number of stamp used. All stamps to be canceled by manufacturer when used, the date of manufacture of wire also being plainly shown. Wire Inspection Bureau specification giving factory tests which will be required on all wire having approved stamps will be ready in a few weeks, and will be furnished to manufacturers of National Electric Code Wire.

Kindly read this letter over carefully, so that we may be sure that you understand the plan given, and in order that no apparent discrimination may be made against you next October through your not being fully advised of the scope and intent of the Wire Inspection Bureau.

Advise whether or not you decide to avail yourself of the services offered so that we may plan accordingly, and let us know as soon as possible how many identification stamps you will require and the proportionate number for 250-ft., 500-ft. and 1,000-ft. coils.

The Situation in Single-Phase Traction.

By C. F. Scott.

On July 22 the Electrical World and Engineer published a letter from Mr. John Whitehouse, commenting upon a brief summary given in your editorial, July 8, referring to an article by me in the *Electric Journal* for June relative to single-phase traction. I think it likely that the impression of the writer of the letter that there was an unwarranted enthusiasm in the original article, and that its conclusions presumed to settle forever the problem of heavy traction, may be due to the fact that the communication was based solely upon your brief editorial and not upon the article itself. The letter seems to deal with the single-phase system in a somewhat academic manner, which may result from the writer's lack of information as to the advance which is being made in single-phase apparatus.

The several points given at the end of my article, noted in the editorial, are not given simply as a personal view, but as "the legitimate conclusion from the foregoing statements" which form the body of the article. Reference is made to a general discussion in which B. J. Arnold, H. Ward Leonard, A. H. Armstrong and W. B. Potter took part, showing that there was a desideratum in heavy traction work, which at that time (June, 1902) had not been secured. The single-phase series motor did not figure in the discussion as a practicable alternative, but only as an unobtainable phantom. The article continues by referring to the comments upon the single-phase motor presented by Mr. Lamme, in his paper before the American Institute of Electrical Engineers in September, 1902. Mr. Steinmetz, for example, said "that alternating-current railroading will become feasible only when the single-phase motor is developed giving the characteristics of the series motor." Hence the conclusion that engineers are in substantial agreement "that the use of single-phase alternating current is essential for heavy and long-distance railway service."

It appears, moreover, that the opinion of the writer of the letter regarding the importance of the single-phase system is in accord with the views upon which my conclusion was based, for after referring to the three-phase tests at Zossen he adds, "Albeit, no one is disposed to deny that single-phase current, other things being equal, would be more convenient and would generally be preferred." Further on he expresses the hope that the enthusiasm for the single-phase system "will prove well founded, for complete success would mean a revolution in railroading."

A further conclusion in my article, viz.: "that a single-phase motor and single-phase system fulfilling the ideal requirements have been developed" is substantiated by the fact that a number of single-phase railways are in operation and numerous others are under construction, both in this country and abroad, which fulfill the ideal requirements, which are in the main: the employment of a single high-voltage, alternating-current trolley wire; a motor with series characteristics; a voltage control enabling efficient acceleration and efficient operation over a wide range of speed.

The present status of the single-phase railway may be gauged by comparing the number of manufacturing companies in America and Europe presenting single-phase railway motors with those advocating three-phase motors, and by comparing the number of roads of each kind which are now under construction and for which orders have been received. It is not three years since the single-phase motor was presented to the public, while three-phase railways have been in operation in Europe for many years.

Discarding possible future discoveries and inventions and considering the apparatus and methods which are now available, the conclusions which I gave are a well-grounded summary of the views which have been expressed by prominent engineers, as well as representing my own views.

◆

The Independent Telephone Situation in St. Louis.

Advices from St. Louis state that all the arrangements have been completed for the carrying out of the plan by which the Kinloch Long Distance Telephone Company, of Missouri, absorbs the Kinloch Telephone Company, of St. Louis. The shares of the local company, representing the issued capital stock of $2,000,000, were exchanged July 7, share for share, for stock of the long distance company. The authorized capital of the latter corporation is $5,000,000, of which $2,800,000 has been issued, including the shares exchanged for the Kinloch Telephone Company stock. The companies, while owned by the same interests, will be conducted as heretofore by separate managements and officers. They will be financed jointly, however, and governed by the same directors. Samuel M. Kennard, president of the Kinloch Company, has resigned because of ill health and the press of private business, which requires much of his time. Wm. F. Nolker, first vice-president, was elected to succeed him. In the long distance company the directors are Adolphus Busch, C. Marquard Forster, August Gehner, Breckenridge Jones, Sam. M. Kennard, W. F. Nolker, Rolla Wells, Philip Stock, Julius S. Walsh, Wm. D. Orthwein, W. J. Lemp, James Green and Henry Nicolaus. The Kinloch directors are Adolphus Busch, C. Marquard Forster, August Gehner, Breckinridge Jones, S. M. Kennard, Wm. D. Orthwein, Charles H. Ledlie, W. J Lemp, Henry Nicolaus, Philip Stock and Julius S. Walsh. C. Marquard Forster is president of the Long Distance Company.

One of the directors states that the reason for the arrangement was that it would considerably simplify the handling of the properties. The Long Distance Company is in much better position to finance future needs than the local corporation. He said that the old order of affairs frequently caused awkward situations and friction. The Long Distance Telephone Company July 12, filed in St. Louis a mortgage on all its properties for $5,000,000, securing the authorized issue of bonds. The American Trust & Savings Bank of Chicago and George M. Galbreath are trustees for the bondholders. The authorized stock and bonds of the Long-Distance, other than what has been issued, will be used for additions and improvements to be paid for at 90 per cent of the cost. The other 10 per cent must be provided for by the company. The offices of both companies will be located in the new Kinloch building now in course of construction.

Notes on the Electrical Contractors' Boston Meeting.

Considerable space was given in the July 22 issue of the ELECTRICAL WORLD AND ENGINEER to the convention and exhibition of the National Electrical Contractors' Association in Boston. Although the meetings were held with closed doors, we are indebted to Secretary W. H. Morton for a brief synopsis of what was done.

The meeting was one of the most successful that the association has ever held, there being a registered attendance of 180 members, many of these being delegates for a number of members. The first session, which was held on July 19 at 10 o'clock, was an open session, to which all persons interested in electrical business were invited. The meeting was opened by an address of welcome by Mr. Frank L. Barnes, president of the Massachusetts State Association. This was responded to by Mr. E. McCleary, president of the National Association, in a speech outlining the work of the National Association and especially bringing out the point that the entire efforts of the association were devoted to the upbuilding of the electrical contracting trade.

Mr. F. E. Cabot, chairman of the electrical committee of the National Board of Fire Underwriters, spoke on the subject of electrical inspection and the National Electrical Code.

Mr. T. Beran, of New York, spoke for the manufacturers and in an able address outlined the position of the manufacturer toward the electrical trade. Mr. James Cole, of Boston, chief of the wire department, spoke on the relations of the city of Boston to the electrical contractors. Mr. G. M. Stuart, of Boston, spoke for the jobbers, and pointed out the rapid growth of the electrical business during the past ten years. A general discussion followed the speeches and closed the open session.

The delegates met in executive session on Wednesday afternoon, Thursday and Friday, and at the close of the meeting elected the following officers: President, James R. Strong, New York City; first vice-president, W. I. Gray, Minneapolis; second vice-president, W. C. McIntire, Philadelphia; third vice-president, F. E. Newbery, St. Louis; treasurer, John R Galloway, Washington; secretary, W. H. Morton, Utica; sergeant-at-arms, J. C. Sterns, Buffalo.

The social features of the convention were many and [illegible] well executed. On Wednesday evening there was a banquet for members only at Hotel Brunswick, at which about 160 members were present. An excellent vaudeville performance was given in connection with the banquet and Mr. McCleary, the retiring president, was given a most enthusiastic reception.

On Thursday the members of the association and their guests were taken on a special boat for a trip around Boston Harbor, ending at Nantasket, where a shore dinner was served to about 560 persons. After the dinner the entire party spent the evening at Paragon Park.

On Friday evening a reception was gotten up by the ladies and was given in Paul Revere Hall, Mechanics Building. This was largely attended and dancing was enjoyed until a late hour. At the close of the reception Mr. McCleary was presented with a handsome silver table service given to him by the membership as a token of their appreciation of the time and work which he has devoted to the organization.

During the three days of the convention the ladies were entertained by numerous trolley trips and automobile rides to the historic points near Boston. Too much credit cannot be given to the committee of the Massachusetts Association, who were in charge of the convention. In spite of the extremely hot weather a most interesting and enjoyable meeting was held, and the visit to Boston will be long remembered as one of the most successful episodes in the history of the body.

Electric Power in Mines.

A very interesting and intelligent statement on electric power in mining has been made at Duluth, Minn., by James Gayley, first vice-president of the United States Steel Corporation, who is making an annual tour of inspection of the Lake Superior mines of the corporation. He said: "There is likely to be rapid development in the northern Minnesota iron ore region from this time on in electrical power. On the Mesabi Range there are some sixty to sixty-five shafts in operation for hoisting ore and pumping water, and there are still more steam shovels mining ore from open-pit mines, from stock piles, and stripping off earth overburden. All these are within fifty-five to sixty miles from the source of large power at Duluth, which can be easily and readily carried to them by wires. The recent great improvement in efficiency of electrical machinery and application, and in long-distance transmission makes it possible, it is believed, to substitute this power for steam, at a vast saving in operating costs.

"Electrical underground haulage systems are going in at several mines at the present time. This is no new experiment, for that system has been in use at mines of the Menominee and Vermilion ranges and in the Michigan copper country for some time and has proved its worth. But the system is on the eve of a wide extension. Long electrical haulage is under installation at this time at some of the Oliver Iron Mining Company's properties on the Mesabi Range, and is to be adopted at once at its and at other mines of the Marquette and Menominee ranges.

"Hoisting ore and pumping water by electricity are not yet adopted methods for the big mining regions of the Northwest. It must be remembered in this connection that what may have been tried and found successful in many mining districts is not necessarily possible for these Lake Superior regions, for on the lake we do things in a big way, and what might elsewhere be considered a success on a large scale would be with us but a mere experiment in a small way, a mere individual unit operation, as it were, that would not give us data upon which to judge general results. But the plan of a large electrical hoist is now under consideration for Mesabi Range plants, and may be adopted any day. It certainly will if the claims for saving and increased efficiency are substantiated.

"It has been doubted if steam shovels could be operated by electricity, as they are moving machines and require power in a peculiar way. But the Oliver Iron Mining Company is now taking up this question, and in a few days may close contracts for dynamos and other electrical appliances to be installed upon one or two of its many [illegible] plants. There is no question of the enormous saving to be gained from these plants if the results are anything like what have been figured out by the engineers.

"The actual beginning of water power development on a large scale at Duluth by the Great Northern Power Company will furnish at low cost the energy necessary for all this new work, and the reduction of coal fuel we hope to secure. The works of this company are going in at a rapid rate, and should be ready to furnish power in a year. There is from 50,000 to 60,000 horse-power in mines of the Mesabi and Vermilion ranges, and more than that amount in the locomotives of the three roads bringing ore from these mines to the head of Lake Superior. If the time ever comes when this great energy can be generated by the rapids of the St. Louis River, rather than by the burning of coal, it will be something worth talking about."

Detroit Municipal Lighting.

Secretary Bowler, of the Detroit public lighting commission, has submitted his annual financial report for the fiscal year ending June 30. The report purports to show that the cash cost for operating an arc lamp was less last year than ever before, the alleged amount being $34.99, which is $5.17 cheaper than the previous year.

According to the report, the receipts for the year amounted to $211,152.43. To this amount are to be added the cash balances in the hands of the city treasurer and secretary on June 30, 1904, which amounted to $42,592.74, making the available cash for the year, $253,745.17. Disbursements for the year were $218,665.23, leaving a cash balance of $35,079.94 on June 30 last.

Investments for the year amounted to $91,523.48, making the total investment June 30, 1905, $899,717.53. Deducting 3 per cent for depreciation, makes the net investment show an increase over last year of $48,704.76.

Total cost of operating the plant was $121,380.41, which is $1,713.58 less than a year ago. The cost of operating the arc plant was $98,605.24, while $2,775.17 was paid out for the incandescent plant. The "cash cost" for each arc lamp was $34.99, showing a decrease of $5.17 per arc lamp from last year. During the year 408 additional arc lights were installed.

Manufacture of Artificial Abrasives.

Mr. J. H. Pratt has issued for the U. S. Geological Survey an interesting report on the manufacture of artificial abrasives for the year 1904, as part of his report on abrasive materials in general. We may quote him as follows:

The abrasive materials included under this head are corborundum, crushed steel, alundum (artificial corundum), and adamite. Of these artificial abrasives, carborundum and alundum are manufactured in the largest quantity and are of the greatest value. The total production of these artificial abrasives in 1904 amounted to 11,870,380 pounds, valued at $830,926, or over one-half the value of the production of natural abrasives, which was $1,406,851. The production of carborundum in 1904 amounted to 7,060,380 pounds, an increase of 2,300,490 pounds, as compared with the production of 4,759,890 pounds in 1903. This is the largest production in any year since the beginning of the manufacture of this abrasive and illustrates the increasing demand for it. With the exception of one year, 1902, there has been a continual increase from year to year in the production and use of carborundum, and in that year the decrease was due to a scarcity of supplies used in the manufacture of the carborundum. This increase in the production and use of carborundum is well brought out in the following table, which gives its production since 1892, when it was first put on the market. Its value now varies from 8 to 10 cents per pound.

Production of carborundum 1892-1904.

Year.	Quantity. Pounds.	Year.	Quantity. Pounds.
1892	1,000	1899	1,741,245
1893	15,200	1900	2,634,900
1894	52,200	1901	3,838,175
1895	20,000	1902	3,741,500
1896	1,[illegible]7,800	1903	4,759,890
1897	1,256,400	1904	7,060,380
1898	1,447,200		

The manufacture of artificial corundum from a bauxite which has been developed and put on a commercial basis by the Norton Emery Wheel Company, of Worcester, Mass., at its plant at Niagara Falls, N. Y., has met with great success, and this abrasive, which is known commercially as alundum, is giving most satisfactory results. The greater part of this material produced by the Norton Emery Wheel Company is used by the company itself in the manufacture of its various emery wheels, stones, etc. It makes a clean, fast-cutting abrasive, being nearly absolutely free from any kind of impurity, and has proved its excellent qualities in actual use

There is another artificial corundum that is being used as an abrasive, but it is only obtained in small quantity, as it represents a by-product in the Goldschmidt thermit process of the reduction of many of the metals. At the present time none of this corundum is made or put on the market in this country, but at the German factories where the Goldschmidt thermit process is employed it is utilized as an abrasive.

It is interesting to note the different colors of this corundum, according to the metal that has been prepared. Thus, in the reduction of the mineral chromite to metallic chromium, the corundum, which is the slag that remains, is of a ruby-red color, sometimes the crystallized portion being perfectly transparent; the nickel ores give a blue to bluish gray colored corundum; the manganese ores give a light, intense yellow to greenish-yellow corundum; and the titanium ores give a brownish to brownish-black corundum. The corundum obtained in this way is very pure, but somewhat different in texture and appearance from the corundum obtained by the reduction of bauxite by the Norton Emery Wheel Company, inasmuch as the latter shows little or no parting planes developed and breaks with an irregular fracture, while the former sometimes shows the parting planes well developed and at other times breaks with an irregular fracture.

In 1904 there were 4,020,000 pounds of alundum manufactured, only a small portion of it being put on the market in the crude form; it was sold at an average price of 7 cents per pound.

Fishing Made Easy.

The invention described below is hardly the idea of a sportsman, but according to the *Saturday Evening Post,* is effective for its purpose: The New York Aquarium, which is the largest and best equipped institution of its kind in the world, obtains its supplies of tropical fishes from the waters of Bermuda. Some of the rarest and most beautiful species are exceedingly hard to catch, persistently refusing to take a bait, and on this account it has been found necessary to resort to a very novel and ingenious expedient to effect their capture—an electrical contrivance, which serves to stun the coveted specimen and reduce it to helplessness until it can be made a prisoner. The device in question consists in part of a small and compact storage battery, which is held in a leather pouch beneath the arm of the operator, who wades as quietly as possible through the shallows and invades, with as little disturbance as may be, pools among the rocks. He carries a long-handled dipnet, to the handle of which a wire is attached. On the other end of the wire is fastened a percussion cap of the kind used for exploding dynamite cartridges. It is the bursting of the cap that is relied upon to stun the fish. Luckily for the hunter, fishes have as much curiosity as land animals, and even the shyest one will approach a bait to look at it, though indisposed to attempt the slightest nibble. Accordingly the percussion cap at the end of the wire is concealed either by something eatable or by a bunch of grass wrapped around it. Mr. Fish wonders what it is, ventures near, and has instant reason to regret his imprudence. The fisherman closes the circuit, the percussion cap is exploded, and the victim is rendered for the moment helpless, though receiving no permanent injury. Promptly, by reversing the dipnet, he is gathered in, and a few days later he finds himself swimming about in a tank.

Success in Electrical Salesmanship.

A little story in the *World's Work* for August will be of interest to many of the commercial readers of this journal. Possibly if the story is true—apparently the event is not recent—they may be able to identify the salesman. It is said that once a bright young salesman went into the office of a Memphis merchant to sell him a bill of carbons for his arc lights. He was conscious of having a distinct advantage in a carbon that he could sell at $11, for which his competitors were obliged to get $16.50. "You can't sell that carbon for $11, can you?" inquired the merchant. "Yes, sir; there is no mistake about it," quietly answered the young man. "If you feel any question about it just let me send you what you need, and if they are not all right in every particular you have only to notify me and I will come here personally and ship them back to the house."

"Well, on that understanding," returned the merchant, "you may ship me 5,000."

This time it was the salesman's turn to be astonished, for this was a sensational quantity for a merchant to buy for his own use.

"May I ask," inquired the young man, "how you are going to use so many?"

"Certainly," answered the merchant, drawing a set of contracts from a pigeonhole of his desk, "here are the contracts for a $15,000 light plant that I am going to put in across the street."

"Signed them?" inquired the young man.

"No; but I'm going to to-night," answered the merchant, "for I've threshed the details of this thing over until I'm sick and tired of them."

"Now," responded the salesman, "I've demonstrated to you that I can beat those people all to pieces on the price of carbons, and I give you my word that I can do the same thing on the plant that you propose to put in. Put off the signing of that contract until to-morrow night, get on the train with me and go to our plant in Chicago and I will show you that I can save you money on equipment."

The merchant finally agreed, with the result that the salesman who saw this opportunity sold the merchant a $15,000 plant.

CURRENT NEWS AND NOTES.

HOT ROLLS.—The presswork of one of the largest printing offices in New York City was threatened with complete stoppage during the recent hot weather by the inability of the pressmen to keep their ink rolls from melting. The situation was cleverly saved, however, by taking out some of the adjacent incandescent lamps and installing fan motors in such a manner that the breeze from them was projected directly on the deliquescent rolls. The currents of air thus obtained were sufficient to keep the composition firm and solid, and the rush of work at a critical moment was all cleaned up, not a single "token" being skipped.

OLD-TIME TELEGRAPHERS.—The twenty-fifth annual reunion of the Old-Time Telegraphers and of the Society of the United States Military Telegraph Corps will be held in New York City at the Waldorf-Astoria, August 29, 30 and 31 and September 1. Mr. John C. Barclay, general manager of the Western Union, is president of the Old-Timers, and Mr. W. B. Wilson, of Philadelphia, is head of the Society. The banquet will take place on Thursday, August 31. Business meetings will begin on Tuesday, the 29th. Numerous committees have been formed, including prominent telegraph men and others in Greater New York, and the outlook promises a large attendance as well as a most enjoyable convention.

ABANDONING THE THIRD RAIL.—With regard to its exposed or unprotected third rail, President Mellen, of the New York, New Haven & Hartford Railroad, has announced that the company intends to substitute the overhead trolley for the rail on its line between Hartford, New Britain and Bristol, Conn. The company had previously announced that it would return to a steam passenger service, which was strongly opposed by the cities and towns affected. It is also proposed to equip the Highland Division, between Hartford and Rockville, with the overhead trolley system for suburban service. The third-rail system is largely patronized and any one who sees the travel over it in this hot weather can readily understand why the local public does not want to go back to the regime of steam and its attendant discomforts.

NEW YORK LIGHTING COMMISSION.—Governor Higgins sent last week to the New York State Senate for confirmation these appointments to the State Lighting Commission: Frederic E. Gunnison of Kings, to be chairman; John C. Davies of Oneida, and L. L. Shedden of Clinton. The names of Messrs. Davies and Shedden had been announced previously with that of James R. Sheffield, of New York, who declined to serve. Mr. Gunnison is appointed to the vacancy created by the declination of Mr. Sheffield. All of the nominations were confirmed, but not until after a vigorous protest by Senator Grady, the minority leader, on the ground that [illegible] commission was wholly partisan. Frederic Everett Gunn[illegible] chairman of the commission, is 36 years old. He is a [illegible] Brooklyn. His father is the Rev. Dr. Alma F. Gunnison, pres[illegible] of the St. Lawrence University. He is a graduate of the New York University Law School, and is a practicing lawyer, a member [illegible] law firm of Harris, Corwin, Gunnison & Myers, at 150 Nassau Street. Mr. Gunnison is serving his second term as president of the Union League Club, and also as vice-president of the Republican General Committee of Kings County.

[illegible] Although the heat in the Subway has been bitterly complained of, that "hole in the ground" proved last week during the hottest weather on record to be the coolest spot in New York. General Manager Hedley issued a statement showing the figures which had been reported to him by his employees. The test at City Hall Station, made at 3 o'clock in the afternoon, July 20, showed a temperature of 90° in the Subway Station, whereas on the street surface the mercury was at 100. At Thirty-third Street at the same time the Subway Station thermometer registered 87 as against 97 on the surface, Columbus Circle showed 90 in the Subway and 100 on the surface at 3 o'clock, while Sixty-sixth Street showed 87 in the station against 99 on the surface. The greatest difference was shown at the Ninety-first Street Station, where, at noon, the thermometer was 86° in the Subway and 104° on the surface, a difference of 18°. At noon the thermometer in the Seventy-second Street Station registered 89°, as against 97° on the surface. The Ninety-first Street Station registered 84° at 9 o'clock in the morning as against 98° in the street above. Throughout the hot period, according to Mr. Hedley, the temperature in the Subway has averaged from 5° to 14° cooler than it has been on the surface. To make a personal test of the atmospheric conditions in the Subway, President August Belmont of the Interborough Rapid Transit Company hit upon the idea last Wednesday, July 20, of holding a directors' meeting in the tunnel. At the same time a general inspection was made of the tunnel route. Instead of transacting business in a board room the directors went to the Bowling Green Station and there took a car, and while on the trip uptown discussed and acted upon various matters affecting the road. The question of ventilation was taken up and at the Brooklyn Bridge Station the directors left their car to inspect the work of the large rotary fans, two of which are being operated there. They can discharge Subway air into the street at the rate of 50,000 cu. ft. per minute. The location of two more of these fans was decided upon. When they have been installed the air at the big Bridge Station will be renewed every five minutes.

POOR WIRING.—In his presidential address before the Incorporated Municipal Electrical Association, Mr. F. A. Newington, chief electrical engineer of the Edinburgh Corporation, said: "The poor quality of the material used and the unsatisfactory way in which the work is carried out are certain to give trouble. So-called india-rubber insulation for electric conductors frequently contains from 50 per cent. to 60 per cent. of something that is not rubber at all. The elastic properties of this mixture soon disappear, and it becomes hard and brittle. If there is any moisture in the pipes the insulation fails, and then the house has to be re-wired. What will be the result of this? Will the consumer be content to be frequently having some of his lamps out of order, and after a period of, say, ten years find it necessary to re-wire his house? Will he not rather be inclined to think that electric light wiring and fittings are too uncertain and expensive to keep up, and so go back to some other form of artificial illumination? The material now very generally used for insulation is not nearly so good, on account of the high price of rubber, as that employed ten years ago. Contractors for electric installation work naturally buy the cheapest material they can, especially as competition in this class of work is very severe, but as a rule they have not any idea of what the insulation is composed of, nor have they the means of testing it. They simply [illegible] to the makers of insulated cables to provide them with material that will pass the official test made by the Supply Authority. As iron pipes are now very generally used for protecting the wiring, a better insulation for the conductors is required than in the days when wood casing was practically the only material used. I do not suppose that the larger users of electric light would discontinue it on account of these troubles, as its convenience and other advantages [illegible] them outweigh these, but to the consumers using [illegible] lights the expense of re-wiring their houses might be [illegible] matter. As these smaller consumers are probably [illegible] to us than the larger it will be to our advantage [illegible] can to improve the existing unsatisfactory way in which this work is done."

NEW YORK CENTRAL TROLLEYS.—At Syracuse, N. Y., on July 22 Horace E. Andrews, of the New York Central-Andrews trolley syndicate announced that the syndicate had acquired the Rochester & Eastern Rapid Transit Railway, now in operation between Rochester and Geneva, via Canandaigua. The road has 65 miles of trackage.

BIG RUSSIAN SEARCHLIGHT.—A cable dispatch from Berlin of July 15 says: "The greatest searchlight in the world has been built here by Siemens & Schubert for the Russian Government. It is of 316,000,000 cp with a current of 200 amp. The reflector measures 6 ft. in diameter and the lamp's carbons are 6 in. in circumference. It is thought that the new searchlight is to be used in the port of Cronstadt."

AMERICAN AUTOMOBILE INDUSTRY.—*Bradstreet's* learns that there were produced by American makers in the calendar year 1904 about 17,500 automobiles, valued at about $22,000,000. Replies received from various offices of *Bradstreet's* in fourteen States of the United States show that there were produced by 100 manufacturers, in the fiscal year ending with June, 1905, 26,601 machines, valued at $34,650,500. Estimates of the capital employed in the production of these machines aggregate $21,313,000. These figures of output certainly make remarkable comparison with the figures of output given in the last census year of fifty-odd machines, valued at less than $60,000.

TROLLEYS IN BELFAST, IRELAND.—United States Consul Moe writes from Belfast, Ireland, as follows: "Large extensions are being made at the corporation generating station in Belfast for the electrification of the tramway system. A plant for 3,000 kw is being installed and about 40 miles of streets are in process of being equipped. The present capacity of the electrical works is 3,400 kw. The connections to the mains are equivalent to 197,000 8-cp lamps, including 2,100 hp in motors. The supply is by the three-wire, low-tension system, with 220 and 440 volts supply pressure. All the generators are arranged so that they can work on the lighting supply or on the traction system."

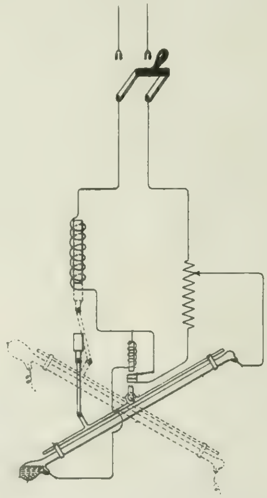
PROTECTION FOR PARALLEL-CONNECTED FEEDERS.—A patent issued July 18 to L. Wilson relates to protective devices for systems in which feeders are operated in parallel. In such systems, under normal conditions, the load is divided equally among the several lines. If, however, a short-circuit occurs on any one of the lines, that line draws an excess current. The inventor proposes to take advantage of this fact for cutting out the faulty line. Each feeder is provided with a switch operated by a differential device having two opposed windings, one of which is energized by the current in a single feeder, while the other winding is energized by the sum of all of the currents, the two windings being so proportioned that under normal conditions their effects are balanced.

IMPREGNATED CARBONS FOR ARC LAMPS.—For the purpose of increasing the efficiency of arc lamps, F. O. Vogel has devised a scheme for enriching the arc with metallic vapors and increasing the temperature of the arc, which scheme forms the subject of a patent issued July 18. The electrodes are provided with channels in which are contained the superoxide of natrium, calcium or barium, which is separated from a light-emitting material by the carbon walls of the electrodes. The superoxide is intended to supply ozone to the arc in order to increase its temperature. The light-emitting material may be lime, aluminum, barium oxide, the carbonates of potassium or strontium. Due to the presence of ozone the arc operates at a high teperature, and it is enriched with the vapors of the light-emitting substances. This action brings about an increase in the conductivity of the arc and in the radiation of light, which is carried to a still greater extent because the points of the electrodes become still more incandescent.

ARC LAMP WITHOUT FEEDING DEVICES.—On July 18 a patent was issued to M. H. Baker and S. P. Wilbur for an arc lamp whose electrodes are arranged concentrically one within the other. By constructing the electrodes in this manner and supporting them in such a way that they point in a downward direction, the arc formed between their lower ends will be so directed as to be blown downward, whereby the arc will be spread into a fan shape. It is evident that such a lamp will require no feeding mechanism. For use with alternating currents the wall of the inner cylinder will be made thinner than that of the outer cylinder, the cubical contents of the two being made equal for obvious reasons. When used with direct current the inner cylinder will usually be an ordinary carbon electrode. The outer electrode will, however, be impregnated and will constitute the positive electrode of the lamp. The proportions of the electrodes will be such that the consumption of each measured along its length will be equal to that of the other.

LIGHT AND POWER IN DUBLIN.—U. S. Consul Moe, at Dublin, Ireland, reports to the Department of Commerce and Labor as follows: "The lighting committee of the Dublin corporation has issued a report in which they recommend a reduction in the rates for general lighting and for the supply of current for heating and for motive power. In the case of general lighting, the rates are to be reduced on the maximum demand system from 14 cents and 5 cents to 12 cents and 5 cents. The committee do not recommend any reduction in the 12-cent flat rate, as in Dublin there is an undue proportion of offices and early closing shops which only use the current from four to five months in the year, and are not profitable even at the rate of 12 cents. For motors and heating current the rates are to be reduced from 14 cents and 2 cents to 8 cents and 2 cents, with an alternative flat rate of 5 cents per unit. The committee reports a steady increase in the demand for motor current though too small to be a satisfactory day load even for Dublin. They are completing an arrangement with one of the largest firms of motor manufacturers in the world for the adoption of a system of hire-purchase, under which motors will be supplied at very reasonable rates on the three-year installment plan. They believe this will satisfactorily affect the demand for power. Flat rates per unit are recommended for certain consumers who use current for a considerable number of hours each day. No concession is made to concert halls and other similar places of amusement, to 'temporary buildings,' or permanent buildings for 'temporary purposes,' or to churches and buildings attached thereto."

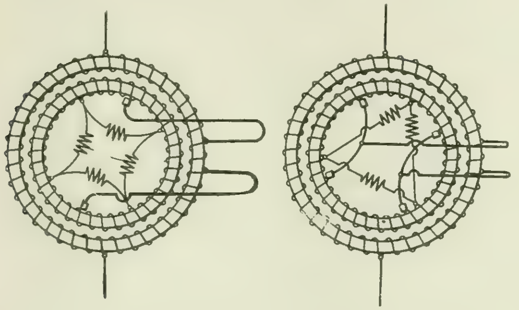
AUTOMATIC STARTER FOR MERCURY VAPOR LAMPS.—The diagram below shows a tilting device for mercury vapor lamps, as proposed by Dr. M. von Recklinghausen, in a patent issued July 18. The lamp, in the form of a long tube, is suspended so that in its inoperative position it will be tilted far enough to prevent connection between the electrodes through the mercury. By means of an electromagnet the lower end of the tube is lifted so as to cause the mercury to form a bridge between the terminals, and the tube is then tilted still further to break the connection. The coil of the electromagnet, after doing its work of lifting the lamp, remains in series therewith as an inductive resistance. An auxiliary switch which serves for completing the circuit through the coil of the lifting magnet when the lamp is in its inoperative position, is opened when the lamp is fully tilted and the mercury vapor has been rendered conducting.



PRODUCING THE ORIGINALS.—A Parisian newspaper has been accused of publishing fake messages, and now comes to the front with the statement that the original of every telegram published will be displayed in its office window the day after publication.

COMPENSATED DIRECT-CURRENT DYNAMO.—In order to overcome the distortion of the magnetic field in the air-gap and pole face of direct-current machinery caused by the magnetic effect of currents in the armature conductors, F. A. Mott, according to a patent issued July 18, would divide the material forming the path for the magnetic lines in the field structure into a number of different magnetic circuits, and would arrange to excite each of these circuits independently. The object of this construction is to allow the density of the magnetic lines in different parts of the pole face to be varied as desired, so as to permit the brushes to remain in practically the neutral position at all loads.

REPULSION-INDUCTION MOTOR.—In a patent issued July 16 to M. Milch is disclosed a self-starting, single-phase commutator motor, which has a speed limit at or near synchronism. In construction the machine differs inappreciably from a repulsion motor. A slight change is made in the rotor winding so that points symmetrically located thereon are joined together through impedances. These impedances are highly inductive, but contain very little resistance. When the rotor is stationary very little current flows through the impedances and the machine receives its starting torque on account of its repulsion motor features. At synchronism, however, the rate of change of current through the impedances is zero, and they act as low-valued resistances to short-circuit the rotor winding, which consequently becomes the secondary to the stator winding, which acts as the primary of a single-phase induction motor. In order to compensate for the exciting current of the induction motor, the circuit to the rotor brushes is opened and there is impressed upon them an e.m.f. of the proper value and time phase position. This e.m.f. is obtained from taps upon the primary winding, as indicated in the accompanying illustrations. At starting this small voltage is overpowered by the voltage induced in the rotor windings and the motor acts as though the brushes were short-circuited.



Electrical Engineers of the Times.—XX.

MR. H. H. CUTLER.

Harry Henderson Cutler was born at Brookline, Mass., 1859. He received his early education at the Boston English High School, and in 1881 graduated from the Massachusetts Institute of Technology in the department of mechanical engineering, and the following year took a post-graduate course at the same institution in civil and mining engineering. In 1883 he occupied the position of erecting engineer for the Southwark Foundry & Machine Company at Philadelphia, builders of the Porter-Allen high-speed engine, and the following year was with the Thomson-Houston Electric Company at Lynn, Mass. In 1885 and 1886 he was superintendent of the Citizens' Electric Light & Power Company of Akron, O., during which time he reconstructed the arc lighting plant. The company having been sued for heavy damages by the Central Telephone Company for disturbing its telephone service, Mr. Cutler rearranged the lighting circuits and succeeded in balancing them so perfectly that the Telephone Company withdrew its suit, accompanied by the statement that under the new arrangement it was impossible to tell by listening over the telephone whether or not the station was in operation. This work was done in the summer of 1885, and subsequently Mr. Cutler was retained by the Thomson Houston Company as an expert to testify in various suits with the Bell Telephone Company.

In 1887 Mr. Cutler became superintendent of the Newton, Mass., Electric Light & Power Company, and in that year purchased for the company the first alternating-current generator built by the Thomson-Houston Company, which was set up in Newton in connection with an arc lighting plant. Shortly afterward Mr. Cutler conceived the idea of connecting incandescent lamps in series of 20 or 40 on 1,000-volt lines without the use of transformers, the same lines being used in connection with transformers for operating indoor incandescent lamps. Early in 1887 sixteen candle-power lamps were operated on this system five miles from a central station, and finally over 1,000 incandescent street lamps were installed in Newton. This system was adopted by the Thomson-Houston Company and quickly went into very extensive use. During 1889 and 1890 Mr. Cutler entered into the manufacture of electric street lighting fixtures at Waltham, Mass., at the same time doing consulting engineering work. He furnished all of the fixtures to the Thomson-Houston Company for the incandescent lighting system which he had developed, some of which are still in operation, not only in the United States, but in St. Petersburg, Constantinople and many other places in Europe. In 1891 he organized with Mr. George Cutter the Electrical Expert Company of Chicago. The following year he sold his interest to Mr. Cutter, and in 1893 organized the Cutler-Hammer Manufacturing Company. For the first seven years of this company's existence he designed all of the apparatus it manufactured. He acted as treasurer and engineer of this company from 1893 to 1898, and in the fall of 1896 purchased the controlling interests and became its president. In 1898 the company was reorganized and the following year the entire plant was removed to Milwaukee.

H. H. CUTLER.

Mr. Cutler has taken out more than 40 patents covering various electrical devices, most of which are now being manufactured by the different companies with which he is connected. Among the recent inventions covered by these patents are a magnetic accelerator, a single-wire system for operating trains of cars and a single-phase system for operating trains of cars over long distances, using single-phase induction motors. While acting as superintendent at Newton, Mass., he designed and constructed the entire plant at that place, obtained the contract for the lighting of the streets and had an ordinance passed allowing the wires to be run within 15 feet of the ground when desired. The problem of wiring the city of Newton was considered at that time a commercial impossibility on account of the great number of very high trees. To overcome this difficulty Mr. Cutler conceived the idea of constructing ornamental hard pine poles and running wires under the branches of the trees, instead of over the trees, which plan was quickly followed by other cities

Mr. Cutler is vice-president and chief engineer of the Cutler-Hammer Mfg. Co., a million-dollar corporation, and also vice-president and chief engineer of the Cutler-Hammer Clutch Company, which manufactures the new type of magnetic accelerator, or clutch of his design above noted. He is a ember of the A. I. E. E. and of the Chicago Electrical Association.

Electrical Power Development at Portland, Ore.

THE Northwestern Gas & Electric Company has completed one of the most difficult tasks in electrical engineering by construction of its power plant and reservoir in Umatilla Co., Ore. Water is taken from the Walla Walla River, and carried over canyons and hills in a 48-in. wood stave pipe a distance of 29,000 ft., to a reservoir on a mountain side, whence it falls 356 ft. to the wheels. The construction was very expensive, as there was a great deal of excavating for the bench on which the pipe is carried, and there were many trestles across deep canyons. Some of these canyons are crossed by use of inverted syphons. Several of them have 170 ft. head. The plant is now in operation and a complete success. It furnishes light for the cities of Pendleton, Walla Walla, Weston and Athena, and power for driving flouring mills and other industries. The plant develops 3,000 hp. The company will build an electric road at Walla Walla, tapping suburban points. The most serious problem in construction was the handling of materials. The site was a long distance from a center of supplies, and there were no means of transportation. Much of the materials had to be hoisted with donkey engines to points along the route of the pipe line, and to the reservoir site, owing to the precipitous character of the country.

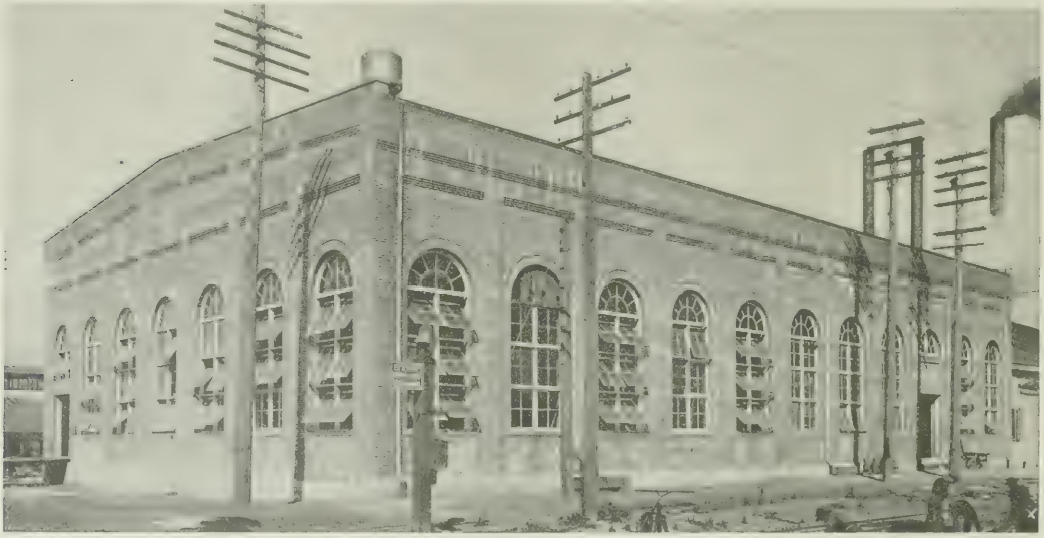


Fig. 1.—Station E, Portland General Electric Company.

By the end of the year 1905 the 12,000-kw of electrical power now driving the street railways, interurban electric roads and other industries in and around Portland will have been increased to 30,000 kw, and in addition there are other important electrical plants now in operation that were not running a year ago in Oregon. This State has vast water powers, originating in streams that rise in the Cascade and Coast Ranges and flow through every part of the State, offering an immense field for electrical development.

The Portland General Electric Company was organized in 1892, and shortly thereafter acquired the valuable water power and canal companies at Oregon City, together with all of the electric light and power companies operating in and about Portland and Oregon City, Ore. The company does the entire public and commercial electric light and power business of the City of Portland and surrounding territory, with a present estimated population in excess of 135,000, and in addition supplies the city street railway system with the greater part of its power.

Portland is a substantial, well built and conservative city, and, as will be seen by the following, is rapidly increasing in population:

Year	1890	1900	1905
Population	46,385	90,426	125,000 (estimated)

The city is located at the head of deep water navigation on the Willamette River, near its confluence with the Columbia River, and is the business centre of the Willamette Valley, a large and very fertile valley about 170 miles in length, noted for its great productivity and agricultural resources. Portland is an important railroad centre, being the terminal point of the Northern Pacific, Oregon Short Line (Union Pacific) and Southern Pacific Railroads, and has a very large jobbing and wholesale distributing trade throughout the State of Oregon and other adjacent districts. It is also a prominent export point for wheat, lumber and their manufactured products and is fast becoming a manufacturing district of importance, having large lumber and flour mills, machine shops and miscellaneous manufacturing establishments.

It is estimated that over one-third of the standing timber in the United States is located in Washington and Oregon. Immense fisheries and vast deposits of coal and iron add to their natural resources, and foster large manufacturing industries. No State in the Union exceeds Washington in the yield per acre of wheat and several other cereal crops. It is apparent, therefore, that although the States of Oregon and Washington have shown almost phenomenal growth, they have as yet scarcely begun their development. Rich agricultural land and vast mineral resources, together with abundant water power, will give them great industrial activity, while three continental railroads and excellent harbors, commanding as they do the oriental trade, assure them a place among the most important commercial States in the Union, and it is but reasonable to believe that Portland, by the census of 1900 their largest city, will continue rapidly to increase in population and commercial importance.

The generating plant of the Portland General Electric Company consists of two principal stations, one located at Oregon City, about fourteen miles from Portland, and operated by water power from the falls on the west bank of the Willamette River, and the other a large new steam plant fully equipped with modern steam engines of both vertical and turbine types, situated in the city of Portland.

The present installed machinery capacity of the water power plants is 8,600 electric horse-power, and of the steam plants 10,000 hp, or a total of 18,600 electric hp. The company's ability to derive a large percentage of its power from water, enables it to generate current at minimum cost. During the last two years the company has expended nearly $1,000,000 in increasing the capacity of its plants and in the unification and improvement of its water and steam units, sub-station and distributing systems. The physical property of the company is of a high standard, much of the equipment having been recently installed. As soon as occasion requires, it is proposed to construct another water power plant on the east bank of the river at Oregon City, of an ultimate capacity of 30,000 hp.

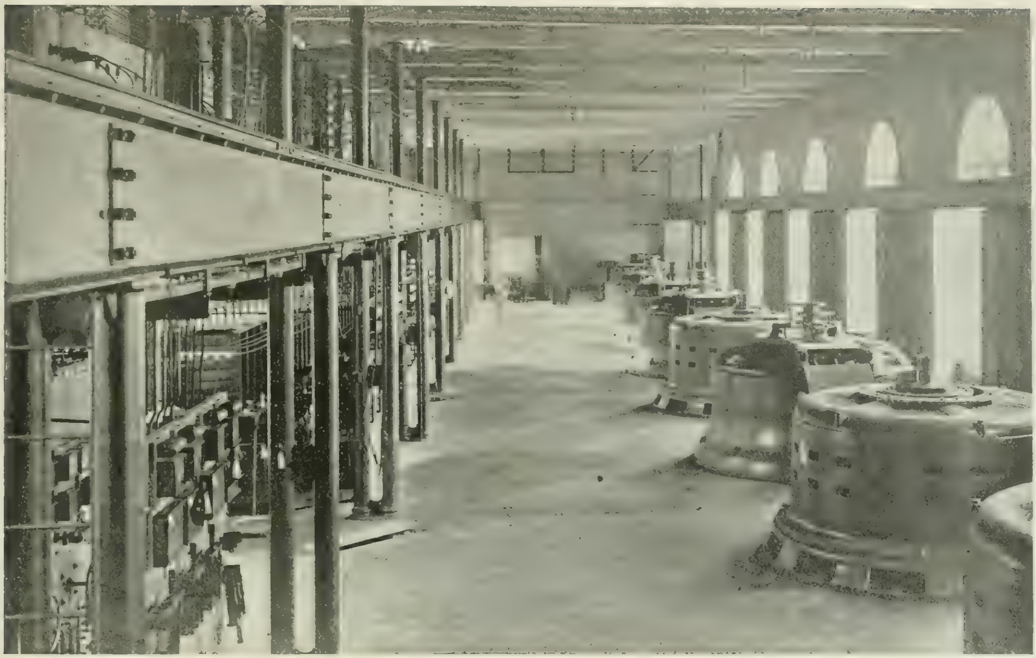


FIG. 2.—INTERIOR OF PORTLAND GENERAL ELECTRIC NEW STATION.

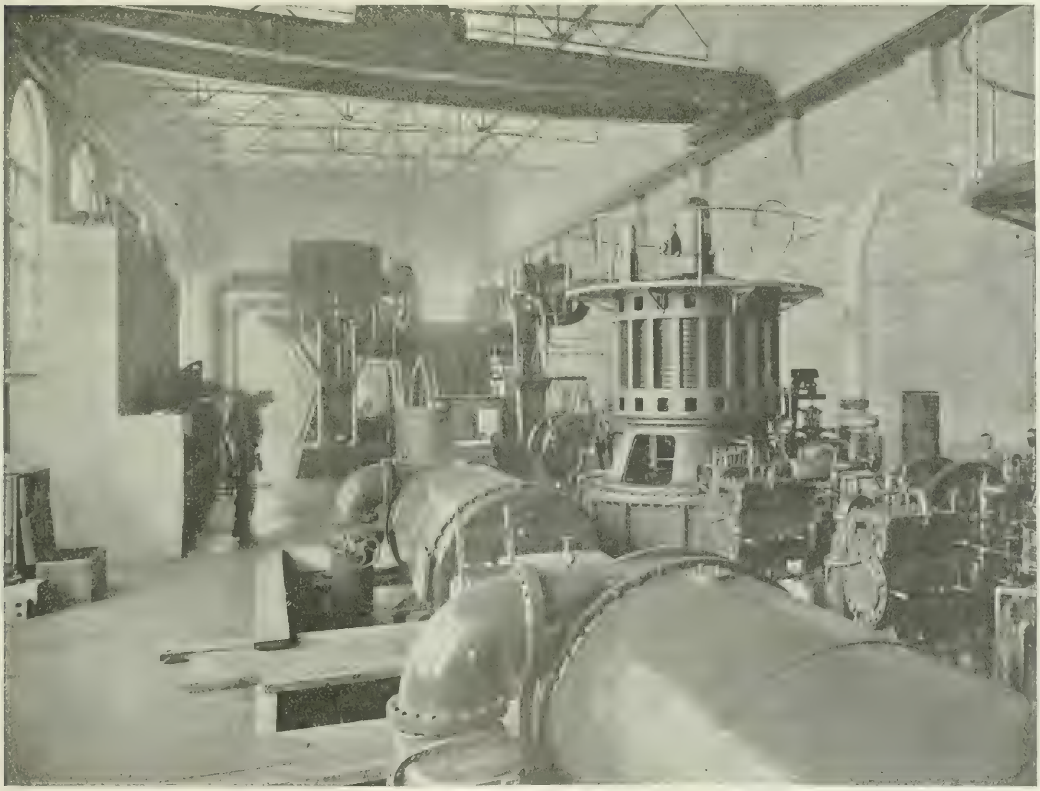


FIG. 3.—INTERIOR OF PORTLAND GENERAL ELECTRIC NEW STATION.

The company furnishes about 3,000 kw of the power necessary for operating the Portland Consolidated Railway's 120 miles of electric road; for driving the Portland Flouring Mills, the largest on the Pacific coast, and a part of the power for operating the 100-mile system of the Oregon Water, Power & Railway Company's interurban road connecting Portland, Oregon City, Canemah and Cazadero; and it also furnishes the public and private lighting for the city of Portland.

FIG. 4.—CLACKAMAS RIVER AT DAM FOR CAZADERO PLANT.

In this connection it would be interesting to state that an order has just been placed for a new street lighting system for the city. This system has been under test for several months and the results show that when it is installed in permanent shape, Portland will be by far the best lighted city in the Northwest. The system referred to is that employing magnetite lamps, supplied with direct current secured from mercury-arc rectifiers and constant-current transformers, direct from the three-phase, 33-cycle, 10,000-volt, primary transmission system.

The new steam station above referred to as fitted with modern generating apparatus, is located in Portland, on the Willamette River, from which it secures an abundant supply of water for condensation purposes. Owing to the very great rise and fall of the river during times of freshets, when the waters of the Columbia River back up, thereby increasing the water level at Portland about 25 ft., special provision had to be made for supplying condensation water. A large water-tight, concrete pit (60 by 20 and 30 ft. deep) was built, and in this and at the level of low water, were placed engine-driven centrifugal turbine pumps, this arrangement at all times insuring a steady supply of condensing water, independent of the river level. The change of this river level of about 25 ft. is expected each year, and the shipping district along the river front provides two-story warehouses and docks for the handling of their business. During the high water period all business is done from the upper floor of the docks and warehouses, and during low river period from the lower floor.

The station building is of brick with concrete floors and iron truss roof and is practically fireproof. As the plant is in the neighborhood of sawmills and frame buildings, special provision has been made to guard against fires from the exterior by means of water tanks, fire pumps, etc

The boiler plant consists of five batteries of Cahill water-tube boilers, each battery rated at 1,040 hp, with a concrete and steel stack 230 ft. high and 12 ft. inside diameter; two 1,400-hp marine type vertical compound engines built by the Willamette Iron & Steel Company, each engine direct connected to a 1,000-kw generator; one Ideal engine exciter of 85 kw capacity; two Curtis steam turbines, each rated at 1,500 kw.

Provision is made for the operation of the plant by the use of sawdust from one of the large lumber mills or by fuel oil, and the change from saw dust to fuel oil, and vice-versa, can be made so quickly that it is unnecessary to extinguish the fires or to reduce the steam pressure on the boilers.

The larger part of the current is generated at 11,000 volts, three-phase, 33 cycles, which is the same type as that supplied from its station at Oregon City.

The power from both the hydro-electric plant at Oregon City and the steam plant at Portland is delivered to a sub-station located in the center of the city. This sub-station contains rotary converters static transformers and motor generator sets by which the energy is prepared for distribution either in the form of direct current 550 volts for the railways or 2,300-volt, 60-cycle current for general distribution. Very large customers such as the Portland Flour Mills, etc., are supplied direct from the 10,000-volt, 33-cycle transmission system. The capacity of the substation is about 10,000 kw. The company a year ago entered into a contract with the Lewis and Clark Exposition to furnish 100,000 incandescent lights for illuminating the fair. Construction of the Fair Sub-station was immediately begun, and the fair is now being lighted therefrom. The current is three-phase,

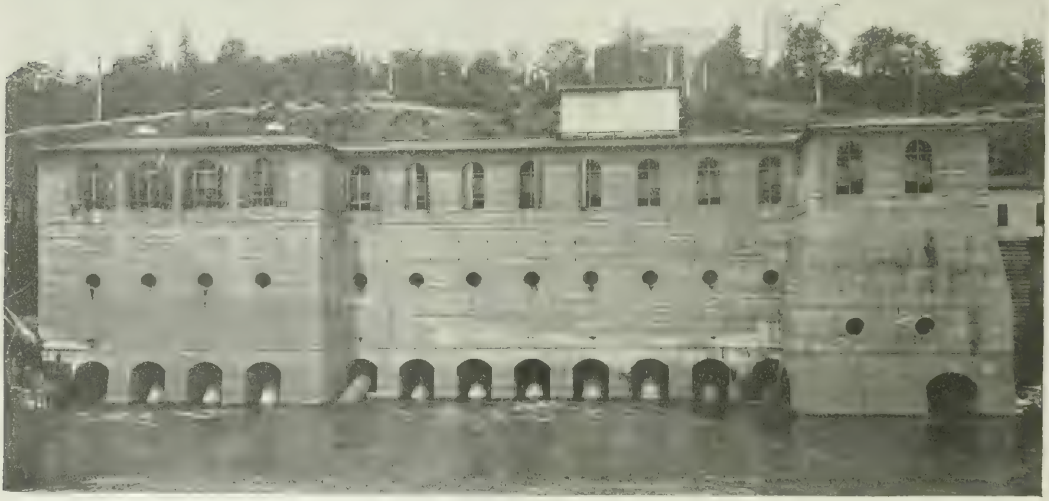


FIG. 5 -POWER PLANT AT WILLAMETTE FALLS.

33 cycles, 10,000 volts, and is carried to the sub-station and changed by static transformers to 2,300 volts for lighting.

After January 1 the Oregon Water, Power & Railway Company, which now buys a part of its current from the Portland General Electric, will sell power to the latter company. The Oregon Water Power & Railway Company is nearing to completion a power plant on the Clackamas River, 40 miles from this city, that will generate 20,000 hp. and the e.m.f. will be stepped up to 34,000 volts for transmission to Portland. The company is expending about $800,000 in erecting its new plant. Half a dozen generators will be installed, each of a capacity of 2,500 kw. Three pole lines will be run to this city,. for railway feeders, trolley and high tension, respectively. The company will this year build an eight-mile extension of its line to Troutdale, on the Columbia River, and establish a ferry across the Columbia to Clackamas, in Washington, for passenger and freight traffic. Power will also be sold to the Oregon Traction Company, which is building an electric road from Portland to Forest Grove, 26 miles.

FIG. 6.—TERMINALS AND DOCKS ON WILLAMETTE RIVER, PORTLAND.

FIG. 7.—HOGAN'S CANYON SIPHON, WALLA WALLA.

The character of the country through which the Clackamas River runs is rugged, and heavily timbered with fir and pine. The banks are precipitous, and the soil is gravel and heavy boulders. The company has riparian rights 2½ miles. It has constructed a timber dam to form a reservoir, from which the water is taken [illegible] in a canal 60 ft. wide and 5 ft. deep, and dropped 125 ft. to the wheels. The water returns to the river. The company purposes to erect another dam and canal, and repeat the operation some time in the future, doubling its capacity to produce electricity.

◆

Meteorology and the Dynamo.

By M. I. Cromack.

Meteorologists are agreed that electricity has much to do with atmospheric conditions, but they cannot in the present state of the science explain in precisely what way this influence is exerted. They know, however, that the crust of the earth and its gaseous envelope are constantly traversed by electrical currents, or dominated more or less by a variety of electrical manifestations. Familiar among these are the awe-inspiring electrical displays witnessed during the prevalence of a thunder storm, and the less frequent but more beautiful exhibitions of electrical energy in connection with the Aurora Borealis.

The identity of lightning and electricity was conclusively proven years ago by the famous kite experiment of the philosopher, Benjamin Franklin, and that the Northern Lights is an electrical manifestation is amply proved by the effect produced upon the mariner's compass and the sensitive apparatus of our telegraph and telephone systems. But even in the absence of these especial exhibitions of electrical energy the testimony of modern testing and measuring instruments proves conclusively that there is no time when earth and air are not saturated, so to speak, with electricity, or when the presence and effects of electrical energy are not plainly manifest.

Heat, light and electricity are doubtless the triune energies that dominate the universe. They are evidently but different manifestations of the same force which seems essential to the propagation and maintenance of all forms of life.

All human inventions are based on some particular phase of natural law. The inventor merely takes advantage of some peculiar attribute of matter, or some especial manifestation of natural force of energy, and bends them to do his will. He can neither create or destroy matter or energy. He can only divert them momentarily from their natural purpose, and by the adoption of adequate means compel them to do his bidding.

Human interference with the natural laws governing the propagation of animal and plant life may be made to produce marked variations in species, and fruits and flowers. Failure to obey or positive infractions of the laws of nature in the realms of hygeia, invariably entail discomfort and distress, if not disaster and death. Chemists tell us that a merely nominal change in the constituents of our mundane atmosphere would render it unfit for respiration, or the support of either animal or vegetable life. Minute changes in other elements, or in the conditions under which we exist, would doubtless be productive of ills innumerable. Light, heat and electricity are doubtless mainly instrumental in the production and stability of conditions favorable to the perpetuation of life as now developed on our planet, as long at least as they perform the duties assigned them by the Creator. But may not even minute interference with the natural performance of those duties be productive of evil?

Since the invention of the dynamo, electric light and power systems have grown and multiplied with phenomenal rapidity, and they are still growing and multiplying with constantly augmenting extent and volume. At the present writing the exploitation of such systems has become world-wide, and there are but few communities in civilized, or even in semi-civilized countries, that cannot boast the possession of one or the other.

The dynamo cannot create electric force or energy, any more than the boiler alone can create steam. Steam results from the combustion of fuel, which releases energy stored away by the sun ages ago. The dynamo merely diverts from its original purpose and turns into new channels electrical energy which has also, perhaps much more recently, emanated from the great orb of day—energy which but for the interference of the dynamo would doubtless have performed other and perhaps more important duties than the production of artificial light, heat and motion.

Up to the present time this interference of the dynamo with the electrical economy of nature, has not been of sufficient magnitude to produce evident effect. But may not the constantly increasing volume of electrical disturbances produced by the rapidly augmenting number and power of such machines, eventually bring about a disturbance of the electrical equilibrium that will result disastrously to animal and vegetable life? May not the delicate balance of our mundane atmosphere, or the meteorological conditions that control temperature and humidity, be so disturbed that cyclonic storms and cloudbursts, hurricanes and floods, unprecedented variations in temperature, and other climatic perturbations may be produced to the serious detriment and discomfort of mankind?

Our beneficent central luminary is constantly shedding on his attendant satellites the energy which their wisely constituted atmospheres transform into heat, light, electricity, magnetism and motion, with the results that our globe, at any rate, is fitted to be the abode of highly organized and rational beings. Like the dynamo of the power house, the sun may be a perfectly cool and non-luminous sphere, the tenuous ether pervading all interplanetary space, equally cool and non-luminous, the conductor, and the mundane and planetary atmospheres the media for converting the solar emanations into the five modes of motion or forms of energy put forth by the dynamo. All of these manifestations of energy are appropriated to a greater or lesser extent by the power-driven dynamo in obedience to man's behest, and to minister to his comfort and pleasure.

Is it not possible that these inroads upon natural force and energy—this wresting of nature's energies from their legitimate channels—may eventually assume such proportions as to justify a note of warning? What may be the result of this disturbance of the electric balance of the world—this constant harrowing of the bosom of mother earth; this continuous agitation of the atmosphere by the constantly augmenting output of the light, heat, power and wireless telegraph dynamos—no one can foretell. What, if any, effect is being already produced upon meteorological conditions is left for the investigations of the electrician and the meteorologist.

Massie System of Wireless Telegraphy.

By A. Frederick Collins.

In striking contrast to the majority of patents issued in the class of wireless telegraphy are those granted to Walter W. Massie, of Providence, R. I., for instead of covering claims of a theoretical and even an imaginary nature, these patents relate exclusively to workable apparatus.

Different from nearly all other inventions in this line, Massie designs, builds and operates his electromechanisms first and then applies for governmental protection. If this mode of procedure were adhered to by his contemporaries, the number of patents would probably be reduced nine-tenths and transmission would be improved some 50 per cent.

In the apparatus to be described the chief features relate to the receptor and a controlling device for switching in and out simultaneously and with a single movement the bell alarm, the oscillophone, the transformer and the motor-generator, the connections of which are shown schematically in Fig. 1. The transmitting arrangement presents no new principles, but follows the specifications of the most recent practice. In sets built for one hundred miles and under the induction coil is utilized, but for transmission over greater distances the initial energy with which the transformer is supplied is taken direct from the street mains, or there is employed a small unit producing 25 amp. at 120 volts. In the first case, if the current is direct, it is converted by a motor-generator into a single-phase, 60-cycle current. The primary of the transformer takes 110 volts and the secondary delivers at its terminals the equivalent of 2.5 kw at a pressure of 60,000 volts. With this high tension there is charged a battery of adjustable plate glass condensers, which, disrupting the spark-gap, sets up the desired oscillation in the radiating system.

An objection to which all receptors employing a telephone receiver as a translator of the impressed oscillations have been subjected lies in the fact that the operator must either keep the 'phone to his ear all the time or frequently lose messages in part or in whole. The usual method for circumventing these conditions is by having the operators set a predetermined time when both shall be at their posts and the telegrams are to be transmitted.

This arbitrary and limiting scheme has been largely responsible for the ban that has been put on this type of receptor, and Massie has made a decided improvement by introducing what should have been done long ago, namely, a bell alarm. Naturally, an alarm demands the use of a filings coherer, and having the latter to contend with it may be asked why its functions should not extend a step further and a Morse register be operated. The reasons may be given in triplicate: since an apparatus merely for signaling and not the alphabetic code entails no such careful adjustment as those for recording intelligence, the sending can be greatly increased in speed, and atmospheric disturbances considerably diminished.

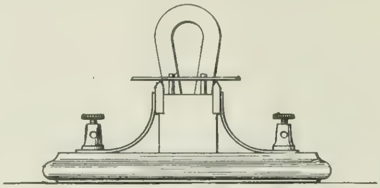


FIG. 2.—END VIEW OF THE OSCILLOPHONE.

The oscillophone, as the inventor has named his receptor, employs an improved form of microphonic contact and a telephone receiver. Its connections with the aerial and ground circuits through the medium of the controlling switch are graphically brought out in the diagram of Fig. 1.

An end view of the oscillophone detector is shown in Fig. 2. This wave responsive device is mounted on a base made of a suitable insulating material, which also constitutes a support for the terminals of the instruments; on this base is mounted a block of hard rubber or slate, the opposite sides having rabbets to receive the carbon terminals of the microphonic detector. The carbons are flat and are about 3 cm. in length, 1 cm. in width and 3 mm. in thickness; these are held in operative relation to each other by bowed springs, which also serve as conductors. The lower ends of the springs are attached to the binding posts to which the oscillophone is connected into the local circuit. The terminals are of a composition of carbon and heavy oil, the upper surfaces being ground to knife edges.

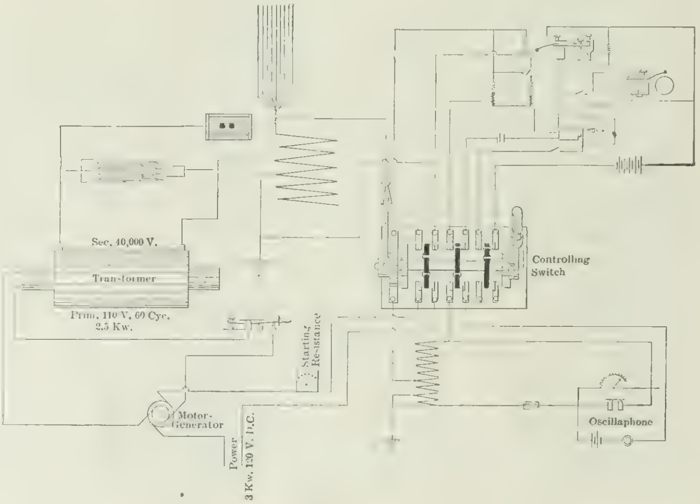


FIG. 1.—DIAGRAM OF CIRCUITS FOR A 250-MILE TRANSMISSION.

In preparing the edged terminals the carbon is ground up and mixed with heavy oil in suitable proportions to make a plastic mass, after which it is moulded in the desired form and then baked. A terminal conductor thus prepared possesses eminently satisfactory characteristics, in that it presents an anti-friction surface to the conducting bridging element or needle extending across the gap between them.

The bridging element for the terminals is made of steel, although some of the other metals have been found to work satisfactorily; steel is eminently adapted for use in the oscillophone detector, since it is possible to hold the needle against accidental displacement on the carbon knife edges by magnetic attraction; a permanent magnet of the familiar horseshoe type is so placed that its legs may be adjusted perpendicularly to the base, so that the lines of force through the bridging element may be made to act as strongly or weakly as desired. Its purpose is to sustain the position of the needle on the carbons magnetically, but absolute contact between the element and the magnet is effectually prevented by metallic stops, which project above the knife edges.

In the ordinary forms of microphonic wave detectors, the bridging element is subject to vibration, and under the action of the local current has a tendency to roll from place to place on the carbons, which not only impairs its efficiency, but renders the readings of the instrument inaccurate; in fact, these are the things that have prevented the extended use of the microphone detector heretofore.

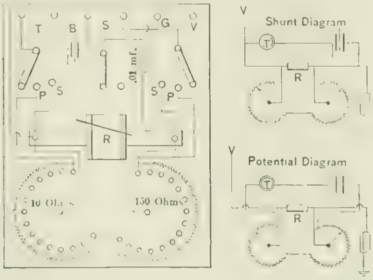


FIG. 3.—DIAGRAM OF OSCILLOPHONE CIRCUITS.

In the Massie oscillophone the needle is drawn gently to the pins and is held firmly against the edges of the carbons, and in this way the prior sources of trouble have been eliminated and, at the same time, its sensibility is increased many fold.

A diagram of the oscillophone circuits is shown in Fig. 3, while a photographic view of the oscillophone is given in Fig. 4. The detector of the oscillophone has a normal resistance of approximately 40,000 ohms, which, after cohesion is effected, drops to less than 700 ohms. The potentiometer, which is divided into two parts, is wound for 10-ohm and 150-ohm steps, respectively, and a condenser of .01 microfarad is connected in series with the earthed terminal, and thence through the system to the vertical wire. There is provided a switch to cut in and out the condenser. The oscillophone may be connected either in shunt or for potential, as the smaller diagrams in Fig. 3 illustrate. Either of these circuits may be used at will by means of the switches, the terminals marked *P* and *S* indicating potential and shunt respectively. The former is used for long-range and the latter for short-distance work.

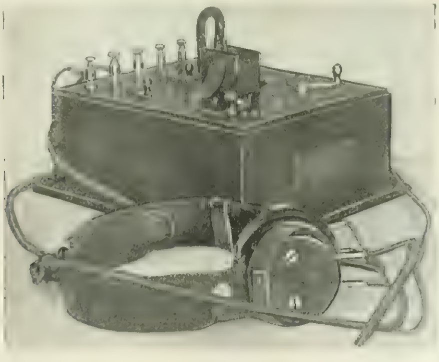


FIG. 4.—OSCILLOPHONE COMPLETE.

In a separate circuit, cut in and out by the controlling switch, is the bell alarm for ringing up the operator. This adjunct comprises a modified form of coherer, a tapper, relay and bell. The novel feature of this arrangement is the coherer, the object of which is to facilitate cohering and thus increase the sensitiveness of the device. Coherers using a magnetized steel needle imbedded in the filings have been experimented with in the past, but in all devices prior to the one here described the oscillations had to cohere the whole mass of filings and overcome as well the weight or force of gravity on the filings in order to form a conducting bridge; further, in coherers of this type the tapper must strike blows of considerable force to decohere the filings, while in practice these requirements decrease to no small extent the sensitiveness of the coherer.

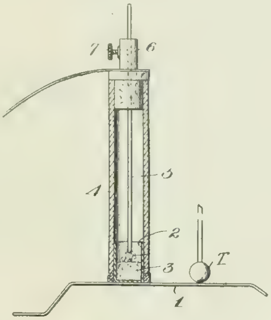


FIG. 5.—MASSIE COHERER.

To obviate these tendencies Massie has designed a coherer in which the magnetized needle is supported with its end out of or free of the non-magnetic filings as distinguished from being engaged with a mass of filings. In the cross-section shown in Fig. 5 a strip of metal, 1, constitutes one terminal of the coherer and supports a cup, 2, also of metal, which serves as a conductor, 3, as well as to contain a mass of silver or other non-magnetic filings; the containing cup is secured within the glass tube, 4. The magnetized needle, 5, may be adjusted in the collar, 6, and its position fixed by the screw, 7. In the diagram the letter *T* designates the tapper, which is of the usual electromagnetic type.

The mass of filings, 3, is placed in the cup, 2, and then the magnetic filings are put on top or superimposed so that when the needle is adjusted in proper proximity thereto the magnetic filings are attracted and held up by the needle and just in contact with the mass of filings in the cup. The magnetic filings are thus cohered at all times, leaving nothing for the oscillating current to do but to cohere the magnetic to the non-magnetic filings, the line dividing them constituting a surface having a multitude of small faces to facilitate the cohering action.

The non-magnetic filings may be of silver, nickel or other metal, and the magnetic filings are preferably of soft Norway iron. The difference in the structure of these metals gives rise to numerous sharp edges and minute forces forming an imperfect electrical contact having an infinitely thin insulating film of air between them. The effect of this superimposing the two different kinds of filings in a line at right angles to the surface of the earth is to produce an effect of cohesion by the electric oscillations and forces of gravitation in identical direction. For this reason it is obvious that the energy necessary to break down the minute air films and weld the edges of the filings together is much smaller than in coherers where the conductor plugs are parallel with the earth's surface.

The current in this coherer need not be directed through the magnetic filings, the surface presented by the top layer of such filings and the sides of the cup acting as conductors; further, the mass of non-magnetic filings shown in the drawings need not be, and, in fact, is not cohered, the cohesion of the magnetic filings to the many faced surfaces being effected by the top layer of the non-magnetic filings, so that the oscillations have materially less work to perform than in other detectors that have sought to aid cohesion by magnetism. Fig. 6 is a photographic reproduction showing the magnetic coherer and bell alarm attachment, and Fig. 7 illustrates the coherer used in connection with a Morse register.

In his letters patent specification No. 787,780, Massie describes a very ingenious switch-controlling mechanism that is a wonderful improvement over the plugs formerly used and the multipole, double-throw switches that are now a familiar adjunct of every system. The advantages of the controlling switch will be apparent by referring again to the diagram (Fig. 1). Here it will be readily observed that the many different circuits are open and closed in sequence by a single movement of the lever. These circuits include those that carry the low-voltage, direct current of the motor and high-tension oscillations of the radiating system, and those operating the bell alarm, oscillophone and high-frequency currents set up in the resonator.

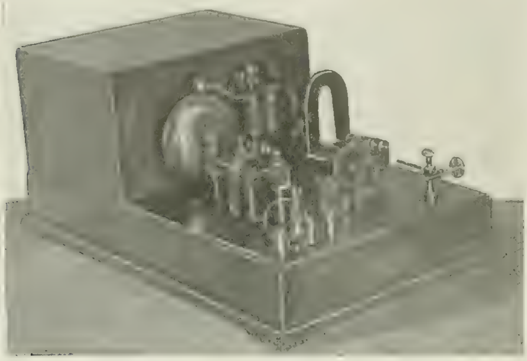


FIG. 6.—MAGNETIC COHERER AND BELL ALARM.

The sectional front elevation (Fig. 8) and the photograph (Fig. 9) will serve to render its construction and operation apparent. The mechanism is mounted on a hard rubber block, and on opposite sides there are two rows of binding posts. Mounted rigidly on the bed are bearings supporting a rock shaft; over the rock shaft and between the bearings is an elongated sleeve made of brass; the shaft and sleeve are associated so that their turning movements are in unison. A peripherally indented disc, 22, is rigidly connected with one of the bearings, 18, and to one end of the shaft, the latter being attached to the hub of a hand lever, by which the rock shaft can be turned to bring it into three different positions. The lever is provided with a spring pawl, the effective portion of which is adapted to be thrust into any one of the three peripheral indentations in the disc 22 by the action of the spring of the pawl in order to positively but yieldingly maintain the shaft in its three positions.

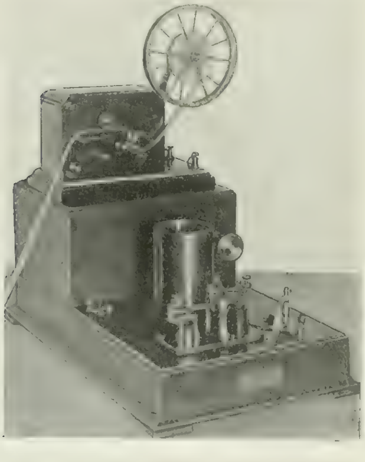


FIG. 7.—MAGNETIC COHERER AND MORSE REGISTER.

The tension of the spring prevents the hand lever and shaft from accidentally shifting, though permitting them to be easily manipulated by the operator. Rigidly fastened to the sleeve are three discs made of a non-conducting material; these discs are arranged to turn between the contact strips, a view of which may be seen in Fig. 1, and which are connected to the binding posts.

By turning the lever carrying the rock shaft, twenty-three different combinations can be secured by causing the three circuit closers or bridging devices. alluded to to extend across and in contact with the upper sides of the several perpendicularly disposed contact strips. Movably connected with the shaft outside of the contact wheel, 28, is the hub of a knife; the hub is loosely carried by the shaft to secure a relative motion between the knife and shaft, the knife constituting a circuit controller.

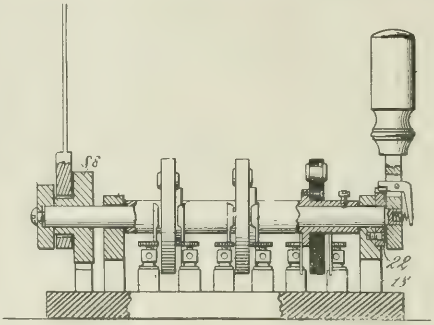


FIG. 8.—DETAILS OF CONTROLLING SWITCH.

From the above statement it will be apparent that when the sending circuit is closed ready for use both receiving circuits are open and grounded so that no injury can result to the operator or to the receiving instruments. By means of this arrangement the entire system is controlled by a single device and to change from the sending to the receiving circuits or vice versa a single movement is all that is required; in this way the speed in operating is greatly accelerated and its rapidity is comparable with the wire system of Morse.

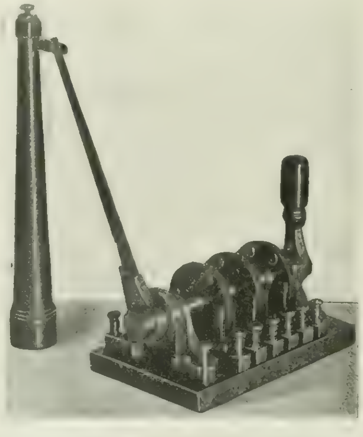


FIG. 9.—CONTROLLING SWITCH.

The first practical installation of the Massie apparatus was at Block Island and Point Judith, where it replaced one of the older and better known systems. A more recent installation was made at Wilsons Point, a shore station, to be used in conjunction with the boats of the New York, New Haven & Hartford Railroad. The Massie system has been in the service of the company cited for over a year, and has been highly satisfactory to all concerned.

The sensitiveness of the oscillophone has been frequently tested by the operations at the Block Island station, where messages in times past were picked up the moment they commenced to signal to the Nantucket Shoals Lightship, 90 miles to the east of Block Island; then assuming the ships were working a distance of 60 miles, the message-bearing electric waves traversed 150 miles to the Rhode Island coast, where they were received and translated by the oscillophone and read by the operator in charge.

Transfer Systems and the Multiple Board in Telephone Exchanges.—I.

By Arthur V. Abbott, C.E.

The switchboard in a small exchange consists of a single panel in which the subscribers' terminals are placed. As soon as this panel is filled the natural course of growth places a second frame beside the first, and when the second panel is exhausted a third is added. So long as three panels provide sufficient space for the jacks and drops, an operator seated before either can reach all subscribers, and if the traffic be sufficient to require the services of more than one operator, each can reach all lines. When, however, the exchange comprises more lines than can be placed in three panels, it is impractical on such a board for all operators to reach all jacks, and, therefore, impossible for each, unaided, to complete every connection that might be demanded. Two methods of solving this problem are in use: The transfer system and the multiple switchboard.

The transfer system is the earlier method, and it is still used for small offices. In addition to subscribers' lines, each operator is provided with a number of jacks and drops, from which circuits extend to every other position in the switchboard. When an operator is requested to connect a calling party with a subscriber located in a panel out of her reach, she inserts the connecting plug into a jack communicating with the panel in which the desired subscriber's jack is located, and rings upon this line in precisely the same manner as if she had plugged into the jack of the subscriber desired. The falling shutter of the drop associated with the jack notifies the operator before whom it is placed that a call is to be answered, exactly as if this drop was the original signal of the subscriber. The second operator inserts the answering plug of a pair of cords into the jack indicated, asks the subscriber for number and completes the connection in the ordinary manner. As by this plan a call is *transferred* from one operator to another, this system is known as the transfer system, and the lines which connect different positions in the switchboard with each are termed "trunk lines." There are many defects in such a system. As the services of two operators are required the cost of operating is increased. Either the subscriber must repeat his order to the second operator, or, if the first attempts to transmit the number, mistakes are inevitable.

The number of calls transferred will depend upon the size of the switchboard, and, assuming traffic to be equally distributed over all lines, it is easy to calculate this. Suppose N to be the number of sections in the switchboard, H the total number of messages, and that each operator can reach the section in front of her and over one section at each side. The number of calls arriving at each section is $\frac{H}{N}$, and $\frac{1}{N}$ of these messages must be completed at each panel of the whole board. Consider first the $\frac{H}{N}$ calls made at any section excepting an end one, then $\frac{H}{N} \cdot \frac{1}{N}$ or $\frac{H}{N^2}$ will be answered on each panel, and as each operator can reach three panels, each one can complete, unaided, $\frac{3H}{N^2}$ of the calls that originate in the panel in front of her. Discarding the two end panels whose operators can reach only two panels instead of three, there will be $N-2$ such sections, each of whose operators can complete $\frac{3H}{N^2}$ of the calls she receives, or $3(N-2)\frac{H}{N^2}$ messages completely unaided. At each of the end sections each operator can complete $\frac{2H}{N^2}$ messages; hence the total unaided completed connections will be $3(N-2)\frac{H}{N^2}+\frac{4H}{N^2}=\frac{H}{N^2} \cdot 3(N-2)$, and the percentage of unaided completed messages $=\frac{3N-2}{N^2}$. This formula shows that the number of unaided messages varies as the square of the number of panels.

Under the system described, all transferred messages are handled by two operators, and each one has to perform precisely as many and exactly the same movements as are used to connect two subscribers that are within her reach; therefore, the cost of the operating labor for all such messages is doubled, and in addition there are the interest, depreciation and maintenance charges on the trunk-line plant, in addition to the delay and inconvenience to which the subscriber is subjected, which cannot be measured in dollars. In spite of these defects the transfer system was for a long time the only method of operating, and under various modifications and guises it still survives and claims as warm advocates many whose telephonic education and skill are of the highest order.

In a way every large exchange may be said to be a transfer system, because whenever there is more than one office some messages must be handled over trunk lines, and except for the mere cost of the additional wire needed to join the panels, it makes no difference whether the sections are ten feet or ten miles apart. Essentially, therefore, all forms and devices for trunking may be classed as transfer systems, and, broadly speaking, toll and long-distance lines fall in this category. Technically, however, the term transfer system is usually understood to cover only methods of handling telephone traffic between the sections of a non-multiple switchboard located in the same office.

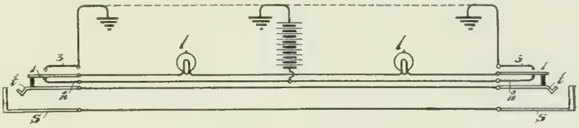


FIG. 1.—SIMPLE TRANSFER CIRCUIT.

A simple and inexpensive transfer circuit for small exchanges, using incandescent lamps as signals, is shown in Fig. 1. Each panel is provided with enough jacks, so that sufficient lines may extend to every panel out of the operator's reach. Each consists of a sleeve S (Fig. 1) and a spring t; these form the talking circuit, and are connected to the trunk line wires. There are three other springs, 1, 2 and 3. Spring 2 nominally is in contact with spring 3, resting upon an insulating block which connects it to spring t. Upon the insertion of the plug, spring t is raised, spring 2 separated from spring 3 and forced into connection with spring 1. Inspection shows that springs 2 of each pair of jacks are connected with one pole of a battery, while springs 3 are connected to the other pole. Springs 1 are respectively connected to one of the poles of the incandescent lamps e and e; when both jacks are unplugged, both of the lamps e and e will be dark. If either operator inserts a plug into the jack in front of her, both of the incandescent lamps will light, and when both plugs are inserted both lamps will be dark. The operation is as follows: Suppose A operator receives a call for a subscriber located in the panel B, she inserts a plug into the jack A illuminating the lamp e and e. The B operator, seeing the illumination of the lamp, inserts an answering plug into the jack B. This extinguishes both lamps and informs the A operator that the B operator plugged into the jack. The B operator asks the subscriber for his order and completes the connection. As soon as the subscribers have finished conversation, and actuate their clearing-out signals, either the A or B operator removes the plug from the trunk jack. The incandescent lamps give a clearing-out signal to the other operator. As soon as the remaining plug is removed both lamps become dark, indicating that the trunk is free.

Such a transfer system is simple and efficient. The objections lie in the expensive and complicated jack and in the fact that each trunk line requires five wires. When few lines are needed and the distance between the panels short, the cost of the jack and of the trunk-line cable and the space required become unimportant. But when long trunking circuits are to be used, economy in wire plant is paramount, and has led to the invention of many ingenious circuit

In the discussion of trunking it has become customary to denominate the operator who receives the subscriber's call the *A* operator, or originating operator, while the other who co-operates in completing the connection is termed the B, or incoming trunk, operator; either *A* operator must tell the *B* operator the number of the desired line or else the *B* operator must ask the subscriber to repeat. Modern methods adopt the first course. Two plans are in use. Both operators may bridge their talking sets across the trunk line and use it to give and receive the order. For the transfer systems employed in small and medium-sized offices this is sufficient, but in large offices the volume of business is so great as to overcrowd the trunk lines and render a separate circuit, called an order-wire, economical. The order-wire is a pair of conductors which extend from all the *A* operators to a head telephone placed upon the ear of the *B* operator. Each *A* operator is supplied with an order-wire key that by touch of the finger connects her talking set with the call wire, so each one can instantly speak to the *B* operator. The order-wire greatly simplifies the trunk circuit, for if the *A* operator can speak at once to the *B* operator, there is no need of any calling signal; hence the lamps, the extra springs in the trunk jacks and three of the wires of the trunk circuit may be omitted.

Consider a set of several trunk lines each one starting in jacks placed in front of a number of *A* operators, and ending in a plug on the cord shelf in front of a *B* operator. If any *A* operator receives an order for a line out of her reach, she touches the order-wire button, extending to the operator (*B* operator) before whom the desired line does appear. For an instant the *A* operator listens to see if any other *A* operator is speaking, and, finding the call wire clear, pronounces the number of the line desired. The *B* operator replies by speaking the number of the trunk line that the *A* operator is to use. Simultaneously the *A* operator inserts her connecting plug into the trunk line jack designated by the *B* operator, and the *B* operator inserts the same numbered trunk line plug into the jack of the called subscriber, the whole operation being completed in two or three seconds. This system is usually known as the reverse-call-circuit trunking system, and is now universally employed between the offices of all large exchanges. The same method may be used for clearing-out. When the subscribers display their disconnect signals, either operator may use the call wire to order the other one to disconnect. But this method has been found cumbersome and confusing, so present practice equips trunk lines with automatic disconnect signals so arranged that when the *A* operator removes the plug a signal is given the *B* operator to disconnect.

The theory of all transfer systems is that of conveying the *message* to the *called* subscriber's line; the *Multiple Board*, which forms the alternative solution of the problem, reverses this and carries the *called* subscriber's line to the *message*. Consider the diagram of Fig. 2, which illustrates a switchboard of say 400 lines divided into four panels of 100 lines each, served by four operators. The diagram shows that if the subscribers' lines terminate as shown the various operators can complete connections as follows:

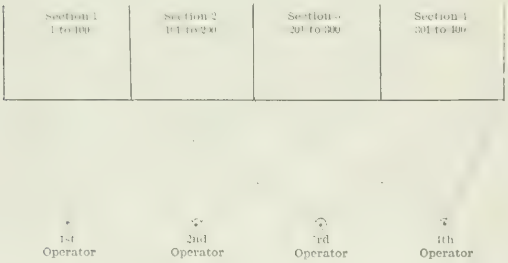


FIG. 2.—DIAGRAM ILLUSTRATING MULTIPLE SWITCHBOARD.

Operator.		
1	to all lines between	1 and 200
2	to all lines between	1 and 300
3	to all lines between	101 and 400
4	to all lines between	201 and 400

The operators are unable to reach lines as follows:

Operator.		
1	cannot reach lines	201 to 400
2	cannot reach lines	301 to 400
3	cannot reach lines	1 to 100
4	cannot reach lines	1 to 200

Now, suppose that in the various panels a lot of surplus jacks be placed, and that the various subscribers' lines be extended and connected to several jacks in such a manner that there is a jack attached to every line within the reach of each operator. Manifestly each operator can complete a connection with every subscriber, and no transfer is necessary. This is the principle of the *multiple* board, which takes its name from the fact that every line has its jacks *multiplied* a sufficient number of times to give every operator access to it. It is unnecessary to multiply the subscribers' calling signal, for when he calls the office the attention of one operator amply suffices. Hence in a multiple switchboard the subscribers' line consists of a calling signal and jack associated therewith (the answering jack) placed before the operator commissioned to attend to the particular subscriber, and a string of other jacks varying in number depending on the size of the switchboard, so arranged as to give all other operators access to the line.

Fig. 3 gives a typical multiple switchboard circuit. Three operators' positions are represented, Nos. 1, 2 and 3, and three lines, Nos. 101, 304 and 508. The drawing shows that each jack consists of two springs, *a* and *c*, normally in contact, and a ring *b*. Each subscriber's circuits may be traced as follows: Taking line 101 from the point *e* where each line enters the board to spring *a* of jack *A* in position 1 to spring *c*, thence through the springs of each of the other jacks in positions 2 and 3, thence to drop *D*, and thence out by the wire *f*. To the *f* side of the line, a branch wire is carried from the jack rings in each section, so that the rings are all in parallel, while the *e* wire of the line runs through the jack contacts in series. The drop is placed last on the line, hence when a plug is introduced it lifts the spring *a* away from spring *c*, and so opens the circuit and cuts off all apparatus connected to *c* spring, relieving the line of all superfluous parts during conversation. The signal and jack associated therewith at the end of the line (including the distributing board outfit) are usually called the subscriber's terminal. For each subscriber there must be one complete terminal. The other jacks are termed the *multiple*, and will vary in number, depending on the size of the board.

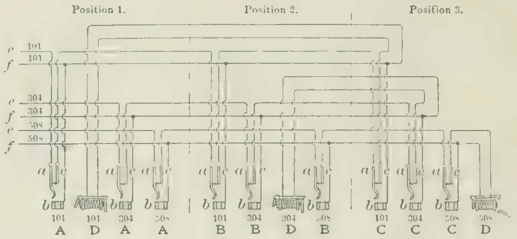


FIG. 3.—TYPICAL SERIES-MULTIPLE SWITCHBOARD CIRCUIT.

* * *

Recent Electrochemical Developments.

ELECTRIC FURNACE CONSTRUCTION.

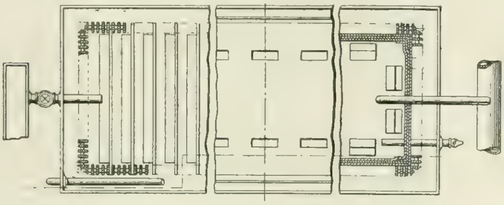
Most electric furnaces now in practical use are designed for intermittent operation—which, for refining and finishing operations, exactly fits the case. On the other hand, where a large output is desired of a relatively crude product, operation is almost universally continuous in metallurgy, or there is at least a strong desire in such cases to render the process continuous. In electric furnace practice there is, for instance, the oven with calcium carbide. The more the electric furnace is coming into use for purposes of this nature the more important is the continuity of the furnace operation. In a recent patent, granted to C. L. Saunders, this is accomplished by means of a continuously revolving circular or annular hearth. The material to be treated is continually charged into the same, while the electrical connections to the furnace are made in such a way that a given zone or area of the hearth is brought into electrical circuit. While passing through this zone the material undergoes the desired change, whereupon it is discharged. The mechanical details of the electrode connections are described.

In best metallurgical practice the treatment of an ore into a finished product is divided into a series of successive steps, producing different effects; it is only in single steps—and generally in the refining or finishing steps—that electric heat is economical under present conditions. This well recognized principle is again indicated in a recent patent of G. H. Benjamin. His furnace consists essentially of four distinct chambers: the calcining chamber with inclined hearth, from which the material passes into the reducing chamber, also with an inclined hearth. Then follows, thirdly, a vertical chamber, below which is, fourth, a basin, which again is in connection with an oxidizing chamber. All these chambers are arranged at progressively lower levels. Only the third, vertical chamber, is electrically heated, the material passing through electric arcs. Regenerative heating is applied.

ELECTROLYTIC PROCESSES.

In processes in which the solution of a salt is electrolyzed, the chief problem is to keep the anodic and cathodic products of electrolysis separate from each other. John F. Kelly tries to accomplish this by means of a three-compartment cell, the salt to be electrolyzed being fed into the middle compartment so that the anolyte and catholyte come into contact with the non-decomposed salt only. If applied to sodium sulphate the catholyte is sodium hydroxide and the anolyte sulphuric acid.

In the electrolysis of common salt, the analogous difficulty is to prevent the sodium hydrate, which is formed at the anode, from passing into the anolyte which is saturated with chlorine. A. B. Larchar, in a recent patent, uses for this purpose the cell construction shown in the illustration.



LARCHAR CELL.

The main feature is the construction of the cathode in form of a grating extending all the way around the cell along the four side walls. The grating consists of steel bars or slats, and upon it is stretched the diaphragm. In the middle of the cell are the anodes of graphite. The electrolyte passing through the diaphragm is divided into a great number of films (between the slats of the grating); these films are in intimate contact with the cathode surface. The inventor adjusts the surface levels of the electrolyte so as to maintain the inside level (of the anolyte) slightly above the outside level, whereby backward diffusion of the caustic through the diaphragm is stated to be prevented.

A. G. Betts' electrolytic treatment of electrolytic slimes (especially those from his own lead refining process) has already been mentioned in these columns. The process is covered by a patent granted on June 20.

L. Dion has patented an apparatus for the electrolytic treatment of mine waters, etc., for the recovery of metals. The main features are mechanical details of construction of the cell, the electrodes and the filter.

BATTERY INVENTION.

Edison's great mechanical skill has undoubtedly solved the mechanical problems of general construction of the alkaline storage battery. Nevertheless, there is still room for improvements in the chemistry of the cell, especially in the preparation of the active materials. Four recent patents refer to such problems.

A. Meister and A. Junker prepare an active nickel electrode for use in the nickel-iron alkaline cell in the following way. Strips of metallic sheet nickel and strips of sheet pulp or asbestos are placed alternately upon each other and are soldered together at top and bottom. This plate is then formed electrolytically as anode in a weak solution of caustic potash containing a small quantity of phenylate with a sheet-nickel plate as cathode.

H. C. Hubbell prepares a nickel electrode, composed of hair-like fibres of nickel intertwined and embedded in a mass of nickel oxide, so as to form a plastic mat or cake. The same inventor makes a silver electrode with a perforated foundation plate of nickel-plated iron, upon which is deposited on both sides a mass of finely divided silver oxide, extending through the perforations, and thus held firmly to the foundation plate. Around this is folded a layer of asbestos paper, and around this a layer of fine nickel wire-gauze. In a third patent of the same inventor a zinc electrode (for use in an alkaline accumulator of the Waddell-Cutz type) is described. He uses a steel skeleton of the following construction, affording a large area for the zinc deposit. It consists of a series of transverse troughs formed of steel strips and having their ends pinched together. Vertical U-shaped channel-plates are firmly connected to the ends of the troughs, and are crimped at their ends to holds the troughs in place.

Four recent patents of H. C. Porter refer to details of construction of storage batteries of the pasted (Brush-Faure) type, three patents relating to three different mechanical constructions of the grid and the fourth patent to the construction of a plate separator. Another construction of a battery grid is described in a recent patent of M. Heisser.

I. Kitsee endeavors to restore the usefulness of overcharged active material in lead accumulators by bringing the active material into contact with a material adapted to in part reduce said active material to a lower oxide and in part change the same to a salt "adapted to act as binder for the particles of said lower oxide." For this purpose chloride of sodium may be used, applied to the electrode moist with the sulphuric acid; or sulphurous gas may be made to act on the moist plate.

A patent of T. S. Witherbee refers to mechanical details of construction of a storage battery jar for automobiles; a patent of P. J. Kamperdyk to mechanical details of construction of a double-fluid primary cell, especially to the construction of the porous cup.

ELECTROMAGNETIC AND ELECTROSTATIC SEPARATION.

Magnetic separation or concentration of ores is a time-honored art and in many cases lean ores have thereby been rendered available for economical treatment. New inventions in this field relate mostly to modifications in the mechanical construction of the separators or to processes for working special materials. H. H. Campbell employs, according to a recent patent, an inclined table with a series of electromagnets arranged in a diagonal row, adjacent to the table. These electromagnets are subjected to reciprocating motion lengthwise of the table. At the end of their forward stroke they are demagnetized and are again remagnetized immediately before they reach the limit of their return stroke. The magnetic particles are thus carried downward, step by step, in a diagonal direction, while the non-magnetic particles simply descend the table unaffected.

E. Kelly and A. Munson have recently patented a process of magnetic separation of ores whereby the usual drying-out step is eliminated as far as those bodies of ore are concerned wherein the percentage of hoisture is inappreciable. They first separate ore of a given size from ore or fines of smaller size, dry out the ore of the smaller size and subject the ore of the larger size to the action of a magnetic separator so as to separate out, as heads, all ore with a given percentage of magnetite, from that, as tails, with a lower percentage. They then reduce these tails and subject them, reduced, and the fines to further magnetic separation.

E. Hedburg has recently patented the following process of treating certain complex ores. The ores are roasted and subjected to the action of a hydrocarbon gas, the effect of which is that the copper, nickel and iron ores become magnetized, while the zinc ores remain non-magnetic. The ores are separated magnetically.

Two recent patents refer to magnetic separation in connection with the recovery of gold. E. S. Bennett removes magnetic iron from placer-sand while the same is being subjected to the action of the gold-saving apparatus, such as an amalgamating tank or a gravitating tank. The primary object is to save gold, including the infinitely fine particles which are found adhering to the exterior of the grains of iron sand. For this purpose he subjects the iron sand to a scouring action of jets under high pressure, which separates from the iron sand the microscopic particles of gold. The iron sand particles denuded of the gold are immediately removed magnetically from the tank, so as not to interfere with the subsequent recovery of these free gold particles.

L. T. Weiss patents a peculiar process for separating particles of non-magnetic metals, such as gold, for example, from sand. Each particle of the metals is first plated in a mass with iron by electrolysis, which is followed by magnetic separation. An electroplating apparatus for this purpose is described.

While electromagnetic separation is old, electrostatic separation has been introduced into practice only in recent years, mainly through the work of Blake and Morscher. A combination of both methods has recently been patented by H. M. Sutton, W. L. Steele and E. G. Steele. In their apparatus, the action of a magnetic roller is combined with a statically charged device for conveying the ore to the roller and charging the ore.

Removal of the Diverting Dam of the Ontario Power Company, Niagara Falls.

The diverting dam in the Niagara River, which has shielded the intake works of the Ontario Power Co. during their construction, is now being rapidly and successfully removed. This dam was built in 1903, extending out from shore above the upper line of rapids and laying dry an area of about 18 acres, including the water courses about the Dufferin Islands. In June, water to operate the first 10,000-hp unit was admitted to the forebays by a sluiceway cut through the dam.

This diverting dam is about 900 feet long, 250 feet of it extending out from shore at nearly a right angle, and the remainder running at an angle down the stream, thus turning the water out toward the middle of the river. It is built of bottom cribs 31 feet long, 16 feet wide and 11 feet deep, which were floated into place, and sunk by loading with stone. No puddle was used, but the dam was made tight by bags of cement placed on the rock bed of the river against the upstream face of the cribs, and by double-lapped tongue and groove sheet piling driven into these bags. A diver, protected from the swift current by a timber shield, placed the bags of cement and fitted the piling to conform to the irregularities of the river bed. This construction has proven very successful, as very little water has leaked through the dam.

REMOVING DIVERTING DAM IN NIAGARA RIVER.

The removal of the dam is accomplished by unloading sections or cribs one at a time, and by swinging as on a hinge in toward the shore, into the quiet water behind the remaining portion of the dam. The stone fill is removed by common labor, no diver being required. An interesting, and in fact surprising, feature of the operation of removal, is that after a crib is unloaded, in spite of the terrific force of the current, it seems almost as stable as before, although held in place only by the small quantity of cement above mentioned. The combined power of a hoisting engine on shore and a derrick on the dam is required to loosen the cribs from the bed of the river, after which they swing easily around toward the shore, as shown in accompanying photograph.

New Telephone Patents,

SEMI-AUTOMATIC SYSTEM.

A sort of semi-automatic system upon novel principles has been patented by Eugene Darnell, of Carrollton, Mo. With this system each line is connected to a switching device which combines both electrical and mechanical features. The former control the usual listening and signaling circuits, while the latter control the interconnecting devices.

From each switching device there hangs a tube carrying at the free end contact ears which form the final terminals of each line. Beneath these tubes there extends a wide belt upon which is mounted a series of transverse members which are made up of two contact plates secured to the sides of an insulating strip.

As soon as a signal is answered and the operator finds out the desired line, by means of the mechanical action she throws the contact lugs of both lines into engagement with the contact plates of a strip upon the belt, and thus connects the two lines and locks them. In order to prepare for the next call the belt is automatically stepped along so that the next contact bar comes into place, the tubes of the connected line following along with the bar to which it is connected.

As soon as a connection is complete, the hanging up of the receiver causes the contact lugs to release the bar, and then they return to the disengaged position automatically.

The idea is to group a set number, say 100 lines, on each section of the switchboard, a transfer trunking system between sections being contemplated.

NEW INSTRUMENTS.

A new transmitter is shown in Fig. 1. This is the work of W. E. Harkness, of Elyria, Ohio, his patent being assigned to the Dean Electric Company. The diaphragm is perforated to receive the pressed electrode chamber, the flange of this latter resting against the diaphragm. The front electrode is secured within the chamber, while the rear electrode is held by an auxiliary mica diaphragm. The chamber is secured to the diaphragm by the pressure of the damping springs alone. Thus a most flexible connection is obtained which is so arranged as not to interfere with the motions of the diaphragm.

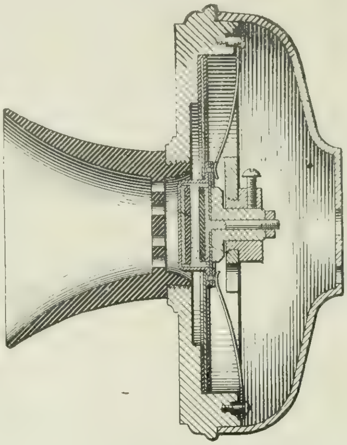


FIG. 1.—HARKNESS TRANSMITTER.

T. E. Brecht, of Washington, D. C., has patented a most peculiarly designed receiver. No permanent magnet is used, the inventor relying upon a battery for polarity effect. The core supports the diaphragm by a single lug passing through the latter's center. About the core is a wooden sleeve, and over this a sheet metal casing. A winding of several small coils connected in parallel completes the magnetic system. This whole is then enclosed in a switch casing.

BUSY TEST.

With two-wire systems, if the busy test shunts any appreciable current from the connected lines, an objectionable sound will be produced in the corresponding receivers. This disadvantage has been overcome sometimes by including in the test circuit a high-impedance relay, which did not affect the connected circuits. This relay controlled local circuits of proper power. Mr. H. G. Webster, of Chicago, has worked upon another principle. He has obtained patents for two systems in which the test tip is maintained so near the potential of the test ring of busy lines that the disturbance due to its contact is negligible. These patents have been assigned to the Stromberg-Carlson Company.

SERVICE METER.

Messrs. C. E. Scribner and F. R. McBerty, of Chicago, have brought out another service meter or counting device adapted for the subscribers' premises. In this case the count is to be registered by the operator, but not until the conversation is completed and the receivers returned to their hooks. A rising switch hook causes a controlling relay to operate to connect the meter to the line, but this relay is immediately released, as it is shunted out by the hook as this reaches the end of its upward stroke. On the down stroke the shunting action is missing and the relay comes up and locks itself as its contacts are thus connected with its winding. The meter is thus locked-connected to the line at both stations, but it does not operate because it is connected between the ground and the grounded limb of the line.

To make a count the operator must push her key. This action sends a sufficient impulse of current out toward the calling line to effect a count, and then the key momentarily severs the connection between the locked relays and the battery. These relays are restored to place and when the operator releases her key all connections are normal. The Western Electric Company has obtained this patent by assignment.

EXCHANGE SYSTEM.

A two-wire common battery system is shown in Fig. 2. It will be seen that the cut-off relay is differentially connected, and thus does not respond to the initial current which sets the line signal. When a plug is connected to the line the balance is destroyed and the cut-off relay is pulled up. The supervisory relay serves as a retardation coil through which current is fed to one side of the line, the other side being connected directly to the battery. It is easy to trace how the supervisory relay cuts its lamp into and out of circuit, the current finding a path back to the battery through the jack sleeves. This system, which was invented by E. Land, of Grand Rapids, Mich., has been assigned to the Stromberg-Carlson Company.

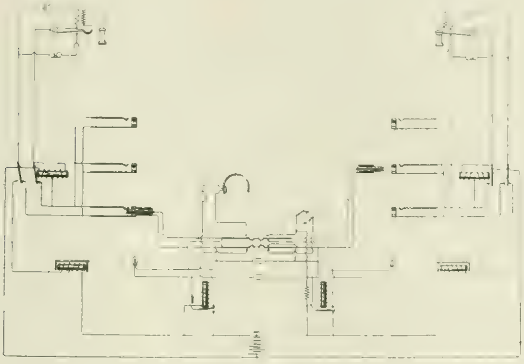


FIG. 2.—LAND EXCHANGE SYSTEM.

INTERCOMMUNICATING-SYSTEM SWITCH.

A self-restoring switch for intercommunicating systems has been patented by Messrs. R. Weman and H. M. Bascom, both of New York City. With this switch, when ringing is done by depressing the switch handle, the contact wipers which normally clear the contacts are depressed and locked against the contacts. When the hook switch is depressed these are released and fly back under spring pressure to clear the circuits.

RECEIVER HOLDERS.

Two patents have recently been granted for receiver holders, one to F. F. Howe, of Marietta, Ohio, and the second to V. Reblum, of Schaghticoke, N. Y. Both supports have a horizontal arm link to the switch hook. Mr. Reblum, in addition, includes a receiver cap adapted to form a closed sound chamber about the ear.

LETTER TO THE EDITORS.

The Electrolytic Detector for Electric Waves.

To the Editors of Electrical World and Engineer:

Sirs:—The question of priority in the case of the electrolytic detector for electrical waves has recently been the subject of considerable discussion, both in the electrical journals and in the courts. I notice in the issue of the Electrical World and Engineer for May 6 a letter from Prof. Blondel on this subject, in which attention is called to the work of Capt. Ferrié in the year 1900. This of course antedates the work of Fessenden, De Forest and Schlömilch, at least so far as publication is concerned. I wish, however, to call attention to a still earlier paper on the electrolytic receiver, namely, that of Prof. Pupin, which was read before the American Physical Society on October 28, 1899, and published in abstract in the second number of the Physical Society Bulletin (Vol. I, No. 2, page 21). It so happened that I was lecturing at that time on the subject of "Electrical Waves," and being much impressed with the ingenuity of Prof. Pupin's device I showed to my class several experiments illustrating its employment in the detection of electrical waves within a few weeks of the meeting at which Prof. Pupin's paper was presented. In my lectures on electrical waves since that time I have always shown the operation of the electrolytic detector, and have, of course, given credit for its invention to Prof. Pupin.

I might add that the abstract in the Physical Society Bulletin, although sufficient to establish priority, does not by any means do justice to the clearness and the completeness of the discussion contained in Prof. Pupin's original paper.

Cornell University, Ithaca, N. Y. Ernest Merritt.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Tendencies in Electrical Engineering.—Janet.—A paper read before the French Physical Society. The author first shows the tendency of increasing the capacity of generators. The largest dynamo at the Exposition of 1889 gave 250-kw, in 1900 it was 3,000-kw; now we have units of 5,000 to 8,000 kw. The increase of the voltage has led to the modern generator with large diameter, running at a low speed. Some notes are given on the turbo-alternators, which now will become the great machine of the future. If one compares the dimensions of the revolving fields of two three-phase, 350-kw., 2,000-volt alternators, one driven by a steam turbine at 3,000 r.p.m., the other by a steam engine at 142 revs., it will be found that the dimensions parallel to the axle are increased for the turbo-alternator from 65 to 80 centimetres, while the diameter is reduced from 310 to 50 centimetres; the centrifugal force is, therefore, much greater in the turbo-alternator. Increase of power of a turbo-alternator necessarily leads to an increase of the dimensions parallel to the axle. Two 5,000-volt alternators, running at 1,500 revs., one with a capacity of 480, the other of 2,000-kw., have approximately the same diameter (95 centimeters), but different lengths, equal to 460 and 1,200 centimeters. He then discusses the following three problems in connection with alternators: Operation in parallel, compounding, suppression of higher harmonics. In discussing prime movers he briefly mentions water turbines, discusses at some length the advantages of steam turbines and refers to gas engines. With respect to the utilization of the waste gases of blast furnaces, he says that "when all of this energy will be utilized—and this is possible only in form of electrical energy—then the iron production will be the accessory and the electrical energy production the main thing in blast furnace countries." Some notes are given with respect to power transmission, electric traction and electric lighting.—*Revue. Gen. des Sciences,* June 30.

Induction Motors.—Workman.—The author describes precautions which must be taken in making a locked saturation test of induction motors.—*Elec. Jour.,* July, 1905.

Mercury Vapor Converter.—Thomas.—An article illustrated by diagrams discussing the general theory and construction of this apparatus.—*Elec. Jour.,* July.

Lights and Lighting.

Incandescent Lamp.—Marshall.—An illustrated Franklin Inst. paper on the development of the Edison incandescent electric lamp from 1881 to 1905. The Edison lamp of today embodies every feature of the lamp of 1881. The progress has been due to changes in details and in improvements in processes of manufacture. The author gives a large amount of information concerning this development. Perhaps the element which has contributed as much to the improvement of the lamp as any other is inspection. The following table shows the change in the life of the lamp, coincident with changes in its elements and the method of its manufacture:

Type of filament.	Year.	Watts. per c.p.	Actual life in hours.	Life to 80% of initial c.p. in hours.
Plain bamboo	1881	5.8	3,000	...
Plain bamboo	1881	4.66	900	...
Asphalted bamboo	1888	3.1	1,000	200
Treated bamboo	1893	3.1	1,200	260
Treated squirt	1896	3.1	700	370
Treated squirt	1900	3.1	750	425
Treated squirt	1904	3.1	800	475

The later improvements corresponding to different periods were obtained, not by elemental changes in the lamp, but by a very gradual improvement in the processes. When the importance of maintenance of candle-power began to be appreciated, it was necessary to decide at what percentage of its initial c.p. a lamp is no longer useful and better be taken out and destroyed rather than allowed to burn longer. This point has, by common consent, come to be fixed at 80 per cent of the initial c.p. In the above table the life to 80 per cent is not given for the earlier lamps, because at that time the importance of that factor had not been recognized. As the life to 80 per cent first began to increase it was accompanied by a very decided decrease in the actual life. The previous long actual life had been due to the rapid diminution of c.p. and the consequent low temperature at which the filament burned.

The 1896 lamp, although having a very much shorter actual life than the 1893 lamp, was really a much better lamp because of the longer life to 80 per cent c.p. The following table shows the life we can expect from 16-c.p. lamps of different efficiencies. The first line gives the watts, the second the life in hours to 80 per cent of initial cp:

Watts	32	40	48	56	64	72	80
Hours	28	132	412	1000	2005	3570	6125

These lamps are all of the same quality and, if burned at the same temperature, would not vary greatly in life. The very great difference in life is due to the difference in temperature. The 80-watt lamp has 4.25 times the surface of the 32-watt lamp, and the light per unit of surface, and consequently the temperature, is very much less. At the usual prices of lamps and electrical energy, the 32-watt lamp, though taking little energy, is not economical, because of the very short life and consequent frequent renewals. On the other hand, the 80-watt lamp, though having a very long life, is not economical, because of the large amount of energy used. In general, the higher the cost of electrical energy and the lower cost of the lamp the lower should be the specific power consumption of the lamp selected.—*Jour. Franklin Inst.*, July.

Street Lighting With Nernst Lamps.—Hoadley.—A paper presented to the (Brit.) Municipal Elec. Asso., discussing the problem of "side-street lighting" (where arc lighting is out of place) from the point of view of the British central station engineer. First, there was competition between the flat-flame gas burner and the carbon filament incandescent lamp, and the latter had, if anything, the better of it. Then the incandescent gas mantle got the best of it. Then came the Nernst lamp and, with respect to it, extensive tests are described by the author. His results show that a 0.5-ampere Nernst lamp at 230 volts gives a degree of illumination superior to that given by an incandescent gas mantle burning 4 cubic feet of gas per hour, both when measured by an illumination photometer in the streets, and, what is far more important, when judged by the eye of the general public. Taking the average inclusive cost of one of these gas lamps at $17.50 per year, he finds that the total cost to the ratepayers of the municipal undertaking of electric lighting by Nernst lamps will be less if electrical energy is supplied at 2.6 cents per kw-hour. (The tests were made with the Nernst lamp of the Allgem. Elek. Ges., of Berlin, which owns the patents for Great Britain.) The author thinks that the Nernst lamp, although still far from perfect, has been "the savior of the side-street lighting business for the electrical world." He suggests some improvements for the German make of Nernst lamp. The ideal lamp for the lighting of the less important streets will, the author thinks, be found eventually in a small flame arc lamp taking about 100 watts, and having a magazine feed so that it will burn for some 60 or more hours without attention. The paper was extensively discussed.—Lond. *Elec.*, June 30.

New Incandescent Lamp.—In a paper by Janet on tendencies in electrical engineering, a new lamp, devised by Canello, is mentioned which has a filament formed of oxides of alkaline earths, covered with a thin layer of metallic osmium. It is, therefore, a combination of the principles of the Nernst lamp and the osmium lamp.—*Revue Gen. des Sciences*, June 30.

POWER.

Electric Winding Machines.—Habets.—The first part of an English translation of his French paper, presented before the (Brit.) Institution of Mechanical Engineers in Liege. The paper gives a very full discussion of the subject. It is profusely illustrated by diagrams and is partly of a mathematical character. The author begins with a dynamic investigation of haulage and discusses the statical moments, the resistances, the moments of inertia of the suspended loads, the moment of inertia of the rope roll, the moment of inertia of the head-gears, the moment of inertia of the winding gears and of the motors, the moments of the accelerating forces, and the power and expenditure of energy. The author then discusses the electric motors used for haulage—either three-phase induction motors or direct-current motors—especially with respect to their starting qualities. The only method which has been used for starting three-phase motors for driving haulage machinery, consists in inserting variable resistances in series with the three circuits of the secondary. The Allgem. Elek. Ges. has designed a rheostat with liquid resistance, consisting of two vessels, the one above the other. The liquid is kept in motion by a small centrifugal pump which takes the liquid from the lower vessel and forces it back into the upper vessel, in which three metallic plates—each for one secondary circuit—are suspended, as shown in Fig. 1. The upper vessel has an overflow, and the plates are only immersed to a depth corresponding to the required resistance. By manipulating the starting lever, which works the reversing switch and closes the inductor circuit, a stop valve V_2 will be closed; the level of the liquid in the upper vessel will, therefore, rise, and the plates will be more and more immersed. The rate at which the water rises can be regulated by a cock on the inlet pipe. The maximum speed of the machine is reached when the liquid has risen to a second overflow, which is always open. When the lever of the reversing switch has been pushed home to the right or left, according to the direction in which the machine is to turn, it may be moved back through a certain angle without breaking the circuit. In doing this, the stop-valve is gradually opened, so that the water can run out again, and the speed will be reduced as desired. The circuit will not be broken until the lever is turned back into its vertical position; as the level of the liquid is falling steadily, the current as well as the speed of the motor will be gradually reduced; the interruption, therefore, will not be sudden. The immersion of the plates may be further limited by an overflow, V_1, so as to reduce the speed when persons are carried up and down. When the pit or the ropes are to be examined, the speed may be still further reduced by regulating V_1. The intermittent working and the increased energy at starting cause sudden and irregular demands on the generators at the power station which must, therefore, be designed liberally and supplied with large fly-wheels. The direct driving of winding machinery by induction motors requires generators capable of standing a considerable overload, and the installation of very powerful sets at the power station. This means an increased expenditure for extra boilers, steam engines and alternators; but, on the other hand, the use of three-phase machines is much simpler and much less expensive than transforming alternating current into direct current. The author then discusses the use of direct-current motors and gives the principal formulas and discusses the following methods of starting: 1. Starting with a rheostat (the same loss of energy as with three-phase motors. 2. Series-parallel control (as on tramcars). 3. Batteries in section (economical, but complicated). 4. Special generator; the haulage motor is separately excited by a constant current, and the difference of potential is varied, and therefore, also

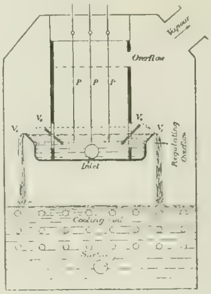


FIG. 1.—LIQUID RHEOSTAT.

the speed, by regulating the e.m.f. of the generator which supplies the motor by means of a field rheostat; the generator must be able to stand all the variation of the load, and the engine driving the generator will be running on no-load during the stoppages. The use of a special generator is not practical unless the haulage machinery is close to the supply station. Ilgner's system is then mentioned. 5. Auxiliary starting dynamo (its armature in series with the armature of the haulage motor across the mains of a constant-pressure circuit; both fields are connected direct to the mains). 6. Starting boosters. Examples of practical applications of these systems are mentioned. The paper is to be continued.—Lond. *Eng'ing*, June 30.

Austrian Water Power Plant.—Steens.—An illustrated description of the central station at Zwömalgreien. The hydraulic power is furnished by the Eggenthalerbach, a creek having its source at the foot of the Latemar group in the Dolomite mountain chain. The central power-house is located at the entrance of the Eggenthal, near Kardaun. The equipment consists of three 500-hp turbines direct connected to three-phase, 60-cycle Oerlikon generators, which furnish current at a tension of 3,600 volts. This current is transmitted to several sub-stations in the vicinity where it is stepped down to 150 volts for lighting purposes. In only one of the several sub-stations does the primary enter through an overhead line. The transmission line runs underground to cylindrical turrets in which are placed the switches and transformers. The secondary lines are, for the most part, overhead. Arc and 32-cp incandescent lamps are used for street lighting.—*Amer. Elec.*, July.

Transmission.—Vaughan.—Some illustrated notes on the transmission of 20,000 hp from the Puyallup River to Seattle and Tacoma, Wash., at a distance of 50 and 30 miles, respectively. The transmission voltage is 55,000. Some details are given of the construction of the transmission line.—*Elec. Jour.*, July.

Traction.

Convention.—A full account of the fourth annual convention of the (Brit.) Municipal Tramways' Association. The papers presented will be abstracted later in the Digest.—Lond. *Elec.*, July 7.

Motor Connections.—Gough.—An article giving diagrams and discussing possible mistakes in motor connections and their effects. —*St. Ry. Jour.*, July 8.

Electric Buckboard.—Brocksmith.—A continuation of the article begun last month on the design of an electric buckboard. Complete information and drawings are given in the present article for the construction of the motor.—*Amer. Elec.*, July.

Installations, Systems and Appliances.

Presidential Address.—Newington.—His presidential address to the (Brit.) Municipal Elec. Asso. The first part of the address deals largely with financial problems, the repayment of loans, the methods of dealing with the profits of municipal electric stations, depreciation of plant, and reserve fund. Many more British towns are now making a profit, and in many instances large profits, as compared with a few years ago. In 1905, the number of British municipal central stations, not including tramways, making a profit, is 115, the surplus being about $2,180,000. Those showing a loss are 67 in number, the amount being $347,400. Of these 67 towns, 42 have completed only their third year of working. The corresponding figures for 1902 were 46 towns with a surplus of about $445,000, and 53 towns with a loss of $432,500. Gas experts are said to have improved the incandescent lamps to such a degree that it is now very suitable for street lighting where a large amount of light is not necessary and where, therefore, arc lamps would be too powerful. "Just at present there seems not to be any form of electric lamp that can quite compete with the incandescent gas mantle for this purpose," although some new forms of electric lamps are in a more or less promising experimental stage. Small householders should be encouraged to install electric light. For small houses where exposed wires would not be objectionable, a system in which fireproofed cables are carried on suitable insulators, fixed to the walls or ceilings, should be perfectly good. With electric motors, if it can be arranged that they are switched off during the two or three hours of maximum load for lighting in the four winter months, extra machinery will not be required, and so a very low rate can be charged. This system is just now being adopted in Edinburgh, and is also in force in a few other cities. He suggests that the members of the association should collect data, showing how far the motors connected to their system are used during the hours of maximum lighting load in the winter months.—Lond. *Elec.*, June 30.

Load Factor.—Sinclair.—A paper read before the (Brit.) Municipal Electric Assoc. on the load factor and its effect upon an electricity station. The author gives a series of diagrams to illustrate graphically the effect attained by incorporating various classes of supply mentioned with the ordinary lighting. The diagrams are intended to show what might be done in common practice in a town of 100,000 to 150,000 inhabitants and a station of 1,500 to 2,000-kw. He concludes that it is essential to the cheap generation of electricity to increase the load factor of a station by every possible means. He recommends the increasing of the ordinary lighting load by systematic canvassing. Public lighting should be extensively used. Great hopes may be held for the future of stations by dispensing power on a large scale to small users at cheap rates. He recommends the hiring out of motors. A traction load is a valuable asset. The author expressed the belief that a uniform price per kw-hour cannot be fixed for electricity, but the price must depends on the nature of the supply, i. e., quantity and load factor. The maximum demand system meets the requirements of the case, but it is too complicated. "If a system simple in itself could be arrived at whereby a customer's load factor could be readily and easily ascertained, his charge per unit could then be regulated by a discount on its rated price. By some such means, the ordinary customer, usually a man of business, would be appealed to because he would readily accept the situation if he is aware that his account is subject to a discount on the quantity (as gauged by his load factor) of energy he uses, whereas when confronted with the complex explanations of the maximum demand, he is amazed—always confused—and if his bill is high, never satisfied." The paper was discussed at some length, various speakers taking issue with the figures given in the author's diagrams. In an editorial note on this subject the following definitions of the load factor and of the diversity factor are given: "Load factor is the average load on the station throughout the year expressed as a percentage of the maximum load." The maximum load on the station is naturally less than the sum total of the maximum loads of each consumer, as these do not occur simultaneously, and "the diversity factor shows the relation between these two figures; it is the sum of the consumers' maximum loads divided by the actual maximum load on the station." It is claimed that in Sinclair's diagrams the diversity factor has not been taken into account. Attention is called to the ambiguity in estimating the load factor of a tramway system. In taking the maximum load for the calculation of the load factor, a difference of 100 per cent may well occur if the momentary maximum be taken instead of the highest load which occurs without taking account of the narrow peaks, which last only a few minutes. To be quite accurate, therefore, in comparing traction with lighting load factors, account should be taken of the relation between the widths of the peaks and the period for which the overload capacity of the machines is rated.—Lond. *Elec.*, June 30.

British Central Station Statistics.—The first part of the annual table giving a list of electricity supply works of the United Kingdom. The present part gives data on 190 stations (alphabetically arranged; this installment beginning with Aberdeen and stopping with Liverpool). Statistical data are given in 27 separate columns on the development and equipment, cost, etc.—Supplement to Lond. *Elec. Rev.*, June 23.

Compound Generators in Parallel with Storage Battery.—E. K. Scott.—An illustrated article on the equipment of a lighting station in Sydney, Australia. The plant contains five steam-driven, 220-volt generators, the armatures being wound on the Eickemeyer principle. They are arranged in such a manner that by re-connecting the armatures double the pressure can be obtained. There are 115 storage cells of 1,000 ampere-hour capacity, to help the plant at its heaviest load; they are recharged during hours of light load in the morning, the excess of voltage being supplied by a motor-generator set. The interesting feature is that although the machines are compound wound—or rather overcompounded 5 per cent—they are run in parallel with the storage battery; and this method has been most successful "for many years." "The regulation of the station is the most perfect the writer has ever seen, and the manager claims that it does not vary more than 1 per cent in a year." Fig. 2 shows the arrangement of the connections. One of the main switches for each machine is of the I. T. E. circuit-breaker type, fitted with a special differentially wound coil by means of which it is tripped in case of a reverse current from the cells or from any other machine. In order to ensure that each dynamo shall take its fair share of the load, it is important that the resistances of the series coils shall be relatively proportioned for their respective outputs, and as this resistance is very low, special attention has to be paid to the section of the equalizing cables. When, however, these are once adjusted, they require no further attention. When switching out a dynamo, resistance is inserted in the field circuit until the machine gives only a small current, when the main switches are opened with very little arcing. By this method there is absolutely no blink in the lights, the machines which still remain in circuit taking up the additional load automatically, and by reason of the overcompounding adjust their voltage to suit the load. On account of the series turns, the commutators work practically sparkless and with very little movement of the brushes. This is largely due to the fact that the series turns increase the field magnetization in the air-gap just at the time when such increase is most required for sparkless commutation. The connections to the station now amount to more than the equivalent of 36,000 lamps of 8 cp.—Lond. *Elec.*, June 30.

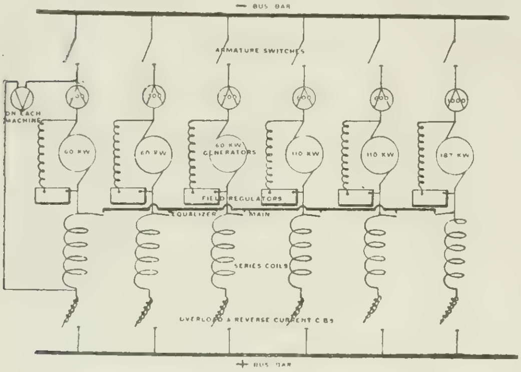


FIG. 2.—DIAGRAM OF GENERATOR CONNECTIONS.

Alternating-Current Boosters.—An illustrated description of variable-ratio transformers for boosting long low-tension feeders which supply some of the outlying suburbs of Sheffield, and for adjusting the voltage on the local circuits of the new generating station, which is situated at some distance from the center of the supply area, and in consequence has to be run at a pressure considerably in excess of that normally obtained at the feeding points. In the latter case there is provided a reversing switch which enables the shunt connections to be changed, and the booster used for raising or lowering the voltage, as may be required. The secondary winding of the variable-ratio transformer is divided into 16 equal sections from which tappings are taken to the contacts of the switch.—Lond. *Elec. Rev.*, June 23.

ELECTROPHYSICS AND MAGNETISM.

Temperature and E.M.F. in Thermocells.—Palme.—An illustrated account of tests made to determine within the temperature interval from 0 to 300° C. whether the e.m.f. is a linear function of the temperature. If this relation holds good, the combination is specially suitable for a thermoelectric pyrometer. The measurements were made with combinations of various chemically pure substances, and the results are given in three diagrams, the first giving relatively low e.m.f's (up to 2.2 millivolts at 300° C.), the second giving medium e.m.f's (up to 6 millivolts), the third giving high e.m.f's (up to 15 millivolts). The latter diagram is reproduced in Fig. 3, in which the abscissas represent degrees Centigrade and the ordinates millivolts. Curve 1 refers to the combination, platinum-carbon; 2, platinum-German silver; 3, platinum-iron; 4, nickel-silver; 5, nickel-iron; 6, constantan-copper; 7, constantan-iron. All the curves are approximately straight lines and 4, 5, 6, 7 give sufficiently high e.m.f's for use in practice without specially delicate instruments. In the other diagrams given in the article, the curves for copper-iron, silver-iron and zinc-iron are theoretically interesting, since they have a maximum at 220° to 240° C.; this maximum value is somewhat above 1 millivolt. The curves then drop again to values of 0.6 or 0.7 millivolt at 300°. Such combinations are, of course, unsuitable for thermoelectric pyrometers, since a certain e.m.f. may correspond to two different temperatures.—*Zeit. f. Elek.* (Vienna), July 2.

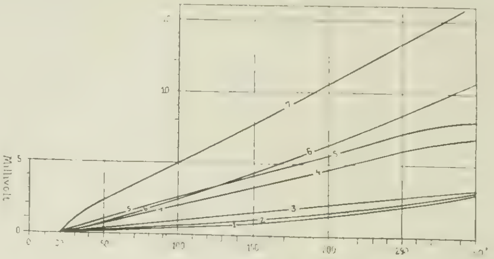


FIG. 3.—TEMPERATURE AND E. M. F. CURVES.

Positive Leak from Hot Platinum.—Richardson.—An account of experiments in which the author determined the rate of leak of a positive charge from a platinum wire at various pressures of the surrounding gas. For a mean potential of 3.5 volts, the results at pressures below 1 mm. show a linear relation between the current and the pressure. Thus the leak consists of two parts, one of which is proportional to, and the other independent of, the pressure. Similar results were obtained with a potential of + 80 volts on the filament. The part of the leak which is independent of the pressure was found to be nearly independent of the potential over a range from 40 to 200 volts.—Lond. *Elec., June* 30; from *Proceedings Cambridge Phil. Society,* May 24.

ELECTROCHEMISTRY AND BATTERIES.

Thermochemistry of High Temperatures.—Richards.—A continuation of his serial on metallurgical calculations. In the present installment very full numerical data are given concerning the specific heats and latent heats of fusion and volatilization of the different elements. As to the specific heat the law of Dulong and Petit is discussed. With respect to the latent heat of fusion the following rules are given: If the latent heat of fusion is expressed per atomic weight of the element (analogous to specific heat of atomic weight), and if they are plotted as ordinates with the melting points as abscissæ in a diagram, a straight line is obtained. Numerically, if the melting points be expressed in degrees of absolute temperature (Centigrade + 273), the latent heats of fusion of atomic weights average about 2.1 times the temperature of the melting point. This rule may be used to predict an undetermined latent heat of fusion. Another rule is that the continued product of the latent heat of fusion of atomic weight and the coefficient of expansion and the cube root of atomic volume (atomic weight divided by specific gravity) is a constant. If the coefficient of linear expansion between 0° and 100° C. is used, the constant is 0.095, or if the actual linear expansion of unit length from 0° to 100° C. is used, the constant is 9.5. The latent heat of vaporization of atomic weight is proportional to the absolute temperatures of the boiling point at atmospheric pressure, and is numerically equal to about 23 times that temperature. The experimentally determined values are given in forms of tables for all elements, arranged in the order of their atomic weights.—*Electrochem. and Met. Ind.*, July.

Lead-Antimony Alloys for Storage Batteries.—Rosset.—The conclusion of his paper on quick methods for determining the composition of lead-antimony alloys for storage battery plates. In the present installment he describes how to determine the composition from the hardness of the alloy.—*Centralblatt f. Accum.*, July 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct-Current Motor Meter.—A fully illustrated description of a motor meter made by the Allgem. Elek. Ges. for currents between 3 and 100 amp. and voltages between 60 and 600 for two-wire and three-wire systems. The meter has been admitted for calibration by the Reichsanstalt and is now described by this bureau. The construction is shown in Fig. 4, while Fig. 5 shows the connections to a three-wire system. The braking disc, *B*, is a sheet of aluminum of 1 mm. thickness with a diameter of 112 mm. The auxiliary coil, *H*, has an internal diameter of 36 mm. and an external diameter of 50 to 60 mm., and has a height of 10 mm. It consists of 3,500 to 4,000 turns of copper wire of 0.09 mm. thickness. The resistance, *W*, consists of 0.05 mm. bare nickel wire and is so adjusted that 0.0125 to 0.014 amp. passes through the shunt circuit.—*Elek. Zeit.*, June 29.

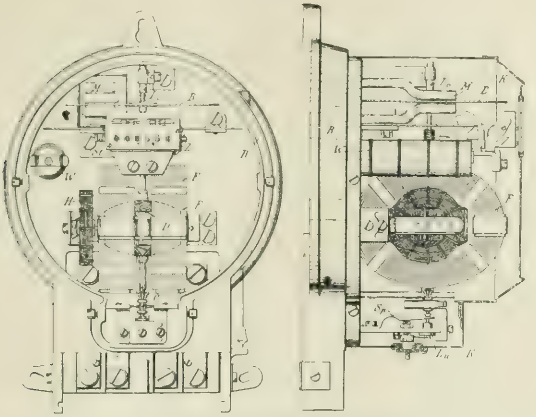


FIG. 4.—DIRECT-CURRENT MOTOR METER.

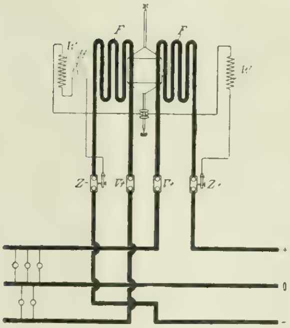


FIG. 5—DIAGRAM OF CONNECTIONS.

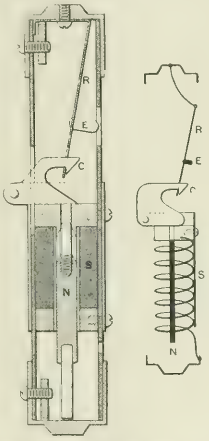


FIG. 6.—PROTECTING DEVICE.

Telegraphy, Telephony and Signals.

Electric Wave Transmission.—Franklin.—A Franklin Institute paper on electric waves and the behavior of long-distance transmission in lines. The author makes use of Maxwell's cellular theory of the ether. He develops the conceptions of electromagnetic action on the basis of this theory and applies them to the discussion of electric waves along long lines. The reduction of line losses and of wave distortion by increasing line induction is explained. The author dwells on the usefulness of Maxwell's cellular theory of the ether, since there is scarcely a phenomenon of electromagnetic action which is not very greatly simplified by the use of these conceptions. His "advice to the younger readers is to swallow Maxwell's cellular theory and digest it, and do not turn away from it in disgust because some one says, truly, that it does not contain the secret of the universe."—*Jour. Franklin Inst.*, July.

Protection of Telephone and Telegraph Apparatus.—An illustrated description of a device by Van Deth of a French telephone company for protecting telephone and telegraph apparatus against currents of slightly increased strength. The device is shown in Fig. 6. It consists of a small solenoid, *S*, which, for a certain strength of current, attracts the small iron core, *N*. This then acts on the pivoted part, *C*, so that the spring, *R*, is released. By a slight pressure on *E* the apparatus is easily reset. The electric resistance of the solenoid is very small. The circuit is automatically broken. The solenoid has a small self-induction which has the advantage of forcing oscillating discharges through the lightning arrester.—*L'Industrie Elec.*, June 25.

BOOK REVIEWS.

Étude sur les Resonances. (A Study on Resonance in Alternating-Current Circuits.) By G. Chevrier. Paris: L'Éclairage Électrique. 76 pages, illustrated.

This little volume is a mathematical treatise on the elementary principles of resonance in simple alternating-current circuits with inductance and capacity in simple series or simple parallel connection. The treatment is somewhat academic in character and deals with the subject rather from the standpoint of the mathematician than from that of the engineer. The topic is dealt with neither historically nor by comparison with experimental results. The conditions of distributed inductance and capacity are barely touched upon. Consequently the theorems developed scarcely apply to long circuits. The book will interest students of mathematical physics.

Einleitung in die Theoretische Elektrizitatslehre. Introduction to the Theoretical Study of Electricity. By Dr. Ignaz Wallentin. Leipzig: B. G. Teubner. 444 pages, 81 illustrations.

If there is anything noticeable about German publications, it is the careful and thorough manner in which German mathematical textbooks are written, corrected, printed and published. This volume is no exception to the rule. It is a carefully prepared mathematical textbook intended for advanced students. It is written from the algebraical and not from the vectorial standpoint.

The book is divided into six sections. The first deals with electrostatics, the second with magnetism, the third with electric currents, the fourth with electromagnetism, the fifth with electromagnetic induction and the last with electromagnetic units.

The treatment is clear and substantial, but follows the classical forms of the great authors of the end of the nineteenth century rather than the newer methods of lesser renown. The style is similar to that of Mascart and Joubert, after making allowance for the difference between the two languages. The book will interest the student of the higher mathematics and physics.

Theorie der Elektrizität. Electrical Theory. By M. Abraham and A. Föppl. Vol. 1: Einfuhrung in die Maxwellsche Theorie der Elektricität. Introduction to the Maxwellian Theory of Electricity. B. A. Foppl. Second edition Leipzig: B. G. Teubner. Cloth, 443 pages, 11 illustrations.

Although there are a number of treatises upon the mathematical theory of electricity, there are comparatively few dealing with that theory from the vectorial standpoint. This volume bases almost the entire mathematical treatment upon the theory of vectors. The theory is a sort of compromise between the Grassman Ausdehnungslehre and the Hamilton quaternions. The book is thorough and clearly developed, but is only intended for advanced mathematical students. It would be improved by an index of subjects. It possesses, however, a final tabular arrangement of formulæ which is very useful for reference.

There is no doubt that the method of treatment presented is of great analytical power, although somewhat unusual to American mathematical readers. The book will be of interest and value to advanced students of mathematical physics.

Maxwell's Theory and Wireless Telegraphy. Part I: Maxwell's Theory and Hertzian Oscillations, by H. Poincaré; translated by Frederick K. Vreeland. Part II: The Principles of Wireless Telegraphy, by Frederick K. Vreeland. New York: McGraw Publishing Company. 255 pages, 145 illustrations. Price, $2.00.

This volume is a welcome addition to our scientific literature, as it meets a want that has been keenly felt in recent years when one hears so much about electromagnetic oscillators and detectors. Every one knows to-day that Clerk Maxwell was not only a high priest in the science of electricity, but also a seer gifted with extraordinary insight into the behavior of dielectrics and with extraordinary power in expressing the properties of the radiation emitted by alternating currents of high frequency. As seer, he predicted the discovery of electric waves and sought to express by a system of equations the laws that would govern them. But these equations, however, and their discussion by Maxwell and others are not easy reading; they demand a mathematical outfit that requires for its weaving years of work by the university loom. Hence our gratitude to those accomplished mathematicians and physicists who, from time to time, have undertaken the task of interpreting the equations for us and showing their application to electrical and optical phenomena. Eminent among these interpreters is Poincaré, whose name is honored in every institution of learning the world over. A careful and discriminating student of Maxwell's theory, and also mathematical expounder of electric oscillations and associated phenomena, few men were as well qualified as Poincaré to translate Maxwellian views into the ordinary language of the physical laboratory. This he did in a booklet of the *Scientia* series, and it is this booklet which Mr. Vreeland now presents to English readers in the first part of the present volume. The accuracy of expression and clearness of exposition that characterize the original are faithfully reproduced in the translation. Not only so, but Mr. Vreeland has greatly enhanced the value of the little treatise by the numerous diagrams and accompanying explanations with which he illustrates every knotty point of the text. We find five figures in the original work and fifty-six in the translation. Many of these are very helpful and suggestive, e. g., Fig. 45, which shows a portion of the spherical wave proceeding from an oscillator, and Fig. 46, which shows the wave front surrounding a wire transmitting electric oscillations.

Part II, from Mr. Vreeland's own pen, is mainly of a practical character showing the rise and progress of the art of electric signaling through space without wires, although the function of the aerial and the grounded wire as well as the physical nature of the waves sent out are fully discussed.

Part I occupies the first half of the book. In this part a physical explanation is given of the ordinary electrical phenomena in accordance with Maxwell's theory, and whenever possible mechanical analogies are given to make clear and to show the corrolation of the electrical phenomena. The distinction between conductors and dielectrics is well shown. Conduction currents in conductors are compared to the motion of a body immersed in a viscous liquid, and just as this motion will continue so long as the moving force exists, so conduction currents continue so long as the electromotive forces which produce them exist. Displacement currents in dielectrics are compared to the motion of a body against the elastic reaction of a spring, and just as such motion continues only until the force of the reaction is equal to the force applied, so the displacement current continues only until the reacting e.m.f. of the dielectric is equal to the applied e.m.f. This conception is made exceptionally clear in this book and is used later to give simple explanations of the phenomena of wireless telegraphy.

Chapters IV and V deal with the experiments of Hertz, which confirmed the mathematical results obtained twenty years before by Maxwell. These chapters are very clearly illustrated, and the methods for obtaining the rapid electrical oscillations and for detecting them and measuring their wave lengths are explained in detail.

Propagation of electrical waves along a conductor is taken up in Chapter VI. The diffusion of the current due to ohmic resistance is compared to the spreading of a caravan along a road by the lagging behind of the followers. The conduction of a continuous current along a wire is also taken up. The next chapters deal with wave length and multiple resonance of electric waves in air and in dielectrics. The last two chapters of Part I explain the relation between electric waves and light. It is here shown that these differ essentially only in the length of the waves, and that they both travel through space at the same velocity It is also shown that all the phenomena of optics can be reproduced with electric waves.

Part II, discussing wireless telegraphy, occupies the second half of the book. In Chapter I general principles are taken up. It is here shown how the phenomena and principles explained in Part I may be applied to understand the problems of wireless telegraphy. Three methods are described which may be employed to signal through space: (1) By electrostatic induction, (2) by electromagnetic induction, (3) by electromagnetic waves It is explained that the last is a complex phenomenon which includes the effects of the two others

Each one of the three methods is clearly illustrated by means of a hydrostatic analogy Examples of actual experiments in signaling through space by each one of the three methods are also given. It is then explained that the electric wave method is the only one that can be used for transmitting over practical distances.

In Chapter II a number of the early experiments in telegraphy through spaces by means of electric waves are explained, including the historical ones of Marconi. The general course of development is clearly indicated, including the introduction of the antenna. The grounding of the antenna and the variations in its form to increase the radiations and make it suitable for very great distances are discussed in the next chapter. The use of high-power generators for long-distance signaling is then discussed and the diagrams of various forms of sending circuits are given. Chapter II presents a remarkable discussion of the propagation of waves from a grounded antenna. Three hypotheses are offered: (1) That they are free waves in the ether exactly like those studied by Hertz; (2) that the transmission is by alternating currents in the ground or sea and is independent of ether waves; (3) that the transmission is by guided waves of a peculiar character, which glide over the surface of the earth or sea.

Experiments are described which prove that each of the hypotheses has some foundation in fact, but the last one is stated to be the only one which completely explains the phenomenon. Chapter V deals with the receiving apparatus. Five types of detectors are described and the advantages and peculiarities of each type are pointed out. Various arrangements for the receiving circuit are also given. The last chapter is on selective or tuned signaling. The physical principles involved are first briefly discussed, and a number of mechanical analogies and light analogies are given to illustrate these principles.

A number of early experiments in tuning are then given, and the development is outlined leading to the various systems in use at present. Various arrangements for multiplex signaling are also discussed. In conclusion the author states that the problem of wireless telegraphy has now passed through the hands of the prophet, the mathematician, the physicist and the practical experimenter, and that it is now in the hands of the engineer and the financier.

Taken as a whole, the book affords a thoroughly clear exposition of ordinary electrical phenomena and of the principles involved in wireless telegraphy. In addition to this the book gives the development of the art of wireless telegraphy from the early laboratory experiments to the commercial stage it has reached at the present time. Being free from mathematics, the book affords comparatively easy and exceedingly interesting reading, which will prove of value not only to those desiring a knowledge of wireless telegraphy, but also to everyone desiring to get a clearer understanding of the ordinary electrical phenomena met in every-day practice.

BOOKS RECEIVED.

Die Fernleitung von Wechselstromen. By Dr. G. Roessler. Berlin: Julius Springer. 243 pages, 60 illustrations. Price, 9 marks.

Hypochlorite und Elektrische Bleiche. By Dr. Emil Abel. Halle: Wilhelm Knapp. 110 pages, 10 illustrations. Price, 4.50 marks.

Das Funken von Kommutatormotoren. By F. Punga. Hannover: Gebruder Janecke. 142 pages, 69 illustrations. Price, 4.60 marks.

Das Elektrische Bigenlicht. Second Edition. By Walther Biegon von Czudnochowski. Leipzig: S. Hirzel. 194 pages, 36 illustrations. Price, 4 marks.

Das Elektrische Bigenlicht. Third Edition. By Walther Biegon von Czudnochowski. Leipzig: S. Hirzel. 95 pages, 36 illustrations. Price, 4 marks.

Gross-Gasmaschinen By Dr. A. Riedler Berlin: R Oldenberg. 192 pages, 130 illustrations. Price, 10 marks.

Le Four Electrique. By Adolphe Minet. Paris: A. Hermann. 76 pages, illustrated. Price, 5 francs.

Instrumente zur Messung der Temperatur für Technische Zwecke. By Otto Bechstein. Hannover: Gebruder Janecke. 64 pages, 61 illustrations. Price, 1 mark.

Die Formelzeichen. By Olof Linders. Leipzig: Jah & Schunke. 06 pages, illustrated. Price, 5 marks.

Elektrische Kraftubertragung. By Wilhelm Philippi. Leipzig: S. Hirzel. 386 pages, 326 illustrations. Price, 18 marks.

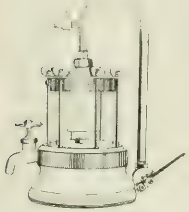
Die Elektrischen Druckknopfsteuerungen für Aufzuge. By A. Genzmer. Hannover: Gebruder Janecke. 166 pages, 180 illustrations. Price, 6 marks.

Les Enroulements Modernes. By A. Meynier and H. Nobiron. Paris: Ch. Beranger. 53 pages, 41 illustrations.

The Telegraphist's Guide. By James Bell and S. Wilson. London: S. Rentell & Co. 227 pages, 197 illustrations. Price, 50 cents.

Electric Water Purifier.

An ingenious device in which electricity is used to assist in purifying water is illustrated in the accompanying cut. The predominating characteristic of the apparatus is its extreme simplicity, as will be appreciated from the description below. The device, which is attached to the ordinary service pipe, allows the water to pass slowly through it after all matter held in suspension has been precipitated and the bacteria have been killed and removed. The water enters first a central aluminum cup from which it can escape through numerous small holes, only after it has passed through a filter cloth made of heavy felt. Surrounding this cup is a second outer aluminum cup through the perforations in which the water flows after it has passed through a second felt filter. Between the two aluminum cups is maintained an e.m.f. sufficient, it is said, to render innocuous all germ life and to remove all metallic salts, oxides, nitrates, saline solids and other matter which may be in solution. It is stated that the water which is drawn from the receptacle is perfectly sterilized and free from all deleterious matter injurious to health.



ELECTRIC WATER PURIFIER.

The containing vessel for the aluminum cups consists of a glass cylinder with hard-rubber end pieces, the contact surface between the hard rubber and the glass being formed by a substantial sheet of rubber packing. Short rods of metal, which pass through the upper end piece, serve for connecting the aluminum cups to binding posts. The switch for controlling the electric current passing through the cups is mechanically operated by the handle of the valve for admitting water to the purifier. The switch is closed only when the water is flowing through the purifier. By means of an adjustable stop on the regulating valve, the rate of flow of water can be set to any desired amount, so that when the valve is in its "on" position the electric current is turned on and the proper amount of water passes through the purifier.

Contrary to the usual belief, it has been ascertained that the e.m.f. necessary to remove the germs is quite small—in fact, less than ten volts is sufficient. The source of e.m.f. can be the usual electric light circuit, in which case the apparatus is connected in series with a single lamp; or a battery composed of six dry cells can be used for this purpose. It has been found that six commercial dry cells, which can be bought at an insignificant price, will supply sufficient electrical energy to purify all of the drinking water that is required by an average family for six months. The device is handsomely made of glass, hard rubber and nickel-plated metal.

Numerous purifiers have been in successful use for some months past. The apparatus is now being placed upon the market by the Electric Water Purifier Company, 52 Broadway, New York.

Portable Wireless Telegraph Sets.

Among the numerous applications for wireless telegraphy, not the least important is the coast defense service. For this work there have been developed special portable wireless instruments, a description of which we are able to give below. The whole equipment, with batteries and instruments, weighs less than 250 pounds, and it is so sub-divided that it can be handled easily by two men. The apparatus can be completely installed in less than thirty minutes, and can be dismantled in fifteen minutes.

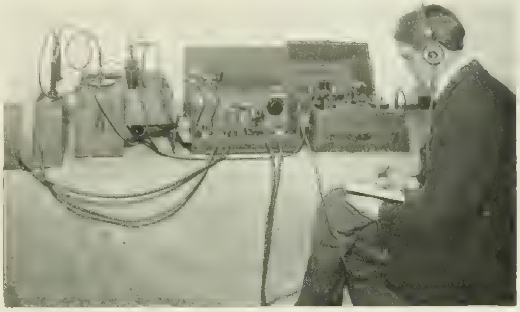


FIG. I.—INSTRUMENTS IN USE AT FORT HANCOCK STATION, SANDY HOOK.

The portable set consists of four units, each of which is provided with shoulder straps, besides the battery, vertical wire and antenna. These units, which may be designated as the transformer unit, the transmitting unit, the condenser unit, and the receiving unit, are shown with their cases in Fig. 1.

The initial source of energy is a storage battery, which consists of 12 cells arranged in three cases of four each. The power used is approximately 4 amps. at 20 volts. The batteries will stand a charging rate of 8 amperes for 10 hours. In the receiving circuit there are used dry batteries having a normal working pressure of from 1.2 to 1.5 volts.

The wave detector is of the filing-coherer type, the filings being arranged magnetically. The coherer gap is sub-divided so as to make a multiple surface of the electrodes at the gap. By means of an adjustable resistance arranged on each side of the coherer circuit it is possible to vary the sensitiveness of the coherer circuit at the filing gap. In connection with the coherer is used a relay. The circuits are so arranged that when the electric waves act upon the coherer, it closes the circuit to the relay, which operates an "attention bell," and simultaneously energizes an electromagnet, which serves to restore the filings in the coherer to their initial condition.

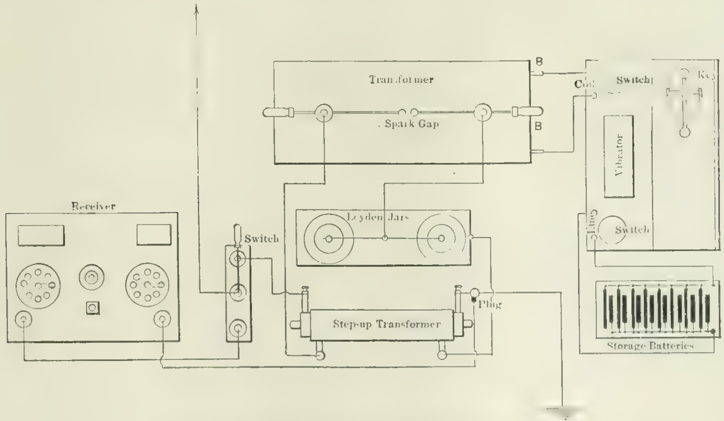


FIG. 2. DIAGRAM OF CONNECTING CIRCUITS.

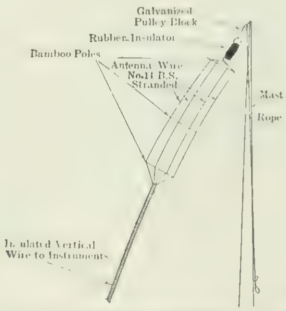

Galvanized Pulley Block
Rubber Insulator
Bamboo Poles
Antenna Wire No.14 B.S. Stranded
Mast
Rope
Insulated Vertical Wire to Instruments

FIG. 3. ANTENNA AND VERTICAL WIRE.

For the continuous reception of signals in actual service, there is mounted at the front of the receiving case a simple multiple steel, carbon and mercury microphone receiver, which is connected through a spring jack and plug to a pair of head telephones.

A single-pole, double-throw switch shown in the diagram of circuits, Fig. 2, serves for connecting the antenna to either the transmitting or receiving apparatus. For the antenna there is provided about 500 feet of No. 14 bare stranded wire, specially tinned. The method of connecting the antenna and the vertical wires is indicated in Fig. 3. The circuit to ground is made through a wire cloth or netting, which can be spread out on the ground or dropped into the water, as conditions may require.

The tests of these equipments in actual service have proved so satisfactory that the signal corps of the U. S. Army has ordered twelve complete sets, which are now being installed for the Artillery Coast Defence by the Clark Electrical Engineering Company, of Detroit, Mich.

New Independent Telephone System for Meridian, Miss.

One of the strongest organizations to take up the work of developing the independent telephone field in the South, is the New Home Telephone Company, of Meridian, Miss., and the interests represented by Messrs. Jones & Winter, contractors, of Chicago.

From Meridian, where the first plant will be installed, it is proposed to extend the system throughout the State and adjoining territory, building plants in all of the principal cities now undeveloped by independent operating companies.

The Meridian plant will consist of a 4,800 line capacity, full central-energy system, equipped for the immediate operation of 1,200 lines. The construction will be a full cable system with underground conduits, and poles conveniently located for distribution.

The entire apparatus and equipment is being furnished by the International Telephone Mfg. Co., of Chicago. The central office equipment will be of their latest design, a full multiple lamp line signal board with double supervisory clearing-out signals and their new four party line apparatus with indicating selective keys in each cord circuit. There will be a full cable system of line construction.

Concentric Diffuser for Incandescent Lamps.

The incandescent concentric diffuser recently designed by the General Electric Company and illustrated herewith will prove of great interest to those who have in the past been bothered by the problem of securing adequate illumination under mezzanine floors, in basements and similar places, where low studding eliminates the arc lamp and large area the separate incandescent lamp. Grouping incandescent or Meridian lamps necessitates, for the best results, a reflector with the widest possible range of lower hemispherical distribution. This the new incandescent concentric diffuser, with its corrugations of progressively increasing amplitude, appears to furnish. The diffuser is 26-in. in diameter, and is made of steel, coated with high-grade Austrian air-dried enamel, which, does not turn yellow, but becomes whiter with age. The black deposit which usually accumulates on the ceiling above the lamps is received by the diffuser, from which it can be readily washed off, so that the diffuser protects the ceiling, in addition to giving an excellent distribution of light.

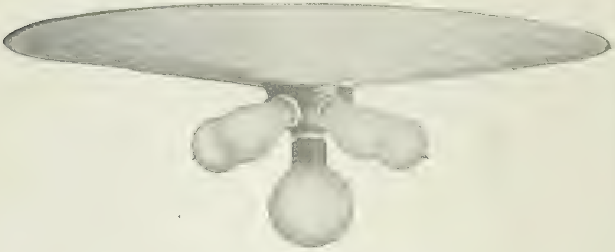


FIG. 1.—CONCENTRIC DIFFUSER.

The diffuser can be installed near the ceiling or on any extension and any standard make of cluster with 4-in. base can be used. The best effects have been obtained with one 25 or 50-cp Meridian lamp in the lower socket, and 3, 4 or 5 standard frosted 8, 16 or 32-cp. incandescent lamps, set radially, as shown in the accompanying illustrations.

From the chart it will be seen that the lower hemispherical candle power has been increased about 40 per cent, and that the general distribution of downward light has been greatly improved.

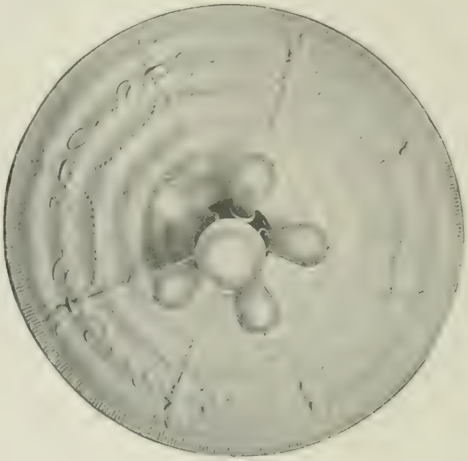


FIG. 2.—CONCENTRIC DIFFUSER.

The radial lines shown in the chart correspond to angles of 10 degrees in elevation, being marked in degrees of arc above and below the horizontal. The distance along these lines from the center to a point on the curve represents the intensity of candle-power in that direction. For instance, referring to the solid line curves, we find that at 60 degrees below the horizontal the cluster alone gives 85 candle power. When the diffuser is used this is increased to 136 candle power, showing a gain of 60 per cent in this particular direction. While it is not advantageous to have all the light concentrated directly beneath the lamp, it is obvious that the most useful light is that thrown below the horizontal and that the light thrown above the horizontal cannot be utilized except as it is reflected downward from the ceiling.

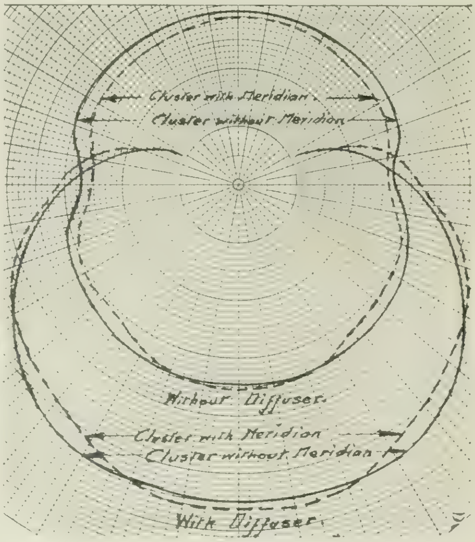


FIG. 3.—ILLUMINATION CURVE.

Recent Developments in Induction Motors.

The Westinghouse type HX motor is designed for constant speed service and belongs to that class of induction motors without contacts or any connection whatever between the supply circuit and the rotating element. The starting mechanism, which is mounted on the shaft external to the frame, consists of a device by means of which resistance is inserted in the winding of the revolving part when starting and gradually cut out as the speed increases until the winding is short-circuited. Thus, by a gradual development the starting current becomes practically the running current, which is a very important feature on small systems where the voltage, which should be kept constant, would be considerably affected by connecting the motor suddenly to the line.

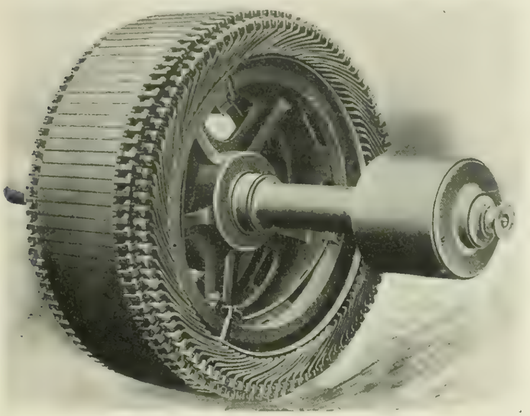


FIG. 1.—SECONDARY COMPLETE WITH STARTER.

The frame of the motor is a solid ring of cast iron with feet for supporting the machine. The core carrying the stationary windings is built up of steel punchings which exactly fit the bore of the frame, and which are firmly held together between two iron rings. Substantial brackets carrying the bearings for the rotating element are bolted to the cast-iron frame, and may be fastened in four positions, permitting the motor to be mounted on the floor, sidewall or ceiling, and the oil reservoirs always to be in the proper position. By means of oil rings revolving in the reservoirs, copious lubrication is provided for the motor while in operation.

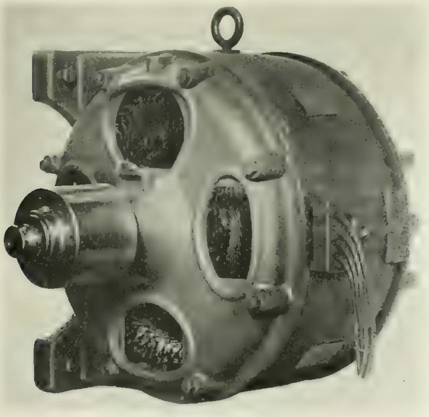


FIG. 2.—INDUCTION MOTOR FOR USE ON WALL.

To secure the starting characteristics above mentioned the secondary windings are similar to those of a polyphase generator. Insulated copper bars are inserted in the partially closed slots in the steel punchings of the rotor. These punchings are mounted on a cast-iron spider which is keyed to the shaft. The overhanging tips of the teeth hold the bars in the slots. The end connectors are secured to the bars after they are in place and the leads are brought out through the hollow shaft to contacts in the starting device. This device, which consists of a resistance which is cut in and out of the circuit by a sliding contact, is so arranged that as the motor accelerates the resistance may be gradually cut out by pushing in the cylinder, until for normal running the winding is short-circuited. In this movement the resistance is cut out by what amounts to an infinite number of steps. The starting device may be operated by a lever rigged in a manner similar to an ordinary belt-shifting device.

The case of the starter, which is a cast iron cylinder of enclosed construction, being dust proof, and the starter being sparkless in operation, the motor may be used with impunity in the presence of inflammable vapor or dust-laden air.

These motors are built for two and three-phase circuits in sizes from 5 to 50 hp, for 3,000 and 7,200 alternations. Standard voltages are 100, 200 and 400 for machines up to 20 hp, and 200 and 400 volts from 20 to 50 hp. The motors retain a high efficiency even on light loads; therefore, their all-day efficiency is very high, because in general service motors may operate on light loads much of the time. The drop in speed between no load and full load has been found by

A new type of polyphase induction motor, shown in Fig. 3, has recently been placed on the market by the Westinghouse Electric & Mfg. Company, which is designated as type CCL. These motors are manufactured in sizes from ½ to 75 horse-power, and are wound for operation on two or three-phase circuits at voltages of 200 and 400 for all sizes except the ½ horse-power. The sizes from ½ to 5 horse-power inclusive are also wound for 100 volts.

The frame of the motor consists of a solid, cylindrical cast-iron yoke to the ends of which are bolted brackets, which carry the bearings. These brackets are open so as to provide good ventilation, and may be fastened to the frame in any of four different positions, making the motor sutable for floor, wall or ceiling mounting. Motors up to and including the 5-horse-power have solid brackets and bearings, with slotted holes in the feet for adjusting the tension of the belt. Larger machines have the brackets and the bearings split horizontally, greatly facilitating the removal of the bearings should this become necessary. Belt adjustment on these motors is made by tension screws which shift the motor on a cast iron bedplate.

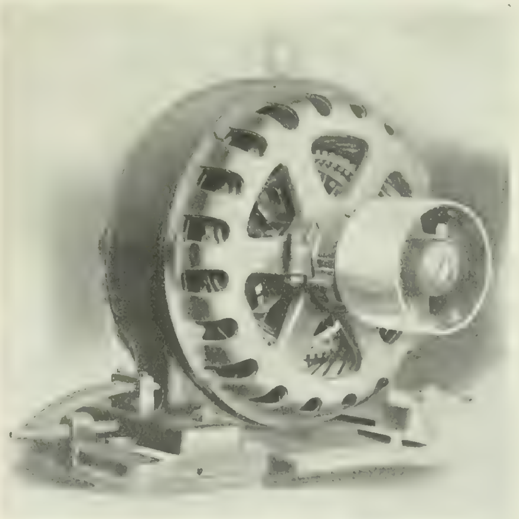


FIG. 3.—POLYPHASE INDUCTION MOTOR.

There are no wearing parts on the machine except the bearings, and as these are of ample dimensions, with a light rotor and flooded lubrication maintained at all times by means of oil rings, the wear is exceedingly slight.

The stationary part of the motor is the primary element which is connected to the source of current. The magnetic circuit consists of circular laminations of sheet steel, securely keyed into the cast-iron frame. Terminal leads are brought out at the base of the frame, being held in a cast-iron cleat. Hand connectors, or knuckle joints, such as are supplied with railway motors, are used to connect the motor to the supply circuit.

The secondaries of these motors are of the squirrel-cage type, a construction which is extremely simple, rigid and durable, and which has given universal satisfaction. The winding consists of square copper bars lying in partially closed slots and bolted at the ends to metallic rings of ample surface to dissipate the heat generated in them. For the ½ hp motor are used round bars which are riveted to brass or copper rings at each end.

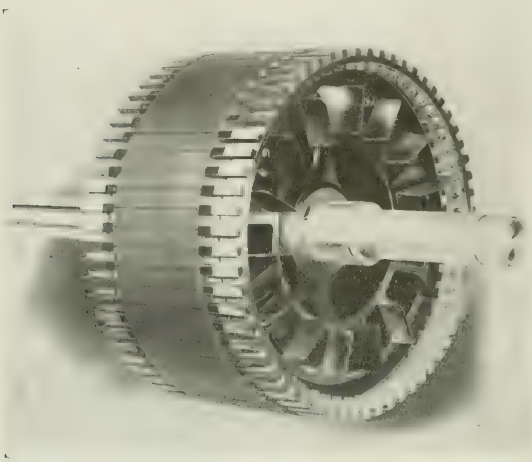


FIG. 4.—SQUIRREL-CAGE SECONDARY.

The design and principles governing the construction of these motors are particularly favorable to maintaining good efficiencies at low loads, which insure a high all-day efficiency, as in general service motors may operate at light loads much of the time. The motors, following the precedent established by type C Westinghouse induction motors, are provided with liberal bearings and shafts, and adjustment of the bearings is unnecessary.

◆

Types of De Laval Turbine Units.

Some four hundred De Laval turbine generators are now in service, ranging through a wide variety of sizes and styles. Subjoined will be found data in regard to the leading types made by the De Laval Steam Turbine Company, of Trenton, N. J., to whom we are indebted for this interesting data.

The direct-current turbine generators range in sizes from 4.6 to 200 kilowatts, and the alternating-current turbine sets from 10 to 200 kilowatts. The direct generators of 50-kw capacity and over are of the two-armature type. Fig. 1 illustrates a 200-kw, direct-current unit. As will be seen, the frame encircles both armatures. This type of generator presents a very flexible arrangement as regards the electrical end, as the generators can be connected either in series or parallel, can be run on two or three wire system; or the turbine dynamo can be run in parallel with other engines and generators of either 125 or 250 volts. The turbine generators of 35 kilowatt capacity and under are of single armature type, Fig. 2 illustrating a 20-kw, direct-current unit. The peripheral speed of the commutator of the 200-kw generator does not exceed 2600 ft. per minute, and of the 20-kw generator 3500 ft. per minute, which is not excessive, thus insuring sparkless running from no load to 25 per cent overload, without shifting the brushes.

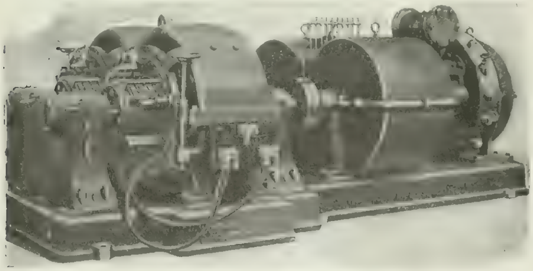


FIG. 1.—200-KW, DIRECT-CURRENT UNIT.

Fig. 3 illustrates 200-kw, revolving field, 2300-volt, 3-phase, turbo-alternator set, with direct-connected exciters. This unit consists of two entirely separate generators of 1150 volts each, armature and fields separately in series, using one field rheostat for both machines, as the two machines are rigidly connected through the turbine gears and pinion. They are very carefully set in phase at the shops, and are, therefore, always in step. The armatures can be connected in series, or parallel, depending upon the line voltage required, and the fields can be connected according to the voltage of the exciting current. The exciters can be direct connected to the alternator shafts, as shown, or belt driven; or a separate turbine exciting set may be used.

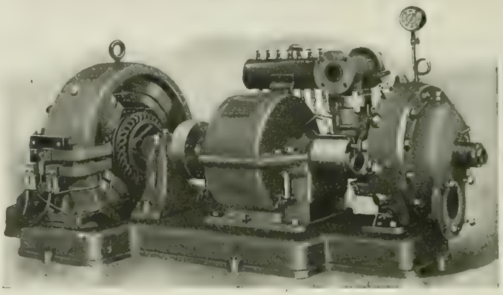


FIG. 2.—20-KW, DIRECT-CURRENT UNIT.

Turbine alternators of 35 kilowatt capacity and under are of the single type; that is, the turbines are single-geared, and only one generator is employed. As is well known, a turbine driven alternator is an ideal unit for parallel operation, and the type of steam nozzle used in the De Laval turbine presents a very convenient method of synchronizing, as the speed of the incoming machine can be regulated entirely with the nozzles, as also the load after the machines are in step, not depending upon the throttle valve at all.

In the factory where these machines are built, there are several tracks leading from the erecting shop into the testing room, for the different machines, each track having its own switchboard, which is arranged for testing direct-current generators and motors, and single, two or three-phase alternators. Each switchboard is connected, through lead-covered cables laid in ducts, to a main cable board, which in turn is connected to the water rheostats and to the shop generator. At the cable board any track switchboard can be connected either to the shop generator, or to any of the water rheostats. The water rheostats are placed outside the testing room, and consist of iron tanks and plates which can be raised and lowered at a point near the machine being tested.

Every generator and motor is given a heat run, which consists of running the machine at full load until the temperature has risen to a steady point, temperatures being taken by thermometer and by resistance. The machine is then run at 25 per cent overload and temperatures taken. During these runs the brushes are set in their proper position and marked, and any defects are corrected. The compounding is gone over very carefully, insulation resistance is tested, all measurements are taken for efficiency tests, and any special test desired can be made.

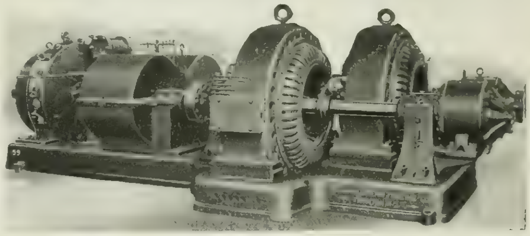


FIG. 3.—200-KW TURBO-ALTERNATOR SET.

The centrifugal pumps manufactured by the De Laval Steam Turbine Company are either turbine or electric motor-driven, using direct or polyphase motors. In case the pump is required to give a variable quantity of water without throttling, a special regulator is installed in connection with the motor. Fig. 4 illustrates a De Laval 75-hp alternating-current, electric-motor centrifugal pump.

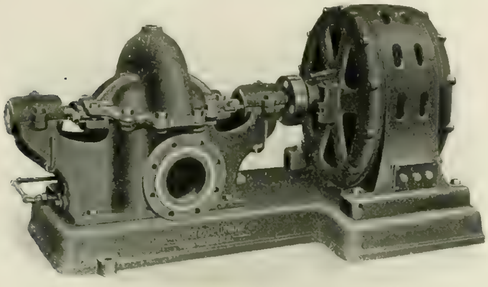


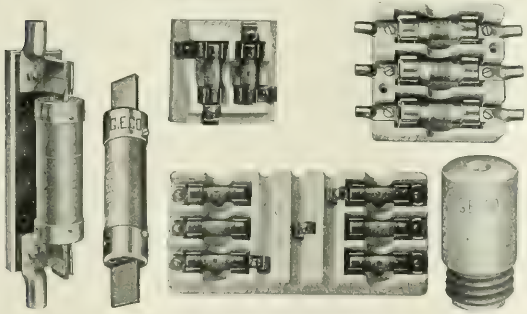
FIG. 4.—CENTRIFUGAL PUMP DRIVEN BY 75-HP ALTERNATING-CURRENT MOTOR.

◆

National Electrical Code Standard Enclosed Fuses and Cut-Outs.

The General Electric Company is now furnishing a complete line of National Electrical Code Standard enclosed fuses and cut-outs, ranging from 3 to 600 amp. for 250 and 600 volts. The cut-outs and fuses are uniformly compact and durable, and the insertion or removal of the fuses is easy and safe. For fuses rated from 3 to 30 amp., 250 volts, cut-outs similar to the Edison plug cut-outs are furnished, and for fuses from 31 to 60 amp., 250 volts, two and three-wire main line and single branch cut-outs are supplied. All other sizes of fuses are provided with single-pole cut-outs. With all cut-outs are used the General Electric wrought-copper cable terminals with the exception of the 30 amp., 250-volt sizes. These are provided with washer and screw terminals.

The fuses are of the well-known enclosed fuse type, ferrule or knife-blade contacts being used, according to the requirements of the code. The knife-blade type, in addition to the standard parts, has a brace placed in each end of the tube to engage the screws which hold the end caps in place. The brace is rigidly attached to the contact blades. This forms a strong mechanical joint which does not depend solely upon the shearing strength of the fibre tube. The knife-blade contacts are of punched copper, and when used with the standard switch clips provide the best form of contact. The parts being copper of high conductivity, generously proportioned, the heating is reduced to a minimum. In the ferrule type the contacts are made of phosphor-bronze clips designed to give the utmost contact and elasticity in the smallest possible space.



FUSES AND CUT-OUTS.

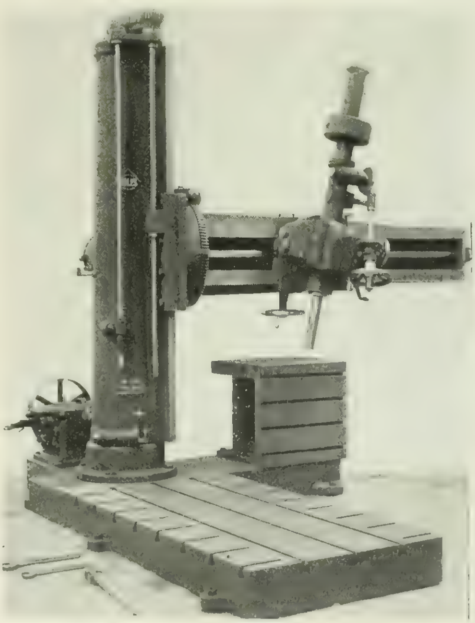
The renewable fuse plug consists of a brass tube with the lower end threaded to fit the standard screw shell, and the upper part insulated by a porcelain shell. There is also in the upper end a spring clip which receives the ferrule contact of the reload, the ferrule on the other end forming the center contact of the plug. The reloads are the 30 and 60-amp., 250-volt enclosed fuses.

◆

New Drilling Machine.

The 6-in. universal radial drilling machine shown in the accompanying illustration is built to use high-speed drills to their fullest capacity. The drill-head saddle fits between as well as outside of the arm guides, which completes the double box section of the arm and insures great rigidity. The column saddle is strongly gibbed to flat-scraped bearings on the column, and the post, about which the column revolves, extends to the extreme top of the sleeve. The use of large shafts, steel gears, bronze bushings and ring oiling bronze bearings for all fast running shafts makes the machine capable of standing the hardest service. The principal feature of this machine, however, is its convenience and ease of manipulation. All the feeds and speeds are changed by means of levers, and great care has been taken to arrange the levers and hand wheels so that they shall be within easy reach of the operator. The column rests on ball bearings. An idea of the simple compact design of the machine can be gained from the photograph.

The machine is adapted for use with either carbon or high-speed drills, the range of spindle speeds being sufficient for this purpose. Friction clutches are used for starting and stopping the machine at high speeds, so as to prevent shock and consequent wear. The speed box is planed on the top, in order that the drill may be easily changed from a belt-driven machine to a motor-driven machine, by the simple substitution of two gears for the pulley. Reversing gears for tapping are provided. All speeds and feeds may be changed while the machine is running at its highest speeds.



UNIVERSAL RADIAL DRILLING MACHINE.

This radial drill is a full universal machine; that is, both the arm and the saddle swivel. This fact should be borne in mind in considering the design. Dimensions of machine are as follows: Drills to center of 2 in.; maximum distance from face of column to center of drill, 77.5 in.; least distance from face of column to center of drill, 22.5 in.; greatest distance from spindle to base plate, 72 in.; traverse of spindle, 20 in. This machine is manufactured by the Niles-Bement-Pond Company, 111 Broadway, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The hot weather tended to retard productive activity, but accelerated the consumption of seasonable merchandise, and had a beneficial effect upon the crops, which are now in a satisfactory condition. Inquiries indicate a general disposition to provide for a large volume of fall and winter business, clothing manufacturers receiving liberal orders from traveling salesmen, while cancellations are exceptionally few. Real estate transfers are large and building operations numerous, often overtaxing facilities for delivery of lumber and other materials. There is comparatively little interruption from labor disputes, and the net result in all commercial and manufacturing branches is exceptionally satisfactory for this midsummer period, which is usually the dullest of the year. Evidences of revival are discerned in those departments of the iron and steel industry that have lain dormant for some time, notably the pig iron division, which has been compelled to cut down production because of rapidly accumulating stocks at furnaces. A better feeling exists in bars and sheets, and stocks of wire goods are reported smaller than some time ago. The bituminous coal trade reports some depression in the Western fields, and summer shutdowns are expected in the anthracite region. Manufacturers of cotton goods find difficulty in filling orders for immediate delivery, but future business is most unsatisfactory. Money has been remarkably easy for this season of the year, considering the nearness of crop moving requirements. Railway earnings are favorable, those for the first half of July showing 7 per cent gain on 1904. The number of business failures for the week ending July 20, as reported by *Bradstreet's*, was 165, against 166 the week previous, and 190 in the corresponding week last year. The copper market continues active, with a good business for both home trade and export. There was a slight advance in prices, Lake closing at 15 to 15⅛c; electrolytic, 14⅞ to 15c.; cathodes, 15⅝ to 15¾c., and casting stock, 14½ to 14⅝.

THE COPPER MARKET.—The "Copper Gossip," of the National Conduit & Cable Company, under date of July 21, says: "There has been an exceedingly active market in copper lately, with demand from domestic sources specially pronounced. Europe also continues to take a lively interest in the trend of affairs here, but as far as recent buying is concerned this country occupies the first rank. Orders have poured in from home consumers in rapid succession, and the enormous size of the aggregate demand since the 10th inst. is clearly indicative of an excellent state of trade now under way. Large sales have been effected at 15 to 15¼ cents for both Lake and electrolytic, and it is significant to note that purchases of liberal quantities were made for deliveries up to the end of the year. Prompt delivery is quoted at 15¼ and business reported thereat. The general tendency of events in connection with copper and the underlying tone all point with emphasis to the remarkable strength of the situation. Notwithstanding the heavy tonnage disposed of during the past ten or fifteen days prices have not been sharply advanced. Indeed, there does not appear to be any disposition to raise prices to an unreasonable level, or put quotations at what might be considered abnormal heights. The important developments taking place in copper may possibly stimulate the market later, as it cannot be expected that a commodity in such urgent request as copper is will continue to remain at a stationary value for an indefinite period. A wonderful outlet for raw copper exists, and in spite of the large current production there is little chance left for the metal to accumulate in dangerous quantities. Europe and America are putting in their claims for monster supplies which are absolutely necessary for legitimate trade needs, and production is being closely pressed by consumption. The conviction is growing that the market is in for an extended period of firmness, and no one can carefully study the situation without being impressed with the surprisingly strong position of copper at the different strategical points. As matters look now it would appear to be the part of a wise conservatism to prepare for a hardening tendency before long, as an advance seems the natural thing if demand should take on any further pronounced increase. Sentiment is of the sanguine order regarding the outlook, and if there is no contraction in exports higher prices may be reckoned among the probabilities."

THE SHIP TRUST BUILDING.—About nine out of ten of the Americans abroad will wend their way, sooner or later, to the new Cockspur Building, just opened in London, which contains the offices of all the lines combined in the International Mercantile Marine Company, better known as the "Ship Trust." Heretofore the steamship offices in London were scattered broadcast. Now they are concentrated in the Cockspur Building, located in a place easy of access, a block or two from Trafalgar Square. Any one can find Trafalgar Square, and, therefore, any one can find the place where he must go to fix up his steamship tickets and arrange other details of his trip abroad. This new Mecca for the American tourist in London is American all the way through. It was put up by American builders with American materials, and is classed among the best examples of the modern types of architecture springing up in the midst of old London. The speed with which the building was run up was the marvel of the day, and its completion a few weeks ago was made the occasion for a good many hard "knocks" about the deliberate methods of British builders. The building is a steel-frame structure, the hollow-tile fireproofing material for which was imported from Perth Amboy, N. J. As one of the first fireproof buildings erected in London on an American model it is attracting a good deal of attention, and partly as a result of this and partly because American fireproofing has lately passed severe tests at the hands of the British Fire Prevention Committee, American steel-frame, fireproof construction is sharing largely in the building boom now in progress in London. The work on the building is due chiefly to the new company in which Mr. J. G. White is interested, and which is building also the new Hotel Ritz in London.

EEL RIVER PLANT.—The Eel River Power & Irrigation Company has closed contracts for the equipment of its electric power transmission plant, which is to be constructed in the Potter Valley, about 20 miles northeast of Ukiah, Cal. The Westinghouse Electric & Manufacturing Company secured the order for two 2,000-kw, 3-phase, 60-cycle generators and the transformers necessary for the 50,000-volt transmission line. Girard water wheels have been ordered and will utilize a head of 440 feet of water. A dam, 90 feet high, in the Eel River, will add about 60 feet to the working head. Additional dams will be constructed in time to provide for storage. The poles are being set for the main transmission line to Ukiah, where the company has secured a contract for city lighting. A line will be run to Willits. Electric light and power will be furnished for a number of towns and several projected electric railways. Transmission to San Francisco Bay points is among the possibilities. The power plant site is on the bank of the Potter Valley branch of Eel River. The discharge water will be conducted from the wheels by a ditch one mile in length and a tunnel into the Russian River. It is said that it is feasible to store fifty billions of gallons of water for power purposes by the erection of a dam at one of the proposed storage locations.

TELPHERAGE IN GAS WORKS.—The United Telpherage Department of the Dodge Coal Storage Company, Philadelphia, calls attention to the utility of the telpherage system in gas manufacture. In one telpherage installation at the works of the Worcester Gas Light Company, Worcester, Mass., the electric telpher picks up a load of coke upon its discharge from the ovens, conveys it, quenched, some 700 feet to a crushing and screening plant, and discharges it into the hopper of the crusher, from which it is delivered to screens of different sizes of mesh. These screens automatically sort and distribute the coke to the various bins, and at the same time separate the breeze. From the bins the coke is drawn directly into wagons for delivery to purchasers.

APPARATUS WANTED.—The Standard Electric Light, Heat & Power Company, of Avoca, Pa., is in the market for a direct-connected, two-phase unit, 60 cycles, 2,200 volts, 200-kw and a corresponding four-valve type of engine. It is also in need of a belted machine and engine, same size, frequency and voltage; also belting, steam piping, separator, switchboard, etc. Mr. Frank Howard is superintendent and Mr. J. B. Russell, treasurer.

NEW HART & HEGEMAN FACTORY.—The Hart & Hegeman Manufacturing Company, which makes electric switches, has commenced work on its new factory at the northwest corner of Capitol Avenue and Broad Street, Hartford, Conn. The building will be 60x190, three stories high, and be built of red-faced brick, fireproof, with concrete, and have steel concrete floors.

THE RYAN CONSTRUCTION COMPANY, of Indianapolis, Ind., has just completed for George S. Cook, of Hope, Ind., a direct current, 220 volts, electric light plant, of 75 kilowatts capacity, for furnishing current for street lighting and commercial purposes.

THE WESTERN WHEELED SCRAPER COMPANY, Aurora, Ill., has completed a large addition in which it has installed a 15-ton, 3-motor, electric traveling crane made by the Northern Engineering Works, of Detroit.

ELECTRIC STORAGE BATTERY.—Advices from Philadelphia state that the Electric Storage Battery Company has recently received important orders both from home and foreign fields and its volume of business at the present time is greater than ever before. Large contracts have been obtained from the New York Edison Company, Kansas City Light & Power, Chicago Edison, one of the Chicago elevated railroads and from Mexico and South American countries. Quite a large installation will be sent to Saó Paulo, Brazil, to be used in connection with a water power plant. In consequence of this great activity in both local and foreign trade the volume of business exceeds all previous records and for the first six months of the present year was actually larger than for the entire year 1904. Not only was this the fact, but the six months' business was greater than that of any full year, with one exception, in the company's history. With the large contracts recently entered into and the orders already on the books continued activity during the remainder of the year is assured and 1905 will far surpass what had heretofore been the banner year in the amount of work performed and of profit arising therefrom. Contracts for supply of batteries to Canada and other British colonies, as well as to Mexico and South America, are filled at the company's plant at Manchester, England, where wages are lower than in this country, and where advantage can be taken of the lower tariffs on goods shipped to those countries from England than on imports from the United States.

SUBMARINE BOATS.—John P. Holland, inventor of submarine torpedo boats, has filed in the Court of Chancery at Newark, N. J., his formal answer to the suit brought against him by the Electric Boat Company, with which he was associated for the five years from 1899 to 1904. The answer is filed by Vreeland, King, Wilson & Lindabury, and contains besides the answer of the defendant inventor his cross bill to the complainant's allegations, in which he prays that all patents assigned by him to the Electric Boat Company be declared to be improperly held, and that the court order that corporation to reassign the same to him because of its failure to fulfill the specifications and terms of the contract under which they were assigned. He also asks that the complainant company be directed to reassign for the same reason all foreign patents granted to him and by him assigned to the company. The answer and cross bill contain allegations as to the causes leading to the want of success on the part of the company organized to exploit Holland's submarine boats. They assert that after securing the assignments from Holland of fifteen patents covering inventions for controlling the operation of the submarine boat and its armament, he was forced to the background and his advice and experience as a practical submarine engineer were ignored, and the management and construction of the vessels were placed in charge of engineers who, he avers, had no knowledge whatever of submarine construction or requirements.

SUBMARINE SIGNALS.—The Submarine Signal Company, of Boston, has received an order from the lighthouse board of Great Britain for the installation of its system on the North Goodwin Shoals lightship and the government lighthouse tender. The company is also in negotiation with the engineer and commissioner of Irish lights at Dublin for a complete outfit there. The company has also received its first order for apparatus from the French Government, the order being placed by the chief engineer of navigation at Cherbourg. The company has just completed an electric shore station at Point Allerton, with a cable running 2½ miles out to mid-channel at the main entrance to Boston harbor, and put in a submerged bell on a tripod 60 feet below the surface at low tide. The *Kronprinz Wilhelm* is to be equipped with signaling apparatus.

ELECTRICAL SAFEGUARDS FOR BATTLESHIPS.—Contracts have been let to the Long Arm System Company, of Cleveland, O., for installing its electrically operated bulkhead doors and hatch gears on the battleships *Montana* and *South Carolina*. The two vessels are now in course of construction by the Newport News Shipbuilding & Dry Dock Company. The Navy Department specifications for these warships provided that "each (power) door must be capable of permitting operation on the spot by power or by hand from either side, and all such doors are to be capable of being closed by power simultaneously from an emergency station." These conditions were met by the Long Arm System.

Financial Intelligence.

THE WEEK IN WALL STREET.—Seasonable dullness prevailed in the stock market, but there was a strong tone despite the professional character of trading, the leading factors of the week, such as the placing of Union Pacific and Amalgamated Copper stocks on a 5 per cent dividend basis, producing a favorable effect upon sentiment. United States Steel stocks were inclined to respond to favorable steel trade news. The United States Rubber shares were prominent on stories of speedy dividends on the common. Quietness prevailed in electric and traction securities, the fluctuations being within narrow limits. Allis-Chalmers common closed at 16, and preferred at 58, the former being a net gain of ¼ point. General Electric is unchanged at 175, and Westinghouse common is down ½ point, closing at 167. Westinghouse preferred closed at 190, which is a net loss of 4 points. Brooklyn Rapid Transit closed at 69⅛, a net loss of ½ point; Metropolitan Street Railway at 126¾, a gain of ½ point, and Interborough Rapid Transit at 204. American Telephone & Telegraph closed at 138⅝, a net loss of ⅞ point, and Western Union made a net gain of ¼ point, closing at 93⅜. The curb market, while not particularly active, had several noteworthy features. The rise in Interborough and in Chicago Subway seemed to be entirely speculative. The advance in United Copper was referable to the payment of a first dividend, and talk about further activity in the copper trade. Following are the closing quotations of July 25:

NEW YORK

	July 18	July 25		July 18	July 25
Allis-Chalmers Co	16¼	15⅛	Electric Vehicle pfd.	25½	26
Allis-Chalmers Co. pfd.	56	55⅝	General Electric	174½	173⅛
American Tel. & Cable	90	90	Hudson River Tel	.	..
American Tel. & Tel.	139	139	Interborough Rap. Tran.	203¾	205
American Dist. Tel	29	29	Metropolitan St. Ry	127¼	125⅛
Brooklyn Rapid Transit	69⅛	67¾	N. Y. & N. J. Tel.	.	..
Commercial Cable	..		Marconi Tel.	..	.
Electric Boat	20	20	Western Union Tel	93	93¼
Electric Boat pfd.	60	60	Westinghouse com.	167	165½
Electric Lead Reduction	..	.	Westinghouse pfd.	.	..
Electric Vehicle	18	18			

BOSTON

	July 18	July 25		July 18	July 25
American Tel. & Tel	139	139	Western Tel. & Tel. pfd.	101	*99
Cumberland Telephone	117⅝	117	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	243	243	New England Telephone	139	*138
General Electric	..	173	Mass. Elec. Ry.	18	18
Western Tel. & Tel.	18	18	Mass. Elec. Ry. pfd.	63	62½

PHILADELPHIA

	July 18	July 25		July 18	July 25
American Railways	51	51	Phila. Traction	99⅞	99⅞
Elec. Storage Battery	81	82	Phila. Electric	8¾	8¾
Elec. Storage Battery pfd.	..	.	Phila. Rapid Trans.	27½	27¼
Elec. Co. of America	11¾	11½			

CHICAGO

	July 18	July 25		July 18	July 25
Central Union Tel.		.	National Carbon pfd.	117⅛	117½
Chicago Edison	..	158	Metropolitan Elev. com.	23⅞	23⅞
Chicago City Ry.	..	.	Union Traction	..	..
Chicago Tel. Co.	.	..	Union Traction pfd.	..	..
National Carbon	63½	63			

* Asked.

DIVIDENDS.—The Chicago Edison Company has declared the regular quarterly dividend of 2 per cent, payable August 1. The $36,000,000 syndicate which took over the Chicago City Railway Company January 1 at $200 per share, paid a dividend on July 1 of 4½ per cent. The American Light & Traction directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock and a quarterly dividend of 1 per cent on the common stock, both payable August 1. The International Steam Pump directors have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable August 1. The Twin City Rapid Transit Company directors have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable August 15. The Montreal Light, Heat & Power Company has declared a quarterly dividend of 1 per cent, payable August 15. The directors of the Butte Electric & Power Company have declared the regular quarterly dividend of $1.25 on the preferred stock, payable August 1. The Boston Elevated Railroad Company has declared a semi-annual dividend of 3 per cent, payable August 5. The Western Telephone & Telegraph Company has declared a semi-annual dividend of 2½ per cent on preferred stock, payable August 1. Directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent, payable August 1. The National Telephone Company, of Fort Wayne, has declared the regular quarterly dividend of 1 per cent. The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable August 15.

TELEPHONY IN PHILADELPHIA.—It is reported from Philadelphia that the telephone business in that city and surrounding territory is being pushed as never before, resulting in a rapid extension of the service on all sides. The Bell Telephone Company, of Philadelphia, in its own operations and those of its controlled companies outside of Philadelphia, is stated to be expending $1,700,000 on extension of its local lines. The capital was lately increased $2,000,000 by an issue of stock; half a dozen companies in the Maryland, Delaware and southern territory were recently acquired by purchase of their stock, and the number of telephones installed by the Philadelphia company and the Delaware & Atlantic will reach 100,000 in a few days. The Keystone Telephone Company, of Philadelphia, is about to spend $750,000 more on its plant, which will then represent a cash investment of about $6,000,000, and the number of telephones installed by this company, now 17,000, is being steadily increased.

ELECTRIC BOND & SHARE COMPANY.—Harvey Fisk & Sons say of the formation of the Electric Bond & Share Company, the $4,000,000 holding company for electric securities organized in the interests of General Electric: "The Electric Bond & Share Company is organized under New York laws, with power to purchase bonds, stock or other forms of securities resulting from electric developments, such as electric street railways and electric light and power plants. The corporation has issued $2,000,000 preferred and $2,000,000 common stock. It begins business with capital stock fully paid up and with a surplus estimated by its officers, after careful appraisal by a special committee appointed for the purpose, to be of the value of $440,000. All of the common stock is owned by the General Electric Company. The preferred stock has a 5 per cent cumulative preference as to dividends, is also preferred in any distribution of assets, and is further protected by a provision that no dividends shall be paid upon the common stock unless there shall remain, after such dividends, a surplus equal to at least 15 per cent of the par value of the then outstanding preferred stock. The preferred stock can never be increased to such an amount as to exceed the amount of the then outstanding common stock, and may be retired upon any dividend date, upon 90 days' notice, at 110. The corporation is forbidden to mortgage, pledge or in any way hypothecate any of its assets without the assent of three-fourths of the preferred stock, or, save by nine-tenths vote of all stock outstanding, to buy or contract to buy any securities unless the corporation at the time of making such contracts has cash in bank sufficient to pay for such securities."

OPERATIONS OF BOSTON EDISON.—The past year's operations of the Boston Edison Company include practically a year's supply to the city of Chelsea, the Edison Company securing this new field of operation through the joint purchase with Massachusetts Gas interests of the Chelsea Gas Light Company, which company not only controlled the gas but also the electric business in the city of Chelsea. It is the present intention of the Edison Company to extend its field of operations this fall and supply the city of Newton and the town of Watertown. At the present time the Newton & Watertown Gas Company supplies these two localities with both gas and electricity, but by reason of its ownership being vested with Edison Company-Massachusetts Gas interests the plant will be dismantled and the electric business will be taken over by the Edison Company and the gas business by the Boston Consolidated Gas Company. The Edison Company has already built a substation in Newton on Commonwealth Avenue, for use in supplying the Newton and Watertown fields, and is now connecting its Boston lines with the electric system of the Newton & Watertown Gas Company. It is possible that the Chelsea Gas Light Company and the Newton & Watertown Gas Light Company will be formally taken over by the Boston Consolidated Gas Company this fall. These companies when taken over will be strictly gas companies, the electric departments of both companies having been sold to the Edison Company.

MILWAUKEE ELECTRIC EARNINGS.—The Milwaukee Electric Light & Railway Company, one of the companies controlled by the North American Company, has reported earnings for June and for the six months ended June 30. The June earnings showed an increase of 5.3 per cent in gross, an increase of 7 per cent in net and an increase of 9 per cent in surplus as compared with the corresponding month in 1904. For the six months ended June 30 gross increased ¾ per cent, net increased 4.1 per cent and surplus increased 8 per cent compared with the same period in 1904. The surplus after charges for the six months, amounting to $318,506, is at the rate of about 5 per cent on the $8,135,000 of common stock, practically all of which is owned by the North American Company and is one of its most valuable assets. Dividends at the rate of 5 per cent yearly are now being paid on the common stock. A considerable amount of the company's earnings are being put back into the property.

B. R. T. BONDS.—To provide for extensions and improvements, the management of the Brooklyn Rapid Transit Company has just sold an additional $2,500,000 of its 4 per cent convertible bonds at 86, as against the present market price of 89. The total amount of these bonds outstanding now amounts to $19,500,000. The increase in earnings on the Brooklyn system is a surprise to the management. This year 200 additional cars have had considerable influence upon earnings. For the first seventeen days of July, gross earnings of the Brooklyn Rapid Transit increased $8,770 per day, or an increase of $149,000 for seventeen days, which would [illegible] a gross increase for July of between $200,000 and $250,000, a phenomenal record. For the year ended June 30, 1905, the Brooklyn Rapid Transit earned $16,000,000 gross. The stock and bonds of the system have naturally been strong on such a showing.

ELECTRIC CRANE CONSOLIDATION.—The Shaw Electric Crane Company, of Muskegon, Mich., has been merged with the Ashcroft Manufacturing Company and the Consolidated Safety Valve Company, of Bridgeport, Conn., and the Hayden & Derby Manufacturing Company, the Hancock Inspirator Company and the United States Injector Company, of Boston, Mass., all of which are controlled by Manning, Maxwell & Moore, of New York City. The new corporation was formed under the laws of New Jersey with a capital of $5,000,000. The board of directors numbers 15 members, John G. Emery, of Muskegon, being one of the directors. The Shaw Electric Crane Company will retain its corporate existence, and no change will be made in the affairs of the company due to the merger.

PHILADELPHIA KEYSTONE TELEPHONE.—A Keystone Telephone interest in Philadelphia says: "The financing of the company is complete by the recent sale of the $4,000,000 5 per cent bonds. The original intention to retire the present stock by exchange for bonds was abandoned. The sale of the bonds clears up all the indebtedness of the company, takes care of all construction not previously paid for, and leaves $600,000 cash for immediate construction. Additional bonds are issuable in the future at a rate not exceeding $600,000 per annum, for future extension. It is estimated that the present basis of earnings is equal to twice the amount of the interest on the $4,000,000 5s. It is understood that the bankers, Fish & Robinson, have until July 17th to pay for the issue, though the sale is an absolute one."

MAIL TUBE A FAILURE.—The Central Trust Company of New York has brought suit in the Supreme Court against the Tubular Dispatch Company to foreclose a mortgage of $600,000 made on July 1, 1897, as security for bonds of the same amount. The mortgage includes franchises, rights, pneumatic plant, property, etc., and two double circuits of pneumatic tubes for the carrying of mail matter. Circuit 1 of the tube system consists of a double line of tubes from the main postoffice to the sub-postoffice in the Produce Exchange Building; Circuit 2 consists of a double line of tubes from the main postoffice to Postal Station H, on Lexington Avenue. The proper way to do this thing is by electricity.

CUYAHOGA TELEPHONE COMPANY.—F. S. Dickson, president of the Cuyahoga Telephone Company, is authority for the statement that the directors of that company have considered the advisability of putting the common stock on a dividend basis the first of next year. He says that at the present rate of earnings the company will be in position to pay 4 per cent on its stock at that time without detriment to its capacity. It is not assured that the company will be able to pay the full 4 per cent, however, but that the stock will get some dividend January 1 seems to be quite certain.

OMAHA ELECTRIC BONDS.—N. W. Harris & Co. are offering $1,200,000 Omaha Electric Light & Power Company first mortgage 5 per cent bonds, due July 1, 1933, but optional, at 105 and interest on and after July 1, 1908. This company owns or controls practically the entire electric light and power business in Omaha, South Omaha and Council Bluffs, the combined population of the cities being at present more than 170,000. The company and its predecessor have paid annual dividends of 5 per cent on the preferred stock for the past fifteen years.

DETROIT UNITED RAILWAY.—The Detroit United Railway has completed the first half of its fiscal year. June earnings which have just been reported showed an increase of 11 per cent in gross earnings and 12.7 per cent in net earnings. For the half year the surplus earnings after charges amounted to $358,030, applicable to dividends. The stock outstanding amounts to $12,000,000, so that the earnings for the half year have been at the rate of approximately 6 per cent on the stock.

CONNECTICUT RAILWAY & LIGHTING.—The first and refunding mortgage 4½ per cent gold bonds of the Connecticut Railway & Lighting Company have just been declared a legal investment for savings banks in the State of Connecticut. This issue was originally brought out by Messrs. Redmond & Co. and J. & W. Seligman & Co. A recent statement of the company's gross earnings shows an increase of 11 per cent over the same period of 1904 and 64 per cent over 1903.

PHILADELPHIA TROLLEY EARNINGS.—The total gross income of the Philadelphia Rapid Transit Company for the fiscal year was about $16,400,000, an increase of $470,000 over last year. The traffic income was $16,200,000 and other income was $200,000. Gross earnings during June increased $95,000 over June of last year.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports as follows: May gross, $50,865; increase, $15,351; May, net, $21,600; increase, $5,246; five months' gross, $259,570; increase, $72,899; five months' net, $100,755; increase, $23,060.

ATLANTIC TELEPHONE.—Articles incorporating the Atlantic Telephone Company have been filed in the Kings County Clerk's office, Brooklyn, N. Y. The capital is $5,000,000.

General News of the Week

The Telephone.

MOBILE, ALA.—The Home Telephone Company has increased its capital stock to $350,000. Two hundred thousand dollars will be used in improving the system at once.

SLIPPERY ROCK, ILL.—The Slippery Rock Telephone Company has been incorporated with $5,000 capital.

TAYLORVILLE, ILL.—A meeting of the independent telephone companies of Christian County has been held, and it was decided to merge all the companies into one. The merger includes exchanges at this city, Morrisonville, Stonington and Edinburg.

LINCOLN, ILL.—The property of the Farm & City Telephone Company, extending through the six counties of De Witt, Piatt, Champaign, McLean, Logan and Macon, was sold to B. F. Wasson, of Clinton, and Samuel Martin, of Waynesville, for $44,186.60, on July 20. They transferred the property immediately to the National Telephone & Electric Company for a consideration of $100,000.

LAFAYETTE, IND.—The Central Union Telephone Company has begun the work of placing its wires underground.

ROSEDALE, IND.—The Rosedale & Fontenac Farmers' Telephone Company, of Parke and Vigo counties, has filed articles of incorporation. The capital stock is $3,000. Thos. M. Patterson, Wm. Stuthard, George Rukes and Chas. Mulvahill are the directors.

CANNELTON, IND.—The City Council has granted a franchise to the Eckert, Branchville & Cannelton Cooperative Telephone Company, a farmers' co-operative concern, with lines running through Dubois and Perry counties and seeking an outlet to the Ohio River.

ROCKVILLE, IND.—The Parke County Telephone Company is establishing a new exchange and its general offices in the Union Block. The new quarters are complete in every particular and the latest and best equipment is being installed. The Parke County Telephone Company was incorporated in 1899, with $12,000 capital stock, which has since been increased to $36,000. The company is now operating over 400 miles of wire and 200 miles of poles, which includes 125 miles of toll lines. The cost of the present improvement will be over $4,000.

ALVORD, IA.—The Cleveland Township Telephone Company has been formed, with a capital stock of $700, by Frank Donelly, John Langfeld and others.

DUBUQUE, IA.—The Iowa Telephone Company has purchased property on Locust Street for the purpose of erecting a telephone exchange. The company has begun the expenditure of $150,000 in local improvements.

BALTIMORE, MD.—The Maryland Telephone Company proposes to extend its lines. Contracts have already been placed for about $300,000 worth of improvements.

DETROIT, MICH.—At the July meeting of the Board of Directors of the Citizens' Telephone Company the quarterly dividend of 2 per cent was declared.

BAY CITY, MICH.—The Northeastern Telegraph & Telephone Company has installed an exchange in Rose City and another in Lupton, and is now covering rapidly the entire northern and northeastern portions of the State. In Alpena, Ogemaw and other counties, rural telephone extensions are being planned. The lines connect with the Michigan Telephone Company at Bay City.

BROWERVILLE, MINN.—A telephone company has been organized with a capital of $2,000 by Harry Lee, president, and Lambert Irefield, treasurer.

HALLOCK, MINN.—The Hallock Telephone Exchange has extended its line in the southern part of town and added many new telephones.

DEERWOOD, MINN.—A new telephone company, to be known as the Deerwood Bay Lake Telephone Company, has been organized by A N. Gray and David Archibald.

ORAN, MO.—The Scott County Telephone Company of Oran has filed letters of incorporation. The capital stock is $12,000. The incorporators are Frank J. Stein, Arthur V. Scheiber, N. H. Stubblefield, Jr., M. Helmacher and others.

ST. JOSEPH, MO.—The Missouri & Kansas Telephone Company, having refused to comply with the request of the Retail Merchants' Association for a rate of $50 per year, a resolution has been adopted which provides that the use of the "old" telephones shall be discontinued at the expiration of contracts now in effect.

ADAMS, NEB.—The Adams Telephone Company has been formed with a capital of $12,500 by John H. Agee and Herbert H. Herndon.

JERSEY CITY, N. J.—The annual meeting of the American Union Telegraph Company of New Jersey has been held, and the following officers elected for the ensuing year: President R. C. Clowry; vice-president, Thomas F. Clarke; secretary and treasurer, A. R. Brewer; directors, R. C. Clowry, B. Brooks, Thomas F. Clarke, J. B. Van Every and J. B. Bertholf.

JERSEY CITY, N. J.—The New York & New Jersey Telephone Company has notified the Street and Water Board that it will submit to it plans for placing all telephone wires here underground in conduits as far as is practicable.

MIDDLETOWN, N. Y.—A 25-year franchise has been granted to the Middletown Telephone Company.

WEEDSPORT, N. Y.—The Weedsport Telephone Company has been formed. Capital, $20,000. Incorporated by Charles S. Gaywood, N. E. Durston.

ALBANY, N. Y.—The Westport, Essex & Lewis Telephone Company has been organized. Capital, $3,000. The incorporators are Frank E. Smith and Melvin E. Lott.

NAPLES, N. Y.—The Ontario & Steuben Telephone Company, of Naples, Ontario County, has been incorporated; capital, $400,000. Directors: J. E. Lyon, W. H. Housel and F. W. James, Naples.

ALBANY, N. Y.—The Commonwealth Telephone Company, of Brooklyn, has been incorporated; capital, $200,000. The directors are E. M. Brooks, Daniel Bohre, Brooklyn; J. A. Crawford, Montclair, N. J.

DUNDEE, N. Y.—At the annual meeting of the Dundee Telephone & Telegraph Company, officers were elected for one year as follows: President, Charles J. Watson; vice-president, Clayton G. Howell; treasurer, Robert B. Swortz; secretary, Harry B. Harpending; manager, Silas A. Price.

JAMESTOWN, N. Y.—At the meeting of the Home Telephone Company, of Jamestown, Jules Vautrot, of Warren, was reelected president, as were C. C. Clawson, R. T. Izant, C. B. Selby and G. B. DeVoe to the directorate. The company added nearly 400 new telephones last year, and the usual dividend surplus of the year was voted to be used for the extension of the company's business the coming year.

JACOBSBURG, OHIO.—The People's Telephone Company, of Jacobsburg, has increased its capital stock from $2,000 to $4,000.

JACKSON, OHIO.—The Citizens' Telephone Company, of Jackson, has been formed and incorporated by Chester A. Dyer, G. W. Brooks, Joseph Lewis, R. E. Swaney and C. C. McKinniss; the capital is $4,000.

LOWELL, OHIO.—The Lowell Telephone Exchange Company, recently incorporated for $10,000, has let the contract for installing the lines and equipment of the company to the A. T. Brennan Company, of Zanesville.

COLUMBUS, OHIO.—Fire on July 14 damaged the apparatus in the Central Union Telephone Company's building to such an extent that the city's entire telephone service will be suspended for days. The loss to the company is about $25,000.

CORBETT, OKLA.—The Citizens' Telephone Company has been incorporated with a capital stock of $10,000 and the following stockholders: E. M. Abernathy, of Lexington, J. P. Corbett, Wm. Montan, Lee Balew and P. A. Homes of Corbett, and W. E. Dragor, of Buckhead.

BERWINDALE, PA.—The Clearfield & Cambria Telephone Company has been formed. Capital, $5,000.

BELLS RUN, PA.—The Bells Run Telephone Company has been formed to build a telephone line; capital, $6,000. Incorporators: Fred E. Gleason and John J. Robarts, Ceres; LeRoy M. Lanphen, Bells Run, Pa., and others.

BALDWIN, WIS.—The Baldwin Telephone Exchange, of Baldwin, has made an amendment increasing its capital to $15,000.

Electric Light and Power.

DOTHAN, ALA.—It is proposed to improve the water works and electric light plant at a cost of $20,000.

ELBA, ALA.—The Pea River Power Company has been incorporated with a capital of $100,000 by Chas. Henderson, H. D. Boyd, J. M. Garrett and others, to supply Elba with electricity for lighting, heating and power purposes.

FAIRBANK, ALASKA.—The Tanana Electric Company has been incorporated at Olympia, Wash., by Abe Spring, of Fairbank, and J. A. Haney, of Seattle, Wash., with a capital of $250,000, to establish a lighting and steam plant at Clery City, Alaska, which is about 25 miles from Fairbank.

SAN FRANCISCO, CAL.—The Western Power Company, which has extensive water rights in the vicinity of the Big Bend of the Feather River, and in the Big Meadows region, is showing great activity again. During the past two years but little was accomplished, but it is understood that a large sum of money has been appropriated for preliminary engineering work of an exhaustive character. About 60 men have been put to work under the general supervision of Engineer Julius M. Howell, who has been connected with the company for several years. A party of Eastern capitalists, who are now interested in the system originally projected by Los Angeles people, have been visiting the proposed power sites. Some intricate engineering problems are involved, which it is proposed to thoroughly investigate before completing the details of the plans. The original purpose was to transmit power direct to San Francisco, a distance of 100 miles, or more. Among the other possible markets for power are mining work, electric railways and main line railroads. The company has enormous quantities of valuable timber on its lands. Dr. Thomas Addison, manager of the General Electric Company's San Francisco district agency, is a stockholder.

NORWICH, CONN.—The municipal electric light plant reports a profit for the year of $10,545. A new unit is needed, also a new smokestack and an addition to the coal shed, which, with other repairs and additions, involve the sum of $48,000.

JACKSONVILLE, FLA.—Bids will be received until August 4 by the Board of Trustees of the Water Works and Improvement Bonds, for furnishing f. o. b. cars, Jacksonville, a motor-generator set of about 300-kilowatt capacity, the generator to be a 550-volt, direct current, compound-wound machine, driven by a direct-connected, 3-phase, 60-cycle, 2,300 volt synchronous motor, large enough to drive the direct-current generator at its rated capacity; machine to be arranged so as to be reversed, and an alternate bid for the same generator driven by a 3-phase, 60-cycle, 2,300-volt induction motor, direct connected, of sufficient size to drive the generator at its rated capacity, the speed of the machine not to exceed 750 r.p.m. Field rheostats for the direct-current machine and starting device for the alternating-current machine to be furnished. R. N. Ellis is superintendent.

CAMILLA, GA.—An election will soon be held to vote on issuing $6,000 bonds for improving the electric light plant.

FORT GAINES, GA.—The City Council has granted the Interstate Water Works & Construction Company, of Washington, D. C., a 50-year franchise for the construction of water works and an electric light plant.

BELLEVILLE, ILL.—The Retail Merchants' Association has decided to organize a company for the construction of another gas and electric plant in Belleville. A charter will be obtained in a few days and franchises asked for.

POSEYVILLE, IND.—The Poseyville Electric Light & Water Company has been incorporated, with a capital of $10,000.

CRAWFORDSVILLE, IND.—The Crawfordsville Water & Light Company has secured a new franchise and will at once make extensive improvements and purchase new machinery.

MUNCIE, IND.—After owning and operating its electric light plant for twelve years this city is about to contract with a private company for electric street lighting at 3½ cents per kilowatt-hour.

PERU, IND.—This city has in contemplation the reconstruction of its electric light plant, and would like to have some one complete the project, both financially and mechanically. Wm. O'Hara is the city clerk.

CRAWFORDSVILLE, IND.—The report of the municipal electric light and power plant for June shows total receipts to be $5,191.76, and the expenses $5,690.76. A street and alley account of $1,064 was paid during the month, otherwise the plant would have been self-sustaining.

INDIANAPOLIS, IND.—The plant, equipment and assets of the Home Heating & Lighting Company have been turned back to the officers of the company after being in the hands of a receiver for a year. All claims have been paid, a new franchise granted permitting an increase in the rates and it is now believed the plant will be operated profitably.

PITTSBURG, KAN.—The contract for furnishing electric machinery and apparatus for the new light and power station of the Home Light, Heat & Power Company, has been awarded to the Westinghouse Machine Company, of Pittsburg, Pa.

RUSSELL, KY.—E. E. Fullerton and H. Willis, of Greenup, are interested in the construction of an electric light plant in Russell.

BANGOR, ME.—Wallace C. Johnson, of Niagara Falls, N. Y., is engineer for the proposed power plant of the Bodwell Water Power Company. No contracts have been awarded as yet.

WATERVILLE, ME.—The Messalonskee Electric Company has been organized under special charter at Waterville, with a capital stock of $250,000, of which $186,500 is paid in. The officers are as follows: President, Harvey D. Eaton; vice-president, John N. Webber; treasurer, William T. Haines; clerk and assistant treasurer, Edward L. Meader; general manager, Walter S. Wyman. The new corporation takes over the present property, franchises and going business in Oakland of the Oakland Electric Company, which was incorporated under the general law, and also the property, franchises and business in Waterville hitherto owned by Messrs. Eaton and Wyman as a partnership.

BRUNSWICK, MD.—G. R. Bready, general manager Harpers Ferry Electric Light & Power Company, Harpers Ferry, W. Va., writes in regard to work contemplated at Brunswick, that about $12,000 will be expended, but contracts have all been closed with the exception of that for a 95-kw. alternator.

LEICESTER, MASS.—At the annual meeting of the Rawson Light & Power Company, in Leicester, the present officers were reelected.

SOUTHBRIDGE, MASS.—The annual meeting of the stockholders of the Southbridge Gas & Electric Light Company has been held. The following officers were chosen: Clerk, Albert D. Wells; treasurer, George N. Corey; auditors, John M. Cockran and Fred. E. Coburn.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has secured the contract for lighting the city for the coming year at the following bid: 92 arc lights at $72 per year, each to burn until 1 a. m.; 20 arc lights to burn all night at $110 per year each, and 72 incandescents at $10 each; total cost, $9,676 per year.

TURNERS FALLS, MASS.—The annual meeting of the Turners Falls company has been held. These officers were chosen: President, Charles T. Crocker, of Fitchburg; clerk and treasurer, Charles W. Hazelton; directors, C. T. Crocker, Jonathan Bulkley of New York, Charles E. Stevens of Ware, Alvah Crocker of Fitchburg, W. P. Dustin, D. P. Abercrombie, C. W. Hazelton. The office of vice-president was created and W. P. Dustin elected to the position. The company has recently finished an extension of the canal, and last year widened the upper end. A new power house has been built the past winter, and is now being equipped with machinery for generating electricity. When the power house is fully equipped the company will have expended probably $450,000.

MANCELONA, MICH.—James R. Jenkins and Dr. J. W. Verdier have applied to the City Council for an electric lighting and power franchise. They propose to secure power from Cedar River.

GRAND HAVEN, MICH.—Contracts have been let for increasing the power of the city lighting plant. The Ball Engine Company will furnish the engine and the Fort Wayne Electric Works the generator.

MANCELONA, MICH.—Fire destroyed the Mancelona lighting plant, entailing a loss of $3,000. The plant was owned by Fred Wilde, of Escanaba, who will at once rebuild, as his contract with the city continues for four years.

KALKASKA, MICH.—The Kalkaska Light & Power Company has submitted a proposition to the village to furnish power for operating 500,000-gallon pumps for the city water works.

ESCANABA, MICH.—There was an overdraft against the municipal lighting plant of $9,995.95 on July 1. On May 1 the overdraft was $9,611.40. Collections in June amounted to $8,414.63. The equipment of the plant is in poor condition and should an accident occur the service would be seriously crippled.

CLARE, MICH.—Negotiations looking to the city's acquisition of the electric light plant on a basis of 80 per cent. of the appraised valuation have been declared off, because the company, having entered into a contract for pumps, refused to release the city short of the full value of the pumps, $2,000.

GRAND RAPIDS, MICH.—The Michigan Trust Company of this city, which operates the electric light and power plants at Cadillac for Wellington W. Cummer, is seeking to incorporate the two companies under the State law that bonds may be issued to secure the costs of improvements and extensions.

PONTIAC, MICH.—The Clinton River Power Company has been incorporated with a capital stock of $75,000, of which $50,000 is common stock and $25,000 preferred stock. The franchise which the company will work under was granted to Fred J. Seeley for commercial lighting in Pontiac. Power for generating the current will be furnished by the Clinton River, which, according to the reports of the engineers, will produce 1,500 horse-power between Pontiac and Amy. The power will be supplied to Pontiac and the surrounding villages and resorts. The contract for the engineering and construction work has been awarded to MacKeen, Ball & Co., of Chicago. The equipment will include twin wheel, 25-inch, horizontal, steel-cased turbines, each of 200-hp. capacity at a 28-foot head of water. Two 200-hp. generators will be coupled direct to the turbine shaft.

AUSTIN, MINN.—The Electric Light, Power & Water Commission will expend about $20,000 for improvements at the electric light plant.

MINNEAPOLIS, MINN.—The Minnesota Power & Trolley Company, Minneapolis, Minn., is having preliminary plans prepared by F. W. Cappelen, Globe Building, for a power house and a 30-foot dam across the Mississippi River at Otsego, Minn.

OMAHA, NEB.—The Omaha Electric Light & Power Company controls the electric light and power business in the cities of Omaha and South Omaha, Neb., and by stock ownership controls the entire gas, electric light and power business of Council Bluffs, Ia. The company owns an electric power station capable of generating 5,000 horse-power, and has contracts with the city of Omaha and South Omaha to provide street lights until 1908 and 1909 respectively. The company showed net earnings for the year ended May 31, 1905, of $124,667, and a surplus of $50,688. The item of operating expenses includes an arbitrary charge of $40,000 per year against depreciation. Gross receipts for the last fiscal year increased 13 per cent. over the 12 months preceding. The company has a capital stock of $2,489,3000, and an authorized issue of $3,000,000 bonds, of which $1,580,000 are outstanding.

SPRING VALLEY, N. Y.—The question of constructing an electric light plant at a cost of $25,000 is under consideration.

NEW YORK, N. Y.—The Board of Estimate has approved the report of Nelson P. Lewis, chief engineer of the Board of Estimate, on the proposed municipal electric light plant and authorized him to prepare specifications for a contract for submission to the Corporation Counsel. The probable cost of the plant is $7,500,000. The contract for construction will probably be let in the fall.

OGDENSBURG, N. Y.—The Ogdensburg Power & Light Company has entered into a contract with the Hannawa Falls Water Power Company to furnish Ogdensburg with electric power. The plant of the Hannawa Falls Water Power Company is located on the Racquette River at Hannawa Falls, St. Lawrence County, four and one-half miles south of the village of Potsdam. Its present development gives it a minimum of 10,000 horse-power. It has 20,000 horse-power yet undeveloped a short distance above its plant. To take the Hannawa power to Ogdensburg necessitates the construction of a transmission line about 38 miles long and the expenditure of about $150,000. Aluminum wire will be used and three wires will be strung at first, on cedar poles set 100 feet apart. The receiving station at the Ogdensburg end of the line will be the present power plant of the Ogdensburg Power & Light Company. Rotary converters will be installed for the Ogdensburg street railway. The alternating current will be used to light the streets of the city.

SOUTH BROOKLYN, OHIO.—The municipal lighting plant shows about $3,000 to the bad. The appropriation is $6,000 against $3,000 income. In fact, the deficit, it is said, may run to a total of $7,500 for the year.

TOLEDO, OHIO.—The City Solicitor having decided that the city cannot charge either the East Side Heating & Lighting Company or the Central Heating & Lighting Company for franchises to operate in Toledo, these two concerns have renewed their application for these rights.

NEWARK, OHIO.—The Capital Savings & Trust Company has been appointed fiscal agent of the newly organized Licking County Light & Power Company, of Newark, incorporated by Melville Gillett, Henry G. Bohl, John P. Maynard, W. G. Barthalow and J. W. Darford. The corporation has $200,000 common, $100,000 6 per cent accumulative preferred stock and an issue of 5 per cent 20-year bonds.

PHILADELPHIA, PA.—The Chester County Light & Fuel Company has been formed with $5,000 capital.

WILKESBARRE, PA.—The electric power plant of the Delaware & Hudson Coal Company, in this vicinity, is being enlarged, and within the next few weeks this company will operate and illuminate all its collieries in the northern part of this city by electricity.

YORK, PA.—The Delta Electric Light Company, located along Muddy Creek in the southern part of York County, has been purchased by the York Furnace, Piqua & Lancaster Trolley Company. The purchase has doubtless been made with a view of furnishing power for the proposed new trolley extension into York County. It is said that later the plant will be enlarged, new machinery will be installed and so improved as to increase its power tenfold.

PITTSBURG, PA.—H. P. Dilworth, of the Dilworth Coal Company, and Chas. Arbuckle Jamison, of Arbuckle & Co., and Stewart Robinson, have secured from the Secretary of War the right to use water flowing over Springdale dam in the Allegheny River for power purposes. It is reported that a $400,000 plant will be constructed and power will be furnished for the traction roads in Allegheny Valley and power and light lines will be extended to Tarentum, New Kensington, Oakmont, Creighton, Natrona and Parnassus.

YORK, PA.—John E. Graybill & Co., electricians, of this city, have been awarded contracts to equip the new Harford County Court House, at Belaire, Md., with complete lighting and electric fire signal system; to install in the new technical high school at Harrisburg a direct-connected generating unit to furnish power for electric motors in various parts of the building; storage batteries, electrical instruments, call bells, signals, etc.; also electrical appliances for the new annex to the Harrisburg hospital. The firm will need all kinds of electrical aparatus and material.

SPARTANBURG, S. C.—The Electric Manufacturing Company proposes developing water power at Nesbitt Shoals, at a cost of about $250,000, but nothing definite has yet been done.

CLARKSVILLE, TENN.—The Consumers' Electric Light, Heating & Power Company has petitioned for a franchise.

CHATTANOOGA, TENN.—W. B. Spencer, 16 Exchange Place, New York, N. Y., assistant engineer of the Chattanooga-Tennessee Power Company, states that bids for the construction of the plant, which will cost about $1,500,000, will be received in about four weeks.

JEFFERSON, TEX.—The Jefferson City Light & Power plant, including the ice plant, was destroyed by fire July 5.

EPHRAIM, UTAH.—Bonds to the amount of $15,000 have been sold for the construction of an electric light plant.

PROVO, UTAH.—The citizens have voted to issue $91,000 bonds to be used for the completion of the water works and the construction of a municipal electric light plant.

MONTPELIER, VT.—The Consolidated Lighting Company is to increase the size of its plant at Montpelier and will install a 1,000-hp. steam turbine and generator.

WALLA WALLA, WASH.—An ordinance has been introduced in Council granting C. M. Maxwell and H. Day Hanford of Seattle a franchise to construct and maintain an electric light and gas plant in Walla Walla. It is proposed to organize a company to be known as the Walla Walla Gas & Electric Company.

TACOMA, WASH.—The City Council has authorized the City Clerk to procure bids for the construction of a steam-power electric generating plant, to be established, if possible, within the city limits. The specifications call for a generating plant of at least 5,000 horse-power and not more than 10,000 horse-power. The idea is to secure bids on all kinds of plants for generating electric energy.

LARAMIE, WYO.—The City Council has granted Alfred E. Kalter, of Indianapolis, a franchise for an electric light plant.

NAPANEE, ONT.—The proposed electric light plant will cost about $35,000. No engineer has been selected as yet. W. A. Grange is the town clerk.

OTTAWA, ONT.—The Dominion Government has appropriated $40,000 for electric lighting and power plant on the Welland. This amount is in addition to $100,000 already voted and is rendered necessary by a change of plans. The Government obtains power from the Cataract Power Company, of Hamilton, Ont., and pays $14 per horse-power for the same up to 500 horse-power.

TORONTO, ONT.—A hydro-electric power commission has been appointed by the Ontario Government to inquire into the whole question of electrical production and development in the Province of Ontario. Adam Beck, of London, is chairman, and Cecil B. Smith, chief engineer. R. A. Ross, of Montreal, and his staff of engineers on the municipal power commission are completing the field work in connection with the development of Niagara power, and the cost of transmitting it to Guelph, Hamilton, St. Catherines, Galt, Brantford, London and other western Ontario towns and cities.

CHARLOTTETOWN, P. E. I.—At the City Council meeting the Charlottetown Light & Power Company made the following offer to the city: At the expiration of the present contract, to sell the real estate and plant for $80,000, or if the city renew the present contract to furnish the new street lamps at $75 per light per annum; to reduce the cost of commercial lighting to 12 cents per kilowatt hour and guarantee not to raise this rate; to do away with minimum rate.

MONTREAL, QUE.—According to an official statement the Montreal Light, Heat & Power Company has decided to have all its stations rendered absolutely fireproof. When this work is completed the company will not carry any insurance on its buildings. A saving of $10,000 a year will thus be effected.

The Electric Railway.

PYATT, ARIZ.—The Mineral Belt Traction Company, of this city and Chicago, Ill., has been formed to build a line between Pyatt, Dodd City, Kingdom Springs and Lead Hill. Capital, $200,000. Incorporated by A. J. Bradford and Robert Somerville.

LITTLE ROCK, ARK.—The Mineral Belt Traction Company, of Pyatt, Ark., and Chicago, Ill., has been granted a charter to build a line between Pyatt, Dodd City, Kingdon Springs and Lead Hill. The capital stock is $200,000. The incorporators are A. J. Bradford, Robert Somerville, E. W. Swarz and Neal Dodd.

HOOPESTON, ILL.—The Interstate Traction Company, Hoopeston, Ill., has been organized to build an electric road from Danville, Ill., to Hoopeston and a large power house at Hoopeston. J. H. Dyer is general attorney for the road.

FORT WAYNE, IND.—The L. E. Myers Company, of Chicago, has been awarded the contract for a 23-mile line between Fort Wayne and Bluffton, for the Fort Wayne, Bluffton & Marshall Traction Company.

INDIANAPOLIS, IND.—The North Central Railway Company has filed articles of incorporation with the Secretary of State. The capital stock is $500,000. The promoters, it is said, will build a line into Chicago that will be used by the numerous interurban lines that are now building toward Chicago. The directors are John Conkey, of Valparaiso; C. H. Jones, B. F. Watson and E. L. Gower, of Indianapolis.

LAKE PROVIDENCE, LA.—The Lake Providence & Gouldsboro Electric Railway & Power Company has been granted a franchise to build an electric railway three miles long from Lake Providence to Lake Providence Landing.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has bought about five acres of land in Seymour Street, to be used as a site for a new powerhouse.

NAHANT, MASS.—The Nahant & Lynn Street Railway has been authorized by the Railroad Commission to capitalize the cost of building and equipping its railway at $50,000.

ORAN, MO.—The Oran Electric Railway Company has been formed by M. G. Gresham and George Metz; capital, $50,000.

BUFFALO, N. Y.—The Stratford Railway Construction Company, of Buffalo, has been incorporated; capital, $50,000. Directors, L. B. Grant, W. J. Bagnell, C. T. Lark, New York.

LIMA, N. Y.—The accounts, franchises, rights of way, property and assets of the Lima-Honeoye Electric Light & Railroad Company have been sold by Receiver Charles B. Hill to William J. Connors, of Buffalo. The price paid was $16,000. It is understood that the road will now be extended.

NEW YORK, N. Y.—The earnings of the Metropolitan system for June were the largest for any June in its history, aggregating $1,887,834, as compared with $1,865,065 in June, 1904. The record month of the system was May, 1903, when $1,948,795 was earned. The heavy travel in June is partly ascribed to the hot weather, which has lessened the subway business.

MT. VERNON, N. Y.—The New York, Westchester & Boston Railway Company is arranging the details of its franchise with the city of Mt. Vernon. The City and County Contract Company, which holds the contract for the building of the entire road, will advertise for competitive bidding within the month on several additional sections of the work, including the section into Mt. Vernon. The Mt. Vernon Board of Aldermen set July 27 as the day for the hearing on the new franchise.

TOLEDO, OHIO.—A deal has been consummated by which the Widener-Elkins syndicate of Philadelphia takes over the Toledo, Bowling Green & Southern traction line by purchase.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has decided to build a line to Lookout Mountain and another to Chickamauga Park within the very near future, according to an official announcement.

FORT WORTH, TEX.—Steps have been taken looking to the construction of an electric railway from Fort Worth to Azle, a distance of 17 miles. Sterling P. Clark is interested.

CLARKSVILLE, TEX.—A project is on foot to build and operate an interurban electric railway between Clarksville and Sulphur Springs, by way of Cooper and other towns, a distance of 45 miles. Local parties are promoting the enterprise.

GREENVILLE, TEX.—A syndicate of Dallas men will make application to the City Council for a franchise to build and operate an electric railway here. The secretary of the Greenville Commercial Club can give information in regard to the project.

CORSICANA, TEX.—A syndicate of Cincinnati (Ohio) capitalists has taken preliminary steps toward the construction of an interurban electric railway between Corsicana and Fairfield, a distance of [illegible] miles. R. [illegible] Prince, of Corsicana, can give information in regard to the project.

GAINESVILLE, TEX.—The Gainesville Electric Railway & Light Company will build and operate a new electric street railway system in Gainesville. It has increased its capital stock from $50,000 to $100,000. The company has been reorganized. It has entered into a contract with E. J. O'Bierne to do the engineering work of the new railway. The plans and specifications will be completed and the construction contracts let as soon as possible. W. H. O'Bierne is secretary and general manager of the company.

KENOSHA, WIS.—Mr. Fritz Foltz, architect, of Chicago, is making plans and specifications for a substation near Kenosha, Wis., for the Chicago & Milwaukee Electric Railway Company. The building will be [illegible] feet, of fireproof construction, of pressed brick and stone. Half will be devoted to machinery, comprising three [illegible]-kw. rotaries, nine [illegible]-kw. transformers and one booster, and the other half to storage batteries.

CITY OF MEXICO, MEX.—The management of the Mexican Tramways, Ltd., of the City of Mexico, has received a petition from the residents of the suburb of Santa Maria asking that the electric railway system be extended to that place. The matter is receiving attention by the railway company and the petition will probably be acted upon favorably.

CITY OF MEXICO, MEX.—The Mexican Government has declared forfeited the concession which it granted three years ago to Jose Garcia and Ernesto Diaz Rugama for the construction and operation of an electric belt railway in the City of Mexico. The guarantee deposit of $25,000 in bonds of the public debt which they deposited is also forfeited.

New Industrial Companies.

THE ELECTRICAL REPAIR COMPANY, New York, has been incorporated; capital, $5,000. The directors are J. G. Eager, Thomas M. Elrath, Jersey City; C. H. Stodin, New York.

THE NORTON ELECTRIC MFG. COMPANY, of Camden, N. J., has been formed. Capital, $100,000. Incorporators: Abner Smith, Frederick G. Norton and David L. Hart.

THE ALPHA ELECTRICAL WORKS, of Superior, Wis., have been formed. The capital stock is $5,000, and the incorporators are Schiller N. Weller, Charles H. Hill and Archibald McKay.

THE NEW YORK ELECTRIC GENERATOR COMPANY has been incorporated in New York; capital, $100,000. Directors: Charles Flavin, Morris Schwartz and Solomon Pulver, New York.

CARLSON & RUSS, of Richmond, S. I., have been incorporated to manufacture engines and motors; capital, $5,000. Directors: C. O. Carlson, J. D. Russ, Staten Island; C. A. Erickson, Brooklyn.

Legal.

HUDSON RIVER WATER POWER.—The temporary receivership of the Hudson River Water Power Company has been vacated and the proceedings connected therewith dismissed by Judge Ray, sitting in the United States Court of the northern district of New York.

DEFECTIVE APPLIANCES.—The Supreme Court of California in the case of Towne vs. the United Gas & Power Company, on the appeal of the defendant, reversed an order denying a new trial, and a judgment in favor of plaintiff. The defendant, an electric light company, furnished its linemen with several pike poles (long poles having an iron ferrule and an iron pike in the end) of the character and construction customarily used in bracing electric light poles while removing the same. One of these pike poles had become dull at the point and unfit to be used with safety. While plaintiff was on an electric light pole, stripping the wires, one of his fellow servants picked up and used the blunt pike pole, which did not fix the electric light pole so as to properly hold the same, and it in consequence fell, whereby plaintiff was injured. Held, that defendant had properly fulfilled its duty of furnishing suitable tools and appliances, and the injury was in no way the result of its negligence. It was also held that the injury was the result of the negligence of the fellow servant, who picked up the defective pole without observing its patent defect.

CUTTING SHADE TREES.—The Supreme Court of North Carolina has decided adversely on the question whether the Asheville Lighting Company, even after it had provided itself with the permission of the Superintendent of Streets, afterward approved by the Board of Aldermen, could cut a tree standing on the outer end of the sidewalk. Mr. Brown sued the company for damages, and the jury awarded him a verdict for $499. It was held on appeal that, while the city had the power, under its charter, to control streets and sidewalks and to remove obstructions when necessary, it did not, when it condemned land for highway purposes, acquite a title to the land, but merely a right of way over it, so that the plaintiff was still the owner of the tree. The authority given the city to permit the erection of poles and wires over the street merely authorized the city to grant franchises, subject to the rights of abutting owners, and an electric light company appropriating any rights of such owner must make compensation. It therefore followed that trees standing on the edge of the sidewalk could not be cut down by an electric company without compensating the owner. Before the company could acquire the right to cut a tree it must show that such cutting was necessary, the mere convenience of removing the tree in erecting poles and wires not being enough to justify it in making the removal.

LIMITING TELEPHONE RATES.—In an opinion filed in the Circuit Court at Baltimore, Md., Judge Harland holds that the Maryland Telephone Company may not charge more than $48 a year for telephones furnished business offices, nor more than $36 a year for telephones furnished dwellings. These rates are for unlimited service of the best character and are prescribed by ordinance No. 110, passed by the City Council and approved by the Mayor on July 1, 1896. This ordinance, the terms of which the Court finds to be binding on the company, provides as follows: "That the prices to be charged by the Home Telephone & Telegraph Company shall not be more than $4 a month for telephones furnished to business offices and not more than $3 a month for telephones furnished to dwellings within the corporate limits of Baltimore City, and to the further express condition that all the rights and privileges hereby and herein granted shall cease and be forever forfeited in case the Home Telephone & Telegraph Company shall be consolidated with any other telephone company in Baltimore, unless the terms of consolidation provide that the consolidated company shall not charge more than the above-mentioned rates for the use of its telephones." In this case it was urged that out of 8,500 subscribers only 18 were parties to the bill, and all the remainder, excepting about 800, who stood on their rights, voluntarily entered into contracts with the company to take the new service at rates of $72 and $60, showing that they believed the new contracts fair and that there was no great interest requiring that a decree should be enforced.

Obituary.

HON. D. S. LAMONT.—The death occurred suddenly on July 23 of the Hon. Daniel S. Lamont, former private secretary to ex-President Cleveland and afterwards Secretary of War. As an associate of Mr. W. C. Whitney he became interested in electric traction and was one of the organizers of the Metropolitan street railway system of New York City. He remained prominent to the end in street railway affairs in New York, Buffalo, etc.

MR. J. H. GATES.—Joseph Holt Gates, an electrical engineer of Chicago, died in that city, after a brief illness. He was born in Brooklyn in 1861, and was the youngest son of the late Gen. William Gates of the Third Artillery, United States Army. Mr. Gates had served in the Twenty-third and Seventh Regiments. He was a member of the Sons of the Revolution, Nassau Boat Club, and the Chicago Athletic and Engineers' Clubs. A widow and one son survive him. He spent many years of his life in the western metropolis in connection with electrical affairs and was often spoken of in electrical circles as "Gates of Chicago."

MR. WILLIAM JESSOP.—Cable advices note the death of Mr. William Jessop on July 4, at his country estate, Thornsett Lodge, Bradfield, England, after a long illness. He was born October, 1856, was educated in Germany, and at Cambridge. At the time of his death, and since 1887, he was chairman of William Jessop & Sons, Limited, steel manufacturers, of Sheffield, England, and was head of the fourth generation of the Jessop family in control of the firm, the business having been established in 1774. He was also President of Jessop Steel Company, of Washington, Pa., president of the Jessop Hospital for Women, an institution founded by his father, the late Thomas Jessop, to which he contributed over $200,000, and which was zealously and liberally supported by his son. He was also a Trustee of the Sheffield Royal Infirmary, and a member of the Bradfield Game Association, and formerly director in the Sheffield & Rotherham Bank and Yorkshire Engine Co. He was a large landowner, worked an estate of 4,000 acres at Huggat, in the Northeast of England, and also an estate at Fosdick, and was keenly interested in agricultural pursuits and an ardent sportsman. He was noted for his kindness and generosity to his tenants, and those in need, and made an excellent landlord, and was greatly esteemed by all He visited Australia, Japan and America, in 1903.

Educational.

UNIVERSITY OF TENNESSEE.—An effective method of bringing to the attention of engineers the engineering features of the University of Tennessee is being used by the Press of the University in the publication of a valuable manual for engineers, which contains a goodly amount of technical information. The object in publishing the book is to increase the interest of men of affairs in technical training, and to present the advantages of technical education as a means of utilizing the undeveloped resources of the South. The popularity of the book is shown by the fact that the present is the fifth edition of 5,000 copies.

THE WORCESTER POLYTECHNIC INSTITUTE has completed plans for the enlargement of its power plant, which will ultimately consist of two 80-hp. and two new 200-hp. boilers, the present engine and generator equipment and the following new apparatus: One 13-in. by 22-in. by 13-in. 175 hp compound engine direct connected with a 2-phase 60 cycle revolving field alternator, a 60 hp direct connected unit, and a 250 hp unit, making about 700 hp. on occasional overload capacity. The two phase alternator will provide current for the institute's lighting and power service at an early date. A blue Vermont marble switchboard in dull black finish with copper trimmings will be installed in 9 panels about 20 feet in total length, and the outfit will not only provide for the service demands of the Institute shops, laboratories and offices, lecture halls and class rooms, but will also be useful for instruction and experimental work.

Personal.

MR. T. D. LOCKWOOD, expert of the Bell Telephone system, arrived in New York recently, after a Canadian trip, from Boston. He will be sailing shortly for England.

MR. B. H. WARREN, president of the Allis-Chalmers Company, returned last week by the "Baltic" from England, after a prolonged stay of three or four months on the other side.

MR. JOHN I. BEGGS, who was receiver of the National Electric Company, of Milwaukee, has now been made trustee of the concern and is carrying on its business in that capacity.

MR. H. WHITFORD JONES informs us that he has withdrawn his active interest from the Cleveland Engineering Company and has opened an office in the Citizens' Building, Euclid Avenue, Cleveland, O., where he will practice his profession as an electrical engineer.

MR. R CRAWFORD. It is announced from Chicago that Mr. R. Crawford a Glasgow traction expert is to visit that city and inspect its possibilities as a field for municipal ownership. Mr. Dalrymple seems to have been a sad disappointment to the municipal advocates.

MR. R. T. LOZIER, of the National Electric Co., has been a visitor in New York recently for the first time in several months. He has been busily engaged with the development and exploitation of the new Lundell motor, and has been successful in its widespread introduction.

MR. GEORGE WESTINGHOUSE has just gone abroad on an extensive trip. Before leaving he formulated as one of the three trustees of the Equitable Life Insurance Society an interesting plan for the "mutualization" of its control, for the benefit of the policyholders.

MR. W. E. COOK, of the Automobile Electric Co., of Chicago, has been a visitor in New York during the past week in connection with important automatic telephonic work that is now in hand. The company has recently received a contract for a 15,000 line system at Havana, Cuba.

MR. W. A. PEARSON.—His associates in the New York City Railway presented Mr. W. A. Pearson, electrical engineer of the road, with a handsome silver punch bowl this week, on the occasion of his departure, August 1, to take up new work at Niagara Falls with one of the large power systems there.

MR. CECIL B. SMITH. A special telegram from Toronto of July 13, says: "Hon. Adam Beck stated, after the meeting of the commission yesterday, that Cecil B. Smith, at present chairman and consulting engineer of the Temiskaming railway commission, has been appointed chief engineer of the Ontario hydro-electric commission, as it is to be known. Mr. Smith will give his entire time to the two commissions. The appointment would appear to indicate the use of electric power on the Temiskaming railway."

MR. J. J. WRIGHT, general manager of the Toronto (Ont.) Electric Light Company, says: It is extremely probable that in the very near future all the railways on the Niagara peninsula will be operated electrically, for the railway locomotive is the most uneconomical form of steam engine there is. There is absolutely no reason why all the trains within at least 40 or 50 miles of the Falls of Niagara should not be operated by electricity. Eventually, no doubt, all the railways in Southwestern Ontario from Toronto westward will be run in that way.

BARSTOW & CHAMBERS.—Mr. William S. Barstow, consulting engineer, New York, and Mr. Frank R. Chambers, Jr., recently of the office of J. G. White & Co., Inc., New York, have formed a co-partnership, as consulting engineers to do a general engineering business in the West. The firm of Barstow & Chambers has opened offices in the Failing Building, Portland, Oregon, and will maintain an office at 56 Pine Street, New York, and thus be in touch at the center with the financial and manufacturing interests of the United States, while the main office in Portland will keep itself informed as to local conditions in the West. Mr. Chambers, who has had a wide experience in reporting upon, designing and equipping large railway and power plants, is located in Portland, where he gives his personal attention to the business of the firm and keeps in continual touch with the rapid development of the West. Mr. Barstow, who is also widely known, is extensively engaged in engineering work in the east, is consulting engineer for the Portland General Electric Company, and is designing the electrical installation of the new 20,000 hp. hydro-electric plant of the Oregon Water Power & Railway Company. This plant is described in our current issue. Mr. Barstow was elected president of the New York Electrical Society in June.

◆

Trade Publications.

THE PIGEON HOLE.—The latest issue of the monthly publication of the Peerless Electric Company, Warren, Ohio, having the above title, contains a few breezy notes on oscillating fan motors, and some thoughts on motors in general, not forgetting that "Peerless motors are good motors."

FAN MOTORS.—The Western Electric Company, Chicago, has issued an extremely handsome catalogue (No. 4005), devoted to W. E. fan motors. The motors are designed for direct-current, alternating current and battery circuits, and in various sizes for desk, bracket and ceiling fans. Both the internal construction and the external appearance of each motor are treated at great length.

GENERATING SETS.—The B. F. Sturtevant Company, of Boston, Mass., has just issued a second edition of its Bulletin No. 63, showing generating sets in a full line of 36 sizes ranging from 3 to 100 kilowatts, and equipped with vertical simple, vertical compound or horizontal engines, according to size. All of these engines are equipped with forced lubrication, watershed partitions and oiltight cases.

DIRECT-CURRENT LIGHTING AND POWER GENERATORS.—The Crocker-Wheeler Company, Ampere, N. J., has issued bulletin No. 53, describing direct-connected, direct-current generators for lighting and power. These machines are regularly built in sizes from 20 kw. to 1500 kw. The bulletin shows not only the design details of the machines, but also exhibits many views of the completed machines in service.

FUSES.—The H. W. Johns-Manville Company, of 100 William St., New York, has issued a 135-page book, designated as the "600-Volt Fuse Bulletin," in which the well-known "Noark" enclosed fuses and fuse devices are fully illustrated and described. The 600-volt catalogue is one of a series of three, the other two being devoted to 250-volt and 10,000-volt devices. These three books describe a complete line of fuse devices suitable for all voltages.

CARTRIDGE FUSE BLOCKS.—Bulletin No. 2 of the Peru Electric Manufacturing Company, Peru, Indiana, is devoted to "Peru" cartridge fuse blocks, which have been designed so as to take any National Code standard fuse. These blocks are exceptionally neat in appearance. The heavy terminals, countersunk in the porcelain, are set back from the end of the block and the porcelain walls extending above the terminals give no possible chance for a short circuit.

DIRECT-CURRENT MOTORS.—The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has issued bulletin No. 145 which describes at great length a recently developed line of motors and dynamos designated as type "L." These machines are semi-enclosed, with hinged covers protecting the commutator, and are designed to meet the demand for a rugged and compact machine, readily adapted to special uses, such as the direct application to various mechanical devices.

RECORDING THERMOMETERS AND GAUGES.—As sole American representative of Jules Richard of Paris, Mr. E. H. Du Vivier, 14 Church St., New York, is issuing descriptive bulletins devoted to indicating and recording thermometers and pressure gauges and electrical recording instruments. The electrical instruments, including the wattmeter, are of the true recording type, a continuous curve being plotted with time as abscissa, showing the actual reading of the instrument at each instant.

STATIONARY TRANSFORMERS.—The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has developed a line of transformers in which the losses have been so proportioned as to reduce the cost of operation to a minimum without making the first cost of the transformer unnecessarily high. These transformers are of the shell type, oil being used as a cooling and insulating medium. The windings of the larger sizes are of copper ribbon. These transformers, which are designated as type "Z," are described in detail in bulletin No. 249.

CENTRAL STATION HEATING.—Mr. W. H. Shott, designer and builder of the Schott systems of central station heating and power plants, 1218-22 Marquette Building, Chicago, has issued an exceedingly attractive booklet, which has been given the title, "Eternal Summer," describing the Schott system as built for the Citizens' Mutual Heating Company, Terre Haute, Ind. The booklet contains numerous views of residences to which hot water is supplied. Accompanying the view of each residence is a letter from the owner showing that the heating system has proved entirely satisfactory during the past winter. The farthest building now on the line is connected approximately 8,000 feet from the central station.

"INTERURBAN RAILWAY CONSTRUCTION" is the title of a handsome oblong pamphlet, quarto size, just issued by the J. G. White Company, of Exchange Place, New York City, dealing with some of the concern's electric railway construction and engineering. It is an interesting story of admirable achievement, and embodies what is in every sense a "White" record. The views of power house, plant and line construction are seen at a glance to deal with excellent engineering and execution of broad plans, so that it is no wonder the company is now engaged on work in North America, South America, the Philippines, Cuba, Porto Rico, etc. At the end of the illustrative and descriptive material is some data with regard to the associated White companies here and abroad.

STORAGE BATTERIES.—The Dayton Manufacturing Company, Dayton, O., has issued bulletin No. 130, devoted to Silvey storage batteries, which is a supplement to the general storage battery catalogue, and contains detailed information relative to isolated lighting plants. The bulletin abounds in valuable suggestions as to the selection, installation and operation of batteries in general and describes the several Silvey systems which have been devised to meet the various requirements. The Silvey type "R" cell is unique in that the plates are piled one on top of another, with two sheets of porous absorbent separating material between the plates. Since the elements lie horizontally, it is practically impossible for the active material to fall from the plates, and the cells do not become short-circuited. This type is particularly recommended for isolated lighting plants.

UNIT ACCUMULATOR.—The National Battery Company, Buffalo, N. Y., has prepared some effective publications for bringing the "Unit Accumulator" to the attention of users of storage batteries. To a selected list of persons there has been sent an article entitled "The Future of Storage Batteries." This article was followed later by a discussion on "Sparkers," and still later by another about "Automobile Batteries." These lines are representative of the smallest departments of its business. The company also furnishes storage batteries for street railways, for lighting and power purposes in central stations, for central-energy telephone systems, and a multitude of purposes. There has recently been sent to the persons composing the above-mentioned list a letter calling attention to these facts, and requesting permission to send its general catalogue or a bulletin on any special subject to any one who is interested and cares to receive further information.

◆

News of the Trade.

NEW CARBON PLANT.—The new plant of the American Carbon & Battery Company, Signal Hill, East St. Louis, Ill., is nearly completed. It will greatly enlarge the company's productive facilities.

BELTED STANLEY GENERATOR.—The Stanley Electric Manufacturing Company's San Francisco office has secured an order for an additional 80-kw., 2-phase, 60-cycle belted generator for the plant of the Tonopah Light & Power Company, which has been acquired by the Nevada Power, Mining & Milling Company.

THE STROMBERG-CARLSON TELEPHONE MFG. COMPANY, Rochester, N. Y., reports having closed a contract with the North State Telephone Company, High Point, N. C., for a 1200-line capacity, generator call, visual signal switchboard. The company also reports having closed a contract with the Anderson Telephone Company, Anderson, S. C., for an 1800-capacity lamp, line signal, multiple switchboard.

AMERICAN ELECTRIC HEATERS.—The American Electric Heater Co., of Detroit, Mich., has opened an eastern department, with a New York branch at 35 Dey St. Mr. B. H. Scranton is in charge. This branch has been opened to take care of its eastern trade, which has grown to considerable volume; and it is contemplated to carry in stock a full line of staple devices bearing the well-known "American" trade-mark, including irons of all kinds, heaters, glue pots, chafing dishes, broilers, foot-warmers, etc.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 18, 1905.

[Condensed by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

794,616. SIGNALING APPARATUS; George C. Graham, Buffalo, N. Y. App. filed July 9, 1904. A device by which the ringing of a gong upon one of the cars of a train completes an electric circuit to ring bells upon another car. The gong is made one terminal, and the electric contact is made between the gong and its clapper.

794,645. INSULATOR BRACKET FOR TELEPHONE POLES, ETC.; Knudt G. Springen, Zumbrota, Minn. App. filed Mar. 10, 1905. A wire frame has a pair of projecting pins which virtually act as nails to secure the insulator support to the usual post. The wire frame also has projecting wires which act as a bail or tie to surround the post.

794,647. ELECTROSTATIC MAGNETIC SEPARATOR; W. L. Steele, H. M. Sutton and E. G. Steele, Dallas, Tex. App. filed Feb. 3, 1902.

794,656. CONSTRUCTION ON ELECTRICAL METERS; Otto T. Blathy, Budapest, Austria-Hungary. App. filed Nov. 10, 1902. Relates to details of construction of a current meter and particularly the manner in which the rotating part is pivoted between the supports of the operating magnets.

794,660. THIRD RAIL; Edward R. Brodton, Atlanta, Ga. App. filed Sept. 3, 1904. A construction of third rail which rests upon specially constructed ties to facilitate the drainage of moisture. The rail includes two special conductors which are made use of to operate a form of signaling apparatus within the engine cab.

794,686. PORTABLE AUDIPHONE; E. W. Schneider, New York, N. Y. App. filed Mar. 27, 1905.

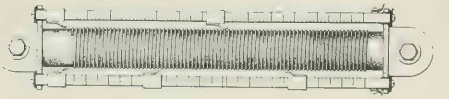
794,702. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed May 27, 1901.

(The above seven patents were issued July 11.)

794,742. SOLDERING NIPPLE FOR ELECTRIC CABLES; Henry E. Procunier, Oak Park, Ill. App. filed July 22, 1903. A metallic sleeve is formed with a conical end to be soldered into a correspondingly coned cavity in the usual lead sheath of the cable. The upper portion of the sleeve has a threaded part to screw into the usual box or well. A cavity or path is left in the sleeve for melted solder to flow into the joint.

794,745. AUTOMOBILE STARTER FOR VAPOR APPARATUS; M. Von Recklinghausen, London, England. App. filed Dec. 13, 1904. (See Current News and Notes.)

794,768. ELECTRICALLY OPERATED KEEPER PLATE FOR DOOR LOCKS; August Arens and Ernest L. Teich, New Britain, Conn. App. filed Feb. 20, 1905. An electric door latch in which the pivoted portion has a stud bearing against a cam face on a second pivoted lever controlled by the usual magnet. The leverage of the stud against the cam face is very small so as to insure against binding of the parts.



794,983.– Rheostat.

794,784. BLOCK SIGNALLING SYSTEM; Harry M. Coulter, Chicago, Ill. App. filed Sept. 5, 1903. A cab signaling system in which the signaling circuits are made through contact plates adjacent to the track rails. Employs ordinary relay magnets and secures an overlap system.

794,788. SHIELD AND SUPPORT FOR X-RAY TUBES; Levitt Ellsworth Custer and David H. Allen, Miamisburg, O. App. filed Apr. 6, 1903. The usual support for the X-ray tube has additional arms which support a shield, having a large aperture or light-orifice. Additional rings are arranged to be nested together and attached to the field so as to reduce the light-orifice to any desired size.

794,790. INTERCOMMUNICATING TELEPHONE SYSTEM; A. S. De Veau, New York, and C. Auth, Brooklyn, N. Y. App. filed Sept. 2, 1902.

794,792. DOUBLE CONTROLLER; Charles I. Earll, New York, N. Y. App. filed Apr. 20, 1903. A pair of separate controllers are arranged with co-axial operating shafts and can be used entirely independently, or may be engaged in such a way as to necessitate their successive operation.

794,820. AUTOMATIC RHEOSTAT; Carson J. Studgeon, Erie, Pa. App. filed Feb. 4, 1904. The rheostat operating magnet is wound with a series and with a shunt coil. Both are energized when the motor is started, but the shunt coil is automatically cut out when the motor arrives at running speed in order to avoid the hanging back of the arm, due to "extra current" when the motor circuit is opened.

794,830. ELECTRIC ARC LAMP; M. H. Baker, New York, N. Y., and S. P. Wilbur, Wilkensburg, Penn. App. filed Jan. 10, 1903. (See Current News and Notes.)

794,864. ELECTRIC BATTERY; P. J. Kamperdyk, New York, N. Y. App filed April 2, 1902.

794,868. VAPOR ELECTRIC LAMP; Richard Kuch, Hanau, Germany. App. filed Nov. 17, 1904. The terminals of the lamp are in portions of the tube having an enlarged section, so that the mercury will condense at these points by virtue of the smaller heating effect of the current thereat. Mercury pockets further promote the condensation at these points.

794,871. DEVICE FOR INCREASING THE ADHESION BETWEEN WHEELS AND RAILS; Robert C. Lowry, Seattle, Wash. App. filed Oct. 10, 1904. An electromagnet is arranged adjacent to the usual car wheels so as to magnetize them in operation, the object being to make them grip the rails more firmly.

794,902. ARC LIGHT ELECTRODE; F. O. Vogel, Berlin, Germany. App. filed July 6, 1903. (See Current News and Notes.)

794,924. APPLICATION OF ELECTRIC LIGHTS TO REVOLVERS OR OTHER FIREARMS; Eugene C. I. Cailliez, Lens, France. App. filed Jan. 6, 1904. The revolver handle contains a pair of dry batteries and a circuit is completed by pressing the trigger which lights a small incandescent lamp near the muzzle of the firearm.

794,935. ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App filed Nov. 1, 1904. The switch operating handle is provided with a rack which engages a pinion to turn the same and tension a spiral spring. After a certain movement the spring is released to throw the switch blade. Additional spring means are arranged to return the switch blade and break the circuit.

794,964. ATTACHMENT FOR TROLLEY POLES; Paul H. White, Indianapolis, Ind. App. filed Aug. 24, 1903. A device for preventing a trolley retriever from catching the trolley wheel upon the upper side of the wire. A pair of cam surfaces upon the pole are adapted to throw the wheel laterally when retrieved to prevent such catching on the wire.

794,967. TELEPHONE SUPPORT; E. P. Baird, Evanston, Ill. App. filed Dec. 19, 1904.

794,983. RHEOSTAT; John W. Howell, Newark, N. J. App. filed Nov. 23, 1903. A rheostat has spirally wound resistance wire thereon and a plurality of contacts may be positioned to place any length of the wire in a simple series circuit, or different parts thereof in a multiple circuit of lower resistance.

794,985. ELECTRICAL FUSE. F. G. Jones, Chicago, Ill. App. filed Nov. 17, 1904.

794,991. MOTOR CONTROL SYSTEM; John B. Linn, Schenectady, N. Y. App. filed Nov. 11, 1901. The contractors are arranged to be operated successively, each of them being actuated by a circuit which is closed by the preceding. In order to avoid too rapid actuation each contractor arm has a dash-pot attached thereto.

794,995. ALTERNATING CURRENT MOTOR; M. Milch, Schenectady, N. Y. App. filed Dec. 21, 1903. (See Current News and Notes.)

794,998. DYNAMO ELECTRIC MACHINE; F. A. Mott, Erie, Penn. App. filed Nov. 27, 1903. (See Current News and Notes.)

795,000. MOTOR CONTROL SYSTEM; William O. Mundy, St. Louis, Mo. App. filed Feb. 20, 1903. A special construction of contactor in which the contact arms form a part of the magnet circuit of the operating solenoid. The shield is so disposed that this magnetic circuit also constitutes a blow-out for the circuit breaking arcs.

795,016. TROLLEY EAR; Montraville M. Wood, Schenectady, N. Y. App. filed Jan. 15, 1903. A rigid frame has a pair of longitudinal slightly inclined grooves therein, and a pair of jaws for gripping so that the wire is gripped when the jaws are moved longitudinally by a suitable rack and pinion engagement.

795,024. PNEUMATIC SYSTEM OF MOTOR CONTROL; Frank E. Case, Schenectady, N. Y. App. filed Dec. 5, 1902. A system by which a train can be completely controlled through two train pipes. The control is not dependent on the mere strength or variations of air pressure, but on the successive manner in which pressure is applied in the two train pipes. Complete control is obtained through a constant pressure applied in a predetermined order in the two pipes.

795,067. PLUG AND RECEPTACLE; Howard R. Sargent, Schenectady, N. Y. App. filed Aug. 17, 1903. A porcelain frame has apertures for the attachment of metallic clips which project at opposite lateral faces to form plug sockets. The construction is designed to be strong and withstand rough usage.

795,072. CUT-OUT FOR TELEPHONES; M. L. Smith, Rutledge, Missouri. App. filed June 7, 1904.

795,137. SAFETY SIGNAL SYSTEM; Frank V. King, Winslow, Arizona Ter. App. filed Dec. 14, 1904. In order to relieve the mind of the engineer of the train dispatcher's orders which he is required to execute at various points, a gear train driven from the car axles is arranged to ring an alarm circuit at any predetermined point or points of the route where the engineer has received orders to do something.

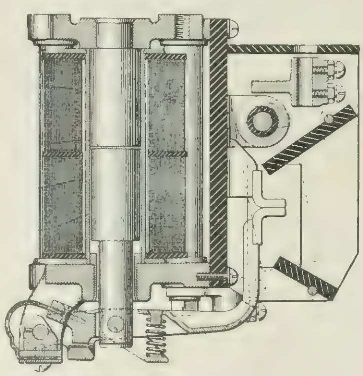
795,155. BEDSTEAD; Arabella A. Nees, New Orange, N. J. App. filed July 14, 1904. A usual bedstead frame is provided with a pocket in which valuables may be placed. The cover can only be removed by a push-button which rings a burglar alarm.

795,170. ELECTRIC BRAKE; W. G. Price, Pittsburg, Pa. App. filed Aug. 17, 1904. A mechanism provided with a brake-applying spring and a motor having a rotating armature for compressing the spring and releasing the brakes

795,182. PROTECTIVE SYSTEM FOR PARALLEL LINES. L. Wilson, Pittsfield, Mass. App, filed Nov. 20, 1903. (See Current News and Notes.)

795,197. SELF-SOLDERING PROTECTIVE APPARATUS; F. B. Cook, Chicago, Ill. App. filed Dec. 20, 1904.

795,201. ELECTRICALLY HEATED HANDHOLD; Fred S. Davis, Robertsville, S. C. App. filed Dec. 29, 1904. Within each of the handles of the usual steering wheel is placed an incandescent lamp, in order to warm the handles in cold weather.



795,000.—Motor Control System.

795,235. ELECTRICAL SWITCH AND OPERATING MECHANISM THEREFOR; Willard F. Richards, Buffalo, and William A. Turbayne, Lancaster, N. Y. App. filed Apr. 9, 1904. The switch blade is longitudinally movable over different contacts and can be stepped along in either direction by a reciprocable bar having ratchet notches thereon. An oscillation of the bar in one direction produces a movement of the switch blade one way, and an oscillation in the opposite direction moves the switch blade in the opposite way.

795,243. RAILWAY BRAKE APPARATUS; Granville T. Woods and Lyates Woods, New York, N. Y. App. filed Apr. 10, 1903. A complete motor control system in which under certain conditions the current is directed through the coils of a magnetic brake.

795,247. CURRENT COLLECTING SHOE; William M. Brown, Johnstown, Pa. App. filed Jan. 26, 1903. The shoe is made very long in order to bridge over spaced contact plates, and comprises a series of independently pivoted spring blades each of which completes a circuit when it is pressed upward by passing over the spaced contacts.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, AUGUST 5, 1905. No. 6.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE ....1139 Monadnock Block
PHILADELPHIA OFFICE ....929 Chestnut Street
CLEVELAND OFFICE ....402 Cuyahoga Building
EUROPEAN OFFICE ..... Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGraw Publishing Co.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

***The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue* 14,500 *copies are printed. Total circulation for* 1905 *to date,* 432,000.**

NEW YORK, SATURDAY, AUGUST 5, 1905.

CONTENTS.

Editorial 205
Telephone Service and Rates in New York City 208
Consolidation of American Street Car Builders 209
Electricity at the Liege Mining Congress 209
Consolidation of the Pole Lines at Los Angeles 209
Preservation of Electrical Poles 210
A College of Municipal Ownership 210
A Sketch of Multiple-Unit Railway Development 210
Cables and the Island of Yap 211
Electric Motor Service in Scotland 211
Programme for Municipal Electricians' Convention 211
Current News and Notes 211
Electrical Engineers of the Times.—XXI Mr. F. V. Henshaw 214
The Clyde Valley Electrical Power System, Glasgow, Scotland 215
Utilization of Gas Engines in Connection with Long Distance Electrical Transmission. By John Martin 220
Recent Developments in Three-Phase Traction on the Valtellina Road 221
Transfer Systems and the Multiple Board in Telephone Exchanges II. (*Concluded*). By Arthur V. Abbott, C. E. 224
New Telephone Patents 228
LETTERS TO THE EDITORS:
Diagrams of Railway Passenger Travel. By J. S. Badger 220
Measurement of High Electrical Pressures. By S. M. Kintner 220
The Double Trolley in Cuba. By A. W. K. Billings 230
Digest of Current Electrical Literature 230
Book Reviews 234
Chain Making by Electric Welding 235
Electric Locomotives for London Underground 236
Storage Battery Locomotive in Power House 236
Sanitary Refrigeration 237
A Large Motor Controller 237
Willans-Robinson Parsons Steam Turbine 237
Automatic Ore Unloading by Electric Motor 239
Electrically-Driven Sinking Pumps 240
Purification of Water for Boilers 240
The Design of Centrifugal Pumps 241
Guy Anchors 242
Industrial and Commercial Notes 243
General News of the Week 246

ELECTRICAL EXPORTS FOR THE YEAR.

With the issuance of the detailed statistics for June, we get the complete year of electrical reports, and a very excellent showing it is. The total export of electrical machinery for 1905, in the twelve months, was $7,291,832 as compared with $5,645,809 last year, and $5,779,459 in 1903. The gain over last year is large and well distributed, Japan coming in for nearly $500,000 of it, and Mexico for about $350,000. These two countries took no less than $2,316,942 of electrical machinery in 1905, or very nearly one-third of the total. Our next best customers were British North America, $1,711,981, and the United Kingdom, $1,088,961. Turning to electrical instruments we find another gain, though not quite so large, the total being $4,962,072 in 1905, as compared with $4,861,204 in 1904, and $4,206,617 in 1903. As will be seen the gain is $100,000 over last year, and $750,000 over 1903. If the exports of electrical machinery and instruments be added together, the respectable total of no less than $12,253,904 is reached. This is at the rate of over one million dollars a month. We believe that with persistence and well-directed effort this could be increased to two and three times as much. The general world consumption of electrical apparatus has barely begun, and customers await in all parts of the globe.

DIRT VS. ILLUMINATION.

There is probably no greater enemy to the efficient use of electric light than the dirt which accumulates in a short time on all the bulbs, globes and reflectors in the down town districts of our large cities. It is not enough that some of the energy in the coal must be lost up the chimney in the shape of smoke and soot, but some of this unconsumed carbon, after having escaped at the steam boiler end of the transformation of energy, must, forsooth, go and attach itself to the incandescent lamp bulb in a final attempt to defeat the efforts of man to transform the energy of coal into light. However, it is not usually the electric light plant chimney which is the offender in the production of smoke, but the multitude of small chimneys. Seriously, it is not an uncommon thing in large cities, where soft coal is the common fuel, to see 50 per cent of the light wasted on account of an unnoticed coating of dirt on lamp and reflector. This is more likely to be true of lamps on high chandeliers and fixtures than those where close inspection and cleaning can be effected easily by the user. However, it is not our mission to preach cleanliness or godliness to the general public. The desirability of both is admitted. The point to be considered by engineers and architects is that dirt is likely to collect, and this should be one of the things taken into consideration in planning the illumination of any building.

There are many places where the illuminating engineer must plan to avoid the glare of the bare incandescent lamp filament and where some diffusing bulb or globe must be employed. Unfortunately, the most efficient diffusing coverings that can be placed over a lamp are usually the worst dirt-catchers. It almost seems sometimes as if the dirt-catching ability of a globe were in direct proportion to its desirability in other ways, so that, while the efficiency when new may be very high, it will in dirty locations be very low on the average unless the user of the light keeps after the globe religiously with a stiff brush and an occasional thorough bath in soap and water. Next after the above type of globe in initial efficiency, when kept clean, come the sand-blasted and frosted or ground-glass globes, which are also excellent as diffusers and softeners of the light. Ground or sand-blasted glass is not likely to collect much dirt without its being noticed on account of the whiteness of the ground surface. The worst thing about this glass is the difficulty of ever getting the dirt off the rough surface. For this reason it is usually advisable, when selecting ground glass as a diffuser, to use frosted bulb lamps instead of globes. As the lamps are renewed every few hundred hours, the chances for great loss of efficiency by dirt are not as great as they would be with a ground glass surrounding globe which must remain up permanently and which when once dirty must remain so. The initial efficiency will also be higher with the frosted bulb than with a clear glass bulb surrounded with a globe. Of course, by using a surrounding globe with the frosting or sand blasting inside and proper means for closing the top of the globe around the shade holder, such globes can be kept reasonably clean for a number of years. This can only be done, however, where a good dust-tight gasket is used on the globe-holder. We can, to be sure, employ globes of the opal and similar classes which are perfectly smooth and can be perfectly clean; but with most of these globes there is more loss by absorption than with either the ground glass or holophane. Furthermore, these globes are not as good diffusers of the intense light from a filament.

The best that the illuminating engineer can do is to make a selection which he thinks will give the highest average efficiency under the assumable working conditions. The probability that dirt will collect will usually lead him to place lights as far as possible in locations where they are above the line of ordinary vision and, diffusing globes are not necessary. When this is done, instead of enclosing globes, open reflectors can be used which are easily cleaned, easily show dirt, so that they are likely to be cleaned, and give an all around higher efficiency than enclosing diffusing globes. Now that preparations will soon be made for the active fall season, some of our readers in the lighting field may find profit in testing these suggestions. In any case, however, the factor of cleanliness cannot be neglected, and in many instances a system of care-taking by which cleanliness can be maintained to a considerable degree will result in an efficiency as high or higher than may be obtained by replacing present globes by others intrinsically preferable but to which proper attention will not be given. As in all questions where several factors enter, the best solution is only afforded after a consideration of all the factors, and in maintaining an illuminating system the light absorbing property of dirt should not be held too homely a subject for thought and remedy.

THE ADVENT OF THE GAS ENGINE.

We are glad to present to our readers some further account, from Mr. John Martin, of the remarkable gas engine installation of the California Gas & Electric Company, now nearing completion. After all the discussion pro and con regarding large gas engines, and all the information accumulated here and abroad it has remained once more for our brethren on the Coast to get up and act. While Eastern engineers have dubiously wagged their heads and mourned over problems of lubrication or proved to their own satisfaction that depreciation's doleful drain would make gas engines too expensive, the energetic Coast contingent has been getting busy, as is its wont, upon a startling scale. In this instance the choice of gas engines was not primarily so much a matter of economy as of necessity, although it is believed that economy will result. The case in hand was the suppply of power to the United Railroads of San Francisco, without risk of a tie-up on account of trouble on the lines. Although the electric service over the 140-mile line that separates the nearest transmission plant from San Francisco has been remarkably free from interruptions, thanks to the numerous sources of power, the chance of a shutdown on the railways was so serious a contingency that the risk could not be assumed. Nor would a steam auxiliary be adequate unless steam were always up, which would mean prohibitive cost. So after mature deliberation it was determined to take the bold step of installing a huge auxiliary plant driven by gas engines.

Contracts were therefore closed for three direct-connected units, gas engine driven and each capable of delivering 4,000 kw; and this equipment is now nearing completion so that it is expected to be in operation by the first of next year. The engines, aside from their great size, involve some features sufficiently unusual to be of great interest. In the first place they are twin, tandem, double acting engines, so that each crank gets two impulses per revolution while the engines are still running on the ordinary four-cycle scheme. The lubrication is accomplished by feeding the oil to each cylinder at four points by independent pumps during the inhalation stroke. The subsequent compression stroke spreads the oil so that on the power stroke the piston finds its path thoroughly oiled. Another feature of the design which particularly appeals is the sectional jacketing of the cylinders so that a temperature gradient can be established in the cylinder in such wise as to keep down unnecessary losses from the cooling. No details of the governor are accessible, but with two impulses per revolution it should be possible to secure pretty good results, helped on by the 65-ton flywheel. Each complete generating unit, it should be mentioned, weighs 600 tons. The gas to be used is oil gas made from California crude oil. Not only will these units be used as an emergency reserve for the railway service, but they will be regularly employed in connection with the great transmission system in trying to build up the load factor which represents earning capacity. They will thus earn their keep richly even if, as seems probable, they will seldom be called on as a safety reserve.

Now all this is a serious matter for consideration. From report, the guarantees of these engines are of a character that will prove surprising if lived up to. And there is no good reason to suppose that they will not be. Once they are successfully in operation, the value of a gas engine reserve will soon be made manifest. In the matter of convenience, the gas engine is in a class quite by itself. It can be called into action in a couple of minutes, and unless all signs fail can produce power at a very low rate. We will not here attempt to discuss the relative cost of power produced by gas engines and steam engines; indeed the advocates of each have thus far failed to get upon a common ground of discussion, each flatly denying the facts taken for granted by the other. But it is perfectly clear that if the big gas engine can operate at the cost claimed for it, or anywhere near that cost, the steam engine has to take the losing end of the game. To beat out the gas engine on the data now at hand one must deliberately take the position that these data have been misread or falsified; and that is pretty dangerous ground. The operation of these big San Francisco engines will go far toward settling many mooted questions of cost if the operating data are made public, as we hope they will be. It would be a strange freak of fate if the recent improvements in steam practice should turn out to have been made just too late. Even at nearly equal costs, the gas engine has the advantage of quick availability, a feature which goes far to offset its relatively low economy when underloaded. At all events, used as it is proposed in San Francisco, to hold up the load factor, there will be no excuse whatever for running on light loads. We are certainly getting near to revelations on the subject of gas engines, and the engineering public will watch with the keenest interest for reports from this great pioneer plant, for such it is as regards the larger aspects of the case.

Electric Waves and Maxwell's Ether.

The July number of the *Journal* of the Franklin Institute contains a paper, by Prof. W. S. Franklin, which embodies a discussion of electric wave propagation from the standpoint of Maxwell's electromechanical theory of the universal ether. The universal ether has never possessed any experimental right to exist. No one has ever yet seen, felt, or tasted it. It is probably correct to say that there is not a single observation, or recorded experiment, which brings the ether home to our senses as ether. Nevertheless, we all believe that it exists, because our minds cannot grasp action across a void, and in order to make our mental conceptions work, we are obliged to create a something out of nothing. We cannot imagine, for example, that the sun's light, which we know by observation takes about 500 seconds to reach our planet, "does time" in empty space, or spends these 8 minutes in nothing—doing nothing. Again, the space within a highly exhausted glass tube cannot, in our minds, be regarded as empty of everything; for if we place the tube inside an electrically excited solenoid, we can ascertain that magnetic energy exists in the tube. We are unable to think that magnetic energy can exist in nothing. To meet these and numerous like difficulties, the ether has been invented.

Once having adopted the ether, its duties develop at an astonishing rate. It has to fill all space, or stretch out to infinity in all directions, without any holes or blank cavities. It must permeate all substances to the innermost, more thoroughly even than water permeates a submerged sponge. The motion of matter must give rise to no displacement in the permeating or environing ether. The ether must be capable of absorbing electric and magnetic energy, and of transmitting gravitational stresses. Electromagnetic energy must be propagated through it at a uniform and definite speed. All of these properties must be everywhere the same; to ranges of billions of miles, so that the ether in which the earth floats next year must be, within measurable limits, identical in behavior to the ether in which the planet floats to-day, for the entire solar system is supposed to shift its position in space by half a billion miles per annum. It must be admitted that an ether which can do all this is a very remarkable entity. Speculations as to what it can be like have been ripe for many decades. Some estimated that it was jelly-like. Others preferred to suppose it made up of distinct grains like extremely small shot. The astronomer wanted one kind and the electrician wanted another. Some scientists postulated for it a rigidity much greater than that of steel, together with a tenuity much below that of the rarefied gases in a Crookes tube.

Clark Maxwell ascertained that the numerical properties of electric wave propagation through space were parallel with, or similar to, the properties of wave propagation in a jelly-like elastic fluid. He invented a mechanical kind of ether which would transmit electric waves like those of light. He imagined all space to be filled with ether-cells like minute marbles. These marbles are alternatively positive and negative, in such a regular organized manner that only oppositely signed cells are in contact. There is no mechanical friction between all these cells filling up the universe; but if any one cell is rotated about its center, all of the neighboring oppositely signed cells in contact with it will also move, as though geared by cogs. A magnetic field is a region in which these ether cells are all rotating, the positives one way and the negatives the other. An electric field is a region in which the positive and negative cells are elastically displaced with reference to each other. Assuming then that the cells have mass and inertia, the properties of electric waves and their propagation can be discovered in the ideal mechanical model ether thus organized. It may be permitted any honest man to doubt the existence of this cog-sphere ether, without being guilty of heresy. We do not suppose that Maxwell ever believed that the ether was built up of alternate positive and negative cog-spheres. As to the real nature of the ether, we are as much in the dark as ever. But if the Maxwell theory offers an ideal machine whose actions can be followed in imagination to a final result, which is the same as that of the actual but unknown machinery, we are justified in using the ideal mechanism merely to assist our ideas. It does not follow that because we consider the actual mechanism is different from the ideal mechanism, we must avoid all use of the latter as a tool. This is Prof. Franklin's position as we understand it.

The article develops the cog-sphere theory to account for the behavior of electric waves over wires, and finds help from the mechanical actions of the systems constructed. The particular value of a mechanical working theory in such inquiries is, however, an individual matter, like æsthetics. What will best aid and satisfy one mind, will not necessarily be most acceptable to another. For example, the theory of electromagnetic waves developed in the works of J. J. Thomson is mathematically equivalent to the cog-sphere theory, but accomplishes the result by purely symbolic methods. One of the salient peculiarities of either the Maxwellian cog-sphere theory, or of any of the methematical theories of electricity, is that whereas an electric stress can be pushed through free space, or through a dielectric space, it cannot be exerted through a conductor. This means, according to the modern views of matter, that whereas an electric stress may be excited through the ether, it fails to pass, or slips, when exerted through organized ether, or matter of a certain kind, which we call metals or conductors. According to the cog-sphere theory, the ether-cells in the substance of a copper wire are devoid of cog projections, or have smooth contiguous surfaces, so that the rotation of the cells outside the wire produce slip at or within the surface of the wire. The paper draws attention to the fact that whereas practical electricians are well aware of the generation of electromotive force by the movement of a magnetic field, as in dynamos, they are not so generally aware of the converse proposition of the generation of magnetomotive force by the movement of an electric field. That is to say, if an electrostatic field is moved rapidly through space in any direction not parallel to itself, a magnetic force will be generated in and across the field. This remarkable fact seems to be incontrovertible from a theoretical standpoint; but it has only recently been established experimentally beyond dispute, and the effect is but a feeble one. No use of it has yet been made. The first proposition is of great practical importance, since all our dynamos are based upon it. By attaining a speed of sixty meters per second in a field of 12.5 kilogausses, as in some homopolar machines, the e.m.f. due to the motion will be ¾ volt per centimeter, or nearly 2 volts per inch. But with the strong electrostatic field of 3 kilovolts per millimetre, which is approaching the breaking stress of stationary air, and the same high speed of 60 metres per second, the magnetic intensity produced would only be about 20 microgilberts per centimeter. It is hard to see what use could be found for so extremely feeble a magnetmotive force, when a coil of wire carrying an electric current is relatively so much more powerful. The practical men may, therefore, be forgiven for losing sight, as a rule, of a proposition, which however interesting scientifically, promises so little utility.

Telephone Service and Rates in New York City.

In April, 1904, the Merchants' Association of New York City, with the object of bringing about, if possible, a reduction in the rates of service, took up the question with the New York Telephone Company and appointed special committees to carry on an investigation as to the different branches of the subject. Mr. U. N. Bethell, general manager of the company, placed the records and system of the company at the disposal of these committees for their investigation, either personally or through experts, and after a series of conferences the work of inquiry was taken up upon the understanding that the telephone company would agree to a readjustment of rates upon an agreed equitable basis if it should appear that such an adjustment was warranted by the facts disclosed.

The association has now issued a voluminous report to its members and to the public, giving in great detail information and data as to the scope, nature and results of its investigation. It was found by the examination of the Audit Company of New York that the average percentage of net earnings to investment for the 15 years to December 31, 1903, was 10.89 per cent, and for the 16 years to December 31, 1904, 11.12 per cent; while for the year 1904 the figure reached 14.64 per cent. The period of 16 years was chosen because it witnessed the complete conversion of the plant from an overhead single-wire system to an underground metallic circuit system, and from the magneto call local battery system to the automatic common battery system. In that period also the system had grown from some 12,000 to over 150,000 subscribers' stations. Upon the basis of this showing, which tended to prove that the percentage of net earnings was rising, the committee concluded that the time had arrived when the public should be given the benefit of a further reduction in telephone rates, and it proposed that the reduction should be on such a scale as to bring the present rate of earning to about a 10 per cent basis. The New York Telephone Company acceded to this proposal, and the readjustment of rates to reduce the net revenue to such a basis was at once begun by the company and carried into effect expeditiously. All subscribers were given the benefit of the new rates regardless of their existing contracts at higher rates. As a matter of fact, the report of the Audit Company shows that while the agreement with the Merchants' Association would carry with it reduction in income of not more than $1,075,000, the reductions actually put into effect for 1905 reach a total of $1,525,000.

The report enters into a very interesting discussion as to the methods upon which a fair charge for telephone service may be based and takes up various questions connected with telephonic financing, engineering and economics in general. As to the New York Telephone System and its relatively high charges as compared with other parts of the country, the report states that improvements and changes have succeeded each other at remarkably short intervals, so that during the 16 years covered by the investigation the whole plant had practically been rebuilt three times, involving necessarily a high ratio of capitalization, as well as a concurrently high rate of depreciation. Some of the central exchanges had, in fact, been rebuilt three times within a period of little more than 10 years. Having in view these facts, as well as the constant expansion of the service and the necessity of offering an attractive investment to new capital, it was the opinion of the committee that to allow a fair return on capital actually and necessarily invested, as well as a proper allowance for contingencies, a 10 per cent margin above operating outlays was only a reasonable and proper one in the telephone industry.

In the discussion of reasonable rates, it is pointed out by the committee that the subject is an extremely complex one, and the difficulty is to find factors in different places which are similar, so great are the variations in almost any item which may be selected for comparison. For example: There are differences in the quality, range and quantity of service rendered, and particularly in the methods of charging for the service. There are differences also in the number of subscribers who take different grades of service. In the eighty American cities having a population of over 50,000 the ratio of residence telephones to the total number of telephones varies from 15 per cent to 71 per cent; of party line telephones to total telephones from 4 per cent to 84 per cent; of private branch exchange telephones to total telephones from 1 per cent to 41 per cent; and of extension telephones to total telephones from 4 per cent to 13 per cent.

Another striking difference in conditions peculiar to the telephone business between large and small cities is mentioned. In a small city a single central station suffices for prompt intercommunication between two or three thousand users or individual stations. A single switchboard and single operator completes each connection called for, and the area served being comparatively limited, the wire-mileage is relatively small. In large cities such simple conditions do not, and in the very nature of things, cannot, exist. For example, in the Borough of Manhattan, seventeen central stations are required. Each of these must not only provide for intercommunication between the individual stations directly attached to it (the average number being over 8,000), as in the case of the single central station in a small city, but must also provide for prompt intercommunication with sixteen other central offices and over 140,000 individual stations outside its district. Thus, each central station, besides the equipment required for service within the district, must have sixteen distinct auxiliary cable systems connecting it with sixteen other districts. Every new central station that is added compels every existing central station to install additional connecting central office apparatus and an additional connecting cable system to afford intercommunication between every district of the entire system. This connecting plant, and the labor required to maintain and operate it, are not represented by any corresponding factors in a small city having but a single central station.

The report also entered into the question of the method of readjustment and distribution of rates, and is very strong in its condemnation of the flat rate as a basis. The committee considered that in large cities the flat rate with unlimited service is based upon a fallacy, is extremely unjust to small users, favors large users unduly, impedes expansion, tends to inefficient service and is unsound as a financial proposition. At the same time, it is admitted that in small places the flate rate system might prove fairly equal to all subscribers as the conditions would not permit any very extreme variations in any of the contracts. The measured service basis is approved of by the report, beginning with a relatively high maximum rate for small users and declining to a relatively low minimum rate for large users. A telephone station and its collateral equipment represent a definite capital outlay, as well as a continuous outlay for the maintenance of an operating staff in readiness, irrespective of the number of calls made. The message rate must provide for this fixed charge and if the calls are few must be relatively high. It is pointed out in the report that in a large area, such as New York City, the public interest is best served by the application of various rates to the different localities so as to meet the peculiar requirements of each section The method of treatment followed in Greater New York has been upon this plan, and the general rates for local service in all of the outlying sections are much less than those in the great Borough of Manhattan, rates in some sections being as low as $24 a year for unlimited local service. In addition to the rates for local service an extra or toll rate is charged for connection with other districts so that the extra rate is imposed only upon those who make use of the extra service. The report shows that in May, 1905, with 148,595 telephones in use, the rates for business telephones were $135 for 2,400 messages; $87 for 1,200, and $60 minimum. In 1894 the corresponding rates were $240, $166 and $150. Equivalent and even greater reductions have been made in the rates for residence telephones.

Some sections of the report are devoted to the consideration of the telephone service given in New York City, and various disinterested authorities are cited who describe the service as unequaled in the world for general efficiency and effectiveness. A report in detail is also presented from Westinghouse, Church, Kerr & Co., on the method employed by the New York Telephone Company in recording local calls, and the technical details show that there have been questionable cases of counter registration in six months of about one-tenth of one per cent of all the counters in service, while the cases it was necessary to adjust were less than one-fiftieth of one per cent. In fact, it is said "The probability of error appears to be reduced to a minimum, and such as may occur seem even more likely to count against the Telephone Company, and in favor of the subscriber." In other words, the automatic recording system designed by the Western Electric Company substituted for the older ticket system is approved by the committee and its experts as being a great advance in that it lessens the demands upon operators, permits them to give uninterrupted attention to the answering of calls and dispenses with much clerical assistance.

One section of the report deals with the question of regulating rates by competition and upon the results of competitive service in any given community. The views of the committee would seem to be that rival systems involve an economic waste and the general conclusions may be quoted as follows: "It is obvious that two systems involve extensive duplication of plant and organization, which entails a heavy additional burden of fixed charges and operating expenses, much of which would be unnecessary if the service were performed by a single system. This duplicated outlay, being in excess of the amount really necessary to perform the service, is an economic waste. In telephone operation no compensatory benefits to users in the form of lesser cost of service or increased efficiency have yet developed to justify this waste. The dangers coming from it are easily seen. Unless it is provided for in the charges exacted from consumers, the capital investment will be gradually eaten up. In the meantime, as abundant experience in railroad competition has shown, equipment will be permitted to deteriorate, operating expenses will be reduced below the proper limit, and the efficiency of service will be lowered.

"In the opinion of this committee, competition in telephone service is not a public benefit, and not a useful means of regulating charges. As shown above, little or no benefit accrues to any part of the public in the way of reduced rates, many consumers are compelled to increase their aggregate outlay, the utility of the service is cut in half, expansion made difficult, the efficiency of the service threatened and the capital investment endangered. Competition in telephone service does not offer a choice of benefits, but compels a choice of evils—either a half-service or a double price."

Consolidation of American Street Car Builders.

Long talked about, a consolidation of American builders of trolley cars has at last been effected, according to announcement made by Kean, Van Cortland & Co., of New York, who are to finance the new organization. Nineteen companies will be taken over and capitalized under a new company at $43,000,000. The name of the new company has not been decided, but Mr. G. Martin Brill, of the J. G. Brill Co., of Philadelphia, will be president. It would seem that responsibility for the promotion of the scheme lies mainly with W. T. Van Brunt, president of the St. Joseph & Grand Island Railway, president of the Furnaceville Iron Company and associate of E. H. Harriman. The companies to be taken over are: J. G. Brill Co., John Stephenson Co., Laclede Car Company, St. Louis Malleable Casting Company, American Car Company, G. C. Kuhlman Co., Cincinnati Car Company, St. Louis Car Company, Wason Manufacturing Company, Osgood, Bradley & Sons, John J. Cummings Car Company, Jewett Car Company, J. M. Jones' Sons, agents; Laconia Car Company, McGuire-Cummings Manufacturing Company, Peckham Manufacturing Company, Niles Car Manufacturing Company, Journal Bearing Company, Easy Access Door Company.

The circular issued by Kean, Van Cortland & Co. descriptive of the plan, does not state the terms at which the companies are to be taken over. The capital of $43,000,000 will consist of $15,500,000 6 per cent cumulative preferred stock, and $27,500,000 common stock. A $13,000,000 issue of first mortgage and collateral trust sinking fund 5 per cent, thirty-year bonds is proposed; $11,000,000 to be issued upon the formation of the company, and $2,000,000 to be reserved for future requirements.

The annual average of net earnings of the constituent companies is put at $1,263,391, and the estimated earnings of the first year of the consolidated company will amount to $2,400,000, the promoters say. The company will be organized and the properties transferred to it under the supervision of the attorneys, Davis, Stone & Auerbach and Guthrie, Cravath & Henderson. It is estimated that the consolidated company will acquire quick assets of $6,400,000, consisting of cash, raw materials, cars and accounts receivable, also many valuable patents and patent rights, by the control of which considerable patent litigation will be avoided. Great economies are expected for concentration of plants and manufacturing at strategic points for delivery.

Electricity at the Liege Mining Congress.

At the Paris Exposition in 1900 there were shown only two or three small electric furnaces with a few samples of all the metals or alloys produced by electricity. At the recent Liege Exposition and Mining Congress, however, there were displayed large steel ingots, blocks of ferro-silicon, chrome iron and other alloys, obtained electrically. A paper by Robert Pitaral, of Paris, pointed out that the great advantage of the electric furnace resides in the high temperature which it affords—namely, 2,000 to 3,000 degrees C. Hitherto the electric process has been possible only for making steels of high quality. It is economical for pig irons when the electric power is cheap and fuel is very dear. It is apparent, however, that in any case the electric furnace will be employed hereafter at the end of the usual refining operations. Gustave Gin, of Paris, stated that the electric furnace is capable of giving all of the series of steels, and will probably serve for making high-class metals. In the making of steel, the electric process has the following advantages over the open-hearth process: A much greater concentration of the heat, permitting the utilization of far smaller spaces; a more methodical and more controllable working, and the avoidance of contact between the metal and the gases, which are often not entirely reducing.

For driving roll trains L. Creplet, engineer of the Société International d'Electricité, Liege, advocated the use of continuous-current motors. There are already several applications in Belgium. The Grievegnée Company uses a merchant mill driven by a compound-wound motor that can develop from 450 to 900 horse-power, and the Providence Company has another capable of from 500 to 1,000 horse-power. The Ougrée-Marihaye Company (which has already applied this improvement) will in a few months have in use a roll-train motor of 1,000 to 1,500 horse-power, capable of direct driving at 75 to 135 revolutions per minute. M. Greiner, general manager of the Cockerill Works, Belgium, stated that the problem of driving roll trains electrically is already solved from an economical point of view, and he expressed the opinion that the best solution is central electric generators driven by gas engines, and each roll train driven by its own motor.

Consolidation of Pole Lines at Los Angeles.

The electrical companies operating in Los Angeles have entered into an agreement to consolidate and combine their pole lines, with the result of abolishing more than half of the poles now in use in that city. The parties concerned are the Pacific Light & Power Company, the Edison Electric Company, the Los Angeles Gas & Electric Company, the Los Angeles-Pacific Railway, the Pacific Electric Railway, the Los Angeles Railway & Interurban Railway, the Sunset Telephone Company, and the Home Telephone Company. The completed plans have been more than a year in the making by Mr. E. A. Beck, superintendent of the Pacific Light & Power Company, who has devised a form of agreement to which all could conform.

The system finally decided upon is absolutely unique in corporate history. A clearing-house is to be established for the consolidated companies and an extensive system of regulations and business by-laws has been drawn up, to which all of the companies must conform and enter into contract for, just as they would to formal articles of incorporation. The clearing-house will be maintained in a separate office, and will be ruled over by a committee, made up of the managers of the different companies, who will meet once a week for the transaction of business. The committee will have a secretary, or secretaries, as they find one or more necessary, who will work solely upon inter-corporation business, and to whom all orders, pole reports and plans for change will be referred. There will be three main agreements, the final details of which are yet to be completed. The first will be between the lighting companies and the street railways, the second between the two telephone companies, and the final btween the parties of the first, and the parties of the second part.

The telephone companies will go by themselves, and telephone wires will be upon telephone poles alone. While light, power and railway cables will be upon one side of the highway, the telephone systems will rise upon the other, in combination, and thus the trolley wires will find their usual suspension.

One of the articles of agreement is this: In combination of the old lines, the companies will use the system having the highest poles. This settles definitely one point—as to whose poles should come down, and whose poles should stay up. All poles in the combination are to be neatly planed, uniformly painted and stepped according to the standard method.

Each party to the pact will maintain his own corporate system of wires, but by a clause in Beck's constitution and by-laws, the company on top—a coveted position—is to maintain the pole. A uniform price has been fixed, and will probably stand at 35 cents per foot, which all parties coming into the combination are to pay, and thus general expenses are to be shared.

In the matter of transmission lines, other than the regular lines, the agreement also contains a clause: Each party owning a transmission line on top of the pole—the usual place for it—must own two shares of the pole's value. Thus, if a railroad and a lighting company are on the same pole, and the railroad has a feeder running along on top, the railway must own two-thirds of the pole's value But if another electric company comes into the combination, the railroad will only have to own half the pole's value—still two shares of it.

Preservation of Electrical Poles.

Attention has already been called to the work of the U. S. Bureau of Forestry, in co-operation with the American Telephone and Telegraph Company and the Postal Telegraph Cable Company, to find the best methods of seasoning telephone poles and of treating them with preservatives. Fifty green poles were furnished every month to each of five experimental stations. Each pole was exposed to the open air and was weighed every month until it ceased to lose. The rate at which weight was lost showed the rate of seasoning in different months.

After one year of seasoning preservative treatment was applied to the poles, beginning last spring. Most of those at two of the stations—Wilmington and Pisgah, N. C.—were treated by applying the preservative with a brush. In a few cases a cap or plate was fitted to the butt of the pole and creosote forced in by a pump, but with unsatisfactory results.

To test the efficacy of the treatment as a preventive against decay the poles, carefully numbered and labeled for identification, have been set in an experimental section of the American Telephone and Telegraph Company, between Savannah and Meldrim, Ga. Each treated pole is set between a green and a seasoned pole, so that the absolute and relative values of the different preservatives will be fully tested.

At Dover, N. J., in addition to the external applications, a number of seasoned poles were treated in an open tank, constructed to take thirty-foot poles inclined at an angle of 20 degrees. In this tank they are boiled in creosote for several hours. They are then either shifted to a tank of similar construction containing cold creosote, in which they stand for several hours, or are left in the hot oil to cool down gradually.

A College of Municipal Ownership.

According to advices from that city, Chicago is to have a new educational organization devoted to the subject of municipal ownership. The plans have been perfected during the last few days and, according to the recent information, the courses will be opened to the public next autumn. The undertaking will start with an ample endowment supplied by several citizens, who are known collectively to the public as the "Dunne Machine." The work of the "Municipal Ownership University" is to be modelled after the extension lecture course in the department of the University of Chicago. The endowment will be devoted to the organization and support of a lyceum as a medium for explaining the problems of municipal ownership to the people, free of charge.

A municipal ownership extension centre will be established in each of the thirty-five wards, and subsidiary centres in as many voting precincts as the demand warrants. The lecturers will appear at these centres in rotation during the next year and a half—until the next city election. A part of the plan is to explain to the people that municipal ownership may be attained by re-electing Mayor Dunne indefinitely until success shall crown his efforts.

Mayor Dunne has selected for the head of his institution City Prosecutor Howard O. Taylor, who formerly was a clergyman and is customarily addressed as Dr. Taylor. The Mayor delegated the organization of the enterprise to Dr. Taylor some weeks ago, and it is understood that the plans are practically completed.

Judge Murray F. Tuly is to be chancellor emeritus and will conduct seminars in municipal ownership theory for more advanced students. Mayor Dunne, it is understood, will lecture frequently. This all sounds like a joke, but is given out as serious news.

A Sketch of Multiple Unit Railway Development.

In the second and concluding section of his interesting narrative of electric railway development, in the *Century Magazine* for August Mr. Frank J. Sprague gives the following historical sketch of the introduction of the multiple unit system:

Pondering over the elevated railway train problem one day, the thought suddenly flashed upon me, Why not apply the same principle to train operation? That is, make a train unit by the combination of a number of individual cars, each complete in all respects, and provide for operating them all simultaneously from any master switch on any car. This idea, sketched on a scrap of paper, marked the complete birth of this new method, then named and now nearly everywhere known as the "multiple unit system." Its great possibilities instantly absorbed my interest, as I saw the opening of a new epoch in electric railway operation. Here was a way to give a train of any length all the characteristics of a single car, with every facility of operation which could be demanded by the most exacting conditions of service and capacity.

After two abortive attempts to get the privilege to demonstrate the advantages of the system at my own expense on the Manhattan road in New York, an unexpected opportunity suddenly arose in the spring of 1897, when I was requested to act as the consulting engineer of the South Side Elevated Railroad of Chicago. A brief inspection of the layout showed a field ripe for multiple unit application, which I briefly explained to Sargent and Lundy, the engineers, and to Mr. Clark, of the General Electric Company, fortunately all old friends. I hastily drew up a report, the main feature of which was an argument in favor of the abandonment of locomotive cars, and the adoption of individual equipment under common control—in short, the multiple unit system. As an earnest of my confidence, I supplemented the report by an offer to undertake the equipment of the general plan outlined, which met with the indorsement of the engineers. This was followed by a visit to Chicago; but the contract was not concluded until after I left for Europe, and then only after a very bitter fight with various companies, and under most onerous conditions, supplemented by a $100,000 bond for performance.

Among other things, I was immediately to begin work on the entire equipment, and to have six cars ready for operation in two months, on a standard track supplied by me, the manner of making the test to be prescribed by the officers and engineers of the road, and to be to their satisfaction. Should the test be not concluded by the date set, or be unsatisfactory, the contract should be cancelled. Satisfactory further tests should be called for elsewhere, and the remaining equipments were to be completed by specified dates. As soon as the power house and road were ready there was to be another test of not less than twenty equipments under service conditions for a period of not less than ten days. Should these equipments prove unsatisfactory, the right remained to cancel the contract and to require waiver of all claims against the company.

I did not return to New York until about the middle of June, so that most of my instructions for the trial equipments were by cable, and the actual preparation was made within thirty days, despite a wholesale strike of the machinists employed in the shops of the new Sprague Electric Company, which soon took over the contract.

On July 16, 1897, two cars were put into operation on the tracks of the General Electric Company, at Schenectady, and on the 26th, the half-century anniversary of Prof. Farmer's test of a model electric railway at Dover, N. H., my ten-year-old son operated a six-car train in the presence of the officers and engineers of the South Side Elevated Road at Schenectady.

In November a test train of five cars was put in operation in Chicago, and on the 20th of April following twenty cars, seventeen of which (one in flames) were taken off during the day because of defective rheostats; but with the last three-car train I had the satisfaction of pushing a steam train around a curve. Three months later, a year after the Schenectady test, locomotives had been entirely abandoned, and the whole 120 cars were in operation, the local work being largely supervised by my assistant, Frank H. Shepard.

The system, with sundry changes in detail, has now been universally adopted for electric train operation on underground, elevated and suburban roads, and the largest present enterprise in substitution of steam operation, the electrification of the New York Central terminals and a portion of its main line, is likewise dependent upon it. There not only the suburban cars, but the great locomotives supplied by the General Electric Company, of 2,200 hp capacity, and weighing 100 tons, are to be controlled on the multiple-unit plan, so that two or even three locomotives, representing an aggregate of several thousand horse-power, under simultaneous control, can be put at the head of any train which may be made up.

Cables and the Island of Yap.

An interesting communication from Washington as to the cable system in the Pacific appears in the New York *Evening Post*. It makes the following remarks as to the island of Yap.

For the meeting place of railroad lines to become an important town, as a creation of their own map-making, has long been common. Similarly the ocean cables in this age are assuming an importance that permits them to give world prominence to any distant island of the sea which lends itself to their uses as a junction point. To-day little Yap, east of the Caroline Islands, but not of them, and about nine degrees north of the equator, has become the most interesting point on the face of the globe in this respect. Three great cable companies have already put wires into Yap, and a fourth one is in contemplation. There they will exchange their messages—transship them, so to speak. Its harbor will be developed into a considerable port of call, since information is a commodity in the modern world influencing the course of navigation almost as much as any article which contributes to the cargo. The completion of our trans-Pacific cable, via Honolulu and Guam, radically affected the ocean lanes of the Pacific. So the developments now in progress at Yap promise to make it a famous town of the future, although its present reputation is chiefly associated with the strange performances of one O'Keefe, one-time "king."

Yap has cable communication with the Island of Jaluit in the Marshall group, connecting it with a great and rapidly growing German system. It has been connected with the American cable line at Guam, which is not far away. It has also been connected with the Dutch East India Company at Meando, which is at the northern extremity of the island of Celebes. It will soon be connected with the British cables at Shanghai. The ship that touches at Yap can thus secure direct communication through the great cable systems with every port in the world.

The development at this German island is of considerable significance in world politics. The Germans will thus flank our connections with the dependencies of the East, paralleling our route to the Philippines by way of Honolulu and Guam, for over a thousand miles, by a cable connecting a chain of islands under the German flag.

Electric Motor Service in Scotland.

In his recent presidential address before the Incorporated Municipal Electrical Association, Mr. F. A. Newington, chief electrical engineer, of Edinburgh, Scotland, said:

"One of the aims of a municipal electrical undertaking is to utilize the machinery during the day time as much as possible, and therefore electricity for power or heating purposes is sold at a low rate. But there is a weak point in this arrangement. The motors are using during the time of maximum lighting load during the winter months and, therefore, additional machinery must be provided for them. If we can arrange for the motors to be switched off during the two or three hours of maximum load for lighting in the four winter months, extra machinery will not be required, so a very low rate can be charged. This system is just now being adopted in Edinburgh, and is also in force in a few other cities.

"On analyzing the consumption of electricity by motors, it is generally found that the load factor is extremely low. The following figures show the average number of hours a day during which the total power installed is used for different classes of work in Edinburgh:

Purpose.	Total hp. installed.	Full load, hours per day
Elevators	610	.9
Butchers and bakers	180	1.27
Printing works	1327	1.52
Breweries	247	1.13
Joiners and builders	1057	1.85
Engineering works	981	2.08
Laundries	40	2.87
Aerated water works and bottling stores	28	3.27

"Unfortunately, these figures refer to kilowatts installed, not to maximum kilowatts required, but they show that the whole plant would only be used for an exceedingly short time each day. From these figures it is quite certain that the total power used at any one time is not half the power installed, and so the hours per day can at least be doubled, but even then the load factor would not be good. As the cost of generating electricity will be in inverse proportion to the load factor of the motors, this should be considered when fixing the price of electricity for power purposes."

Programme for Municipal Electricans' Convention.

The annual convention of the International Association of Municipal Electricians is to be held at the Reed House, Erie, Pa., August 23, 24 and 25. Secretary F. P. Foster, of Corning, N. Y., sends us the following programme: "The Effects of Electrostatic Influence in Telephone and Telegraph Circuits," H. R. Allensworth, Columbus, Ohio; "The Advisability of Fusing Fire and Police Telegraph Boxes," C. E. Diehl, Harrisburg, Pa.; "Electric Light Engineering," A. S. Hatch, Detroit, Mich.; "Erection and Maintenance of Electric Lighting Plants," C. L. Williams, Meridian, Miss.; "Suggested Improvements in Fire Alarm Telegraph Systems," Capt. Wm. Brophy, Boston, Mass.; "The Necessity of a Rigid Inspection by the Municipality," T. C. O'Hearn, Cambridge, Mass.; "Underground Construction," Louis Gascoigne, Detroit, Mich.

CURRENT NEWS AND NOTES.

ILLINOIS STATE ELECTRIC ASSOCIATION.—Mr. D. Davis, Litchfield, Ill., secretary of the Illinois State Electric Association, states that the next annual meeting of that association will be at Peoria, October 5 and 6.

TELEPHONE UNDER WATER.—Under the provisions of a bill passed by congress for the establishment of a system of submarine signals along the Atlantic Coast for the prevention of shipwrecks and for signaling to naval vessels, the sub-marine telephone is being tested at the Boston navy yard.

CANADIAN MUNICIPALITIES.—The fifth annual convention of the Union of Canadian Municipalities is being held during the current week at Winnipeg, Man. A number of papers are listed dealing with municipal topics, one or two of them discussing municipal ownership, and one the work of the parliamentary telephone committee.

FRENCH CABLE IN VENEZUELA.—A cable from Caracas to the New York *Herald* says that the Venezuelan authorities have instituted proceedings against the Compagnie Francaise des Cables Telegraphiques (the French Cable Company), for damages incurred by the government through the cable company's alleged participation in the Matos revolution.

A STREET CAR FARE TAX.—Mr. A. Sato, a member of the Japanese peace embassy, in an interview on his arrival in New York, said that the war taxes had not oppressed the people. "One of the taxes is on street car fares. The ordinary fare is 1½ cents, and on every ticket sold there is a ½-cent tax, collected by means of a special coupon attached to the ticket. A curious thing is that if you buy one ticket you have to pay the full ½-cent tax, but if you buy 100 tickets at once, the tax is only 5 cents."

DEVELOPMENT OF PERU.—The city of Iquitos, Peru, is to have an electric lighting plant, and a wireless telegraph station communicating with Puerto Bermudez. The city of Asuncion, capital of Paraguay, is also to have an electric light plant.

WATER POWER IN SPAIN.—The Sociedad Electroquimica de Flix (Tarragona Province) has received the concession to take power from the River Ebro at the rate of 80 cubic meters of water per second. The installation must be commenced within five months.

TELEPHONES TO TEACH DEAF MUTES.—The Board of Education of Cleveland, Ohio, will install telephones in the Willson Avenue School for the Deaf to instruct children who are able to distinguish sound in a slight degree. The plan was suggested by its success in an institution for the deaf at Rochester, N. Y.

BRYAN ON TELEPHONES.—At Lima, O., a week ago, in an interview, Mr. William Jennings Bryan declared for the municipal ownership of telephones and said: "A city should have but one telephone system. More than one works an unnecessary hardship upon the business and professional people. One system of rural telephone service is sufficient, and that should be owned by the county, and the city should own its system."

ELECTRIC FANS.—U. S. Consul-General Wright, of Munich, Bavaria, mentions electric fans as one of the American specialties that could be introduced and pushed to advantage in Switzerland, Southern Bavaria and the Tyrol, where, as he says, the increasing number of tourists, particularly Americans, has made it necessary to have more of the modern improved appliances for comfort. Almost all of the resorts have electric current available from water power.

THE MANILA TROLLEYS.—From correspondence in the London *Chronicle* we take the following: "We were fortunate enough to land in Manila on the very day when the new electric trams were opened. There are 50 miles of rails, all installed on the latest Yankee plan. The streets were crowded with Filipinos, Spanish, Chinese, etc., staring in wonder at the novel sight. 'No pushee, no pullee, go like hellee!'" Could Kipling himself put it more graphically than does that touch of pidgin English?"

N. E. L. A. PUBLICATIONS.—There has been a brisk demand for the excellent Question Box and Wrinkles publications of the National Electric Light Association this year, from members who do not wish to wait for the final bound volume of transactions. Mr. W. C. L. Eglin, the secretary, announces that it has been decided to meet this call for extra copies by furnishing them in paper, at a cost of $1.25 for the two books. Orders should be sent to the Association office, at 136 Liberty Street, New York City.

THE MURGAS WIRELESS SYSTEM which was described recently in these pages, was tested satisfactorily last week between Wilkesbarre and Scranton, Pa. The tests were conducted by Father Murgas, Joseph F. Stokes and Ferdinand Muckley, of Philadelphia, who are backing him, by Mr. E. W. Stevenson, the electrical expert, and some expert telegraphers. The test was between the station in Wilkesbarre and the one in Scranton, and the first message sent over the wire was "Thank God for His blessings." Other messages were sent. Father Murgas receives a lump sum for his patent and also gets royalties.

SUBMARINE BELL SIGNALS.—It is stated from Canada that the River St. Lawrence is not to have the benefit of the submarine bell signals which were contracted for some months ago by the Dominion Government. At a recent meeting of the Shipping Federation of Canada the matter was gone into and the decision was arrived at that the seagoing shipping of the St. Lawrence would not adopt them. It was contended by members of the Shipping Federation that while there was no question of the system being an aid to navigation in the St. Lawrence between Montreal and the sea, the expense incurred by steamboats, by the establishment of the system on board each vessel, was such that they could not afford to take it up. It appears the owners of the submarine signal company, of Boston, proposed to charge each steamship $500 for special equipment of the coast line down through the gulf.

A TWO-BLOCK TROLLEY LINE.—The Williams Terminal Railway Company, of Brooklyn, has been incorporated at Albany with a capital of $10,000 to operate an electric surface line from the tracks of the New York Dock Company on Bowne Street to the property of J. H. Williams & Co., in Richard Street, Brooklyn. The railroad is to be used for transferring freight. It is to extend for two blocks and connect with the freight shifting road of the New York Dock Company, which runs along the water front. It will handle forgings.

THE EDISON BATTERY.—In an interview in Philadelphia last week, Mr. Edison made some interesting statements about his recent storage-battery work: "By October my light battery will be ready for the market and we shall be ready to equip automobiles of all descriptions," he said. "To reach a definite conclusion of its possibilities I manufactured 14,000 cells, and equipped about 160 conveyances of all descriptions. In Washington we attached the batteries to a number of express delivery wagons, with the result that after many months the cost of operation has been found to be 58 per cent of that of horses. The batteries manufactured varied in types, so that I might obtain the happy average I wished to strike, and I am prepared to make the unqualified statement that the Edison battery will revolutionize the storage-battery problem. It will weigh just one-half of the present battery in general use, and will be about the same size, although it stands somewhat higher in its proportion than the other. As to its power, there can be no question. I had a big two-ton car brought to my factory in Orange, where it was fitted with cells, and we took it out and sent it over the roads of New Jersey at 33 miles an hour. The new factory, where the new cell batteries are to be manufactured is being erected in Orange, and automobiles will be built and equipped there."

ALUMINUM PAPER.—U. S. Consul-General Guenther, of Frankfort, Germany, writes: "Aluminum paper is now manufactured in Germany and recommended as a substitute for tin foil. It is not the so-called leaf aluminum, but real paper coated with powdered aluminum, and is said to possess very favorable qualities for preserving articles of food, for which it is used as a covering. Chemical analysis has proven that aluminum paper contains but few foreign substances; occasionally it may contain up to 2 per cent of iron, but never any arsenic or other poisonous metals. Hence it appears that the powdered aluminum used for the manufacture of aluminum paper is relatively pure. The paper used is a sort of artificial parchment, obtained through the action of sulphuric acid upon ordinary paper. The sheets are spread out and covered upon one side with a thin coating of a solution of resin in alcohol or ether. Evaporation is precipitated through a current of air and the paper is then warmed until the resin has again become soft. Then powdered aluminum is sprinkled upon it and the paper subjected to strong pressure to fasten the powder thereon. The metallic covering so obtained is neither affected by the air nor by fatty substances. Aluminum paper is much cheaper than tin foil and will, so it is thought, become a strong competitor thereof."

HARTFORD-WORCESTER TROLLEY.—It is stated from Boston that plans for the construction of the Hartford & Worcester Street Railway, which will form a long trolley line between the two cities, have been completed by the Shaw interests of Boston, which control and operate the Boston & Worcester Street Railway. The moving spirit in the enterprise is James F. Shaw, who carried into effect the plans for the Boston & Worcester line. The Hartford & Worcester will practically be a continuation of the Boston & Worcester line. The principal reason for building the road is that it will furnish the Boston & Worcester with a feeding tributary, and a direct branch road will be run into Springfield, Mass. The completion of these continuations will place Boston and Worcester in direct competition with the New York, New Haven & Hartford interests, the latter having bought up the Springfield street railways. An agreement exists between the Boston & Worcester and Worcester Consolidated Street Railway Companies whereby the cars of the former and the Hartford & Worcester will be taken over the tracks of the Consolidated, the managers of the latter company taking the cars at Lake Quinsigamond and running them out of the city to Spencer, where the Hartford cars will enter upon a private right of way. Most of the route is over private right of way, as in the case of the Boston & Worcester.

CHEAP RADIUM.—A cable dispatch from Berlin of July 27 heralds cheap radium, or a substitute, once more, as follows: "The German scientific world is much interested in a discovery made by Herr Erfeurt, a chemist, who has succeeded in transmitting the qualities of radium to a substance he calls radiopher. Radiopher can be made cheaply. It is of great use in medical practice, for it can be injected under the skin and in other parts of the body. It is said to possess all the qualities of the original radium." As is well known, Dr. W. J. Morton and others in this country have already done some pretty good work in the production of radioactive liquids, which has been duly recorded in these pages.

WIRELESS ONE THOUSAND MILES.—Lieut. Kaiser, who had charge of the wireless apparatus on board the cruiser Brooklyn, flagship of Rear Admiral Sigsbee's squadron on the trip to France and return, has made a report to the Bureau of Equipment on the tests made during the voyage to determine at what distances wireless messages may be received aboard ship from shore stations. He reported that the longest distance at which wireless messages were read during the daytime was 540 sea miles, and at night 1,100 sea miles, while a wireless signal was heard at a distance of 1,780 sea miles. The message received at a distance of 1,100 miles, he said, came in so strong that doubtless it could have been taken effectively at a still greater distance.

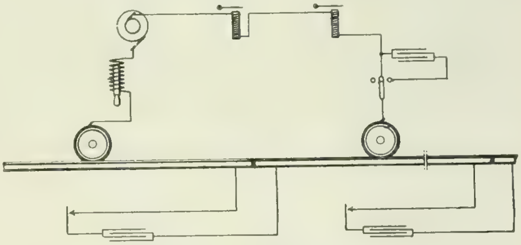
"SPOT LIGHTS."—An actress named Margaret Esmonde is plaintiff in a suit for $10,000 based on the fact that a defective spot light employed to enhance the piece de resistance of her part impaired her eyesight to the tune of $10,000 worth. The case in question concerned a death scene, wherein Miss Esmonde, prone upon the floor, was compelled to portray a death stare, and the continual glare of a spot light on her eyes has resulted in damage to her optic nerves. Miss Esmonde claims to have been favored with other spot lights in other theatrical performances without serious results, but in this case her deductions portend a defect in the electrical appliance, which acted upon her eyes so seriously that she is now compelled to seek redress. It will be interesting to see how this curious case results.

SPEED REGULATION OF REPULSION MOTORS.—An analysis of the internal reactions of the magnetic fluxes of a repulsion motor reveals the fact that to obtain the best performance from the machine the brushes should be placed in a certain position on the commutator when the rotor is at rest, and that they should occupy a different position under speed conditions. An invention of G. H. Hill, which was disclosed in a patent issued July 25, has for its object to provide means for automatically shifting the brushes of the motor according to the speed of the rotor. The brushes are mounted on a rotatable holder which is connected mechanically with the moving member of an electro-dynamometer the torque of which depends upon the current taken by the motor. The torque at which the dynamometer will be effective in moving the brushes is adjustable by means of a counter weight. With decrease of current and consequent decrease of torque the weight causes the brushes to be shifted in a direction to allow the motor to take more current through its circuits. The device produces a constant current flow through the motor, and gives an acceleration corresponding to a constant current.

ENGLISH RAILROAD ACCIDENT.—A cable dispatch from Liverpool, of July 27, says: "An electric express train on the Lancashire & Yorkshire Railroad, bound from Liverpool for Southport, came into collision this evening with an empty stationary train at the Hall Road Station, 6½ miles from this city, causing the death of 23 persons and the injury of many others. The first car of the express, which was crowded, was smashed to pieces, and only six of the occupants escaped. The road was recently equipped with electric power. This is the first serious accident on an electric railway in England. The collision lifted the roof of the first car of the express completely off the steel frame and crashed it down again on the unfortunate passengers, 20 of whom were killed outright. More of them would have been killed but for the presence of mind of a Liverpool architect, who, seeing that a collison was inevitable, shouted to his fellow-passengers to throw themselves upon the floor of the car. Almost immediately after the crash the wreckage burst into flames. The victims included several women and children. Fortunately the badly injured number comparatively few." This road is very successful and has already developed a large traffic. The expresses run about 60 miles an hour.

ELECTRICAL FIRES.—The Electrical Bureau of the National Board of Fire Underwriters in its report No. 48 gives a summary of the record of electrical fires which have been brought to its attention between April 10, 1905, and July 10, 1905. Twelve fires were caused by the grounding of circuits, of which four were on gas pipes, the resulting arcs burning holes through the pipes and igniting the escaping gas. Twelve cases are recorded of fires caused by short circuits in service wires. Seven crosses of high and low-potential circuits have been reported. Seven fires were caused by uncovered fuses throwing molten metal into inflammable material. Six fires are attributed to electric heaters and flat-irons. Seven fires were due to lightning. Five pole and tree fires were reported. Reports of 35 other fires attributed mainly to defective electrical fittings have been received, making a total of 91 known to have been due to electricity during the last quarter. The losses aggregate over $593,800. These reports have been compiled so as to demonstrate, by actual illustration, specific dangers that lie in a lax enforcement of the National Electrical Code of Rules, and to bring about a greater unanimity of opinion regarding the problems presented by clecfricity considered as a fire hazard.

ELECTRIC SIGNAL SYSTEM.—A novel use for a condenser is disclosed in a patent issued July 25 to W. S. Franklin and W. R. Whitehorne for a system designed to indicate in the operator's cab of a train the condition or position of successive signals along the line of the track. Each semaphore is provided with a switch so supported that it will be closed whenever the arm is in its inclined, or safe, position, and open when the arm is in its horizontal, or danger, position. One terminal of this switch is connected to one rail-section and the other terminal is joined to one terminal of a condenser whose second terminal is connected to the adjacent rail section. The circuits are indicated in the accompanying diagram. Upon each locomotive, or operator's, cab there is placed a small alternating-current generator, one terminal of which is connected to one of the wheels of the locomotive, which is electrically insulated from the other wheels. The second terminal of the generator is grounded on the frame of the locomotive through certain magnet windings. Except when the locomotive is immediately over the insulated break in the track, the amount of current which the generator is able to force through the impedance in the local circuit is too small to be effective in operating the signal governed by the electromagnets on the locomotive. When the locomotive spans the insulated break in the track, the current in the local circuit either drops to zero value, if the semaphore switch (referred to above) is open, or increases, perhaps, ten fold if the semaphore switch is closed. The abnormal increase in current at the instant when the locomotive passes into a section where the semaphore arm is in the "danger" position, is due to the introduction of the condenser in series with the inductive impedance, the condensive reactance and the inductive reactance having been so chosen as to neutralize each other at the frequency of the current obtained from the generator, which current, therefore, increases to a value limited only by the resistance of the local circuit. The action of the increased value of the local current is to cause an electro magnet to release a spring which sets a "clear" signal in the cab of the locomotive. When, however, the current in the local circuit drops to zero value, the decreased strength of a separate electromagnet allows a "danger" signal to be set in the cab.



ELECTRICAL POWER IN ONTARIO.—It is stated that the Electrical Power Commission, recently created by the Ontario Government, proposes to divide the province into four electrical districts, the idea being to select a water power in each district where electrical power may be generated and transmitted to all other points in the district. The four great water powers destined to supply the respective districts are Niagara Falls, the Chaudiere Falls at Ottawa, St. Mary's Rapids at the Soo, and Kababeka Falls, near Fort William. It is estimated that power from these centers can be transmitted for 200 miles and still be more economical than steam power. The commission proposes to secure the fullest information with regard to the cost of development, cost of transmission and price that would have to be charged consumers in order that a proper return may be made on the money invested. It is said that the Government does not propose to go in for power development itself except as a last resort, but will endeavor to govern and restrict the operations of private corporations, particularly in the matter of rates.

DALRYMPLE ON MUNICIPALISM.—A special dispatch from Chicago as to the Dalrymple report has the following: "There can be no great reform in the affairs of American municipalities until the political boss and the labor union cease to be dictators. They are the greatest curse the United States has to contend with." This is the keynote of James Dalrymple's famous letter in which he reported to Mayor Dunne his suggestions on the municipalization of Chicago's street railways. The much-discussed epistle of the Scotch traction expert to the Mayor of Chicago has never been made public. The impression was that he had backed down on his stand for municipal ownership. Instead, he stands by his guns. No such reform as the proposed municipal traction system can be successfully brought about where American labor union principles find support, he declares, adding that the same is true of American political methods. "I have the highest regard for the Mayor of Chicago," Mr. Dalrymple writes, in substance. "Yet that does not alter the fact that the theory of American politics is opposed to public ownership. Until the system is changed American cities can never hope for successful municipal ownership and operation of public utilities. This is as true of Cleveland as of Chicago—of New York and Philadelphia as of Cleveland."

Electrical Engineers of the Times.—XXI.

MR. F. V. HENSHAW.

Frederick Valdemar Henshaw was born in Brooklyn, N. Y., in 1868, the son of the late George H. Henshaw, a prominent civil engineer of Montreal. His early education was obtained at the High School and at Bishop's College, Montreal, where he devoted some time to the special study of chemistry and engineering.

His first employment was on a survey of a part of the St. Lawrence River during the summer and fall of 1886. He had early been desirous of taking up electrical work and in the spring of 1887 entered the employ of the Royal Electric Company, of Montreal, and was successively apprentice, draftsman and assistant to the chief engineer. While in the employ of this company, which besides manufacturing the Thomson-Houston apparatus, did a great deal of original work, Mr. Henshaw was engaged in the design and construction of probably what was the first alternating-current dynamo build in Canada.

In 1889 he came to New York and accepted a position with the C. & C. Electric Motor Co., where he later became assistant engineer, and remained until August, 1895. During that period this company rose from a small concern making motors not larger than 1 horse-power to be one of the largest manufacturers of stationary motors and generators in the country. Mr. Henshaw's work consisted chiefly in designing and testing machines and apparatus. It may be mentioned that he was one of the first to design direct-connected motors for very large ventilating fans and blowers.

During the next two years Mr. Henshaw was a member of the firm of Downes & Henshaw, of Providence, R. I., which acted as consulting engineers for the Narragansett Electric Light Co., Armington & Sims Engine Company and other large Rhode Island interests. Among other notable work done in that capacity was a series of exhaustive efficiency tests of commercial lighting transformers. The firm also constructed and remodeled a number of lighting and power plants in Rhode Island, and designed a line of generators for direct connection to high-speed engines.

In the fall of 1897 Mr. Henshaw entered the service of the Crocker-Wheeler Company as engineer and designer, becoming, later, chief draftsman and finally assistant engineer, with executive management of the engineering and installation departments. He designed many improvements in the construction of direct-current motors, generators and controlling apparatus; elevator motors having very low starting current; improved magnetic brakes for cranes and improvements in factory plant. He assisted largely in the design and commercial introduction of the multiple voltage system of motor speed control. He proposed this system to the Bethlehem Iron Company for their machine shops about the time that "high-speed" tool steel was being developed, and engaged in tests at Bethlehem which demonstrated at an early date that the power supply for, and the design of, machine tools would need revision to keep up with the capability of the new tool steels. Mr. Henshaw was a pioneer in the serious commercial application of electrical power to industrial plants and did much towards standardizing methods of machine tool drive and in establishing a better understanding between the designers of such tools and the makers of electrical machinery. He gave much study to power requirements of steel works and had a large part in building up the remarkable electric power plants of the National Tube Co. The successful use of electric power for almost all operations in these mills was due to a constant study of the unique conditions and the devising of new forms of construction to meet them, resulting finally in the development of entirely new types of motors particularly adapted to this large field of usefulness.

MR. F. V. HENSHAW.

Mr. Henshaw also had charge of manufacturing costs and estimates on standard and special machinery and construction work, correcting and determining these figures for the use of the sales department. He wrote and suggested much of the technical matter published by the company and handled the bulk of the technical correspondence. The installation department of the Crocker-Wheeler Company, organized and managed by Mr. Henshaw, had charge of erection work in many well known plants, such as the generators for the Government Printing Office, Washington; U. S. Mint, Philadelphia; Grand Central Station, New York; American Smelting & Refining Company, Perth Amboy; New York Navy Yard; De Lamar Smelting & Refining Company, Maurer, N. J., and many traction power plants, including the Intramural Railway at the St. Louis Exposition.

Mr. Henshaw has been a frequent contributor to the technical press, one of his recent articles being "A Discussion of Systems of Power Supply for Mine Operation" in the "Engineering Magazine" for March, 1905. He has had considerable experience in electrical engineering work for the Government, and a number of his suggestions have been accepted and embodied in the standard specifications of the Navy Department.. Mr Henshaw is a member of the American Society of Mechanical Engineers; the American Institute of Electrical Engineers, the Engineers' Club, and is secretary of the Electrical Department of the Brooklyn Institute of Arts and Sciences, and a past vice-president of the New York Electrical Society.

The Clyde Valley Electrical Power System, Glasgow, Scotland.

FOR many years the Clyde and the neighboring district has been famed as a center of high industrial and engineering importance; and it is the avowed object of the Clyde Valley Electrical Power Company, which was initiated by local enterprise, to help manufacturers in the district surrounding Glasgow to maintain the position they have so long held, and to aid them in competing as keenly as ever in the world's markets. The company was incorporated in 1901, and has obtained powers over an area extending along the Clyde Valley from Craigdoran and Port Glasgow on the west, to Lanark and Shotts on the east. This area, which comprises about 750 square miles, contains the most important manufacturing and coal producing districts in Scotland. The company has taken over the provisional order which was granted to the Burgh of Clydebank in 1901. This was sanctioned by Parliament in 1904 and enables the company now to supply electricity for both power and lighting in that burgh, for which purpose a special plant has been installed.

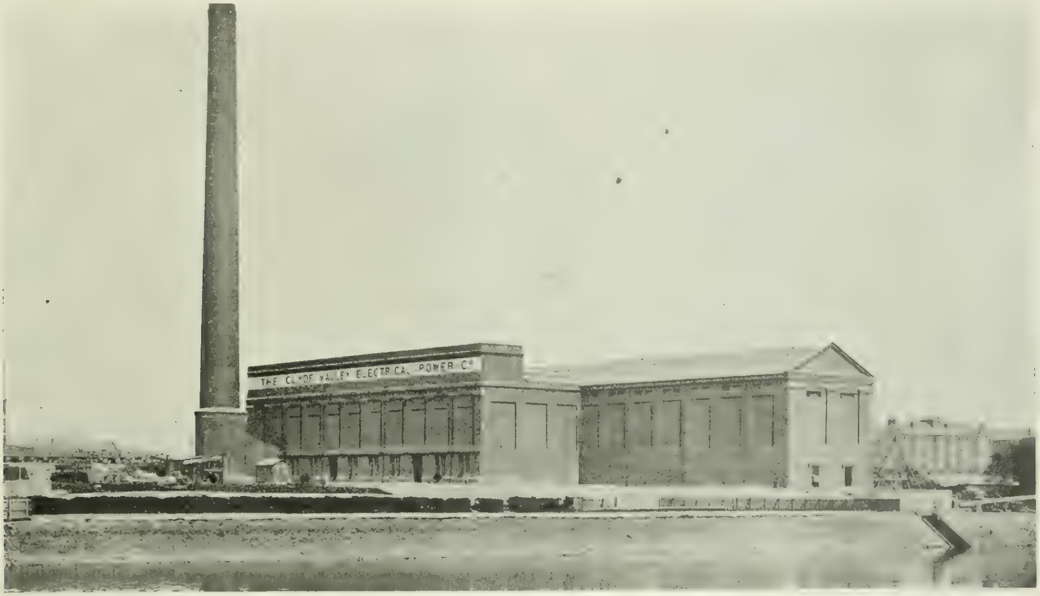


Fig. 1. Yoker Generating Plant, Clyde Valley System.

The city of Glasgow and the burghs of Govan, Partick, Port Glasgow, Paisley and Hamilton, although actually situated in the above area, are not included in the company's schedule unless any of them should elect to take a supply. Under the act of Parliament the company was empowered to acquire land for the erection of generating stations at Yoker and Motherwell, five miles and fifteen miles out of Glasgow, respectively; and in September, 1902, a contract was entered into with the British Westinghouse Electric & Manufacturing Company, Limited, for the erection and equipment of these two stations and the various sub-stations that are dotted over the area.

The Yoker generating station of the system (Fig. 1) is situated on the banks of the Clyde, where an unfailing supply of water for condensing purposes is available. The Motherwell station of the system being situated at a higher elevation, and above the level of the River Clyde, depends for its water supply for condensing purposes on electric pumps working against a head of 140 ft. The offices occupy part of the south end of the engine room, being placed adjacent to the switchboard galleries. Accommodation is provided here for the station superintendent, storekeepers and timekeepers. The offices are divided off from the switch galleries by iron doors and everything is of a thoroughly fire-proof construction, special attention having been paid to this important matter. The two plants at Yoker and Motherwell are very similar in most respects.

The boiler house has an internal measurement of 186 ft. long by 50 ft. wide. It is well lighted, and is designed in every way to afford a maximum of convenience. There are at present four double drum Babcock & Wilcox water-tube boilers in position, each having a heating surface of 4,400 sq. ft. and fitted with superheaters capable of imparting 150° F. of superheat. The steam pressure is 175 pounds per square inch. The boilers are connected to a main flue passing along the back, and a Green's economizer of two sections and 432 10-ft. tubes (Fig. 3) is installed between this flue and the chimney, the usual bye-pass flue being provided.

The chimney is built of special perforated and moulded bricks on the Alphonse Custodis system, and is 225 ft. high above the foundations, with an internal diameter at the top and bottom of 11 and 14 ft., respectively. It is lined with fire bricks up to a height of 85 ft. above the top of the foundations, which extend to a depth in the ground of 22 ft. The base of the foundations occupies a space of 2,116 sq. ft., and the weight divided over the entire area is two tons per square foot, allowance being made for wind pressure.

Each of the boilers is fitted with a Roney mechanical stoker manufactured by the British Westinghouse Company, and adapted for burning efficiently a cheap class of coal. These are driven through special worm gearing by two 4½-in. by 4-in., 5-hp Westinghouse standard engines, running at 400 r.p.m., and situated in the boiler house.

The coaling arrangements of the power station are most complete, and from start to finish the fuel is untouched by hand. Coal is brought in wagons to the company's private siding, where it is dumped by hydraulic ram into the crusher pit, passing through a crusher and screen operated by a 10-hp enclosed shunt motor running at 650 r.p.m. It is there picked up by a bucket conveyor, constructed by Graham, Morton & Co., and carried to the storage bunkers over the boiler house. This conveyor, which is driven by a 15-hp enclosed shunt-wound motor, is also used for carrying the ashes away from the boiler house.

From the bunkers the coal passes automatically to the stokers, being weighed, also automatically, in transit, and the number of hundred weights used recorded on an indicator. To prevent the coal sticking in the shoots a motor-operated agitator is installed, which keeps it constantly on the move.

The engine room consists of two floors, one on the ground level and one in the basement, the latter containing most of the auxiliary machinery. The turbine condensers, which are of the Mirrless-Watson vertical surface type, each with 6,250 sq. ft. of cooling surface, are placed here, their upper ends projecting through the main floor a few feet. Each turbine exhausts directly into its own condenser and each condenser is provided with a steam-driven, two stage, dry air pump situated in the basement (Fig. 4). Arrangements have also been made for exhausting to atmosphere if necessary.

The circulating water for the condensers is drawn from the Clyde, running by gravity into a large circular well 18 ft. in diameter and of a depth below water level of 9 ft. There are two 30-in. pipes leading into the well from the river and the water is drawn out through a 30-in. cast-iron pipe by means of a steam-driven centrifugal pump placed in the basement.

After passing through the condensers the water is discharged by a 36-in. pipe into a tank on the bank of the river. The condensed water is pumped into the hot well, which is also in the basement, by a centrifugal pump driven by a 6-hp, vertical shaft, shunt-wound motor, running at 625 r.p.m. From here it passes to the suction of the two feed pumps, which are of the J. & P. Hall & Sons' tandem compound, double-acting type, each capable of delivering 9,600 gallons per hour against a boiler pressure of 175 pounds. The make-up water is taken from the city mains, that of the Clyde being unsuitable for boiler feed purposes; there is, however, a standby suction from the river for use in case of emergency.

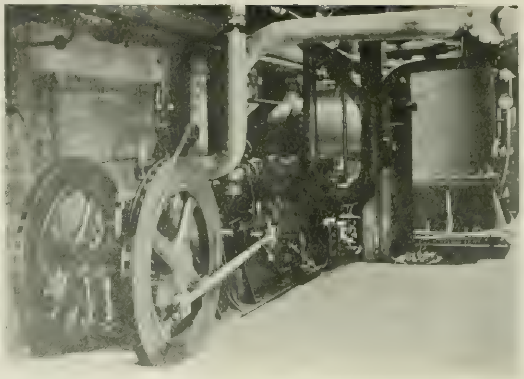


FIG. 4.—TWO STAGE DRY AIR PUMP FOR TURBINE CONDENSER.

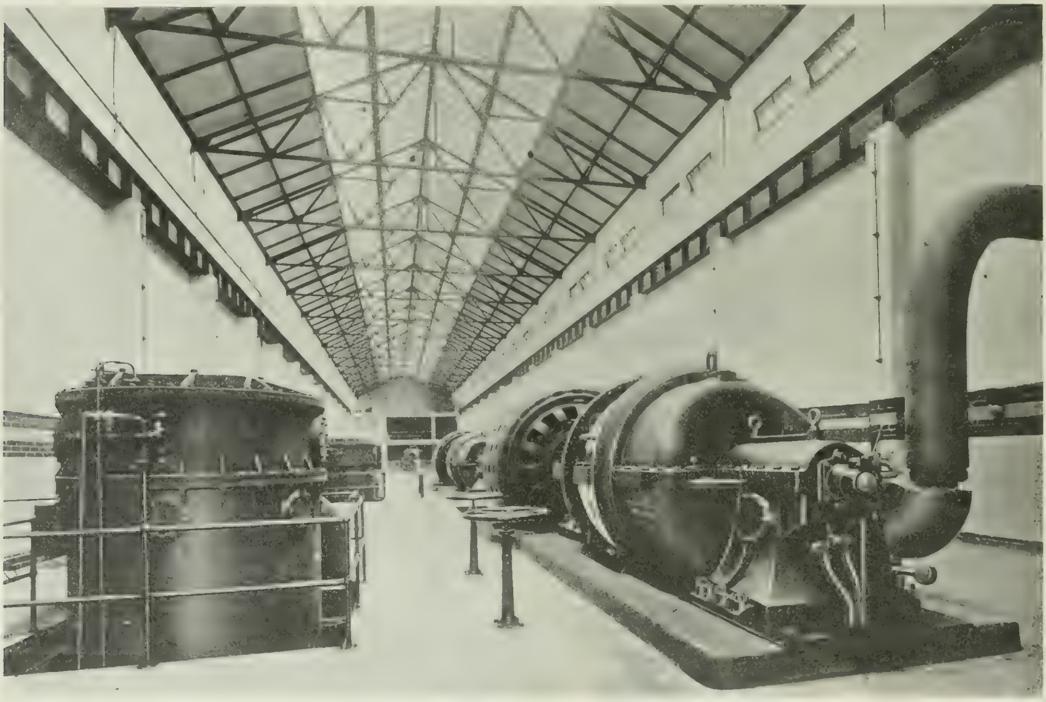


Fig. 2.—Interior of Yoker Plant.

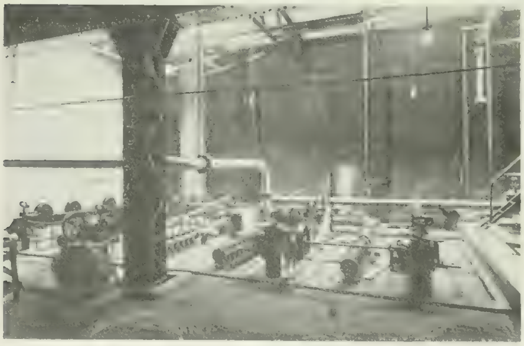


FIG. 3.—VIEW OF ECONOMIZERS.

The exciter sets have their separate surface condenser, which is of the Worthington Pump Company's make, and has 600 sq. ft. of cooling surface. In addition to the above auxiliary plant there is installed a feed water heater by Joseph Wright & Co., having a heating surface of 700 sq. ft.

The upper and principal floor of the engine room measures 252 ft. long by 43 ft. 5½ in. wide. It is well lighted from the roof, the walls are faced with white glazed bricks, and the floor throughout is paved with Italian mosaic work. At the north end are situated the switchboard galleries and offices, which have an inside measurement of 53 ft. by 43 ft. 1 in. wide.

The main generating plant at present installed consists of two Westinghouse-Parsons steam turbine units (Fig. 2), each with a normal capacity of 2,000 kw and an overload capacity of 3,000 kw. The speed is 1,500 r.p.m., which corresponds to a peripheral velocity of the rotating part of five miles per minute. The turbines are of the latest double-flow pattern, steam entering at the center and exhausting at both ends, and each contains no less than 20,000 blades.

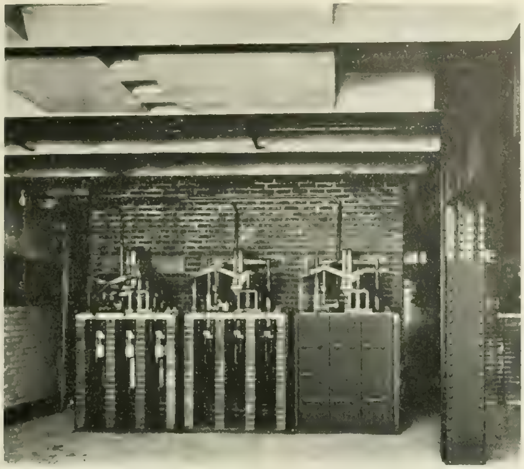


FIG. 5.—SWITCH GEAR, GROUND FLOOR.

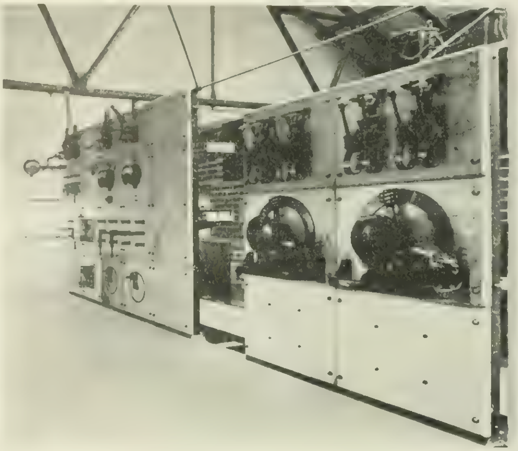


FIG. 8.—AUTOMATIC RHEOSTATS

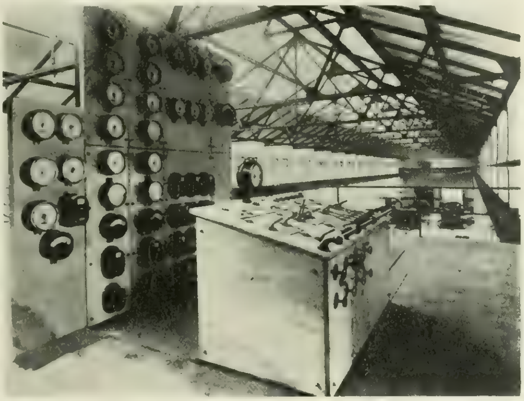


FIG. 6.—TOP GALLERY OF SWITCHBOARD.

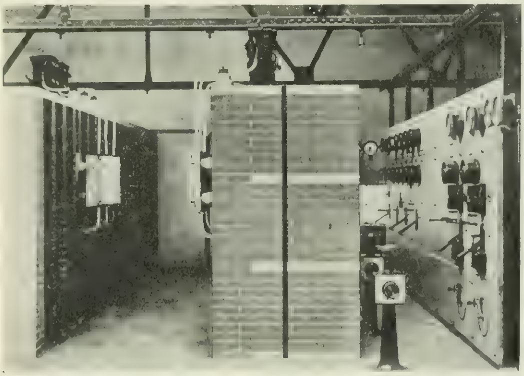


FIG. 9.—BUS-BAR CHAMBERS AND MOTOR-GENERATOR SWITCHBOARD

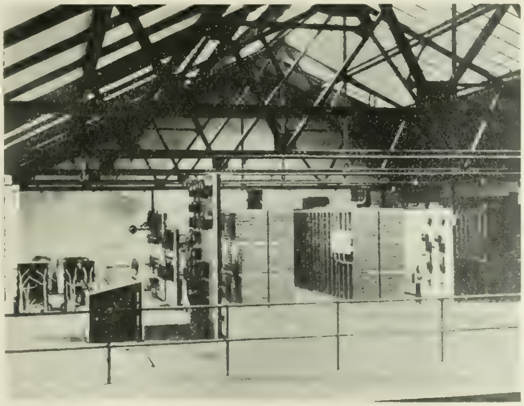


FIG. 7.—GENERAL VIEW OF TOP GALLERY.

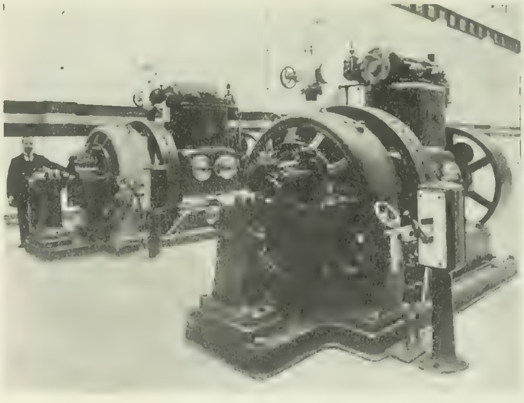


FIG. 10.—EXCITER SETS.

THE CLYDE VALLEY ELECTRICAL POWER SYSTEM, GLASGOW, SCOTLAND.

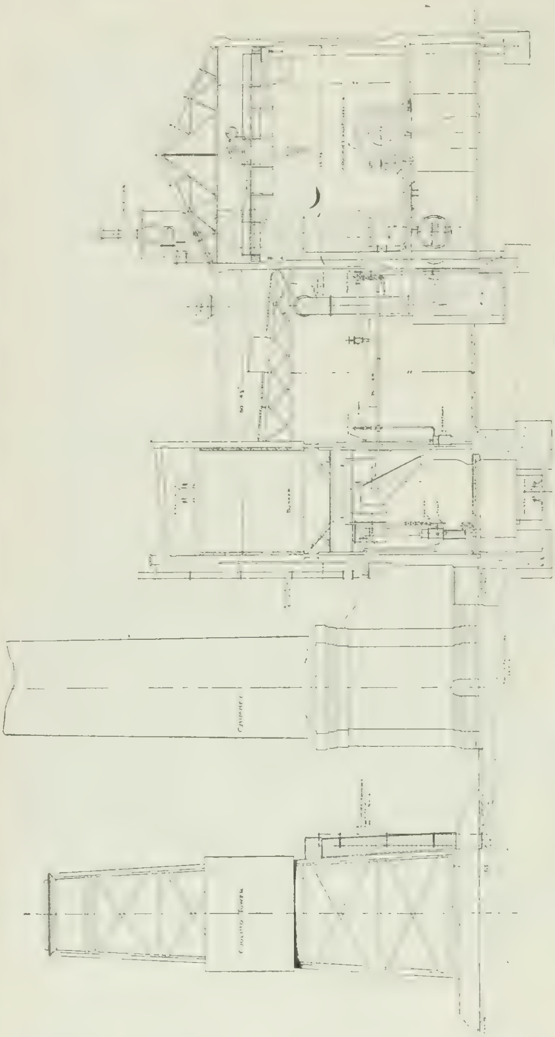


Fig. 12.—Cross-Sectional View of Motherwell Power Station.

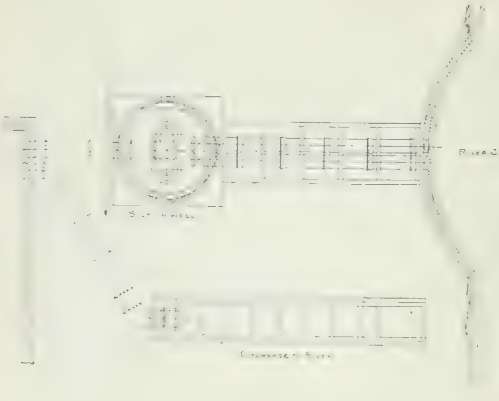


Fig. 11.—Part Plan of Yoker Power Station.

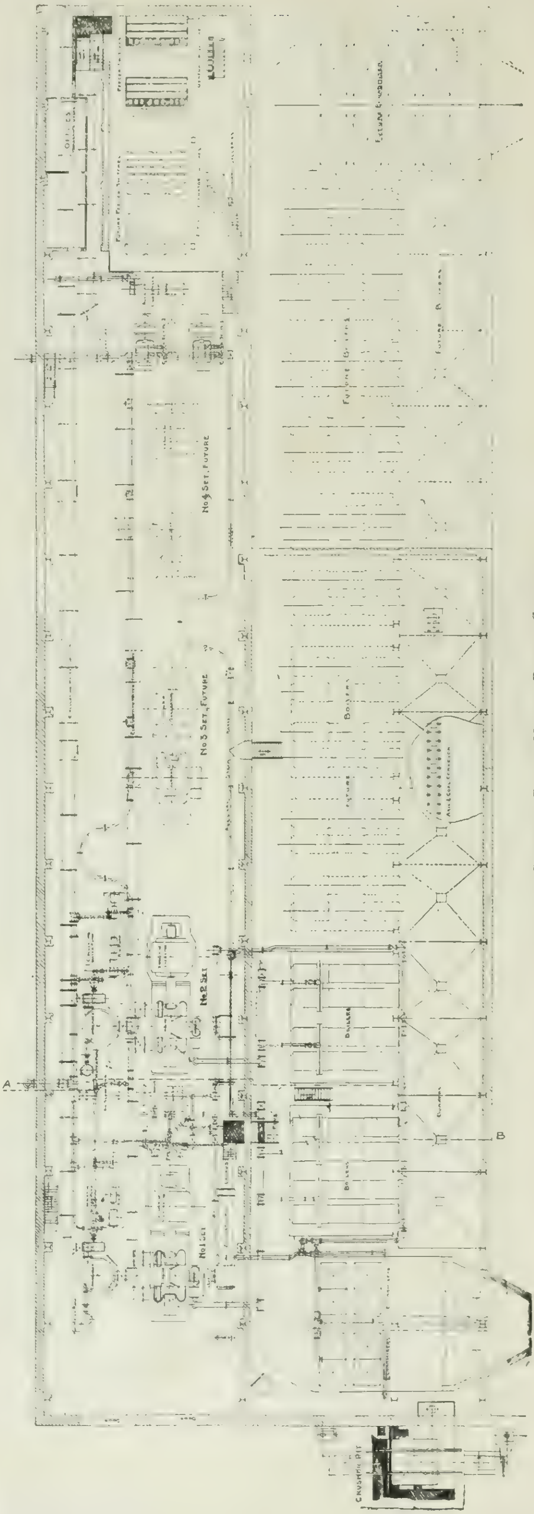


Fig. 13.—General Plan, Yoker Power Station.

THE CLYDE VALLEY ELECTRICAL POWER SYSTEM, GLASGOW, SCOTLAND.

These are securely fixed to the steel drum and are of drop forged steel in the first series and special metal at the low-pressure end so as to prevent corrosion due to the wetness of the steam. The cylinder is of close-grained cast iron and the rotor consists of a rolled steel drum fixed to the shaft by the aid of forged steel umbrella-shaped discs shrunk into the drum and pressed on the shaft.

Each of the turbines is directly connected to a Westinghouse 2,000-kw, 11,000-volt, three-phase, 25-cycle generator of the rotating field type. These are of the normal Westinghouse design. The two-pole field magnets consist of a solid forging of Whitworth fluid pressed steel combining high magnetic properties with strength, and the armature of laminated iron wound with copper bars in practically closed slots is supported by a heavy cast-iron frame divided horizontally. The starting, stopping and speed variations of the generators are under control from the switchboards by electrical means, current for this purpose being taken from the exciters (Fig. 10).

The oiling of the turbines is carried out on the gravity system. A large tank in the basement of the engine room receives the oil overflowing from the bearings, which is then passed through coolers and raised by a special oil pump to a tank in the roof of the boiler house, flowing from thence by gravity under a head of 50 ft. back to the bearings. Oil pressure gauges are provided on the latter in order to indicate at a glance how the apparatus is working.

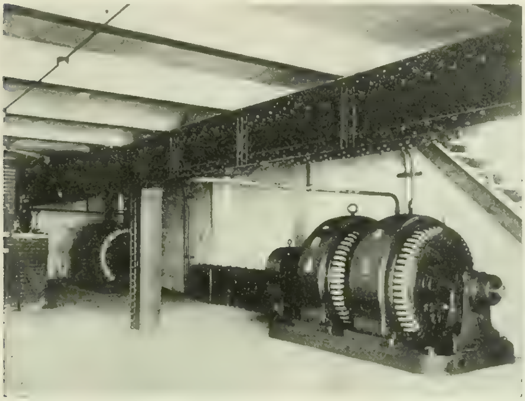


FIG. 14.—MOTOR-GENERATOR SET IN SWITCH GALLERY.

The engine room as at present constructed will accommodate one more 2,000-kw set and a fourth unit of 3,500 kw, which will eventually make the total capacity of the station 9,500 kw. The additional sets will be added as soon as one of the present units is loaded up, so that there will be always one spare ready at any moment in case of accident.

The two exciter sets (Fig. 10), situated at the south end of the engine room, are each capable of furnishing the exciting current for both the main generating units at present installed. They are of 75 kw capacity each, and consist of a Westinghouse 11-in. by 19-in. by 11-in. vertical compound engine, running at 290 r.p.m., coupled direct to a 125-volt, compound-wound dynamo.

In addition to their natural function these exciters supply current for operating the motors of the coal and ash conveyor, crushers, agitators, economizers, pumps, traveling crane, etc., and also for the electrically operated main and other switches.

The traveling crane was furnished by Messrs. G. & A. Musker & Co., and in the case of the Yoker plant has a span of 42 ft. It is of 30 tons capacity, of the three-motor type, these being of the Westinghouse type SB, totally enclosed pattern, series wound. The motors are of the following horse-powers and speeds: Lifting, 25 hp, 460 r.p.m.; longitudinal travel, 10 hp, 650 r.p.m.; transverse travel, 4 hp, 935 r.p.m.

The whole of the switch gear is contained in the three galleries at the south end of the engine room. That on the ground floor (Fig. 5) and the first gallery consists of the oil switches and feeders. On the third or top gallery of the switchboard (Figs. 6 and 7) are placed the main bus-bars in brick compartments and the main controlling board, as well as the resistances, etc. Following the latest practice, the control board consists of a small desk directly facing the various instruments such as ammeters, voltmeters, power factor indicators, relays, etc. All the main switches and smaller gear are electrically operated from this desk by the exciter current as before mentioned, and the speed of the turbo-generators and their starting and stopping is also controlled from here (Figs. 8 and 9).

The Yoker and Motherwell power stations are, as already noted, of the same size and almost identical in arrangement; the foregoing description, therefore, applies generally to both, with the following exceptions. The Motherwell station is not so favorably placed as Yoker, being 400 yards from and 140 ft. above the level of the river. A cooling tower of Balcke make has, therefore, been installed for cooling the circulating water. It is of the natural draught, enclosed type, 73 ft. high, and is constructed entirely of wood thoroughly soaked in carbolineum of the best quality. The tower has a normal capacity for cooling 220,000 gallons of water per hour from 120° F. to 80° F. when the temperature of the air is 70° F. or less; and the amount evaporated under ordinary conditions of atmospheric temperature does not exceed 2½ per cent of the water circulated.

The condensing plant is another of the features in which the Motherwell station differs from Yoker, a barometric jet condenser being installed. This is capable of giving a vacuum of 27.5 in. when dealing continuously with 80,000 pounds of exhaust steam per hour, if supplied with 348,000 gallons of circulating water per hour at a temperature of 80° F. In connection with this condenser there are installed at Motherwell two Alberger-Corliss two-stage dry vacuum pumps, one of which is capable of dealing satisfactorily with the air in the condenser when one turbine only is in operation. The dimensions of these pumps are as follows: Diameter of steam cylinder, 10 in.; diameter of air cylinder, 24 in.; stroke, 24 in. Their normal speed is 100 r.p.m., but they are capable of working at a lower rate if necessary. The steam and exhaust valves are of the Corliss type, and so designed as to permit of a high speed in cases of emergency without noise or jar.

Six feeders are provided for distribution from Yoker, and all are protected where they enter the building in the basement by Westinghouse lightning arresters. The cables for supplying power to any part of the district between Clydebank and Scotstoun, as well as to Temple, are practically finished. They are all laid in duplicate, so that in case of any accident happening to one of them the spare one can be connected immediately, while the duplicate is being repaired.

As previously stated, the Clyde Valley Electrical Power Company is authorized to supply in the adjacent Burgh of Clydebank. For this purpose special plant has been installed at Yoker consisting of two 150-kw motor-generator sets (Fig. 14). Each set is provided with a small motor coupled direct to the shaft, which serves for starting and running up to speed. The motor-generators are situated in the first switch gallery of the Yoker power station, and the switchboard controlling the distribution to this area is placed on the top gallery.

Both the high and low-tension cables for the Clydebank district were supplied and laid by Messrs. Henley & Co., and the British Insulated Wire Company has been entrusted with the extra high-tension cable work throughout the entire area. The number of substations at present installed in the layout of the scheme is ten for the Motherwell district and two for Yoker.

The general arrangement of the entire plant was designed by Strain & Robertson, consulting engineers, of Glasgow. Mr. H. A. Barnett, resident engineer to the Clyde Valley Company, has had the supervision of the erection and installation of both power stations and the distribution system since the commencement. The data here given are due to the above-mentioned gentlemen and to Mr. D. A. Starr, general manager of the Clyde Valley Company, who has also kindly furnished assistance in the preparation of this description.

Memorials to Davy and Faraday.

Last month at Clifton, England, Mr. G. Marconi unveiled a memorial tablet to Sir Humphry Davy. The tablet is on the house at Rodney Place, where Davy and other celebrities lived. During July also, the London County Council opened a new park or small "breathing space" in Walworth and named it the Faraday Garden, after Michael Faraday, who was born in the district in 1791.

Utilization of Gas Engines in Connection With Long-Distance Electric Transmission.*

By John Martin.

THE very rapid progress in the development of electrical machinery and appliances during the past ten years has invited the capitalist and engineer to install and operate many hundred thousand horse-power, utilizing the waters of the various streams, as a source for generating the current. The prime incentive for such development from the investor's standpoint was the fact that the source of power was being constantly renewed by the laws of nature, and with the authentic records of precipitation as a guide, the prudent engineer has recommended a great many plants to be constructed, which have proven financially and commercially successful. The most notable examples of this progress have been, and are being, developed in the State of California. A great many surprises of a practical nature have been encountered by the managers of these various water power electric developments with particular reference to earning capacity, and more particularly with reference to the relation of "plant utility to plant capacity," commonly termed "load factor." The manager is constantly trying to find ways and means of utilizing the electric current during such times of the day or night when his present consumers do not require it. Numerous plans and devices have been utilized to further this end.

Within the past year the problem was presented to the officers of the California Gas & Electric Corporation, who were desirous of furnishing all the electric current for the operation of the street railroads under the control of the United Railroads of San Francisco, and negotiations were commenced with the officers of the latter company, with that end in view. It was very difficult for the railroad people at first to develop even a hope that such a condition of affairs could be made feasible. Here was a company with its thousands of horse-power developed at no point nearer than 140 miles from the proposed place of consumption, and while it is true that this company has many sources of supply and many avenues of delivery, yet there was an insurmountable barrier in the minds of the railroad people as to the advisability of purchasing current at any price if the convenience of its patrons was to be sacrificed in any way. As one of the officers of the railroad company remarked: "We certainly desire to save money in the operation of our property—within reason—but at the same time we care more for the good will and satisfaction of our patrons; and if any interruption of service should occur on all your lines feeding into this city at one time, we cannot expect our citizens to be patient while sitting in the cars for an hour and a half, until you get up steam." The railroads are operating their steam plant for this service, and the power company suggested the continuance of the operation of these steam plants, and receiving a portion of the power from the power company, but this plan was not considered advisable.

After numerous interviews with an honest desire on both sides to try and accomplish the economic result, if it could be done without sacrificing the interests of the patrons of the railroad company, a firm conclusion was reached that in a service so large and important as the carrying of hundreds of thousands of people daily in a large city, nothing could be done on the plans outlined, unless some absolute guarantee of continuity of service were available, and it certainly was not favorable from the standpoint of the utilization of steam engines for emergency purposes, because if steam were being maintained constantly under the boilers, no economy could result, and if the plants were allowed to cool off the time element of starting would prohibit their use. The officers of the power company had been making thorough investigations of the development of the gas engine in large units, having sent two of their engineers throughout the entire East to make full and complete reports. In consequence, and as a last resort, the power company agreed to install three gas engine electric generating units, each unit having a capacity of 4,000 kw, or a total initial capacity of 12,000 kw. This plant will be enlarged as rapidly as the requirements of the railroad may demand.

The guarantees which have been made by the manufacturers of these engines are particularly interesting, and if successful will undoubtedly place long-distance electric transmission in a position to practically guarantee continuous service, regardless of the length of its transmission lines or the momentary interruptions which do occur through causes beyond human control.

It might be fairly stated that the gas engine stands alone as the only means of instantaneous generation of electric current at distributing centers in times of emergency, at any fair or reasonable cost. The gas engine electric generating plant of the California Gas & Electric Corporation will also be utilized to a certain extent for the purpose of increasing the load factor of the transmission line, for it is obvious to those familiar with power transmission plants that after proper installations have been made, including full capacity at the hydraulic end, as well as in the power house, and in pole lines, there is absolutely no increased cost for current to the power company, whether its load factor be .2 or .99, and any device which can be utilized to improve that load factor adds that much income and net profit for the power plant. In this particular case the gas engine generating plant was a necessity, for without which the California Gas & Electric Corporation would have been unable to have obtained the contract for power. That being the case, the officers decided to make a virtue out of this necessity, and up to the extent of the cost of fuel being less than the increased value derived from improving the load factor on the power lines, they propose to operate this gas engine plant in that manner and for that purpose.

The gas which will be used to drive these engines will be manufactured from crude oil and will be of the quality similar to the illuminating gas now being distributed throughout the State of California manufactured by this process, ranging from 610 to 660 B.T.U. per cubic foot.

Nearly all of the gas engines in use throughout the East and Europe are utilizing producer gas or blast furnace gases, except in very small units or where natural gas can be obtained, and from investigations which I have made I have ascertained that the largest gas engine using manufactured gas of more than 600 B.T.U. has a rated capacity of 300 hp, while those in process of installation near San Francisco will, in each case, be more than seventeen times as large. The nearest approach to these large engines in size are two, which are in operation at Hastings, W. Va., each having 4,500 hp capacity, and driven by natural gas, and being used for the compression of natural gas for transmission through a pipe line 200 miles in length. These engines have been and can be started from cold and rest to full load in less than 60 seconds.

These gas engines are now being built by the Snow Steam Pump Works, of Buffalo, N. Y., and in general design and detail resemble very closely a modern high-grade, massive American steam power engine. They are of the horizontal, twin tandem, double-acting, four-cycle type, giving two impulses to each crank per revolution. This is equivalent to a cross-compound steam engine. Any cylinder head can be removed from any cylinder by simply disconnecting one jacket water supply pipe and removing the nuts holding the head to the cylinder. All working parts are above the engine room floor, nothing but water supply, gas, air inlet and exhaust pipes are below the floor, and these are arranged so that they can be trenched. All the main parts have their proper relative positions positively and permanently fixed by male and female centering fits of large diameter, thus practically insuring self-alignment. Lubrication of the cylinders is effected by spreading. This is accomplished by leading four oil feeds, fed by individual oil pumps, to each cylinder, and entering the cylinder at points to successfully effect the proper spreading of the oil. The oil is fed to the cylinder on the inhalation stroke, and is spread on the compression stroke, thus being properly lubricated for the power or impulse stroke. The lubrication of journals is effected by means of a positive feed lubricator. Each oil feed is carried to the part to be lubricated by means of small tubing leading from a multiple feed oiler containing a small oil pump for each feed led therefrom. The feed to each part is positive and can be adjusted to give a fixed supply of oil per revolution of the engine. When the engine stops the oil feed stops, and when the engine starts, the oil feed also starts. Inlet valves, mixers and cut-off valves will be designed so that gasoline can be injected to the surfaces necessary to be cleaned, rendering the dislodgment of any deposit an easy matter without removing the parts. The pistons are carried by cross heads, thereby materially reducing the weight carried on the bore of the cylinders. By the use of three cross heads the main, intermediate and outboard proper alignment of the pistons is permissible after years of service, and it is questionable whether an engine without this feature can be regarded as entirely satisfactory.

The question of regulation in the generation of electric current by means of direct-connected electrical generators, has been a problem not only for the gas engine people, but for the steam engine manufacturers to solve, and this has been done in the latter case within the past two years, practically to the satisfaction of the electrical engineer, so that parallel operation is now successful. The builders of this engine are also following steam practice in this respect, and will be able to keep the angular variation within each revolution at a minimum, satisfactory to the electrical generator manufacturers. The main shaft will be of the over-hung crank type, having the cranks forged with the shaft and with crank pins forced into the cranks. The main connecting rods are simple, plain, with solid adjustable stub ends. The main cross heads are fitted with adjustable babbitted gibs and removable crucible steel wrist pins. The pistons are designed in such a way that expansion of the faces can take place without affecting in any way the strength or life of the piston. Piston rods extend from the main cross heads clear through the cylinders to the outboard cross heads and secured to same by nuts. Each cylinder is made in two parts, the joint being circumferential and located half way between the ends. Separate supply pipes for each individual part to be water-jacketed, will be furnished so that the amount of water fed to each part can be regulated, thus permitting the carrying of high temperatures in such parts as cylinder heads, medium temperatures in cylinder jackets, low temperatures to the rods, pistons and metallic packing. These engines are started by the use of compressed air on storage in compression tanks. Safety devices are provided which carefully control the speed limit.

---

* A paper read before the Pacific Coast Gas Association.

The dimensions of these engines are very interesting: Length over all, 70 ft.; width over all, 34 ft.; weight of heaviest casting, 60 tons; diameters of cylinders, 42 in.; length of stroke, 60 in.; main journals, 30 in. diameter, 54 in. long; main cross head gibs, 27 in. wide, 54 in. long; diameter of center of shaft, 38 in.; weight of fly-wheel, 130,000 pounds; total weight of engine, fly-wheel and generator, 1,200,000 pounds.

These engines will probably be in operation on or before January 1, 1906, and from all the investigations which have been made by my co-workers we are laboring under no doubt as to the absolute success of this installation when completed.

Recent Developments in Three-Phase Traction on the Valtellina Road.

WE have had occasion frequently to refer to the electrical equipment of the Valtellina Railway in northern Italy, upon which considerable interest has been centered on account of the pioneer work undertaken in connection therewith. It will be recalled that the road uses high-voltage, low-frequency, three-phase currents, and represents one of the earliest installations to adopt alternating current motors. It is believed that a report of the recent developments on that railway will prove of special value in view of the experience obtained with the equipment.

Both the current-taking device and the water rheostat, which were severely criticised when first proposed, have given excellent satisfaction in actual practice. The current collector consists of two long rollers mounted on the same wooden shaft and rotating in ball bearings. The current is taken from them by carbon brushes. As an advantage offered by this system of current collection, it may be stated that after three years of actual service it is not possible to measure any diminution of the section of the trolley wires. The Valtellina line was the first to use the water rheostats as starting devices for traction purposes. Compressed air moves the water to and from the plates of the rheostat, producing a contact of a more or less broad surface and thereby varying the resistance. In the early periods of the service the cooling of the water was not quite sufficient, owing to the fact that the rheostats were originally calculated and constructed for a smaller capacity. But after the necessary alterations were made the water rheostats proved more suitable for railway service than metallic ones. Their weight is less; moreover, repairs which, in the case of metallic rheostats, are sometimes very troublesome, are practically avoided, as water rheostats do not burn when overloaded, nor does solder melt out. The worst that can happen is that the water evaporates. Accordingly, the overload capacity of the rheostats is large. Starting can also be effected very smoothly, as there are no steps in going from one speed to another.

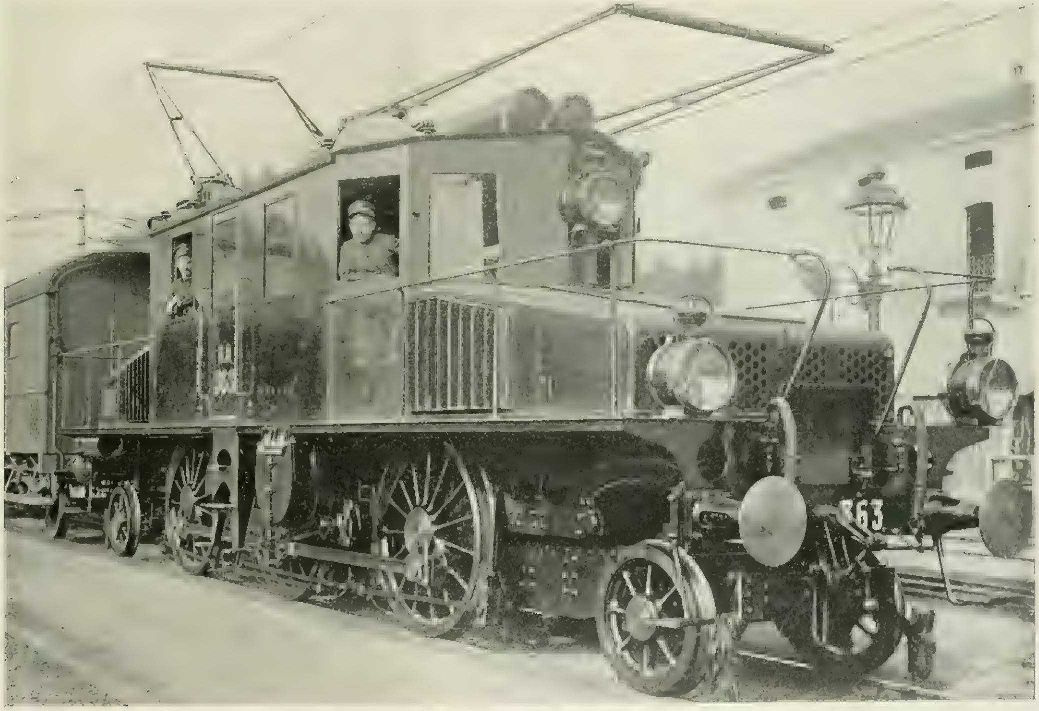


FIG. 1.—THREE-PHASE LOCOMOTIVE

One important result of the Valtellina installation is the proof furnished that the small air-gap in three-phase traction motors does not interfere with the safety of the railway traffic in any way, supposing the bearings are properly designed. Most of the motor cars have run over 100,000 miles, and it has not yet been necessary to change the bearings or to renew the bushes. Only two or three breakdowns have occurred that were due to the burning out of the bearings, and all these cases were caused through the carelessness of the attendant in forgetting to oil the bearings. A great deal has been said, also, in technical periodicals about the difficulty of using two overhead wires in switches and station yards. They are said to be complicated and to involve a constant danger to railway working. The cost of maintenance and repairs of the air switches has been only a very small percentage of the whole cost of maintenance of the overhead line, and quite unimportant.

The first electrical equipment of the road included motor cars for passenger trains and locomotives for freight trains. In extending the service, however, the company decided, after a careful study of the question, to employ electric locomotives for all purposes. This decision was reached partly because the line connects, with others, and the use of through cars was thought to be a convenience, and partly because it was thought the cost of inspection and maintenance would be smaller.

For the motor cars and the first locomotives, there were used direct-coupled motors with a flexible coupling between axle and motor. This method of driving has proved to be quite practical, and to work satisfactorily in every respect. Direct coupling has, nevertheless, great drawbacks in the eyes of the railway engineer, especially in the case of induction motors. As the casing of the latter is not made of two pieces, it cannot be opened, and in case of any repairs on the windings, the wheels have to be pressed off the axles. For the new Valtellina locomotives, therefore, the following solution was adopted: The motors run with the same number of revolutions as the driving axles, but are mounted between the two axles and drive the axles with cranks and coupling rods. The main advantages to be claimed for this design are: The motors, being built in between two axles, may easily be taken out for repairs and can be replaced by other motors. The slippings and brushes of the motors are put outside of the locomotive frame, the use of such a design enabling ready access to those parts of the motors which require attendance and revision. As all driving axles are driven by all motors with the same mechanism, there is no danger that different loads are thrown upon the individual motors, or that one of the driving axles should slip. The mechanism has no dead point, the cranks on the two sides being keyed at a different angle of 90°. This mechanism has only rotating parts, which can be completely balanced by counterweights, so that no disturbing oscillations can arise by unbalanced masses, as in the case of steam locomotives. The energy losses in the mechanism are small, whereas the piston rods and connecting rods cause the most friction in the mechanism of a steam locomotive. The weight of the motors has no hammering effects on the rails, as all parts are spring supported.

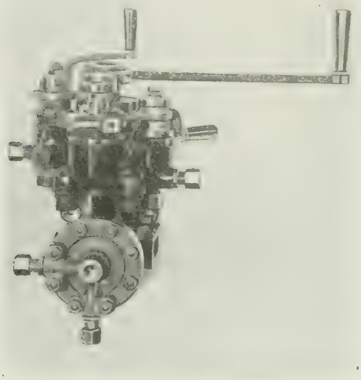


FIG. 2.—PNEUMATIC MASTER CONTROLLER.

Figs. 1 and 2 show the general design of these locomotives. They have ten wheels (five axles), six of them being driving wheels. The total weight of the locomotive in working order is 62 tons, 42 tons being divided as adhesional weight on the three middle axles, and 20 tons as dead weight on the first and fifth axles. Each locomotive is driven by two motors, one of which is placed between the second and third axle, and the other between the third and fourth one. The locomotive has only one fixed axle, viz.: the middle one. The other two driving axles have a range of movement sideways of about 1 in. At both ends of the locomotive there is a pony axle (a leading and trailing axle, respectively), both having a radial movement. One of them also has a lateral movement. This portion of the design is not new, as it has been used with the best results with steam locomotives of the Adriatic Railway and was designed by the company's own engineers. The electric locomotive can be run equally well in both directions.

The two motors of each locomotive are of the same type. (See Fig. 3.) Both are double motors uniting a high-tension and a low-tension motor on the same axle and in the same casing. Both halves of these twin motors have eight poles, and hence at 15 cycles the number of revolutions is 225 per minute, or when working in cascade 112.5 per minute. During official tests they have repeatedly developed double their normal tractive force, even when the voltage dropped about 25 to 30 per cent. The two halves of the twin motor have common slip rings. When the group works in single, only the high-tension motor is switched in, and then its rotor is short-circuited through the slip rings. When the two motor halves work in cascade, the slip rings are not used at all, since the two rotors are connected together and the stator of the second motor is short-circuited. In cascade connection each pair of motors is combined in such a manner that the primary of the one (the high-tension motor) is connected to the line, whereas its secondary is connected to the primary of the other motor. The secondary of the second motor is either connected to the rheostat or short-circuited. In single connection each motor used is independently connected to the line.

The locomotive is provided with the same system of current collectors as has been used on the other vehicles of the Valtellina Railway. That is, two pairs of current-collecting rolls are used, working alternately, corresponding to the two directions of the run. (See Fig. 1.) The current-collecting rollers are pressed against the overhead wires by compressed air, which is conducted into the cylinders of the under frame; in order to lessen the shocks in raising or lowering the current collector, a glycerine dash-pot is used. Moreover, the experience gained during the operation of the Valtellina line has been utilized, viz.: that the current collectors give greatest satisfaction when pressed to the overhead wires with a strain corresponding to the running speed. Accordingly, two degrees of pressure are provided, corresponding respectively to the two main speeds of 64 and 32 km. per hour. When inserting the trolley valve, compressed air is admitted only to the surface of the main piston, corresponding to the lower speed. When regulating with the pneumatic master-controller up to the higher speed, compressed air passing through the bore of the piston rod is simultaneously admitted on the surface of the auxiliary piston, which further presses the trolley spring and causes a greater pressure on the wires. The pressure on the contact wires by the current collector at the smaller speed is 6.6 kg. (14.5 pounds); at the higher speed, 8.5 kg. (18.7 pounds).

The entire connecting and regulating apparatus of the motors is operated through two pneumatic master controllers fitted at both sides of the locomotive. The pneumatic master controller, Fig. 4, is a combination of valves. It has three levers performing various functions and being interlocked. The main lever, which is also a starting lever, serves for operating the starting and regulating valve. At standstill the starting lever stands vertically to the longitudinal axle of the locomotive. At starting the locomotive driver pulls the starting lever toward himself, when it describes a certain angle and is brought in its first position at which it acts upon the starting lever and thus admits compressed air to the primary switches and rheostat switch heads. In this way the primary switches are first thrown in, while the rheostat heads are brought into a position at which, while not yet in circuit, they are ready to be acted upon by the regulating valve. When the lever is further turned the regulating valve begins to act and effects the insertion of the water rheostat. The second, shorter lever, below the starting lever, is the reversing lever and acts upon the reversing valve. The outward position of this lever makes the locomotive run forward, whereas if the lever

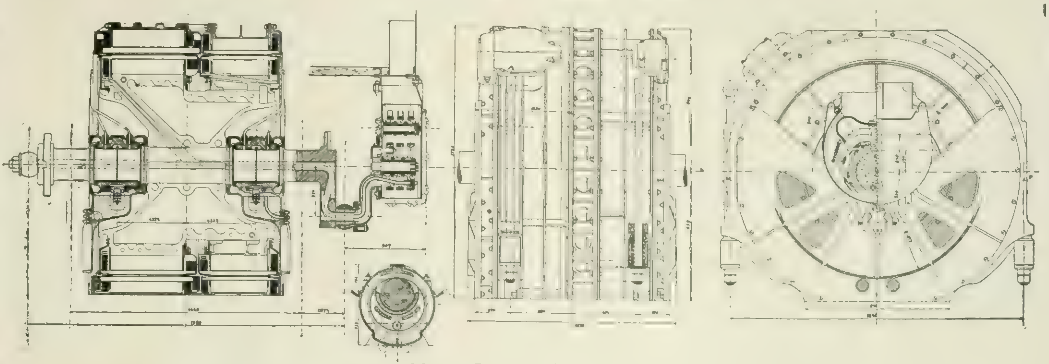


Fig. 3.—Views of Motor, Showing Position of Collector Rings.

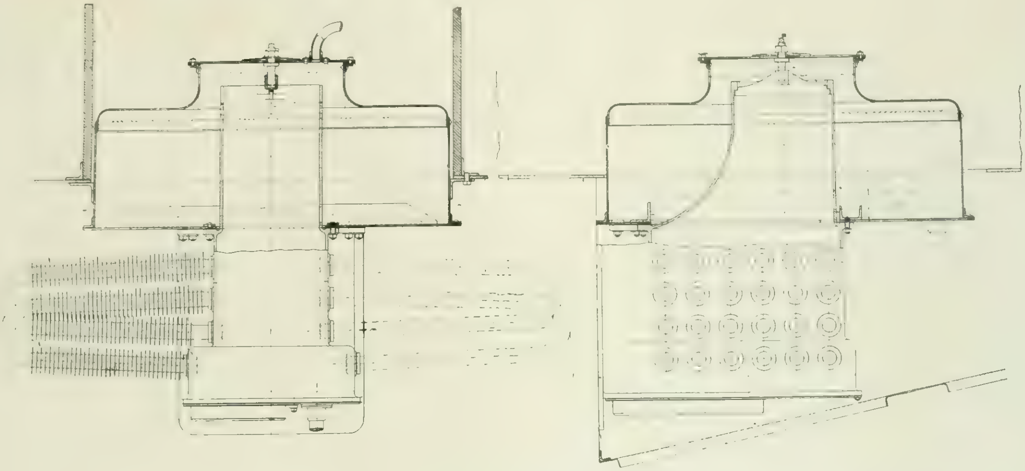


Fig. 4.—Sections of Water Rheostat, Showing Cooling Coils.

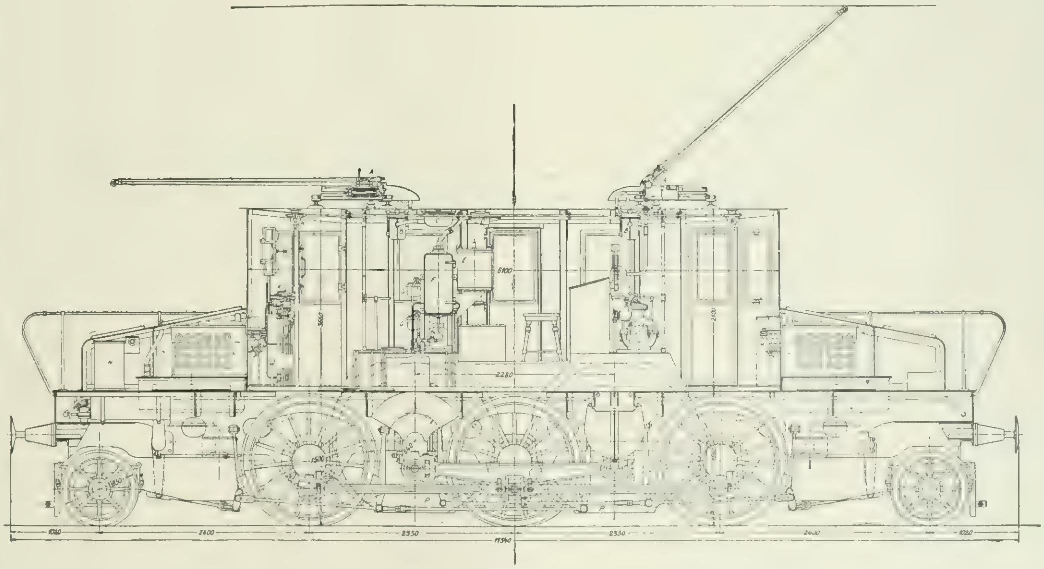


Fig. 5.—View of Locomotive, Showing Position of Driving Motors and Connecting Rods.

RECENT DEVELOPMENTS IN THREE-PHASE TRACTION ON THE VALTELLINA ROAD.

is thrown toward the inside, the locomotive moves backward. The regulating valve has two openings, which are connected with the corresponding parts of the air pistons of the primary switch. According to the position of the regulating valve these openings are connected either with the air tank or with the open air. The third lever at the left hand from the starting lever, is the speed lever, and connects the motors either in cascade or single. The various levers are interlocked in such a manner as to allow of the reversing lever and speed-regulating lever being moved only when the starting lever is in its initial position, so that both the primary switch and the rheostat are disconnected. On the other hand, the starting lever can be moved only when the two other levers are in their end positions.

For every twin motor there is a water rheostat (Fig. 4) which consists of a vessel made of two parts. In one part three groups of sheet-iron plates are suspended. When not in circuit the water does not touch the sheet-iron plates. When the rheostat is thrown into circuit compressed air is admitted into the other part, forcing the water upward around the plates. The more air is admitted to the rheostat, the greater will be the surface of the plates in contact with the water until the resistance becomes a minimum. The connections from the three secondary motor ends are finally united directly together.

The experience on the Valtellina line shows that safety, in connection with high-tension current for electric traction, is only a question of good engineering. During the entire period of three and a half years of the trial runs and normal service, no man was killed by the high voltage used on the railway. The service on the Valtellina line has shown that in railway operation any security desired can be attained with the high-tension, three-phase equipment, supposing that it is designed properly. After the first period of difficulties the present service is quite satisfactory. In the first year of the regular service considerable trouble was caused by the oil getting to the windings of the motor, but after repairing the damaged insulation and providing for a hermetical closing, no further repairs were necessary; in fact, there has been no occasion during the subsequent period of the last one year and a half to repair the motor windings. This is the best proof for the reliability of three-phase traction motors.

Some years ago a great deal was said in periodicals about troubles which alternating current with earth return may cause in telegraph and telephone circuits. At the opening of the Valtellina line, although the periodicity was not more than fifteen, the railway company was obliged to erect separate insulated return wires for all telegraph and telephone lines running parallel with or near the railway line. Later on different methods were adopted to permit the operation without return wires, and as a matter of fact the telegraph lines along the Valtellina Railway are now working on earth return with entire satisfaction.

An Electric Micrometer.

A new micrometer of great range and accuracy has been described by Mr. P. E. Shaw, before the Royal Society. It consists of a system of six massive levers, the final effect of which is to reduce the movement of a micrometer screw in the ratio of 1,000:1. Contact between the last lever and the object to be measured is made electrically, and the smallest distance which is distinctly measurable is 0.4 $\mu\mu$, a quantity of the order of the size of molecules. The short ends of the levers are fitted with hardened steel plates and with a metal casing which forms the sides of an oil bath. The long ends are fitted with pins which rest on the steel plates, and are partly submerged in the oil to reduce friction and catch dust particles. The electric contact surfaces are of iridio-platinum. The plate in contact with the micrometer screw is of agate. The instrument is enclosed in a felt-covered box, and is suspended by rubber springs from the top of a massive frame, which itself rests on a pile of heavy concrete slabs with rubber cushions at intervals. Contact is discovered by a telephone, the difference of potential being 0.01 volt, which produces a spark not more than 0.1 $\mu\mu$ long. Compared with other micrometers, the instrument is less portable than the optical lever and slower than the microscope, but 500 times more accurate than the latter, and 10 times more accurate than the former or any interference method, besides having a much wider range, amounting to 10,000 units.

Transfer Systems and the Multiple Board in Telephone Exchanges.—II.

(*Concluded.*)

By Arthur V. Abbott, C. E.

Fig. 4 shows the cord circuits consisting of an answering plug, a connecting plug, with ringing keys, which enable the operator to ring either subscriber at pleasure. The clearing-out drop, wound for from 500 to 1,000 ohms, is bridged across the line. The cord circuit contains a condenser, *c*, a retardation coil, *r*, and a battery, *b*. When the listening key is pressed the condenser *c* is placed in series in the tip conductor. The object is to provide the so-called busy test. In the non-multiple switchboard each subscriber's line has but one jack always in sight of the operator who serves it, consequently the operator can, at a glance, tell whether a line is engaged in conversation or not, by noticing whether its jack contains a plug. In the multiple board each line has many terminals which may not be within the operator's sight, and it is impossible to tell by inspection whether a line is free, so that means must be provided whereby each operator can quickly ascertain whether she can use the jack within her reach without interrupting a prior conversation.

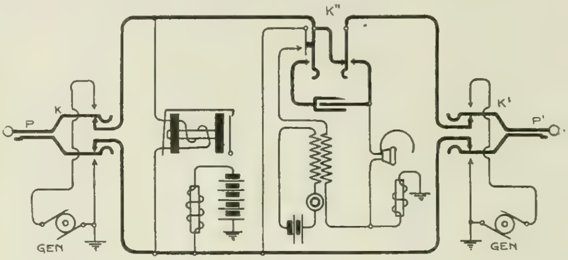


FIG. 4.—CORD CIRCUIT OF SERIES-MULTIPLE BOARD.

According to Fig. 3 every jack is provided with a ring, *b*. Fig. 4 shows that when two lines are joined by the cord circuit, the battery becomes connected to the ring of the jacks into which the plugs are inserted, and as all the jack rings of each line are in multiple, the insertion of the plugs raises the potential of the rings to that of the battery. One pole of this battery is grounded or connected to a common wire. The center of each operator's receiver is grounded, or similarly connected. If, therefore, an operator touches the tip of the connecting plug to the ring of any jack which is at a higher potential than that of the earth, current will flow through the tip side of the line and charge the condenser. The charging of this condenser causes the receiver to emit a loud click. If, on the contrary, the tip of the answering plug be touched to the ring of a jack at earth potential, there is no click; hence after an operator at a multiple board receives the subscriber's order, the first operation is that of testing the desired line. The operation is illustrated in Fig. 5. Lines 304 and 508 are shown as engaged in conversation in position 3. In position 1 the operator has inserted the answering plug into line 101, has received an order to connect with line 304,

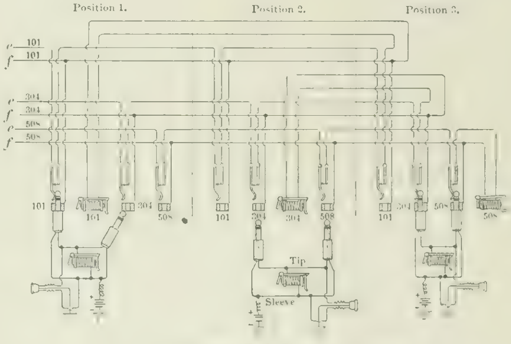


FIG. 5.—BUSY TEST, SERIES-MULTIPLE BOARD.

and touches the tip of the connecting plug to ring 304. Then there will be a flow of current from the positive pole of the test battery in the cord circuit of panel 3, to the ring of jack 304, thence to the ring of jack 304 in panel 1, thence to tip of plug touching this ring to the operator's condenser which is charged, the negative charge set free returning to the negative pole of the test battery. The receiver clicks, indicating that the line is busy. This condenser prevents a continuous flow of current, beyond that necessary to charge the condenser.

The series-multiple switchboards possess a grave objection: One side of the line is extended through the jack contacts in series and as there may be many jacks there will be as many contacts in series. Whenever a plug is introduced, the springs are separated, and frequently a small particle of dust lodges between the contact points. When the plug is withdrawn, the contact fails to close and the line remains open. It is then impossible for the subscriber to call the office, and his only recourse is to hunt up some other telephone station and complain. The branch terminal, or bridging multiple switchboard, was invented to remedy this defect. Fig. 6 shows the circuit of one type of this board, positions 1, 2 and 3 being represented, containing lines 99, 304 and 510. One side of each line *t* is connected with the ring *f*. All the *c* springs of each line are in multiple with each other and are connected to tip side *t* of each line, and similarly all of the *f* rings of each line are in parallel with each other and joined to the sleeve, *S*, of the line, hence the name of *Branch Terminal*, or *Bridging Board*, because there are no contacts in the jacks, and consequently subscribers' lines cannot be opened by particles of dirt. Each jack contains two others springs, *b* and b^1 and a ring *g*. All the *b* springs of each line are connected in parallel to a ground, or wire *B*, common to the whole office. Each *g* ring is in series with the b^1 spring of its jack, and all the b^1 springs of each line are connected in parallel to a third wire belonging to that line. Therefore this type of board is often called a *"Three-Wire Board."*

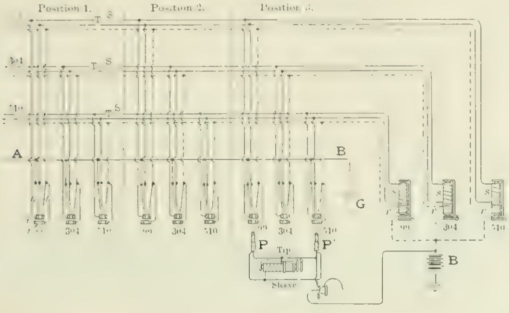


FIG. 6.—CIRCUITS OF BRANCH TERMINAL BOARDS.

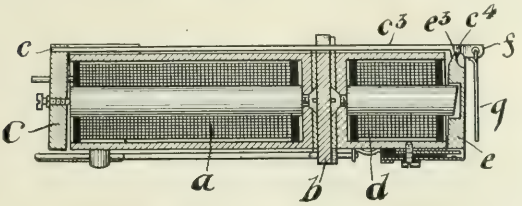


FIG. 7.—SELF-RESTORING DROP

The subscriber's signal is a drop having two windings, *s* and *r*. The *s* coil has a resistance of 500 to 1,000 ohms, and is bridged across the line. When the subscriber rings, this winding actuates the drop mechanism and displays the signal; as the drop cannot be cut off by the opening of a jack contact, the signal winding must possess sufficient impedance to avoid shunting the voice current. The resistance of the *r* winding varies from 25 to 50 ohms. One end of this winding of each drop goes to one pole of the office battery B^1. The other end of this winding on each drop is connected to the third wire of the line to which the drop belongs, runs through the board and to the b^1 spring and *g* ring of each jack of the line in question. Fig. 7 shows the mechanism of the drop. When the subscriber rings, the coil *a* is excited, the armature *c* attracted and lever c_3 raised in the usual manner, allowing the shutter *e* to fall by gravity. Instead of being a thin piece of brass, shutter *e* is a thick block of iron having a hole in its center into which the core of the drop protrudes. In front of this shutter is a very light aluminum flap, *g*. As *e* falls *g* is raised, disclosing a signal painted on the front of *e*. Shutter *e* moves but a short distance, so if coil *d* is excited the magnetism developed in the core will retract *e* to its normal position, and allow *g* to drop, concealing the signal. Further, so long as coil *d* is excited *e* is locked in place, and no false signals can be displayed.

Fig. 8 shows an enlarged sectional view of the plug, jack and drop, from which the circuit which restores and locks the drop shutter may be readily traced.

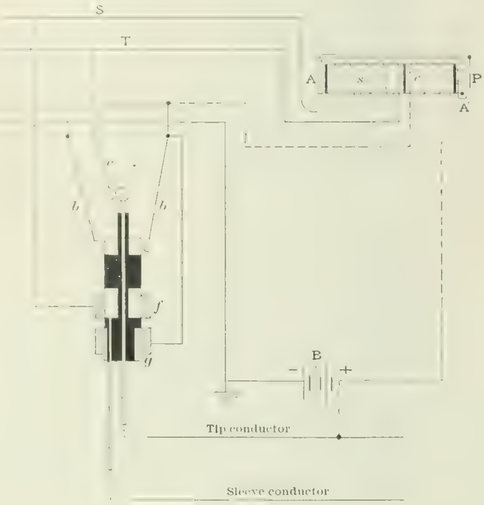


FIG. 8.—SELF-RESTORING DROP.

The cord circuit of the branch-terminal switchboard is illustrated in Fig. 12, from which with Figs. 6 and 8 the busy test may be traced. These illustrations show that the tip of each plug and the *g* ring of every jack are normally connected to the same pole of the battery *B*. Hence, if the tip of a plug touches ring *g* of an idle line, no sound will be emitted by the receiver, for both ring and top are at the same potential. When a jack is plugged, springs *b* and b^1 are connected by the jack ring. But spring *b* is grounded; hence ring *g* will be grounded and its potential lowered. The operator is bridged across the line when testing with a grounded centre, hence when the tip of the plug touches a grounded ring, the receiver clicks.

Fig. 9 is a rear view of a branch terminal board, and shows the drop ring at the top of the frame succeeded by the multiple cables, underneath which come the cords and miscellaneous apparatus.

Fig. 10 shows a trunk circuit frequently employed with the branch-terminal system, and a modification employing simpler jacks, having two springs and one ring. The long springs are bridged to one side of the line (the sleeve), the short ones to the other (the tip), forming the talking circuit. The rings are in series with a drop-restoring winding and are connected to the ground. One pole of the office battery goes to the plug ring, the other to the ground, so that as soon as the operator inserts an answering plug, the restoring winding is excited, and the drop is locked. Normally, the rings are grounded, and the plug tip is neutral. A busy line has a battery on the ring, and the test is made as usual with a split receiver. Each cord is supplied with an order-wire key, *K*, whereby the operator may bridge her telephone upon the order-wire which ends in the talking set of the *B* operator at the incoming trunk office. The order-wire is also supplied with a self-restoring drop, *D*, which may be operated by the key, *K"*, so that at night or when the *B* operator is not near her receiver, the *A* operator may signal.

The trunk line is split into three parts by means of two repeating coils, *R* and R^1, partly to render the line quiet when connected to grounded subscribers and partly for ease in giving a disconnect signal by furnishing what has been termed a *"phantom circuit."* From the trunk-jack ring, *B*, a conductor, 1, runs to the center, 2, of the trunk line side of the repeating coil in the originating office, while from the center, 3, of the trunk-line side of the repeating coil in the incoming trunk office, a conductor, 4, passes to a signal, 5, and to ground. After the *B* operator has assigned the trunk to the *A* operator, the *A* operator inserts the connecting plug into the trunk-line jack. This connects battery and the ring, whence current flows to the center of the trunk-line side of the repeating coil, divides, flows equally over both sides of the trunk-line to the center of the coil in the incoming trunk office, then to the signal, to ground and back to the originating office. The signal is the largest type (see Fig. 11) consisting of an electromagnet, furnished with pivotted armature. When the magnet is excited, the armature is attracted and a conspicuously colored disc is made visible. So long as the connecting plug is in the trunk-line jack at the originating office, this busy signal will be displayed, because battery current flows over the trunk circuit. But as the current splits equally over both sides, there is no interference. When the clearing-out drop in the *A* office indicates that the subscribers have finished, the *A* operator removes both plugs, and the target signal disappears, indicating to the *B* operator that the trunk circuit is free.

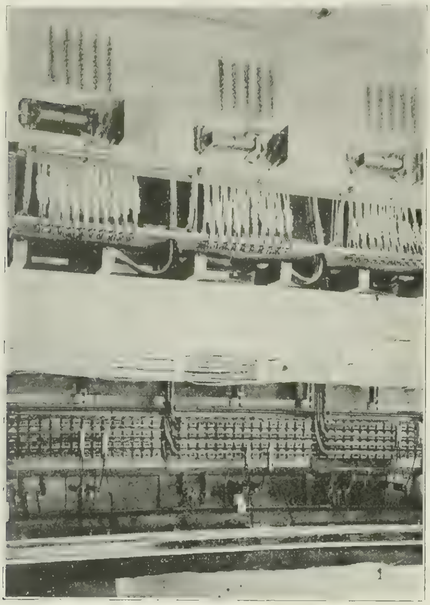


FIG. 9.—REAR VIEW OF BRANCH TERMINAL BOARD.

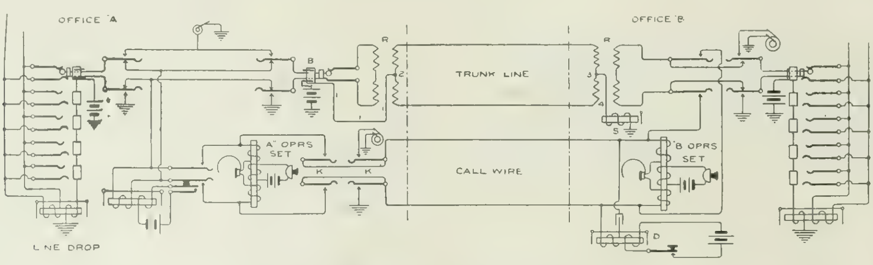


FIG. 10.—TRUNK LINE, BRANCH TERMINAL BOARD.

The use of the multiple board produced a marked effect in decreasing cost of operation and in improving the service, so that telephony developed with great rapidity, producing a tendency to concentrate a large number of subscribers in a single office. There is, however, a limit to such concentration, because as soon as the number of jacks become so great as to make it impractical to place all lines within the reach of every operator, the multiple system fails, and some transfer method becomes necessary. To carry the multiple principle as far as possible, the greatest ingenuity has been exercised in devising jacks to occupy the smallest space, so that a very large number can be concentrated in front of the operator. Figs. 13, 14 and 15 are examples of modern methods of jack construction. Fig. 15 shows two-point jacks, designed for multiple switchboards, mounted in strips of 20. The strip is of hard rubber, drilled and slotted to receive the rings and springs, which are respectively of brass and hard German silver. Such jacks are mounted on ½-in. or ⅜-in. centers. Fig. 13 shows four-point jacks of the cut-off type having platinum-contact, German silver springs. The illustrations show the mounting used for answering jacks, ready for association with the line signal jacks. Fig. 14 is a five-point jack, the economy of design having been carried far enough to allow these to be arranged upon ½-in. centers.

The quantity of equipment of a multiple switchboard depends upon two different factors. The number of answering jacks and signals depends solely upon the number of lines, while the number of multiple jacks depends upon the number of operators, which varies as the amount of traffic. For example, assume an exchange of 1,000 lines in which the average rate of originating calls is 6 per day, and suppose that each operator can answer 1,000 calls per day. As there are 1,000 lines there must be 1,000 answering jacks and signals. The total number of originating calls per day will be 6,000, and, if each operator answers 1,000 calls, 6 operators will be needed. Suppose that the originating calls average 16 per day instead of 6, there will then be 16,000 calls per day, and, at the same rate, 16 operators will be required. Evidently the number of line signals and answering jacks must be increased to place each line within the reach of 16 operators instead of 6.

FIG. 11.—TARGET SIGNALS.

The modern switchboard consists of a substantial iron frame, which is sub-divided into panels into which the apparatus is placed. It is customary to design the frame so that a full multiple will occupy either 5, 6 or 7 panels, depending upon the size and the style of the jack, and hence switchboards are frequently designated 5, 6 or 7 panel boards, indicating thereby the number of panels which are required for one multiple. Practice has settled to the idea of arranging the multiple to cover the space occupied by three positions, so that the middle operator sits in front of the second third of the multiple, has the first third on her left and the third third on her right. Therefore, in order that all operators shall have access to every line it is essential to provide an extra one third section of multiple jacks for each operator at the ends of the switchboard. To determine the number of multiple jacks required it is necessary to estimate the number of operators. This number divided by three give the total number of complete multiples; to this add two-thirds of a multiple to care for the end sections; the number of lines multiplied by the number of multiples, plus two-thirds of a multiple, will give the total number of multiple jacks. For incoming trunk service, where operators work at higher rates of speed, it is sometimes customary to use a two-operator multiple, in order that there shall be less interference between adjacent operators.

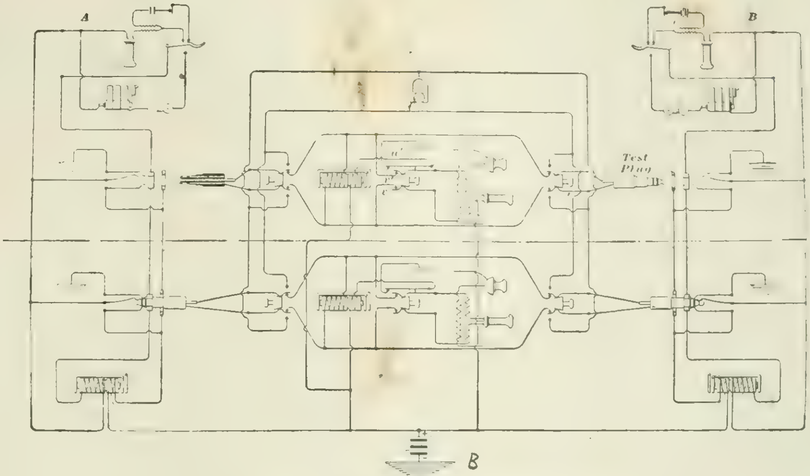


Fig. 12.—Cord Circuit, Branch Terminal Board.

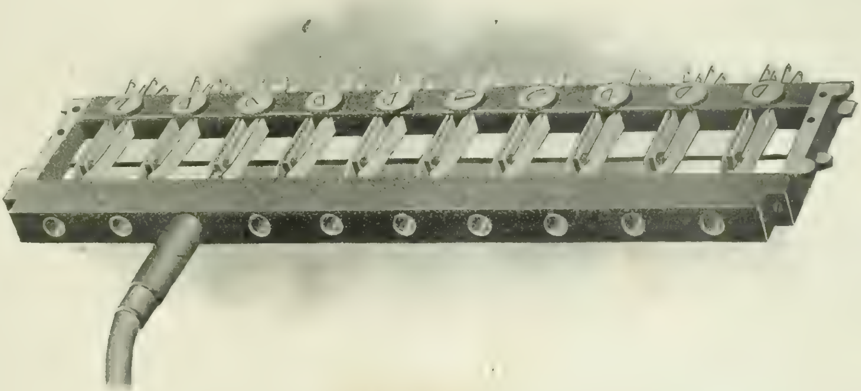


Fig. 13.—Four-Point Answering Jacks.

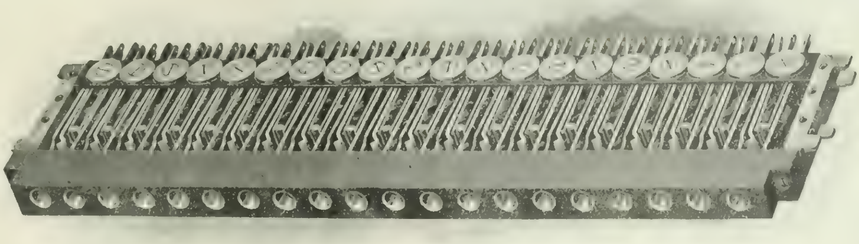


Fig. 14.—Five-Point Multiple Jacks.

TELEPHONE TRANSFER SYSTEMS AND THE MULTIPLE BOARD.

The chief objection to the multiple board is the expense of the large number of multiple jacks which are required in large offices. To economize, all sorts of transfer systems have from time to time been devised. In some instances the board has been cut into two parts, half of the subscribers being located in one section and half in the other. In each section there is provided a subscriber's answering jack and signal, and the sub station is so arranged that the subscriber can signal either section at pleasure. By this means the number of multiple jacks is reduced, but twice as many answering jacks and signals are required, and experience has shown that subscribers are so prone to signal the wrong section of the board as to make this method of doubtful expediency.

Experience has shown that *B* operators can handle more calls per day than *A* operators, so the expedient has been tried of placing the subscribers' terminals before an *A* operator who shall answer, take the order and transfer the call to *B* operators placed in front of a multiple. This method produces an economy in cost of installation, but it is open to the disadvantages of any transfer system. It has been usually argued that since a transfer system requires the co-operation of two operators, the service is more expensive, but it is found that the office management is the more important factor in regulating the expense than the co-operation of two operators versus the interest and depreciation on the cost of multiple jacks, for careful statistics show that the expenses of handling calls in offices of approximately the same size, whether on a multiple board or a divided board, are closely the same.

The business of a telephone exchange varies from minute to minute, and if a method could be devised whereby the load on the answering operators could be equalized, enabling all to work at a steadier rate, much more business could be accomplished more cheaply. Of the many transfer systems that have been suggested for the solution of this problem, most notable is the so-called *"Sabin Express System."* The subscriber's signal is placed before an operator, and is also furnished with trunk lines extending to the other operators. These trunk lines are equipped with busy signals to indicate whether an operator is or is not engaged. When the subscriber's signal is displayed, the operator in front of whom it appears transfers the line to any disengaged operator. The first operator is often termed a *Y* operator, the second an *A* operator, because the latter takes the subscriber's order and by means of a trunk line extends the subscriber's line to a *B* operator in front of whom the jack of the desired subscriber appears. Then the last operator completes the connection. Apparently the operating load should be steadied, more work accomplished at cheaper rates and the cost of the multiple jacks saved. But under operating conditions, neither this nor any other transfer system has succeeded in competition with the multiple. This fact is doubtless partially due to a reduction in the cost of multiple jacks. Formerly jacks and cable were rated at $1 to $1.25 each, whereas now the price has fallen to 25 cents. This reduction of cost has reduced installation expense and consequently stimulated the development of multiple switchboards. In fact, the improvement and perfection of the multiple board has been in recent years one of the favorite branches with inventive workers in the telephone field, and a large proportion of the patents issued in telephony have been devoted to the modern multiple board. It is difficult to take any issue of the *Patent Office Gazette* and not find in it some patents devoted to the multiple board, not only as to circuits, but as to construction and concentration.

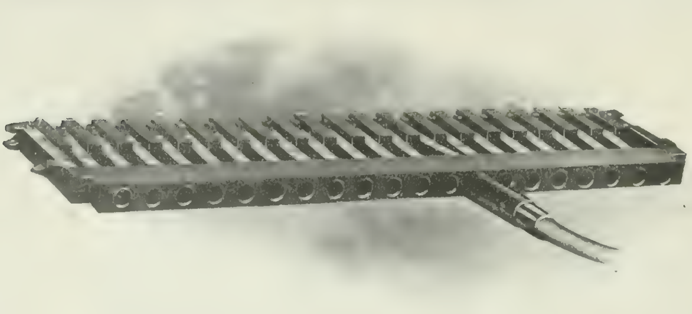


FIG. 15.—TWO-POINT MULTIPLE JACK.

New Telephone Patents

CIRCUIT SYSTEMS FOR SWITCHBOARDS.

Three patents for different common battery switchboard circuit systems have been issued to Mr. W. W. Dean, these patents all being assigned to the Kellogg Switchboard and Supply Company.

All three are worked out upon the two-wire basis, i. e., there are but two joints to the various jacks. Fig. 1 shows one of the systems. It will be seen that the line relay controlling the lamp must be of high resistance. Then while it operates upon the closing of the circuit at the subscriber's station, yet insufficient current flows to operate the intermediate and cut off relay. When an operator answers, a circuit may be traced through the plug sleeve and cut-off relay, to the subscriber and back through the plug tip. The cut-off relay cuts off both line and intermediate relays. Should the subscriber hang up, the intermediate relay will operate to cut the line relay circuit, the current supply for this relay coming from the cord circuit over the sleeve of the plug. The cord circuit is one often employed with this type of system. It will be noted that a busy test potential is put upon the test ring of the jack as soon as a call lamp is lighted, as this ring is connected to the line relay circuit between the cut-off relay and line relays.

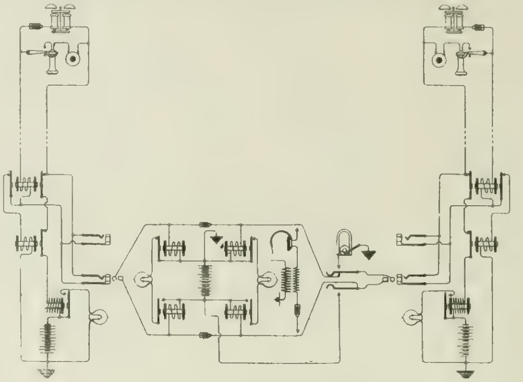


FIG. 1.—DEAN SWITCHBOARD CIRCUIT.

In the other two systems, one side of each line is permanently connected to the grounded pole of the battery through one coil of a double-wound relay. The other pole of the battery is similarly connected to the other side of the line, but in addition it is connected to both strands of the cord pairs. The operation may be readily traced. In this system the cut-off relay being in the battery circuit must be shunted as herein shown, or must be differential as described in the third patent.

VARIOUS APPLIANCES.

Mr. E. P. Baird, of Evanston, Ill., has invented a transmitter arm of the usual adjustable type, in which the clamping screw which usually appears at the base is done away with. The usual wings or ears of the base piece are recessed internally to receive spring washers placed upon both sides of the arm proper. These washers have a stud at the center which engages recesses in the arm. The spring washers thus serve by their friction not only to clamp the arm in any position desired, but also serve as pivots.

A hand microphone for the use of the deaf has been patented by E. W. Schneider, of New York City, he having assigned his patent to the Mears Ear Phone Company. The telephone or receiver part is of the watchcase type and is mounted upon a hollow handle within which the small dry cells for the transmitter are placed.

Mica fuses, so called, are now in general use. These consist of a small piece of mica sheet, carrying copper terminals between which a small piece of fuse wire is stretched. The mica serves to protect the minute fuses required in telephony. As a still further protection, Mr. F. G. Jones, of Chicago, has arranged the fuse between two micae, the terminal serving to clamp the whole firmly together.

Mr. F. B. Cook has made further improvements in the self-soldering sneak current protectors recently patented. These are of a type in which the grounding springs are held by teeth in the thermal device. This latter becoming heated, rotates under the pressure of the springs and these latter are released and ground the circuits. The present improvements involve a special shaping of the springs such that a test plug may be inserted and withdrawn without disturbing the normal relations of the apparatus.

A very different type of protector is that patented by M. L. Smith, of Rutledge, Mo. This is an apparatus for opening a line or lines at the subscriber's premises. A lever serves to pull apart contact springs included in the line and to thrust into the opening between them a sheet of insulating material.

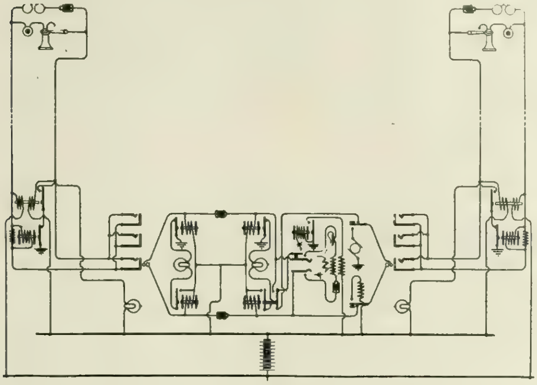


FIG. 2.—DEAN SWITCHBOARD CIRCUIT.

INTERCOMMUNICATING SWITCH.

A self-restoring intercommunicating switch is described in a patent granted to Messrs. A. S. De Veau, of New York, and Charles Auth, of Brooklyn. The switching is done by buttons which become locked into position until the act of restoring the receiver restores all to normal, by shifting the latch plate.

TELEPHONE SWITCHBOARD.

It is a well-recognized fact that a telephone switchboard is difficult to keep free from accumulations of dust or dirt. To overcome the ill effects of dirt, Mr. M. C. Burt, of Chicago, arranges all his wiring within a hollow cylinder, through which he proposes to blow a stream of air to blow out dust.

LOCK-OUT SYSTEM.

A patent has been issued to T. Matheny and R. C. M. Hastings, of Athens, O., with which no connections of the various telephones to the talking line may be made without the assistance of the exchange. Thus a party desiring to talk must send in his station number. Unfortunately this must be done on a third or signal wire, which at once prohibits the general use of the system.

LETTERS TO THE EDITORS.

Diagrams of Railway Passenger Travel.

To the Editors of Electrical World and Engineer:

Sirs:—In an editorial which appeared in the issue of the Electrical World and Engineer for February 18, 1905, attention is drawn to the value of load diagrams. It is believed that the accompanying diagrams present some features of interest. These diagrams do not indicate the load on the station, but show the number of passengers traveling upon the Brisbane tramway at different hours of the day. The diagram of Fig. 1 shows the number of passengers actually on the cars each half-hour from 6 a. m. until 12 midnight. It represents the average of counts taken on two separate Tuesdays. There are three curves, one of which shows the outbound passengers; the second, inbound passengers; and the third, total passengers. This and the diagram of Fig. 2 were obtained by actually counting the passengers on the cars every half-hour during the day. The conductors were supplied with cards suitably ruled, and the diagram was made up from the returns.

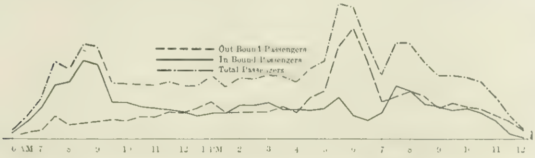


FIG. 1.—CURVES SHOWING PASSENGERS CARRIED ON TUESDAY.

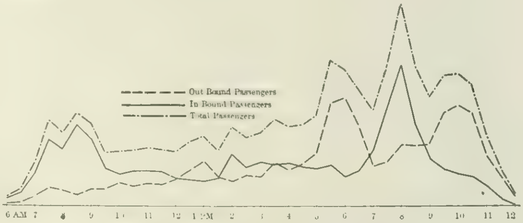


FIG. 2.—CURVES SHOWING PASSENGERS CARRIED ON FRIDAY.

The curves of Fig. 2 show the average of the number of passengers on two Fridays. The difference between the shape of the diagram of Fig. 1 and that of Fig. 2 is quite marked. There is in force at this place a law which requires that all stores be closed at six o'clock every night except Friday, which is recognized as the laboring man's shopping night. The diagram of Fig. 3 represents the receipts by periods of ten minutes for a Saturday. The data for this curve were obtained from the conductors' way bills.

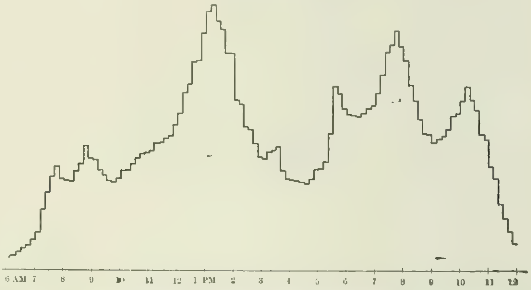


FIG. 3.—CURVE SHOWING RECEIPTS FROM PASSENGERS ON SATURDAY.

Brisbane, Australia. J. S. Badger.

Measurement of High Electrical Pressures.

To the Editors of Electrical World and Engineer:

Sirs:—In the issue of your journal under date of July 8 there appeared a report of part of the discussion on my A. I. E. E. paper on "Methods of Measurement of High Electrical Pressures," and an editorial on the same subject. As these articles both lean very strongly on one side of the question I trust I may be allowed sufficient space to indicate some facts which, from the standpoint of the practical operator, point very decidedly to the other.

First in reply to the criticisms of the editorial. It was stated that one weak point in the static meter described by me was in that the law of the deflectors was not simple enough to permit of one observation and then a calculation of the rest of the scale. This same criticism is true of nearly every alternating-current meter in use, including the spark gap, and while perhaps an inconvenience, is so trivial in comparison to the difficulties overcome as to be negligible.

The criticism that the meter reads square root of mean square values instead of maximum ones is rather odd, in view of the fact that all alternating-current meters read the same and there seems little possibility of getting any other kind. At present, aside from oscillographs and instruments of that type, there are no meters that indicate maximum values. These, under commercial testing conditions, are not to be considered, on account of excessive cost, difficulty of manipulation, expense of auxiliaries and errors involved in use of same.

The statement that the maximum voltage "ought to count" in insulation testing is certainly true—the only question is, How can that maximum value be most accurately determined? Dr. Steinmetz looks to the spark gap as the best way of determining the maximum values, and even goes so far as to state that "if the instruments and spark gaps do not agree that the spark gap is correct," and the spark gap must be considered the ultimate "court of appeals." The maximum voltage that should count in an insulation test is the one that regularly recurs each alternation. The one the spark gap indicates when working under its best conditions is the maximum one of a great number that occur during its application. This maximum one may be 15 per cent or 20 per cent higher than the normal maximum values, caused by some momentary surge on the system, and the tester is fooled by that amount. Yet this one high value, which the meters would ignore, would cause no damage to the insulation. Mr. W. L. R. Emmet, before the A. I. E. E. at its Buffalo convention in 1901, called attention to the ability of solid insulation to stand momentary excess voltage while air would break down.

Mr. Fisher has noticed that differences in the size of the points of needles selected from the same pack cause variations of 15 per cent or 20 per cent in the voltages required for a given gap. His tests were made at about 15,000 or 20,000 volts. I have noticed variations of as much as 70 per cent in the voltage for a certain gap due to a loose contact. Current-limiting devices, such as condensers and resistances, change the jump values very decidedly, though a voltmeter on the line shows no change.

In addition to all the above and much more that could be added, which are simply errors that are likely to creep in and cause a mistake in the value of the pressure that is supposed to have been applied, the spark gap is a positive menace to the apparatus under test, as well as the testing apparatus. This is particularly true of transformers, high-voltage generators and motors, as the change in the distribution of the electro-static charge may cause strains between turns and develop a trouble which would otherwise not have occurred. The danger is less when line insulators, cables and apparatus without inductance are under test.

My experience in high-pressure measurements leads me to believe that for accurate, consistent results this type of meter is far superior to any other with which I am acquainted.

In closing I wish to state that I am in perfect agreement with you in the statement that there is a demand for an instrument which will indicate maximum values—and no one will welcome its advent more than I—but the spark gap is not it. I am also in agreement with your closing remarks in the editorial of July 1st, "that a simple and reliable voltmeter for very high tension is much to be desired," and I believe the one proposed in my paper, which after six months' service has not developed any serious defects, will be found very useful.

I believe the views expressed above regarding spark gaps are quite general among a large majority of the engineers whose experience qualifies them to judge of this question. The discussion at Asheville, of which a part only was given in your report, indicated that such a belief exists.

Pittsburg, Pa. S. M. Kintner.

The Double Trolley in Cuba.

To the Editors of Electrical World and Engineer:

Sirs:—In reference to your editorial in your issue of July 8 regarding the double-trolley system, you have been misinformed regarding the use of double trolley on the lines of this company now under construction in the vicinity of the city of Havana. While we will use two trolley wires outside of the city, they will be used in a way common to a large number of interurban roads in the States; the single-trolley method being used, with track return.

We were compelled to use the double-trolley system in Havana proper by the United States military engineers, due to their belief that this was the only method of avoiding the possibility of the danger of corrosion of the existing water works system.

In general our road will be along the lines of the usual interurban road in the States, except where changes are made necessary by local conditions.

Havana, Cuba. A. W. K. Billings,
Chief Engineer Havana Central Railroad.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Cascade Rotary Converter.—An illustrated description of the "cascade rotary converter" of the Nancy General Electric Company. This machine is intended to combine the advantages of the motor-generator and of the rotary converter. It is self starting and when started it runs up to synchronism. The synchronizing torque is so strong that it is almost impossible to get the machine out of step. The direct-current side of the machine may be adjusted to suit any case. The voltage can be regulated by means of a rheostat in the shunt-exciting circuit. The machine may be connected to a 3-wire system and in this case acts as an automatic balancer. Any reversal of polarity is impossible. The efficiency is more than 2 per cent higher than that of a motor-generator of the same capacity and is about equal to that of a rotary converter with its transformer. Employed as a generator of alternating current, its regulation is excellent even with a low-power factor and its price is lower than that of an ordinary motor-generator of the same capacity. The machine consists in principle of an induction motor and a converter, the axles of both machines being rigidly coupled. The rotor windings of the induction motor and of the converter are connected in cascade, as shown in Fig. 1. It may first be assumed that the motor and converter have the same number of poles—two poles in this case—and that the rotor and the converter armature revolve with an angular speed corresponding to half the frequency of the primary alternating current. Under these conditions the revolving field induced in the rotor by the primary re-

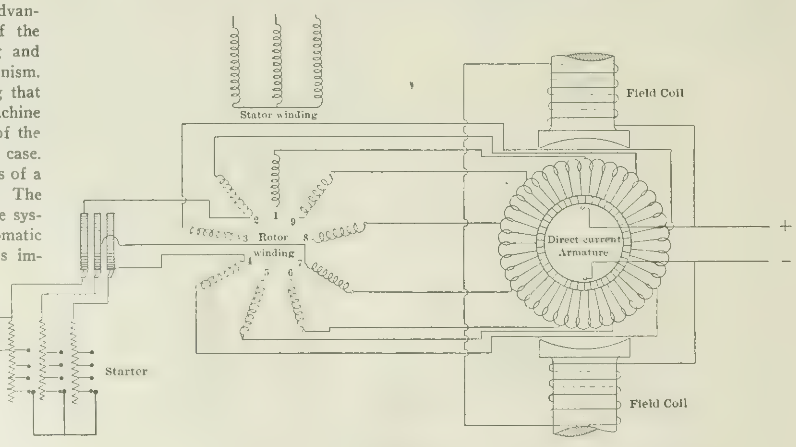


FIG. I.—ROTARY CONVERTER.

volves with respect to the rotor with half the frequency of the supply current, so that there is induced in the rotor winding an alternating e.m.f., the frequency of which is equal to one-half the frequency of the primary circuit. This e.m.f. creates a current in the armature winding of the converter so that there is produced in the armature a revolving field which revolves with respect to the axle with a speed corresponding to half the frequency of the supply current, i. e., with half the speed of the axle. Now the armature of the converter is connected with the rotor in such a way that the revolving field revolves in a direction opposite to that of the axle. It follows therefore that this revolving field does not move in space and that therefore the machine works at this speed as a synchronous motor. Since the induction motor revolves with the speed corresponding to half the frequency of the primary current, half of the electric power furnished to the induction motor is transformed into mechanical power and is transmitted through the axle mechanically to the converter, while the other half is transmitted electrically to the rotor windings and through these to the armature of the converter. Under these conditions the induction motor works half as motor and half as transformer, while the converter works half as direct-current generator and half as a converter. If the induction motor and the converter have not the same number of poles the machine revolves with a different speed depending on the ratio of the number of poles of the motor and of the converter, and the amounts of power transformed in the motor into mechanical power and electrical power are proportional to the number of poles of the motor and of the converter respectively. Consequently, the number of poles of the direct-current machine can be chosen so as to realize a great saving of material. At starting, a high-tension alternating current passes through the stator and induces currents in the rotor winding. At starting only three of the nine windings of the rotor are utilized, as shown in Fig. 1. They are connected by means of slip rings and brushes to an external non-inductive rheostat. This resistance is gradually cut out while the speed of the machine runs up. The other terminals of the three phase-windings are permanently connected with three points of the armature of the converter. The direct-current supply circuit of the converter is of course open during starting. The machine starts as an ordinary polyphase motor. At the same time the direct-current side excites its field. As indicated in Fig. 1, the resistance connected to the rotor cannot be cut out completely, since the rotor can attain half-synchronism only. While resistance is being cut out the amplitude of the oscillations of the voltmeter diminishes. A few seconds after the last notch on the controller is reached the voltmeter falls to zero, indicating that the machine runs at half synchronism. Now the slip rings are short-circuited and the points 1, 2, 3,......9 of the rotor windings are connected together so that the nine phase-windings of the rotor are now in service. In the transformation of alternating currents into direct current, the total drop of voltage between full load and no load may be regulated between 3 and 15 per cent. In general in transforming from alternating into direct current the voltage drop is 3 to 5 per cent with a power factor equal to unity and 5 to 12 per cent with a power factor of 0.8. If the converter shall supply a 3-wire distributing net work it is arranged as shown in Fig. 2. The converter operates as a balancer and as the generator and the balance is so perfect that if one of the two halves is completely loaded and the other half is unloaded the difference in the voltages is not more than 3 per cent.—*L'Industrie Elec.*, July 10.

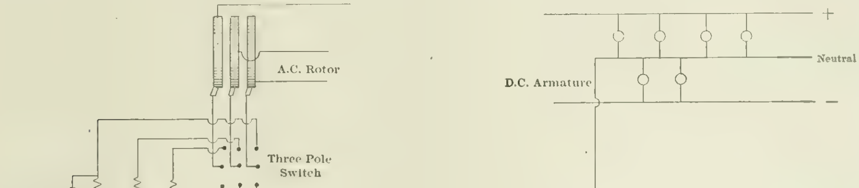


FIG. 2.—ROTARY CONVERTERS.

Commutation Poles.—BRESLAUER.—A long illustrated article on direct-current machines with commutation poles. The author first discusses the principle and gives the results of tests which he has made. He then discusses the best dimensions of the commutation poles. These poles should not be made too thick in their tangential dimensions. Even when the thickness of the poles was decreased to 40 per cent of the slot pitch with five segments per slot good results were obtained, while the axial breadth was two-thirds of the armature breadth. As a material for the commutating poles solid iron may be used, while the length of the air gap is determined by mechanical considerations. For the ampere-turns required for the auxiliary poles, he found values which are between 1.2 and 1.4 times the armature ampere-turns. This, of course, increases the cost of the machine. On the other hand there is a saving in the copper of the main poles since the air-gap may be reduced as far as is possible on account of mechanical considerations; further, in view of good commutation and small field distortion, there is no longer any necessity of high saturation of the teeth. A further saving is accomplished by reduction of the dimensions of the commutator. He concludes that a machine properly designed with commutation poles will cost only little, if at all, more than an ordinary dynamo. Since good commutation is taken care of, it is only necessary to take into consideration the limit due to the heating of the machine; if perfect ventilation is provided, then it is only necessary to take the efficiency of the machine into consideration. The author thinks that this involves the possibility of another essential reduction of the cost of direct-current machines.—*Elek. Zeit.*, July 13.

Inverted Rotary Converter.—CLINTON.—If a specially excited rotary converter be driven at a constant speed with the rings and brushes on open circuit, the ratios of the maximum alternating e.m.f. between the rings to the e.m.f. over the brushes is given by a well-known expression. If, however, the converter be driven by current supplied to either side, the other side being on open circuit, then a correction on the above value becomes necessary owing to ohmic drop in the armature conductors. The author treats this problem mathematically and finds the following numerical results. The value m in the table is the ratio of the voltage on the brushes to the ohmic drop from brush to brush.

Type of Machine.	Corrected Ratios (as percentages)				Uncorrected Ratio as Percentages.
	m = 10.	m = 50.	m = 200.	m = 500.	
Single-phase	67.13	69.61	70.42	70.58	70.72
Three-phase	56.70	60.18	60.95	61.10	61.24
Four-phase	46.04	49.11	49.75	49.905	50.00
Six-phase	32.46	34.73	35.19	35.29	35.25
Twelve-phase	15.60	17.97	18.21	18.26	18.30

The percentage corrections due to voltage drop on the unloaded machine is practically independent of the number of phases if the value of m is of the order usually found in good design.—*Phil. Mag.*, July.

Magnetic Pull.—NIETHAMMER.—An article giving several formulas for calculating the magnetic pull in dynamos and motors, due to errors in symmetry of construction.—*Zeit. f. Elek.* (Vienna), July 9.

LIGHTS AND LIGHTING.

Mercury Arc Lamp for Ultraviolet Rays.—AXMANN.—The mercury arc is very rich in ultraviolet rays, but if they are to be made use of, ordinary glass cannot be used, since it absorbs these rays. Heraeus has constructed a mercury arc lamp from fused quartz giving ultra-violet rays of 220 $\mu\ \mu$ wave length. Fused quartz apparatus, however, is expensive. Schott has devised a new sort of glass which he calls Uviol, from ultra-violet). The spectrum of the mercury are lamp made from uviol glass reaches to 253 $\mu\ \mu$, which is sufficient in most cases. In his lamp he uses two carbon terminals with a small quanity of mercury; the lamp is lighted by means of tilting. Since both terminals are of carbon they may be exchanged at will, but it is necessary to have the negative terminal of the lamp at the lower level, so that it is always covered with mercury, as otherwise it would burn out. The following applications of ultraviolet rays are mentioned. Photochemical effects, generation of ozone, ionization, fluorescence and especially applications in medicine.—*Elek. Zeit.*, July 6.—A longer illustrated article by Schott on the same subject is published in *Zeit. f. Beleucht.*, June 20.

Ratio Between the Mean Spherical and the Mean Horizontal Candle-Power of Incandescent Lamps.—FLEMING.—A (British) Phys. Soc. paper with reference to the experimental result obtained by Dyke as to the ratio of the m.s.c.p. of incandescent electric lamps to the m.h.c.p., taken when the lamp was rotating round a vertical axis. In the case of 9 different types of electric incandescent lamps, this ratio was found to be a number near 0.78. The present author shows mathematically why this must be so.—Lond. *Elec.*, June 23.

POWER.

Power Distribution System.—An illustrated article on the Clyde Valley electric power system. The district to be supplied comprises about 750 square miles and contains the most important manufacturing and coal-producing district in Scotland. There are two generating stations at Yoker and Motherwell, while 10 sub-stations are at present installed in the Motherwell district and 3 in the Yoker district. These 2 districts will not at present be connected in any way, although they may be in the future. Each power plant contains 2 Westinghouse turbo-generators, running at 1,500 rev. per min. The turbines are of the double-flow pattern, steam entering at the centre and exhausting at both ends, and each contains 20,000 blades. Each of the turbines is directly connected to a 2,000-kw, 11,000-volt, three-phase, 25-cycle generator of the revolving-field type.—Lond. *Elec.*, June 23. (See this issue E. W. & E. for full details.)

Oil as Fuel.—CHAMBERLIN.—A very long illustrated article on the North Beach power station of the United Railroads of San Francisco, which was put in operation during the summer of 1903. The capacity is 6,600 hp. Since the start, oil fuel has been used with much success. "It is preferable to coal on account of its cheapness both in regards to first cost and handling, in ease of operation, in cleanliness and in heating capacity." The oil consumption is at the rate of 0.28 gal. or 2.24 pounds per kw-hour.—*Power,* August.

Electric Winding Machines.—HABETS.—The conclusion of his paper, the first part of which was abstracted in the Digest last week. He describes several electrically-driven winding machines installed in European mines. The final conclusion is that the electric-haulage machine, even if it is not more economical than the best steam-driven machine, is certainly not more expensive. The greater facility and safety with which it can be manipulated, the smoothness with which it works and its much greater flexibility will often make it preferable to the steam-driven machine, even in the case where transmission of energy is not required. There can be no hesitation in the choice between the two systems, when the power has to be transmitted from a distance, or, where the production of energy can be centralized at one power station.—Lond. *Eng'ing.*, July 7.

Electric Power in Mexico.—BLACKWELL.—Coal costs at ports on the Gulf of Mexico about $6 (in gold) per ton, while in the interior the cost of transportation increases the price per ton by from $10 to $20. The country is mountainous and, though no large rivers exist, high waterfalls make many developments possible. The author gives a review of water-power developments in Mexico. The latest plant now under construction is that of the Mexican Light & Power Company, at Necaxa. This will be one of the largest plants in the world and in addition will deliver power over a greater distance than has yet been undertaken by any other installation. There will be two plants, which will eventually be capable of furnishing 60,000 kw electric horse-power.—*Cassier's Mag.*, July.

French Power Transmission.—SOULIEF.—An illustrated description of the power plant of Bourlillon, Isere, for power transmission at 35,000 volts to Vienna, a distance of about 55 miles. The power plant contains three turbo-driven generating sets each of 1,000 kilovolt-amperes, three-phase currents at 3,800 volts being generated. The voltage is raised to 35,000, which is a very high value for France.—*L'Industrie Elec.*, July 10.

Power Plant of Department Store.—The first of a series of articles on details of the Wanamaker power house in Philadelphia. The building will be equipped with eight 663-hp, water-tube boilers, four 500-kw and six 175-kw direct-connected generators.—*Eng'ing Record,* July 23.

[illegible]—NEILSON.—The concluding article of his serial on this subject. He discusses central condensers, cooling towers and auxiliary machinery of the condensing plant.—*Eng'ing Mag.*, July.

Modern Steam Traps.—A long illustrated article on the modern steam traps, explaining their construction and method of operation, and giving in many instances the steam-pipe connections essential for the best working of the traps.—*Amer. Elec.*, July.

German Electric Traction Statistics.—The annual statistical tables on electric traction in Germany. The statistics cover 233 full pages and a summary is given in an editorial. The statistics are divided into three parts, dealing with, first, those electric railways which were in operation on October 1, 1904; second, electric railways in course of erection; third, railless traction systems (there are six such systems in Germany). The following table shows the development of electric traction in Germany since 1896:

	1896.	1900.	1903.	1904.
No. of main centres of electric railway systems	42	99	134	140
Length of lines in kilometers	582	2,868	3,692	3,791
Length of single track in kilometers	854	4,254	5,500	5,670
Number of motor cars	1,571	5,994	8,702	9,034
Number of trailers	989	3,962	6,190	6,477
Capacity of electric machines in kw	18,560	75,608	133,151	133,326
Capacity of accumulators in kw	...	16,890	38,736	39,809

There is given a table which shows the capacity of machines installed per kilometer of single track or per motorcar in different cities. These figures, of course, vary greatly in different sets, according to local conditions. The highest figures are for Gotha (maximum grade 0.67 per cent) where these figures are 61.1 kw per kilometer of single track and 33 kw per motorcar. In Barmen, with a maximum grade of 2 per cent, these figures are 40.4 and 28.4 kw respectively. In Wiesloch, with a maximum grade of only 0.16 per cent, the machine capacity per motorcar reaches the very high figure of 60.0 kw. The lower figures are in the case of Bremerhaven and Frankfurt; here these figures are 7.8 and 8.6 kw per kilometer of single track and 6.6 and 6.0 kw per motorcar The average figures from 74 cities are 20.7 kw per kilometer of single track and 17.0 kw per motorcar. The system of operation has not undergone any essential change during the last year. There is still a strong tendency to substitute the trolley system for conduit systems or storage battery systems. A mixed system combining trolley and storage batteries is in use only in Dresden, combinations of conduit and trolley are used in Berlin, Dresden and Duesseldorf. "The safety of operation of conduit systems compared with the trolley system still leaves much to be desired, so that the substitution of the latter for the former is probably only a question of time." Pure storage-battery traction is in use only on a 2.5-mile road in Bremerhaven, while, on the other portions of this system, horse traction is used. The intention is to introduce the trolley system throughout. On the other hand, it is pointed out that on real railroads the storage-battery system has not been replaced, but, on the contrary, it is being introduced on additional lines. The local road between Ludwigshafen and Mundenheim is now in the 10th year of storage-battery traction and the Palatian railways in Bavaria now use storage battery traction on 10 branch roads. The same system is now being introduced on three main lines, partly to test its suitability in this case. The third rail is used on three roads, among them the elevated road and the subway of Berlin. Three-phase traction has now lost its attractions, and single-phase traction is in the foreground of interest. After the successful tests on the Niederschoenweide-Spindlersfelde road, it has been decided to employ the same system on the Hamburg-Altona road and its extensions; for this purpose a large power station with turbo-dynamos is being erected. This is the first case in which the Prussian State railways introduce electric traction on one of their roads. The system will be opened on October 1, 1906. The Siemens-Shuckert works have installed single-phase traction on the local road from Murnau to Oberammergau, which was formerly operated with three-phase currents. Careful plans are now being made to introduce the single-phase system on the Stadt-und-Ringbahn in Berlin.—*Elek. Zeit.*, July 13.

Lighting and Power From Railway Circuits.—An editorial discussion of this subject. If the fluctuations of a railway load are such as to forbid lighting directly from alternating-feeder circuits, it is still possible to get good service by using motor-generators for the lighting load. Every long railway system has scattered sub-stations which require attendants, and, by installing small motor-generators in one of these, a very useful lighting service may be worked up. The question is discussed whether a railway circuit at 25 cycles can give reasonably good service directly from its wires, assuming that a district does not furnish enough business to justify sub-station working. It seems that 25 cycles is just too low a frequency for satisfactory service, at least with 16-cp, 110-volt lamps. With 50-volt lamps, particularly of 20-cp or more, the fluctuations due to frequency will be far less troublesome, although those due to the variation of voltage from the railroay load would still remain. The question is then discussed whether a motor-generator set with a synchronous motor or one with an induction motor is preferable in obtaining power for lighting from a railway circuit. The advantage of a synchronous motor is that it averts all speed variations in the motor due to variations of voltage in the supply, and this may be of importance at the end of a long feeder. On the other hand, when the amount of lighting to be provided is small and it is necessary to use a motor-generator requiring the minimum of attention, the induction motor is altogether preferable. The last uestion discussed is whether voltage regulators on the fields of the generator of the motor-generator can be made to give good service in lighting when the frequency of the circuit varies 3 to 5 per cent, owing to the fluctuations in the load. This depends on the character of the fluctuations, and the purpose will be accomplished if the fluctuations are not too rapid.—*St. R'y. Jour.*, July 22.

Financial Aspect of the Electrification of Steam Railways. —BARKER.—A communication analyzing the accounts of the Mersey Railway Company in Great Britain, which has abolished the use of steam over the whole of its system, and substituted electricity in the place thereof. The half-year, which ended December 31, 1900, in which steam was used, is compared with the half-year ending December 31, 1904, in which electricity was used. The gross sum spent for working expenses by electricity was $164,415, while for steam it amounted to $164,875; the gross receipts were $208,940 for electricity and $195,245 for steam; the ratio in the two cases being 79 per cent for electricity and 84½ per cent. for steam—an improvement of 5½ per cent in favor of the former. The train-mileage has been increased by more than 250 per cent. In 1900, 156,450 miles, and in 1904, 415,625 miles were run. Expressing the expenses and receipts in costs and earnings per train mile, the sum paid for each mile run was 39 cents by electricity and $1.05 by steam. The receipts for electric traction per train-mile were, however, 50 cents and for steam $1.25, whilst the net receipts per train-mile were 10 cents and 19 cents respectively. Unfortunately, the increase of passengers carried is by no means commensurate with the increased train-mileage. There were 5,199,976 individuals carried on the electric trains against 4,169,478 by steam, so that while it has been thought necessary to run 2½ times the number of trains, the passengers have barely increased one-fourth. Electric passengers cost 3.0 cents and paid 3.8 cents—profit 0.8 cent. Steam passengers cost 3.8 cents and paid 4.5 cents—profit 0.7 cent, but in these figures the all-important factor of additional capital expenditure is neglected. The writer assumes the rate of interest at 3½ per cent, and adds the interest on the additional capital to the working expenditure, whereby the cost per train-mile is increased from 39 cents to 69.5 cents, and taking from this the earnings per train-mile of 50 cents there is a loss of 19.5 cents on every train-mile. He thinks that this state of affairs does not look too hopeful for the extension of main line electric traction.—Lond. *Eng'ing*, July 14.

Electric Traction Without Rails.—SCHIEMANN.—A paper read before the German Assoc. of Elec. Eng., and giving a review of his system of electric motorcars being supplied from an overhead trolley line, but running on ordinary roads without rails. They are intended especially for those roads on which existing traffic is not sufficient to render traction on rails economical. The advantages of the system in mountain districts are pointed out. Whenever necessary, it is easy to place around the wheels corrugated tires to increase the adhesion on ice, etc. The first cost of a rail-less traction system is 20 to 25 per cent of a real railroad, but, of course, in the former case not the same traffic can be taken care of. The cost of operation per car-mile is about the same as on small electric tramways.—*Elek. Zeit.*, July 6

Railway Signals.—A long illustrated description of a new system of electric signalling employed at the Derby station of the Midland Railway.—Lond. *Elec.*, June 23.

ELECTROPHYSICS AND MAGNETISM.

Hysteresis in a Revolving Field Under the Action of Direct Current, Interrupted Current, Alternating Current and Hertzian Waves. —RICCARDO ARNO.—A summary of various investigations published by him in various Italian journals. (From an article in Lond. *Elec.*, July 7, it appears that the arrangement of his experiments was as follows: A steel cylinder was suspended with its axis at right angles to the plane of the rotating field, and was surrounded by a coil through which the continuous, interrupted, alternating or oscillatory currents were passed. Fixed on the same suspension was a second cylinder in an equal but opposite revolving field without a coil. When no current flows through the coil of the first cylinder, the torques balance. But when a current is passed through the coil, the moving system deflects and is turned back to zero by a torsion head. The angle is taken as an indication of the magnetic lag in the cylinder, and, Arno assumes, also of the hysteresis.) The main results are as follows: If one uses a sufficiently strong revolving magnetic field, one always finds a diminution of hysteresis in the cylinder placed in the field, when subjected to the action of direct current, or interrupted current, or alternating current, or Hertzian waves. This diminution of hysteresis is the greater, the stronger the revolving field and the stronger the secondary magnetic field produced by the current to the action of which the cylinder is subjected. If one employs a revolving magnetic field of feeble intensity one may get an increase of hysteresis; this will be the case as long as the strength of the secondary field is not above a certain value; if it becomes greater than this value a diminution of hysteresis is observed. There exists always a certain value of the strength of the revolving field for which the increase of hysteresis is a maximum, and a certain value of the strength of the revolving field for which the hysteresis is neither increased nor diminished. If one uses weak revolving fields there exists always (for a given revolving field) a certain value of the strength of the secondary magnetic field for which the increase of hysteresis is a maximum; and a certain value of the secondary field for which the hysteresis is neither increased nor diminished. If the hysteresis is increased, the increase is smaller for direct currents than for interrupted currents or alternating currents. If the hysteresis is diminished, the diminution is greater for direct currents. If one submits the magnetic cylinder to the action of a direct current, he may choose the conditions so that the hysteresis is neither increased nor diminished; in this case if one employs an interrupted current or alternating current an increase of hysteresis is observed. On the other hand, one may subject the magnetic cylinder to an interrupted current or an alternating current and choose the conditions so that the hysteresis is neither increased nor decreased; then under the same conditions a direct current will give a diminution of hysteresis. It is possible that the same conditions may give a diminution of hysteresis with direct current and an increase of hysteresis with interrupted or alternating current. The increase of hysteresis is the greater the higher the frequency of the alternating current or the higher the frequency of the interruptions of the interruptd current. The diminution of hysteresis is the greater the smaller the frequency of the alternating current. If a magnetic cylinder is submitted to the action of an alternating current of given frequency one may choose the conditions so that the hysteresis is neither increased nor diminished; if the frequency is then increased, the hysteresis is also increased. On the other hand, if the frequency is diminished the hysteresis is also diminished. Finally, it is possible that under otherwise the same conditions, an alternating current of a certain frequency may give a diminution of hysteresis, while with a higher frequency the hysteresis is increased.—*L'Industrie Elec.*, July 10.

Magnetic Alloys from Non-Magnetic Metals.—FLEMING AND HADFIELD.—An account of an investigation of a sample of Heusler's alloy. A sample consisting of 60.49 per cent copper, 11.65 aluminum, 22.42 manganese and no iron, was found to exhibit magnetic properties identical with those of a feeble ferro-magnetic material. The magnetization (or B. H.) curve is of the same general form as that of a ferro-magnetic metal such as cast iron, and indicates that with a sufficient force, a state of magnetic saturation would most probably be attained. The alloy exhibits the phenomenon of magnetic hysteresis. It requires work to reverse the magnetization of the material and to carry it through a magnetic cycle. The material has a maximum permeability of 28 to 30, which is not greatly inferior to that of the values reached for cobalt or a low grade of cast iron for small magnetic forces, and occupies a position intermediate between the permeability of the ferro magnetic and the merely para magnetic bodies, such as liquid oxygen and ferric chloride. The material exhibits, therefore, the phenomenon of magnetic retentivity and coercivity. It is not merely magnetic, but can be permanently magnetized. The authors are led to the conclusion that the magnetic properties of this alloy must be based on a certain similarity of molecular structure with the familiar ferro-magnetic metals, and that ferro-magnetism of itself is not a property of the chemical atom, but of certain molecular groupings. It may be possible to construct alloys which are as magnetic, or even more magnetic than iron itself.—Lond. *Elec.*, June 16.

ELECTROCHEMISTRY AND BATTERIES.

Electrolytic Manufacture of Fine Wires.—ABRAHAM.—An account of experiments in which he succeeded in preparing very fine and uniform wires by the partial decomposition of a wire in an electrolytic tank. The diameter of the wire is controlled by measuring its resistance, and for this purpose it is attached to metallic rods at both ends. It hangs in the liquid, which does not touch the rods. The solution must be very dilute, and the action slow. The resistance is concentrated in the immediate neighborhood of the wire. The author uses distilled water containing a few thousandths of its weight of copper sulphate for copper wires, or silver nitrate for silver wires. The current employed is about 10 milliamperes per square centimeter of surface of the wire. It must be reduced as the wire becomes thinner. This current intensity allows time for the products of electrolysis to diffuse through the electrolyte. The resistance then keeps highest at the thinnest portions of the wire, and thus regulates the process of solution. The breaking stress of the wire is inversely proportional to its resistance.—Lond. *Elec.*, June 23; from *Comptes Rendus*, May 29.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Slip of Induction Motors.—CLINTON.—A communication with reference to the recent article of Bailey (ELECTRICAL WORLD AND ENGINEER, April 22, 1905, p. 756). The author states that the same method has been used by Seibt, who employed the pulsation of light of an incandescent lamp as indicator, and also obtained permanent records by the introduction of a Morse printer into the circuit. Both methods have been used by the present author for some time and have proved successful. The circuit consists of a lamp in series with a contact breaker on the motor shaft fed from a pair of the stator terminals. When required, the Morse printer is put in series with the lamp. The writer has found that the lamp can be used without difficulty as long as the pulsations of light do not exceed more than about two or three per second. With greater frequencies the counting is difficult, and the use of the Morse printer with its permanent record is to be preferred.—*Lond. Elec.*, June 23.

Correcting Factor of Wattmeters.—SMITH.—The correcting factor of a wattmeter with which its reading must be multiplied to get the true watts is due to the self-induction of the pressure coil; this cannot be absolutely avoided, although it may be made practically negligible. The author has studied the magnitude of the correcting factor by the use of the oscillograph. He assumes that, so long as the current in the fine wire coil is to all appearances in phase with the e.m.f. at its terminals, the correcting factor is unity.—Lond. *Elec.*, June 23. Edgcumbe.—A communication, in which the writer objects to the conclusion in the last sentence in the preceding abstract. He points out that a small angle of lag in the fine wire coil would produce a very serious error in the indication of a wattmeter, particularly at low-power factors. He describes a method by which the correcting factor can be determined under working conditions, if two similar watt-meters are available. One of these instruments is to be connected up in the ordinary way, and a switch so arranged that the moving coil of the second wattmeter can be connected in series with that of the first, an equal amount of resistance being at the same time cut out of circuit. Now, it can be shown that very approximately the error is proportional to $\frac{\textit{self-induction}}{\textit{resistance}} \times \tan \phi$ at constant frequency, where $\cos \phi =$ the power factor of the main circuit. Now, by the above device the self-induction of the circuit is doubled, while at the same time the resistance is kept constant, and consequently the error in the indication has been doubled. In other words, the change of reading produced by substituting the moving coil of the second wattmeter for an equivalent non-inductive resistance is equal to the original error due to self-induction, and this under actual working conditions. although the error due to self-induction is an important one it is easily estimated, easily allowed for and easily rendered negligibly small, and a great deal too much has, the writer thinks, been made of it in the past. He thinks that a more insidious trouble is due to eddy currents.—Lond. *Elec.*, June 23.

Cathode Ray Tube.—VARLEY AND MURDOCH.—An illustrated article describing several applications of the Braun cathode-ray tube for experiments with alternating currents and for demonstration purposes.—Lond. *Elec.*, June 16.

Measuring the Moment of Inertia of Armature.—BOEHM-RAFFAY.—A description of Fabry's method of determining the moment of inertia of the armature of a dynamo by observing the decrease in speed after the current supplied to the motor has been interrupted while the excitation is maintained constant.—*Elek. Neu. Anz.*, June 15.

Deep Borehole Surveying.—MARRIOTT.—An illustrated paper describing electrical devices for deep borehole surveying. First there is described a continuously recording instrument for determining dip in a borehole and then an intermittent recording instrument for the same purpose.—*Eng'ing News*, July 27.

Leakage Indicator.—RAPHAEL.—With reference to recent regulations as to the use of electricity in mines in Great Britain, several instruments are described by means of which the leakage current from the installation may be measured and the occurrence of a fault immediately recorded.—Lond. *Elec.*, June 16.

Electricity Meters.—GERHARDI.—Continuations of his illustrated serial, describing various types of prepayment meters.—Lond. *Elec.*, June 23, 30.

MISCELLANEOUS.

Reinforced Concrete.—NOAILLON.—Apaper read before the (Brit.) Inst. of Mech. Eng. on "ferro-concrete" and some of its most characteristic applications in Belgium. Although unknown to the general public a few years ago, this material has now entered with phenomenal rapidity in all branches of structural work.—Lond. *Elec.*, June 23.

Pioneer Work in Electric Engineering.—ELIHU THOMSON.—An address giving personal recollections of the rise of the electrical industry, especially in Lynn, Massachusetts.—*Eng'ing. Mag.*, July.

BOOK REVIEWS.

TESTING OF ELECTRO-MAGNETIC MACHINERY AND OTHER APPARATUS. By B. V. Swenson and Budd Frankenfield. New York: The Macmillan Company. Volume 1. Direct Currents. 420 pages, 150 illustrations. Price, $3.00.

The arrangement of this book is well planned and systematically carried out. Each experiment is treated as a separate unit, and the descriptive matter relating thereto is not abbreviated by reference to previous experiments. This method of treatment is excellent for flexibility in the application of the text to any chosen list of experiments. The authors have very properly laid great stress on this feature, and they have met good success in applying the method without excessive increase in the size of the volume.

After having described the various testing instruments and the methods employed for their calibration, the testing of the component parts of the machine is taken up under magnetization and resistance measurements. The book then deals with the characteristics of completed machines, and the operation of machines singly and in pairs under normal and exceptional conditions. Much attention is given to the efficiency tests of dynamos and motors, proper emphasis being laid upon the value of the stray-power and loading-back methods of testing. The book covers 96 separate tests, the character of which indicates that considerable care has been exercised in their selection.

With the description of each test is given a brief outline of the theory of the machine under the conditions to which it will be subjected, so that the student may gain a fair idea of what the test is expected to prove. The book is essentially a laboratory manual for students, and has not been written for the factory. In an appendix, however, a brief outline is given of the tests which are employed by the manufacturers of direct-current machinery. The authors have been exceptionally liberal in their references to the works of others. The completed list of references to similar experiments as described by others, which is given with each test, adds materially to the value of the book as viewed by the instructor.

DIE FÜR TECHNIK UND PRAXIS WICHTIGSTEN PHYSIKALISCHEN GROSSEN. (The Principal Physical Magnitudes of Technics and Practice.) By Olof Linders. Cloth, 396 pages, 43 illustrations. Leipzig: Jäh & Schunke. Price, 10 marks.

The book contains a systematic analysis of the various geometrical, mechanical, thermal, optical, electrostatic, magnetic, electrodynamic and electromagnetic units in practical use. The mutual relations of these units are developed tabularly with respect to various systems employing the centimeter, decimeter and meter as units of length; the gramme, kilogramme, 100 kilos and metric ton as unit of mass, and the mean solar second as unit of time. A large amount of labor must have been expended by the author in arranging the tables, which are useful for reference. As may well be imagined, there is difficulty in denoting the eight different sets of units in such a manner that the algebraic symbols may not be confused. The author suggests several kinds of type and also resorts to Greek and Russian letters, besides English and German characters. To this plan we take no exception. Anyone who attempts to write out eight sets of units in their proper notation will realize the need either for different alphabets or for different fonts of type in international use. It is of much less consequence what types are used than that some international agreement should be arrived at between the writers of text-books. For this purpose the Russian language characters might be as useful as the Greek.

The value of the book seems greatest in its general classifications and far-reaching development. So far as concerns electric and magnetic units, we think that there is much omitted that might be included with advantage. Thus no allusion is made to the fact that the volt-ampere-ohm system of units or practical system is virtually a quadrant-eleventh-gramme and second system or Q. E. S. system, as was first shown by Maxwell. Again, no reference is made to the Giorgi system, the Fleming system, the Fessenden system, the Kennelly proposals, the very important Hospitalier notation, or the relations of kappa and mu involved in the C. G. S. system, as was first shown by Rücker and developed by Gray. From an electromagnetic point of view, therefore, the treatment is very elementary and meagre. We hope that these omissions may be made up in the next edition.

Chain Making by Electric Welding.

In a recent issue of the Iron Age there appeared an interesting article by Andris-Jochams, of Brussels, Belgium, describing the Gibaud process for welding chains by electricity. This process, which receives its name from the inventor, Eugene Francois Gibaud, of Poulaincourt, France, is characterized by economy and rapidity of operation, and superiority of product

In forming and cutting chain links by the Gibaud process there is required only a single machine, a view of which is given in Fig. 1. This machine is entirely automatic in its operation. The coil of stock is placed on the reel and the end started through the straightening rolls into the feeding mechanism of the machine, after which it is cut and bent automatically into links of uniform dimensions. Each new link of stock is passed through the last completed link and bent in that position, so that the links issue from the machine assembled in a continuous chain. The weld is made on the side of the link instead of on the end, as in the former processes, and the ends instead of being scarfed at an angle of 60 degrees are cut square and left about 1/16 in. apart ready for butt welding. On the bending machine, shown in Fig. 1, 20,000 links of 9/32-in. stock can be cut and wound in one day, 5 horse-power being required for driving. The links being ready to weld are fed into the welding machine, illustrated in Fig. 2.

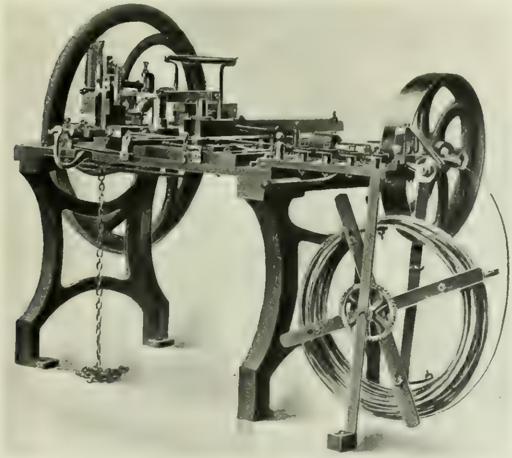


FIG. 1.—BENDING MACHINE.

The chain is passed through the machine twice, as only alternate links can be welded at each passage without revolving the entire chain 90 degrees about its axis for each succeeding link. In the machine each link to be welded is brought in contact with two electrodes, one on either side of the split in the link, and current is passed until a welding heat is reached. Meantime slides carrying dies adapted to engage the ends of the link press the joint together. After the weld has been effected and while the metal is still hot a spring-actuated hammer, having a semi-cylindrical groove in its face, strikes the link against an anvil with a correspondingly grooved face. This removes the fin formed during welding and finishes the surface. These machines are made both automatic and non-automatic. The best work is performed on a non-automatic machine, which may be operated by unskilled labor.

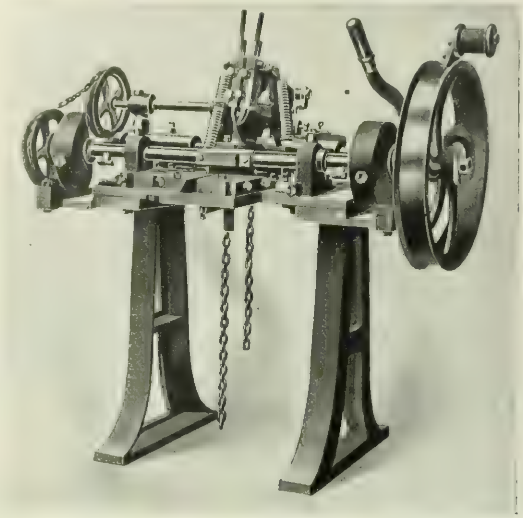


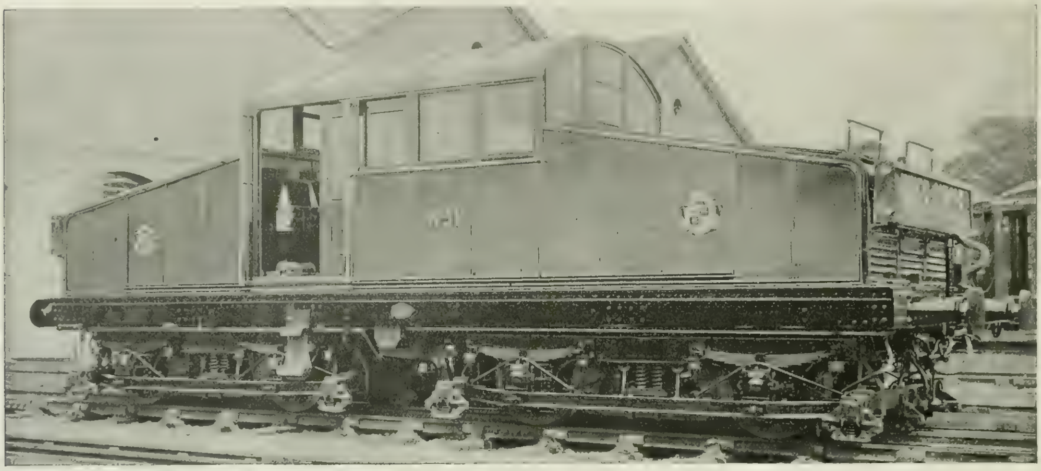
FIG. 2.—WELDING MACHINE.

The first and most important consideration in any welding process is the certainty of securing a perfect weld. In the Gibaud welders, the link is firmly secured in the welding clamps in full view of the operator. As the current is applied the ends of the link may be watched while they come to the proper heat, and the current can be cut off at the right moment. The current is applied just where the ends abut, and then the ends are forced together. The moment the two ends touch, the current crosses and the resistance of the metal at the point of contact produces the heat necessary in welding. There is no waste heat, as the heating does not commence until the ends are in contact, and when the weld is made the current is cut off.

A link heated in a fire is heated from the exterior inwardly; consequently the outer surface reaches the welding heat first. It is often the case that when the appearance of the link would indicate that the proper heat has been reached it is in reality heated insufficiently in the interior, so that when a weld is attempted it will stick together only on the edges. In electric welding, on the other hand, the heat is developed first in the interior and makes its way out, so that when the usual white sparks are emitted it is known that the entire joint is heated to the welding temperature.

The heated portion of the link to be welded is not exposed to the air, as in the fire welding process where oxidizing occurs, forming scale that often prevents a perfect weld. There is no noise, no dirt, no intense heat to contend with, no waste due to overheated or imperfectly welded links and no dependence on skilled labor.

With electric welding perfect homogeneity is secured, which may not be said of welds secured by any other process. Tests show that the conductivity of the weld is just the same as that of the body of the material and in some cases actually higher. The molecular structure of the welded part is exactly the same as the rest in the case of electrically welded steel, while in electrically welded iron the fiber and structure are as perfect as before the weld is made. There is no danger to the operator in handling the welding machine, for though the quantity of the current used is large, the potential at which it is applied is very low and the welding terminals of the machine may be touched without injury. It is stated that chains may be made by the Gibaud process at a cost to compete successfully with those made in any quantity by any other process.

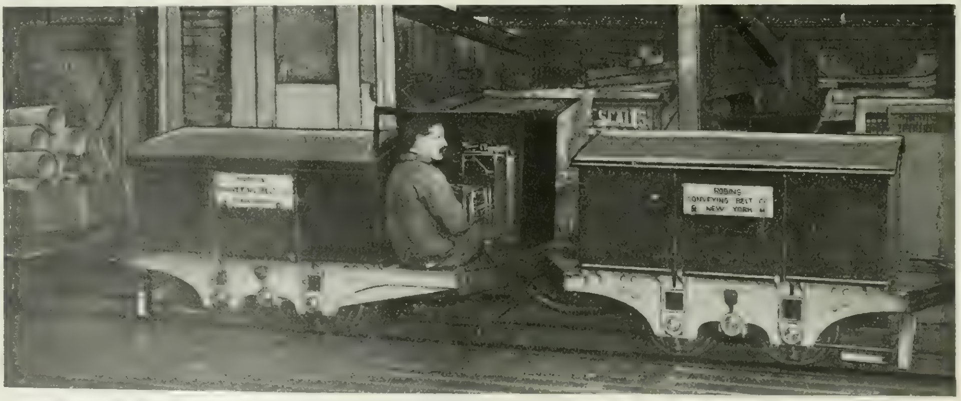


Electric Locomotive for Metropolitan Railway, London.

◆

Electric Locomotive for London Underground.

The first of ten 50-ton electric locomotives supplied to the Metropolitan Railway, London, is herewith illustrated. Each locomotive has four motors of 300-hp. each, or 1,200-hp. in all, but as the terminal facilities are somewhat restricted, it has been found necessary to use smaller motors than usual for such a type of equipment, and to supply forced ventilation, in order to keep the length of the locomotive within the space available at the termini for handling them. Under these conditions, very satisfactory results it is understood have been secured. The locomotives are being built by the British Westinghouse Company.



Storage Battery Locomotive.

At first these locomotives will be used for hauling the main line trains between Harrow and Baker Street, the steam locomotives which do the hauling from Aylesbury being dropped at Harrow and picked up again for the return trip. The train load is 120-tons, and the new locomotives are to make a speed of 36 miles an hour. The same locomotives are to be used on the Metropolitan half of the "Inner Circle" underground for goods traffic, and for hauling the steam trains of the other companies that possess running powers over the system. Trains will thus be picked up by the electrics at Edgeware Road, the steam locomotives resuming their functions at the point where the train leaves the Inner Circle.

◆

Storage Battery Locomotive in Power House.

In the new power house of the Interborough Rapid Transit Company, ashes, after being quenched, are carried away from beneath the boilers in cars drawn by an electric locomotive illustrated herewith. This storage battery locomotive is articulated and rounds curves with great readiness and with less overhang of corners than if constructed in but one unit. This matter is of great importance where there is lack of space.

The motors are not supported on the axles, but on springs and placed above the platform and away from the dust and mud. They are subject to little jar, consequently being less liable to injury. The axles are driven by silent chain, thus permitting the axle boxes to rise and fall independently of motors, which are of the highest grade and show 90 per cent efficiency. This high percentage of efficiency is called for in order to economize consumption of current and for the same reason the control is of the multiple unit system and is made entirely without starting resistance. The arrangement of control also calls for an even output of energy from each cell, so that no one bank may be exhausted before the others. The wiring of cells and design of trays has been carefully worked out to obviate the leakage of current and local short circuits.

The locomotive has a height of but 4 ft., and will easily round a curve of 12 ft. radius. The vital parts are well protected but so placed that they are very easy of access from the top should repairs be necessary, therefore, no pit is needed.

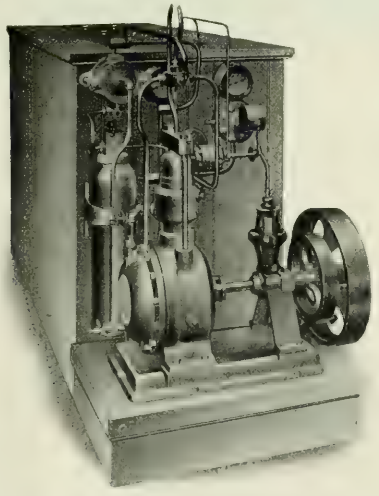
The locomotive has developed a draw-bar pull of over 2,000 lbs., thereby showing that it is capable of hauling 200 tons or more.

Brushes are fitted to the ends of the locomotive to clear the supporting rails from any ashes or dirt which may have fallen on them.

This locomotive was designed and constructed by the Robins Conveying Belt Company, of New York, who a short time ago completed the installation of the entire coal and ash handling system for the above power house, consisting of hoisting tower, belt conveyors, scraper conveyors and industrial railroad.

Sanitary Refrigeration.

Of the many advantages offered by mechanical refrigeration in comparison with the success of obtaining low temperatures by means of ice, not the least important is the elimination of the moisture and the attendant disease germs. It is now known that many epidemics have their origin in the ice that is used for household purposes, and that disease germs are not exterminated by mere freezing. It has been fully demonstrated, however, that all such disease germs are destroyed by boiling the water. The accompanying illustration shows a combined ice-making and refrigerating machine which is attached to a household refrigerator box and secures to the user hygienic ice and pure sanitary refrigeration.



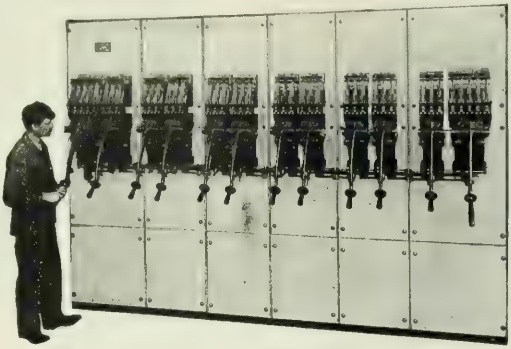
AUTOMATIC ICE PLANT COMPLETE.

These machines are thoroughly automatic and are as free as possible from complications. The household plants are arranged to be operated from 8 to 10 hours per day, sufficient cold being stored during this time to maintain the temperature throughout the night while the machine is idle. The compressor can be operated by any available power, electricity being the most desirable where it can be obtained. These plants are built by the Brunswick Refrigerating Company, New Brunswick, N. J.

The plant was designed particularly for export and is meeting a long-felt want abroad. The plant is absolutely complete in every detail, the machine and ice-making compartment occupying the same base and being shipped as a unit. It is only necessarw for the purchaser to connect power by belt and water under pressure for condensing purposes when the machine is ready to operate. The machine is fully charged with anhydrous ammonia, and the charge should last from 8 to 10 months. Ammonia is also furnished in special cylinders, which are interchangeable, each cylinder containing a full charge of ammonia or 8 to 12 months' supply. In putting on one of these cylinders it is only necessary to remove the old one and replace the new one, which can be done in ten minutes, thus doing away with the trouble and annoyance of purchasing ammonia in large cylinders and charging the machines in the old style.

A Large Motor Controller.

The cut herewith shows what is probably the largest capacity electric motor controller ever built, it being one of two designed and constructed by the Cutler-Hammer Mfg. Company, of Milwaukee, for the Carnegie Steel Company, of Pittsburg. The panels are of white Italian marble, their total dimensions being 11 feet long and 7 feet 8 inches high. The first and last switches have a continuous capacity of 10,000 amp. and the intermediate switches a continuous capacity of 6,000 amp. The levers with which the swtiches are operated are a trifle over 3 feet long, but by means of a toggle-joint action they can be easily thrown into contact. Before these two controllers were built, there was but one extra large capacity controller in the United States, that being installed over a year ago in the plant of the Pittsburg Reduction Company, at Massena, N. Y. That apparatus was of 6,000 amp. capacity on first and last switches and 3,500 amp. capacity on intermediate switches and was installed on 500-volt circuit. Those for the Carnegie Steel Company will be installed on a 250-volt circuit. The resistance for these starters is composed of steel rails arranged in a rack 10 feet high, 30 feet long and 14 feet wide.



MOTOR CONTROLLER.

Willans-Robinson-Parsons Steam Turbine.

The Willans & Robinson Co., Ltd., of England, have taken out a license to make steam turbines under the Parsons patents, and have now brought up their type of the familiar parallel flow turbine, the changes being more particularly in processes of manufacture and details of design.

Among the features thus receiving special attention and modification are the governor gear, oil pump, steam and water piping, etc., as it has been found that ability to inspect the working portion of a turbine without dismantling any attendant gear is a convenience appreciated by those who have to take charge of the running and maintenance of machinery. To enable this to be attained, all the gearing and fittings named above are mounted on the bottom half of the bearing pedestals, and the top cover of the turbine as well as the bearing caps of the three main bearings, are left free for instant removal. To further facilitate opening the turbine, the top half of the casing has been arranged with two hinges, thus avoiding the use of guide studs and placing the turbine cover in a suitable position for examination. In the case of the 1,000-kw Willans-Parsons turbine, it is possible for two men to remove the main bearing caps and to open up the turbine for inspection in less than an hour. A view of the turbine opened up in this manner is shown in Fig. 1.

It has been found possible by a rearrangement of the balancing passages to shorten somewhat the length of the ordinary parallel-flow turbine, and, further, by Mr. Fullagar's system of balancing, it has been found possible to dispense with the large balance piston at the high-pressure end of the turbine and to substitute in its place one of considerably smaller dimensions at the low-pressure end. In practice, it is said, this method of arranging the balancing pistons has the advantage of enabling castings of a more symmetrical form to be adopted, and in this way many of the troubles brought about by unequal expansion of the different parts are avoided.

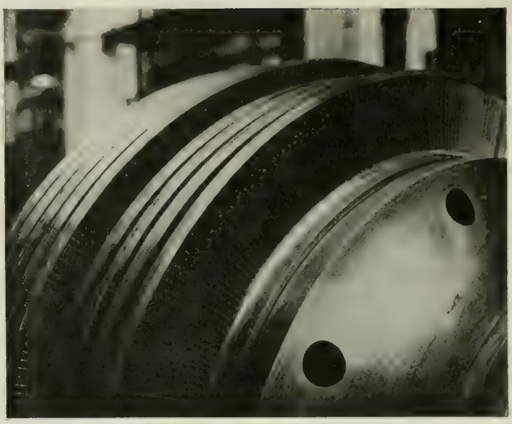


FIG. 3.—VIEW OF SHROUDING AROUND BLADES.

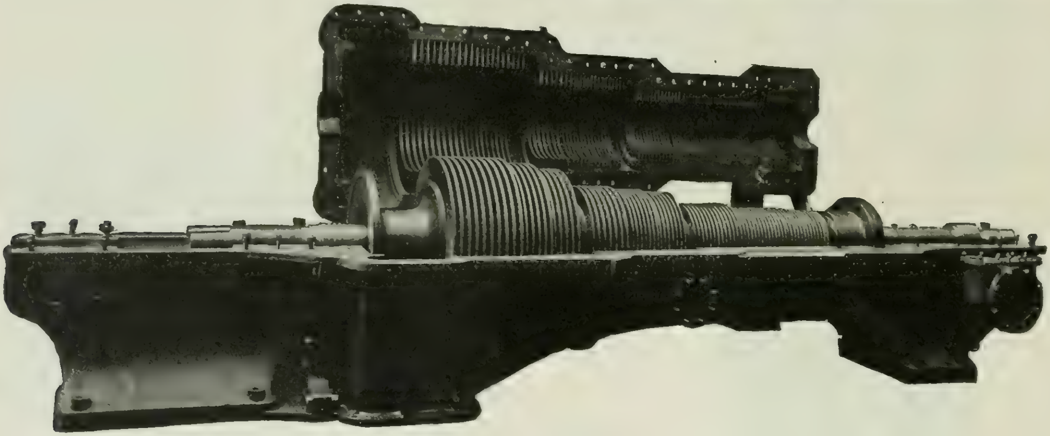


FIG. 1.—VIEW OF TURBINE OPENED.

What is considered an improved method of attaching the blades to the rotor and casing has been adopted. Extraordinary stiffness and rigidity is given to the blade rings when they have been fitted into their respective body or shaft grooves. In the ordinary turbine of this type each blade is fixed separately into the rotor and casing by means of its own caulking piece. As will be seen from Fig. 2, the blades for one complete ring are built up on two half rings, which rings have had the necessary grooves for receiving the blades cut in them by means of automatic machinery. These complete half rings of blades are then caulked into the shaft or the casing. Attention might be drawn to the fact that the cutting and assembling of the blading by means of specially designed automatic machinery insures that the whole of the blade angles and openings on which the efficiency depends are mathematically correct. Fig. 2 shows two of these half rings complete for assembling on the shaft and in the casing.

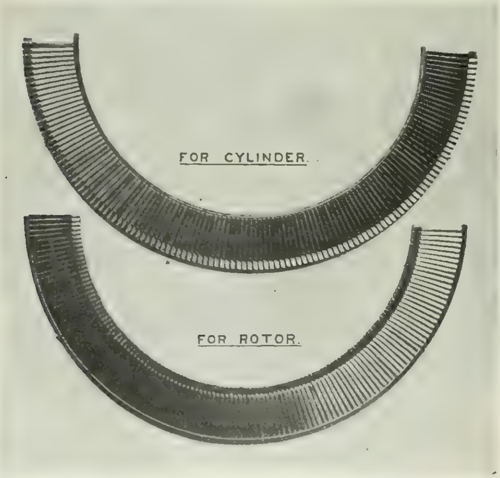


FIG. 2.—HALF RINGS COMPLETE READY FOR ASSEMBLING.

A special feature of the Willans-Parsons turbine consists in the interesting channel shrouding encircling the blades which this manufacturer has the right to use under the patent of Mr. Fullagar. This shrouding is fixed on the half ring of blades before assembly on the shaft or in the casing, and has several points of merit. It adds materially to the mechanical strength of the blades themselves and removes any danger of the blades stripping should the rotor come into contact with the casing, or the blading on the casing come into contact with the revolving shaft. Further, the action of the channel shrouding when under working conditions minimizes the loss due to leakage over the revolving or fixed rows of blades, and by this means a considerable gain in the steam economy is effected. A view of the shrouding around the blades is shown on the right-hand side of Fig. 3.

As already noted above, special attention has been paid to the question of governor gear with a view of making it as simple and as reliable as possible. By dispensing with some of the intermediate gears it has been found possible to obtain results in the direction of close governing which it is believed surpass anything hitherto obtainable. All the turbines are fitted with by-pass valves, which automatically open when the maximum economical output of the turbine is exceeded, and by means of these by-pass valves any required overload can be obtained up to the full capacity of the generator, the steam economy of the turbine being, of course, reduced.

The Willans-Robinson Company has 24,250 kw of this type of turbine at work or nearing completion, the smallest at the present time being of 750 kw normal capacity and the largest of 5,000 kw normal capacity. Among others might be mentioned the following: Two 3,000-kw and one 1,500-kw for the Glasgow Corporation; two 1,000-kw for the Bristol Corporation; one 3,000-kw for the Metropolitan E. S. Company, London; two 1,000-kw for Bruce, Peebles & Company, Ltd., and one 1,000-kw for Messrs. Watson, of Linwood; also three 750-kw for the English McKenna Steel Process Company, Ltd., Birkenhead.

Automatic Ore Unloading by Electric Motor.

Among the notable applications of electricity to heavy service in industrial operations, is that adopted in the unloading of iron ore from boats at various lake ports. In this connection, the accompanying illustrations of two electrically-operated Hulett automatic ore unloaders at the docks of the National Tube Company, Lorain, Ohio, will be of especial interest. These views represent the latest installation of these rapid unloaders. An idea of the heavy service required of these machines may be had from the fact that they handle an enormous grab bucket, which automatically digs and conveys from the hatches of the boat 10 gross tons of ore at a load. This grab bucket is carried at the lower end of a vertical dependent leg suspended from a pivoted walking beam which is carried on a carriage or trolley which travels back and forth on the girders of the machine. The entire machine is mounted on moving trucks, enabling it to travel up and down the dock, from hatch to hatch of the boat, without moving the boat. The leg carrying the boat is always maintained in a vertical position, and the operator who controls all the motions of the bucket rides at the lower end of the leg directly above the bucket. By means of hoisting mechanism, the walking beam is made to oscillate up and down, carrying the bucket down into the hold of the boat, and up above the dock. The travel of the trolley back and forth on the girders carries the walking beam and the bucket out over the boat and back again over the dock. To reduce the trolley travel as much as possible, suitable hoppers for receiving the contents of the bucket are mounted between the girders at the front. These hoppers discharge into an auxiliary bucket car which carries the ore back to the stock pile. As there is a high bank back of the Hulett unloaders at Lorain, each machine is provided with special cantilever extensions designed particularly for delivering the ore on this bank. The bucket car travels on the cantilever extensions to any desired point and automatically dumps its load, returning closed to its position under the hopper.

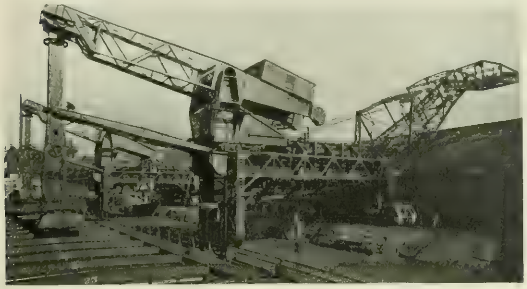


FIG. 1.—VIEW OF AUTOMATIC ORE UNLOADER.

The dependent leg of the unloader carrying the bucket is mounted on rotating trunnions in the walking beam, so that it can rotate in a circle when operating in the hold of the vessel, allowing the bucket to reach out in all directions. The bucket is opened and closed by specially designed motors, its total spread when wide open being 18 feet, and by telescopic motion it can reach, when open, more than half way from the center of one hatch to the center of the other. It also travels lengthwise of the hatch to the sides of the boat; consequently the operator is able to reach almost the entire cargo. In ordinary boats there is no difficulty in reaching 90 per cent of the cargo, and in some of the modern boats the Hulett unloaders have actually unloaded 97 per cent without the help of shovelers. With slight modification they can be adapted for use in connection with the ordinary tramp ocean steamer to even better advantage than with lake boats. They handle successfully, any kind of lump ore, digging through to bottom easily and rapidly.

A special feature of these unloaders at Lorain is the fact that they are mounted on swiveling trucks. The docks at the point where these unloaders are located are curved to such an extent that while the ends of the boat touch the dock at intermediate points there may be as much at 12 feet of open space between the dock and the boat; the tracks on which the unloaders travel being correspondingly curved, the swiveling trucks were provided to permit of easy squaring of the unloader leg and bucket to any hatch of the boat. The walking beams are located at the top of these machines and the parallel bars below; this arrangement permitting very advantageous distribution of materials employed, and also simplifying the matter of counterbalancing.

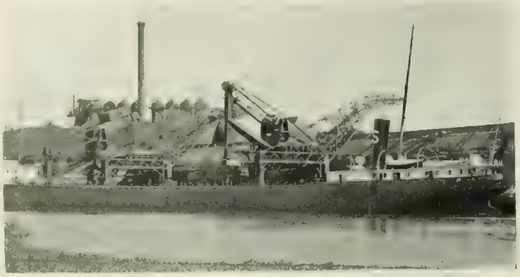


FIG. 2.—UNLOADING A STEAMER.

The bucket operater who rides into the hatch and out over the dock with the bucket, controls all motions of the machine except travel from hatch to hatch and operation of the bucket car; his position in the bucket enabing him to watch the work to the best advantage. Another operator controls the moving of the machine from hatch to hatch, and also the operation of the bucket car.

The Hulett unloaders may be arranged for steam or electric operation as desired. Those at Lorain are, as stated, electrically operated, the power being supplied from motors which take their current through sliding contacts from rails laid along the dock. The motors for operating the bucket are 110 horse-power, those for hoisting the walking beam 150 horse-power, those for trolleying in and out 50 horse-power, and those for operating the bucket car and moving the machine 150 horse-power. The hoisting and trolleying may be done simultaneously, speeds being figured to produce a round trip a minute. The controllers are of magnetic type especially built for heavy service.

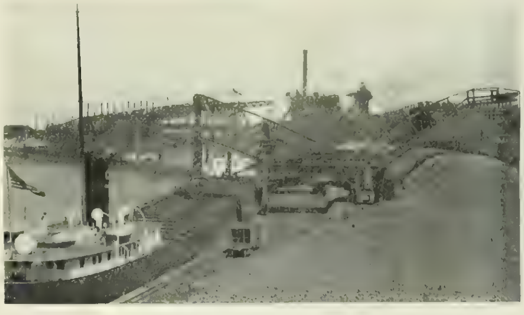
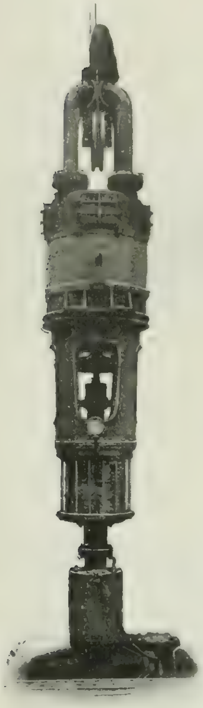


FIG. 3.—ANOTHER VIEW OF UNLOADER.

The unloader is the invention of Mr. Geo. H. Hulett, third vice-president of The Wellman-Seaver-Morgan Company, Cleveland, O., who are exclusive builders of these machines. The same company has already done a great deal of work of similar character, inside iron and steel works, for the charging of furnaces, etc., and its machinery for such purposes is in use in large plants on both sides of the Atlantic. This apparatus is usually associated with electric motors, its practicability, indeed, often depending upon the employment of electric power.

Electrically-Driven Sinking Pumps.

An interesting form of electrically-driven sinking pump is shown in the accompanying illustration. The pump is designed for a discharge of 500 gallons per minute under a head of 300 ft. It is driven at 1,150 r.p.m. by a four-pole motor wound for 500 volts.



SINKING PUMP.

The motor is connected to the pump by a flexible coupling. Ball bearings are used at the top of the motor case to take the weight of the armature, and ball bearings are placed above the pump to carry the weight of the impellers. In order to minimize the space occupied by the equipment, the passageway for the discharge of water from the pump is carried up between the poles of the motor, so that not only is much room saved, but the pipes are protected from damage in sinking and blasting operations, and the motor is kept cool. The four-fold discharge pipe is combined in a junction pipe which also carries a sheave around which is passed a wire rope for the purpose of raising and lowering the pump in the shaft.

The pump equipment is of moderate weight and is generally compact and easy to handle. Special precautions are taken to insure that no danger can occur to any portion of the pump from blasting operations. There are provided arrangements for allowing the pump to continue to run while lifted clear of water.

These novel pumping equipments have been designed by Mather & Platt, Manchester, England, for use in the Dutch East Indies and along the northeast coast of England.

Purification of Water for Boilers.

When central power plants are installed for the furnishing of electric current, it is naturally not possible, at all times, to select a location where the water for use in the boilers is entirely suitable, and many boiler plants must contend with great difficulties on account of being located where only hard water is obtainable. As is well known to all engineers, the use of this hard water is extremely derogatory to the boilers, much scale or sludge being deposited on the plates or on the tubes. This deposit necessarily causes overheating of the plates and the burning out of the tubes if the scale is not regularly removed, and entails considerable loss of heating power.

The photograph reproduction of Fig. 1 shows a type of water softener which has been constructed for removing the impurities from the water. The general design and principle of its action are indicated in Fig. 2.

The hard water is admitted into a syphon tank containing a float which is mechanically connected with two displacers. When the water rises in this tank the displacers are drawn out of the tanks containing the lime water and soda solution, which are then automatically filled up to a given level by means of ball cocks. The syphon tank is so arranged that it discharges its contents automatically when the water reaches a certain level, thus ensuring an exact quantity of water being discharged at each emptying. The ball cocks in the reagent tanks are set to fill the tanks to a point just below the discharging troughs, so that when the displacer enters, say, the lime tank, a bulk of lime water exactly equal to the portion of the displacer submerged is pushed over into the mixer. The displacer is capable of easy adjustment so that any smaller or large quantity of lime water can be delivered to suit the chemical nature of the hard water being dealt with. The displacer in the soda solution is similarly arranged. It will thus be seen that the discharge of the reagents is exactly dependent on the quantity of water to be softened. If this is reduced, the syphon tank fills fewer times per hour, and consequently the number of times the displacers work is reduced in the same proportion.

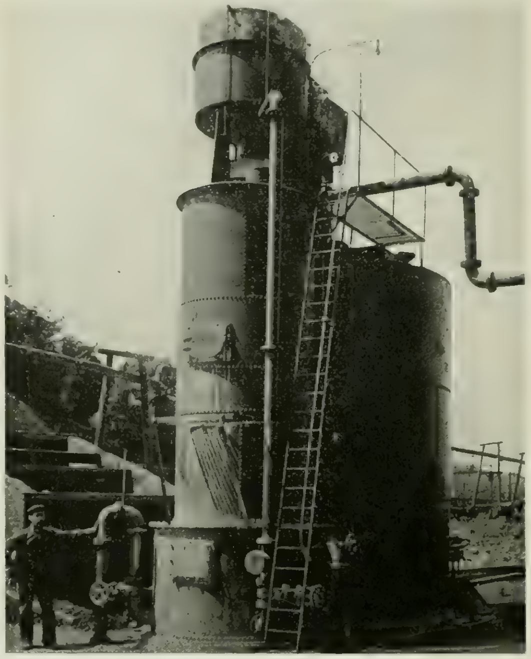


FIG. I.—"CRITON" WATER SOFTENER.

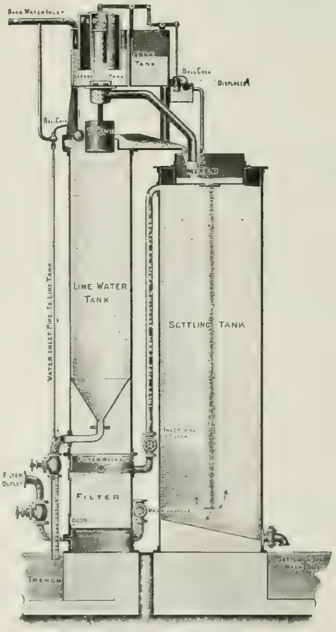


FIG. 2—CROSS-SECTION OF SOFTENER.

The discharges from the hard water syphon tank, and from the lime and soda tanks, all meet at the same time and at the same place, viz., the mixer, thus ensuring an immediate and thorough mixture in their proper proportions.

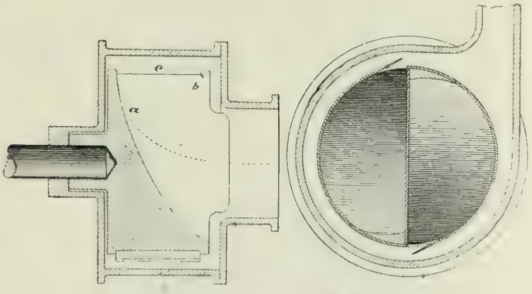
From the mixer the treated water is passed through a down pipe to the bottom of the settling tank, whence it steadily flows upward, leaving in its progress the heaviest of the suspended matters caused by the action of the softening process. From here it passes through the filter, emerging at "filter outlet" soft and bright. The filter is cleaned without the removal of the filtering medium. The lime tank is recharged with lime daily, and the spent lime drawn off. The total attention required in the case of medium sized plants is stated to be that of one man for an hour once in twelve hours.

The type of water softener here described is known as the "Criton." It is manufactured by the Pulsometer Engineering Company, Ltd., Reading, England.

The Design of Centrifugal Pumps.

There are given below a few facts relating to the elements which have been considered in the design of a centrifugal pump which has shown the remarkable performance of producing a vacuum of 28.75 in. when the barometer stood at 29.56.

In studying the reactions taking place, it is found that the volume of water flowing through any centrifugal pump is acted upon continuously by centrifugal force and by atmospheric pressure. Centrifugal force at all times acts radially and perpendicularly to the axis of rotation of the impeller. Atmospheric pressure in the case of an axially disposed inlet pump, obviously tends to maintain the liquid in a straight line in continuation of the direction in which it enters the pump—in a direction parallel with the axis of the pump. The path which the liquid will actually pursue is dependent upon at least three considerations, namely: the centrifugal force acting upon it, the atmospheric pressure acting upon it, and the extent to which it is controlled, guided and deflected by the construction of the passages through the pump. The construction of the pump should be such as to permit the liquid to take that path which it naturally tends to take under the combined action of the centrifugal force and the atmospheric pressure, modified only by considerations of practical construction. In other words, whatever power is consumed in deflecting and guiding the liquid out of its natural course is power consumed in impact, and is power wasted.



FIGS. 1 AND 2.—SECTIONS OF CENTRIFUGAL PUMP.

It is obvious that all parts of the inflowing column of water will not be equally affected by centrifugal force. That liquid which enters at the exact center of the inlet will pass into the influence of the impelling blade at a point where the latter has practically no movement. Accordingly, there is practically no centrifugal force imparted to the column along its axial line, and the liquid might flow on indefinitely in a straight line were it not for the two considerations that it is a part of a body or column of liquid which as a whole is deflected, and that because the blade of the impeller has an appreciable thickness, the liquid can never enter exactly in the axis of the pump. It is evident, however, that this liquid which enters substantially at the axis of the pump will be deflected radially very slowly at first, and with increasing force and abruptness as it departs from the axis and comes into the influence of the more and more rapidly moving parts of the impeller blade.

That liquid which enters at the periphery of the inflowing column will obviously come immediately into the influence of a part of the impelling blade traveling at a relatively high speed, since it is comparatively remote from the axis of rotation. Accordingly, this peripheral portion of the column will be deflected much more abruptly, and it will not be long in acquiring a direction of flow substantially perpendicular to the axis of the pump.

In Fig. 1, which is a correct axial sectional view on a reduced scale of a Brooks 4-in. pump having a 5-in. inlet, these resultant lines of force (the extreme inner and outer) are indicated by the lines *a* and *b* which have been plotted from accurate data obtained by an unlimited number of tests. It will be seen that these two resultants are divergent at all points; it will also be seen that the inner curve *a* is a much flatter curve, and that both of the curves are more or less parabolic; it will further be seen that these two extremes coincide with the extreme ends of the outlet slots *c* of the hollow piston.

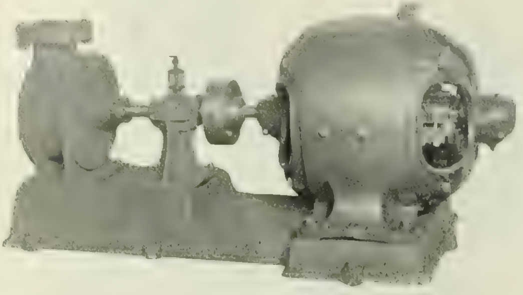


FIG. 3.—MOTOR-DRIVEN SINGLE-STAGE PUMP.

It will be seen therefore that in the pump illustrated there is no impact of the liquid or guiding of the latter whatever during its passage through the impeller.

Since it is the very purpose of the pump to accelerate the motion of the liquid passing through it, it follows that the combined area of outlet from the hollow piston must be substantially less than the total inlet area, or else (since water is a practically non-expansive fluid) the delivery outlets will not be kept filled and the pump will be inefficient both because the piston outlets are defectively sealed, and because there would be more or less churning or eddying of the liquid. In other words, if the column of liquid entering a pump be considered as divided into two columns, then each of these columns will be of increasing diameter in cross-section in one direction, but of decreasing diameter in cross-section in the other direction.

It will be readily seen that the resultant lines of force, *a* and *b*, depend upon another factor, namely, the speed of revolution. This means that a given design of pump must be operated at a given speed if its greatest efficiency is to be secured.

There are other considerations, and important ones, which contribute both to the efficiency and to the lifting power of the Brooks pump. By reference to Fig. 2 it will be seen that a lip overhangs each of the two outlets of the piston. These lips are directed tangentially and rearwardly. They perform two functions which contribute to the efficiency of the pump, viz.: they serve as guards which keep the outflowing columns of liquid from impinging directly against the annular body of the liquid between the casing and the piston, thus minimizing the eddying, and they to some extent impel the liquid onward toward the casing outlet. It is evident that throughout nearly the entire circumference of the annular space between the casing and the piston, the liquid is flowing onwardly or in the same direction with the piston movement. Clearly the minimizing of the eddying will decrease the losses, and this the lips effect by confining the disturbance due to the overflow to the space immediately next to and surrounding the piston.

In the rapid rotation of the piston, the lips obviously tend to create a vacuum in the rear or lee of each, and this creates an effective drag on the liquid just delivered, pulling it along in the direction of the general flow.

On Nov. 30th, 1904, a test was made at the St. Louis Exposition in which the Brooks 2-inch single-stage pump worked successfully on an actual suction of 30 feet and against a pressure of 25 pounds (equivalent to about 57.6 feet); this was interesting from the fact that it actually raised the water through a height of 30 feet on the suction side—a severe test for any pump of the direct type. The test was witnessed by a number of prominent engineers.

The manufacturer of the Brooks pump is the Dayton Hydraulic Machinery Company, of Dayton, Ohio, with a New York office at 133 Liberty Street.

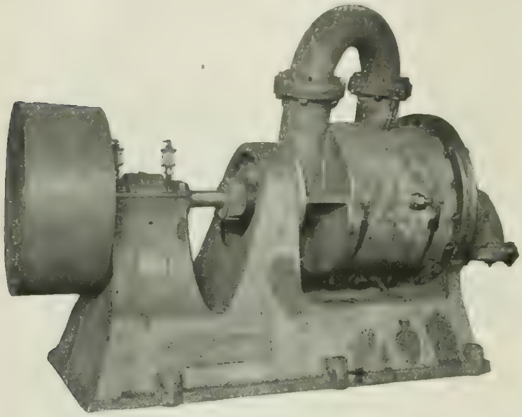


FIG. 4.—SLOW-SPEED TWO-STAGE PUMP.

Guy Anchors.

The accompanying illustrations show the method of installing Stombaugh guy anchors made by W. N. Matthews & Brother, of 227 North Second Street, St. Louis. The smaller sizes of these anchors are shown in Figs. 1 and 2. Fig. 1 illustrates the rodless anchor. A piece of galvanized-iron cable or wire, 7 or 8 ft. long, is attached to the eye of a rodless anchor and then passed through the hollow pipe of the installing wrench. The anchor is then keyed to the wrench and the wire drawn tight and a clamp set flush with the crossbar of the wrench, as illustrated in Fig. 1. The rodless anchors are only made in 5 and 6 in. Fig. 3 illustrates the 5 and 6-in. anchors with rod.

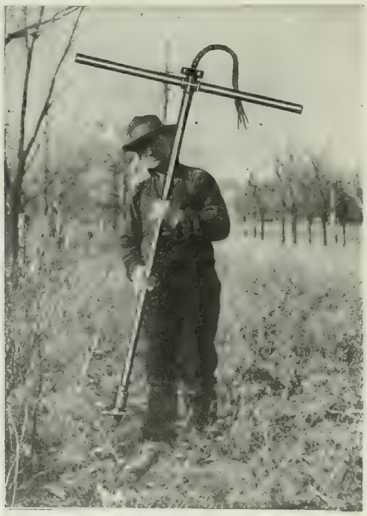


FIG. 1.—RODLESS GUY ANCHOR.

The new feature of these anchors is that the pipe of the wrench is now being made longer than formerly, and allows about 1½ to 2 in. of the eye to project beyond the crossbar. A metal or wooden wedge is driven firmly into the eye, as shown in Fig. 2. The clamp on the strand and the wedge in the eye prevent the wrench from slipping off the key from the torsional strain while the anchor is being set. The anchor must always be bored into the ground at the angle at which the guy wire is to run. When the proper depth is reached the wrench is pulled out and the guy cable from the pole is attached to the end of the cable coming from the anchor, or to the eye of the anchor left projecting from the ground.

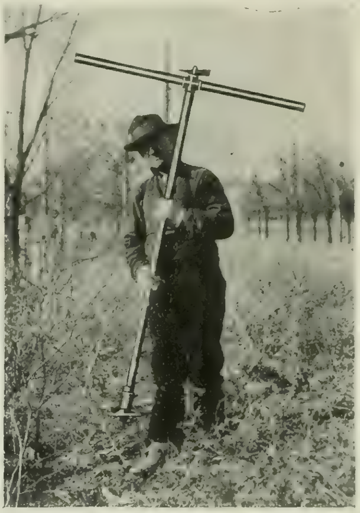


FIG. 2.—GUY ANCHOR.

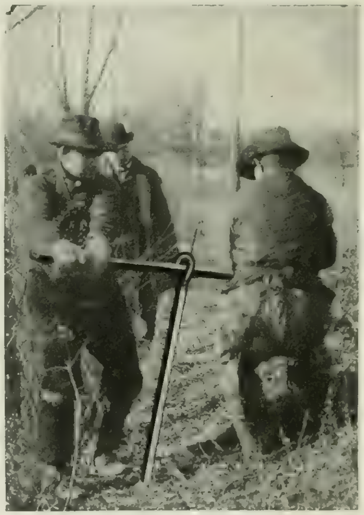


FIG. 3.—GUY ANCHOR WITH ROD.

Fig. 3 shows the method of installing the larger sized anchors, those from 8 to 12 in. in diameter. These sizes are provided with bars sufficiently heavy to withstand the boring strain and have large eyes at the end through which a bar is passed to serve as a crank to bore them in. It is obvious that lines that have been strengthened and braced in this manner have a maximum ability to stand strain: and such has proved to be the case in every instance.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Improvement is generally reported in trade, although progress is hampered by some inflation of prices for the raw materials of textile and footwear industries. Confidence expands as the crops are secured. Weather conditions have been favorable for retail distribution, reduced stocks in the hands of dealers being reflected in enlarged wholesale, and jobbing demands. Evidences of faith in the future are increasing, more disposition being shown to provide for requirements beyond immediate consumption. The industrial situation is in striking contrast to conditions prevailing a year ago, when there was much idleness, both on account of quiet trade and of labor controversies. Complete returns now available for the leading departments indicate that the first half of 1905 made a better comparison with the corresponding six months of last year than even the most sanguine estimate, which naturally increases optimism regarding business during the second half. The tonnage movement on the country's railways is very heavy for this season of the year, the rather later movement of winter wheat being made up for by the increased volume now reported. The general tendency has been toward a further slight improvement in collections. The iron trade shows some quietness. Foundry iron is less active at the east, but the lull is as much due to the advance of 50 to 75 cents per ton as to any other reason. Southern iron has further strengthened, and raw materials for iron manufacture are in more active request. Sales of structural materials, rails and other finished products are heavy for this season of the year. Coke is more in demand and rather firmer. Bituminous coal is dull and still easy in price, but recent advances in anthracite are rigidly adhered to. Other industries show considerable activity. The summer shutdown of glass factories will be the shortest reported in many years. Building is more active throughout the country, confirming the most optimistic predictions made earlier in the season. The total number of business failures during the week ending July 27, as reported by *Bradstreet's* was 197, against 165 the week previous and 174 the corresponding week last year. Copper closed at 15¼ to 15⅜ for Lake and electrolytic, and 14⅞ for casting stock.

CANADIAN WHITE COMPANY.—Another sign of the activities in the engineering field associated with the name of J. G. White is to be seen in the formation of the Canadian White Company, Sovereign Bank Building, Montreal, to work in close affiliation with the other White organizations that begirdle the globe, and which have done some of the largest electrical plants now in operation for light, traction and transmission. It will do a general contracting and engineering business. Mr. H. P. Douglas, formerly vice-president and general manager of the Canadian Otis Elevator Co., will be treasurer of the concern; Mr. H. C. Hitch, formerly with the Thompson-Starrett Co., will be the superintendent of building construction. The Canadian White Company, Limited, will undertake any civil, mechanical, electrical, hydraulic and building work. It will be fully equipped to handle large construction contracts for steam or electric railways, and will be prepared to design, build, equip and operate electric lighting plants and power installations, gas works, water supply, sewage systems, piers, docks, harbor works, office buildings, apartment houses, hotels, etc. The company does not manufacture machinery or apparatus, nor is it interested in any manufacturing agencies, but purchases from the leading manufacturers such machinery and materials as are required in carrying out its contracts.

THE PELTON WATER WHEEL COMPANY, of San Francisco and New York, has just closed contract for a water wheel installation for D. J. Aguirre & Co., of Tepic, Mexico. The head available is 175 feet and the plant consists of two Pelton wheel units of 700-hp capacity, each direct connected to General Electric generators, 300 r.p.m.; also two Pelton wheel units for driving exciters. Sturgess oil type governors will be used. Pelton wheels are universally employed at the sugar plantation of Aguirre & Co., there being six wheels at present employed for driving heavy sugar rolls by means of direct connection, machine shops, electric lighting, etc. It is worthy of note that the export trade in Pelton wheels has largely increased in the past year, this company having made large shipments to Central and South America, Japan, and the Strait Settlements. Indications for further increase in these directions are most favorable.

AMERICAN EXPORTS AND IMPORTS.—Below are given the statistics of the year ending June of American export and import trade the best year this country has ever had in foreign commerce

Twelve months imports articles.

	1905.	1904.
Food and live animals	$273,629,853	$233,211,398
In a crude condition	386,459,421	321,500,006
Wholly or partially manufactured	143,152,036	130,508,793
Manufactured ready for consumption	165,886,082	107,537,191
Luxuries, etc.	148,385,237	132,239,983
Total imports	$1,117,512,629	$991,087,371

Twelve months exports products of:

Agriculture	$821,074,439	$853,693,133
Manufactures	543,620,207	452,445,629
Mining	50,646,447	45,917,624
Forest	62,098,899	68,884,310
Fisheries	7,318,705	8,576,790
Miscellaneous	6,985,908	5,661,531
Total domestic exports	$1,491,744,695	$1,435,179,017
Re-exports	26,817,025	25,648,254
Total exports	$1,518,561,720	$1,460,827,271

EQUIPMENT FOR APARTMENT HOUSE.—A 12-story apartment house is to be built at the northwest corner of 70th Street and Central Park West, New York, in which will be installed a complete steam, electric and refrigerating equipment. The Vailima Realty Co., of 648 Broadway, is the owner; Mr. Robert T. Lyons, 31 Union Square, is the architect. Mr. Percival Robert Moses, 320-322 Fifth Avenue, has been retained as consulting engineer. There will be three horizontal tubular boilers of 100 horsepower capacity each. The three engines will be of simple automatic high-speed horizontal type. Two will be 13x12, and one 12x12 in. They will operate at about 300 r.p.m. The generators will be direct coupled, direct current, compound wound multipolar, 115 volts. There will also be an extensive storage battery equipment.

ADVANCE IN COPPER.—The stiffening in the price of copper has resulted in the expected advance. All the principal copper selling agencies, including the United Metals Selling Co., have advanced their prices ⅛c. per pound. Lake copper is now selling at 15⅜c.; electrolytic at 15¼c. The tone of the market is very firm and demand strong at the higher prices. A large copper producer says that the strength of the stocks of the various copper companies is due largely to the increased demand for the metal. "The rise in the price of the metal," said he, "is free from speculation, as the big producers believe that a sharp upward movement would only tend to disturb conditions that are satisfactory to consumer and producer alike."

WESTINGHOUSE ORDERS.—Orders have been received by the Westinghouse Electric & Mfg. Company from Nelson Morris & Company for nineteen type CCL induction motors varying in sizes from 5 to 50 horsepower and totaling 410 horsepower, and for eight motors of the same type from the Decatur Car Wheel & Mfg. Company, Birmingham, Ala. These are the latest design of induction motors which have been built and have been just recently placed on the market. On the same day an order was entered from the Illinois Steel Company for eighty direct-current motors having an aggregate capacity of 3,920 horse-power. These motors are all of the railway type and range from 30 to 75 horsepower.

THE HAWAIIAN ELECTRIC COMPANY, of Honolulu, has contracted for two 1,200-kw, three-phase, 2,200-volt, engine type generators, two 125-kw. exciters and seven 500-kw. oil-insulated self-cooling transformers. The Rumford Falls Power Company of Rumford Falls Me., will install one 550-kw. and one 800-kw. alternating-current generator which will be direct-connected to waterwheels. The order includes two 450-hp variable speed induction motors, and 120 type OD transformers for use on the distributing lines.

NAVY BIDS.—Bids will be received until Aug. 8 at the Bureau of Supplies and Accounts, Navy Dept., Washington, for furnishing at the Navy Yards at Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C. and Norfolk, Va., motors, electrical conductors, cable, brass and steel conduits and fittings; boilers, hydraulic jacks, Pratt & Whitney turret lathes, etc. Address H. T. B. Harris, Palmaster-General, U. S. N.

THE RISDON-ALCOTT TURBINE COMPANY of Mount Holly, N. J., has just shipped to the Cramer Electric Company, Hailey, Idaho, an 800-hp turbine unit, consisting of three wheels on horizontal shafts for setting in a concrete flume. These wheels are to be direct-connected to a Crocker-Wheeler generator for the power plant to be installed by the Cramer Electric Co.

COMPETITION WITH NATIONAL CARBON.—The Cleveland *Plain Dealer* makes the following announcement: "The National Carbon Company will very soon have a competitor with immense financial backing. It developed here yesterday that Rockefeller interests are behind the United States Carbon Company, which will soon be financed with a capitalization close to $1,000,000. For more than a year the United States concern has been closed down. About one month ago, however, the property was bought up by Martin B. Daly, general manager of the East Ohio Gas Company, a well-known Rockefeller corporation. The plant is now being overhauled at an outlay of nearly $100,000. It will be turning out carbon products by September 5. Burton P. Foster, manager of the company, stated that in addition to the plant here branches will be established in the natural gas belts of Ohio and a mammoth organization will be built up rapidly to compete with the National Company. Mr. Daly is now abroad, but will return August 15, and immediately thereafter the financing will be begun. The company will be reorganized and will probably be given a new name among other changes. Mr. Foster admitted that Rockefeller capital is interested in the project, and spoke optimistically of the future of the company about to be formed. He said that one carbon customer has already been secured who will net $100,000 a year to the concern. He also intimated that various lighting plants and electrical concerns will throw enough patronage to the new organization to insure for it great progress. Foster is in charge of the overhauling of the old plant. New machinery is being put in and the old is being repaired. Four new buildings will be erected, and when the changes are all made the plant will cover four acres. At this plant high grade carbon batteries and motor brushes will be turned out, while at the branch plants lower grade carbon will be manufactured. The capacity will be increased as the demands become heavier. Mr. Foster stated that the new company will be maintained as an independent instituion regardless of its backing, and will have the distinction of being the only independent carbon company on American soil. Cleveland will thus be the storm centre of a carbon war, which is not only imminent, but soon to become a reality. Mr. Foster, who is an expert in this line, will have charge of the operation of the plant. The other officers will be chosen from institutions of the highest standing. The fight that will get its impetus here will be carried all over America, and to the shores of countries across the water." The National Carbon Company has a capital of $4,500,000 7 per cent preferred stock and $5,500,000 common stock, on which 1½ per cent has lately been paid semi-annually.

CALIFORNIA POWER.—It is believed in California that the Southern Pacific Railroad is securing power plants. Two large electric power plants at Reno are reported to have changed hands, and there is some speculation in local financial circles as to whether the properties have been taken over by the Southern Pacific Company or the California Gas & Electric Company. The Southern Pacific is being credited with a desire to establish itself in the electric power business on the Truckee River with the idea of generating power for the construction of its proposed tunnel through the Sierras and for the operation of trains after the tunnel is completed. General Manager Calvin states that the tunnel project is at a standstill at present, and that the company has no thought of acquiring any power plants on the Truckee River, which lends credence to the belief that the Martin-De Sabla Company is creating all of the present stir at Reno. Negotiations looking to a consolidation of the interests of the California Gas & Electric Company and the San Francisco Gas & Electric Company are said to be still in progress, and there is talk of the formation of a third company with a capitalization of $60,000,000 for controlling the light and power situation. One theory advanced is that the Southern Pacific and its allied interests will line up for the development of electric power for their own and other uses on one side. On the other, may be the California Gas & Electric Corporation, the Western Pacific (representing the Gould interests), and possibly the Western Power Company of Plumas County, which has an electric power transmission project headed for San Francisco. The San Francisco Gas & Electric Companies and other lighting stocks are strengthened by the general situation.

ELECTROMETALLURGIC PLANT.—A special dispatch of July 27 from St. John, N. B., says: "According to Attorney-General Pugsley, who recently returned from New York, a number of prominent New York capitalists are contemplating the promotion of certain enterprises at Grand Falls, which will involve the expenditure of over $10,000,000. Large deposits of bog iron, or manganese, have recently been discovered in the province, and it is the intention of the promoters to establish at Grand Falls a huge plant in which the ore can be treated by electricity, thus manufacturing ferro-manganese, a very valuable product. The plant will be run by water power, and will have a minimum of 60,000 horse power, with a maximum of about 300,000. It is intended also to supply Grand Falls and other towns along the St. John River with electric energy for lighting and power purposes; to acquire the International Railway between Campbellton and Grand Falls and operate it by electricity, and to erect pulp and paper mills with a capacity of 600 to 800 tons a day—the largest mills, it is believed, in the world. The operations of the company, if successfully carried out, will give employment to thousands of people, while the industrial development of the St. John Valley will receive an enormous impetus. Although the preliminary expense will be very great—involving, as has been said, an expenditure of $10,000,000—the capitalists interested in the enterprises appear entirely satisfied with the outlook, and feel that the undertaking will offer profitable employment of capital. It is probable that operations will begin during the present year."

PROSPECTS IN HUNGARY.—Mr. Arthur A. Brandt, Technisches Bureau, N. W. 24 Berlin, is opening an office for the representation of American electrical and mechanical firms in Vienna, and sends us the subjoined interesting remarks: "In the ELECTRICAL WORLD AND ENGINEER I observe often the not only interesting, but also very valuable hints and information you are giving the U. S. A. exporters by publishing articles about conditions of trade and industry in foreign countries. One part, however, it occurs to me has up to now not been noticed sufficiently by the American exporters; i.e., the altered conditions of import into Austro-Hungary, As will be known to you, with the beginning of next year the new custom regulations between Germany and Austro-Hungary will begin also. According to this new tariff, most of the German goods will be taxed so high that the present large import from Germany must decrease to ¼-⅓ of the present. The duty for electrical machinery and appliances is then so high that it will be absolutely impossible to import German manufactures in future. The ¾-⅔ of import which Germany loses must consequently be gained by the other countries importing into Austria, and it will be necessary for the American to make all efforts to prevent this new business from going entirely into the hands of the other continental countries. I am convinced that there will be a rapidly growing demand for American goods in Austro-Hungary."

CONTRACTS FOR ELEVATORS.—The Marine Engine & Machine Company, manufacturers of electric elevators, have removed their offices to No. 126 Liberty Street, this city, where they occupy the entire fourth floor. This company has recently secured the following contracts: The Hutchins Building, at southeast corner of 5th Ave. and 39th St., C. P. H. Gilbert, architect, Thompson-Starrett Co., builders, four of their direct-connected, electrically-controlled elevators. The College of the City of New York, George B. Post, architect, Thomas Dwyer, builder, eleven electric elevators. One tandem electric elevator for the building of the New Orleans Railways, Sanderson & Porter, engineers. One electric elevator in the Hartford Building, 17th St. and Union Sq., this city. Two electric elevators for the Pennsylvania Railroad Co., at Long Island City, Westinghouse, Church, Kerr & Co., engineers. One electric elevator for the Willett Realty Co.'s new building at West End Ave. and 82d St., Carlton Strong, architect; and one automatically-controlled residence lift for C. W. Luyster at No. 16 East 67th St.

POWER IN WESTERN PENNSYLVANIA.—The Western Pennsylvania Motor Company is securing right of way for a trolley road from New Castle to Pittsburg by way of Ellwood City, Pa. It is controlled by the Pittsburg capitalists who own the Pennsylvania Power Company, at Ellwood City, Pa., and are building a large steam plant at Ellwood City for light and power. The company has 10 or 15 miles of transmission line erected and is selling all the power it can produce. When the new steam plant is completed it will build large dams on the Connoquenessing River, as it owns both sides for miles. The river has a rapid fall between high, rocky banks, and stone for the dam is procured at low expense. A large hydro-electric system will then be created.

THE MILFORD CONSTRUCTION COMPANY.—Wallace C. Johnson, of Niagara Falls, chief engineer, has closed a contract with James B. Mullen, of Bangor, Me., for constructing its dam and power house. The plant consists of a concrete dam about 1,000 feet long across the Penobscot River, at Oldtown, Me., giving about 25 feet head, and a power house containing twelve 1,000-hp generators direct-connected to water wheels. Hydraulic power has been used at this point for several years. About 3,500 hp is now in use, produced by a wing dam and canal along the west bank of the river. The current generated by the new plant will be transmitted to the city of Bangor, 15 miles away, where a market exists for all that can be thus produced.

TRADE WITH BOLIVIA.—Mr. Benjamin Chabaneix, Calle Commercio, 9, 11 and 15 La Paz, Bolivia, commission and export house established in 1844. wishes to receive catalogues and samples of all classes of merchandise for that country.

THE MOVEMENT FOR RECIPROCITY.—The adoption by several of the principal European nations of retalitaory tariffs for the purpose of excluding American products and manufactures is operating to rapidly crystallize a movement by important manufacturing, farming and cattle raising interests of this country to promote the negotiation of reciprocity treaties to preserve American export trade from the dangers which threaten it. This movement has sprung up spontaneously in widely separated parts of the country and is spreading over the entire United States with great rapidity. A National Reciprocity Conference has been called to be held in Chicago August 16 and 17. Although this movement was organized principally by live stock breeding interests, the immediate co-operation of many important commercial and manufacturing bodies was tendered. Among the numerous organizations which have adopted resolutions favoring reciprocity and taking action to co-operate in the conference are the Chamber of Commerce of the State of New York, the Merchants' Association of New York, and the Produce Exchange of New York. These organizations are representative in important business and manufacturing interests of the metropolis, as well as a large part of the Eastern States. They will be represented at Chicago by strong committees authorized to voice the sentiment of their constituents in favor of reciprocity.

TELEPHONY IN CUBA.—The Cuban Telephone & Telegraph Co. has closed a contract for a 15,000 line automatic system for Havana to displace the old "Red Telefonica" system formerly owned by a Spanish company. The initial installation will be 5000 lines. The company will soon erect a new building and lay a new conduit and cable system for the new plant and within a year Havana will have a more perfect and modern telephone system than many American cities possess. The cosmopolitan character of Havana's population makes the automatic the only logical system to use there, for it would be necessary for human telephone operators to be linguists in a city of so many nationalities. The Cuban Telephone & Telegraph Co. has also contracted for a 600-line automatic system for the town of Marianao, a suburb of Havana. As already announced, the contracts have been made with the Automatic Electric Co. of America.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull throughout the week, although there was a strong tone. The favorable report of the United States Steel Corporation for the June quarter had a moderately bullish effect on the Steel stocks. Increased attention was paid to various industrial specialties. There was considerable strength in electric and traction securities, the advance being headed by General Electric, which made a net gain of 5¼ points, closing at 179¾, the highest price being 180 and the lowest 172. Westinghouse closed at 168½, a net gain of 1½ points, and Allis-Chalmers common at 18¾ and preferred at 62⅞, these being net advances of 2¾ and 4⅞ points, respectively. Brooklyn Rapid Transit closed at 69⅝, thereby gaining 2⅛ points net, and Metropolitan Street Railway 128, a gain of 2⅞. Interborough Rapid Transit closed at 213½. Other closing quotations and changes are as follows: American Telephone & Telegraph, 139, a loss of ⅝-point; Electric Storage Battery, 82, a loss of ½-point, and Western Union, 92⅜, a net gain of ⅜. The curb market was generally strong, with sharp advances in Chicago Subway and Interborough Rapid Transit. The volume of business was nearly double that of the previous week. The advances were largely sympathetic with those on the Stock Exchange. Following are the closing quotations of August 1:

NEW YORK

	July 25	Aug. 1		July 25	Aug.
Allis-Chalmers Co	15⅝	18	Electric Vehicle pfd	26	25
Allis-Chalmers Co. pfd	55⅝	62	General Electric	173½	179
American Tel. & Cable	90	90	Hudson River Tel	..	..
American Tel. & Tel	139	137	Interborough Rap. Tran.	205	215
American Dist. Tel	29	29	Metropolitan St. Ry	125⅝	127⅞
Brooklyn Rapid Transit	67¾	68⅞	N. Y. & N. J. Tel	..	..
Commercial Cable	..	..	Marconi Tel	..	..
Electric Boat	20	20	Western Union Tel	93¼	93
Electric Boat pfd.	60	60	Westinghouse com.	165½	165
Electric Lead Reduction	..	..	Westinghouse pfd	..	..
Electric Vehicle	18	18			

BOSTON

	July 25	Aug. 1		July 18	Aug. 1
American Tel. & Tel	139	138½	Western Tel. & Tel. pfd	*99	*99
Cumberland Telephone	117	117¼	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	243	244	New England Telephone	*138	135
General Electric	173	180	Mass. Elec. Ry	18	17½
Western Tel. & Tel.	18	18	Mass. Elec. Ry. pfd	62½	61

PHILADELPHIA

	July 25	Aug. 1		July 25	Aug. 1
American Railways	51	51	Phila. Traction	99⅞	..
Elec. Storage Battery	81	82	Phila. Electric	8¾	8¾
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans	27¼	27⅜
Elec. Co. of America	11½	11½			

CHICAGO

	July 25	Aug. 1		July 25	Aug. 1
Central Union Tel	..	..	National Carbon pfd	117½	117
Chicago Edison	158		Metropolitan Elev. com.	23⅞	24
Chicago City Ry	..	*196	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd	..	..
National Carbon	63	63			

* Asked.

TELEPHONY IN ENGLAND.—The report of the National Telephone Company of Great Britain for the year ending June 30 compares as follows with the two preceding years:

	1905.	1904.	1903.
Gross	$10,601,605	$9,629,300	$8,812,550
Net	3,512,465	3,272,825	3,063,090
Charges	919,880	751,430	674,300
Dividends	1,480,165	1,480,165	1,464,585
Surplus	1,103,420	1,032,230	924,205
Reserve	1,125,000	1,250,000	950,000
Total Reserve	48,495	46,850	29,155

There has been a growth in gross earnings since 1895 from $3,875,870 to $10,601,605. A sale of the company is to be made at the end of 1911 to the British post office, subject to approval by Parliament, at a fair market value.

KANSAS CITY RAILWAY & LIGHT COMPANY.—The Kansas City Railway & Light Company makes the following report for the year ended May 31:

	1905.	1904.	Changes.
Gross	$4,449,134	$3,878,358	Inc. $570,776
Expenses	2,235,260	2,090,172	Inc. 145,088
Net.	$2,213,874	$1,788,186	Inc. $425,688
Other income	16,588	5,689	Inc. 10,899
Total income	$2,230,462	$1,793,875	Inc. $436,587
Deductions	1,501,862	1,371,586	Inc. 130,276
Surplus	$728,600	$422,289	Inc. $306,311

DIVIDENDS.—The Consolidated Car Heating Company's dividend, payable on August 1, was 1½ per cent and 1 per cent extra. The dividend in February was 1½ per cent. The stock is thus placed upon a 4 per cent basis for 1905. The dividend in 1904 was 6 per cent and that of 1903 was 7 per cent. The highest ever paid by the company was 7½ per cent in 1900, and the lowest was 1 per cent in 1895. The decrease in the dividend for the present year is explained by the fact that the company has been increasing its plant. The directors of the New England Telephone & Telegraph Company have declared a dividend of $1.50 per share, payable August 15, to stockholders of record July 31.

HAMPSHIRE & WORCESTER STREET RAILWAY.—The stockholders and creditors of the Hampshire & Worcester (Mass.) Street Railway Company have received notice of the petition of Receiver G. S. Taft, of Worcester, for leave to sell the property of the company at public auction. The petition states that the property is mortgaged to the American Loan & Trust Company of Boston for $400,000 to secure the payment of principal and interest of certain bonds, of which $135,000 at par are outstanding. A hearing will be held in the Supreme Court, first equity division, in Boston, this month, to show cause why the petition should not be granted.

NEW ENGLAND TELEPHONE & TELEGRAPH.—The directors of the New England Telephone & Telegraph Company have voted to increase the capital stock of the company 30,860 shares for the purpose of providing funds for the payment of its third series of bonds due in 1906 for the extension of the property and business the company. The new stock will be issued at par ($100) to stockholders of record at the close of business August 19, in the proportion of one new share for every eight shares now outstanding. Subscriptions close September 16.

WEST INDIA ELECTRIC COMPANY, LTD.—The West India Electric Company, Ltd., of Kingston, Jamaica, has issued a statement for the year ended December 31, 1904. It compares as follows:

	1904.	1903.	1902.
Passengers carried	3,480,625	3,692,109	3,505,306
Gross	$131,166	$138,724	$129,810
Net	63,248	75,022	64,436
Surplus over charges	28,131	39,532	29,265

This system is equipped with American apparatus.

PORTLAND, ORE., GENERAL ELECTRIC MORTGAGE.—Stockholders of the Portland General Electric Company at a special meeting voted to authorize the directors to make a new mortgage to include all the property of the company for an issue of $10,000,000 of bonds, $4,000,000 of which will be sold at once to refund outstanding indebtedness at a lower interest rate, pay for the new steam plant erected at the foot of Twenty-first Street, and provide a surplus in the treasury for improvements that are already planned.

PHILADELPHIA BELL TELEPHONE.—The Bell Telephone Company of Philadelphia has passed the 100,000 mark, the number of its telephones and those of the Delaware & Atlantic Company having increased 17,503 since January 1. The stock subscription rights have been bid up to 5½. Nearly all of the $2,000,000 new stock is being subscribed by the stockholders of the company.

SHREVEPORT LIGHTING COMPANY.—The Shreveport Gas, Electric Light & Power Company has placed on record a mortgage in favor of the American Trust and Savings Bank of Chicago for $1,000,000. The bonds to be issued under this mortgage will be used to retire outstanding bonds and to make improvements in the property.

General News of the Week

The Telephone.

MAGNOLIA, ARK.—The Magnolia Telephone Company has been formed with a capital stock of $15,000, by R. L. Moore, president, and Gus Kohn, secretary.

FOWLER, CAL.—The Fowler Independent Telephone Company has been formed by W. T. Crawford, P. W. Hastie, and others. Capital, $75,000.

WASHINGTON, D. C.—The Cumberland Telephone & Telegraph Company has issued a statement showing a total of 130,582 subscribers, June 30, 1905.

ATLANTA, GA.—The Southern Bell Telephone & Telegraph Company is having plans prepared for a five-story building of steel construction. It will have a capacity for 25,000 telephones.

GALESBURG, ILL.—The Galesburg Union Telephone Company has increased its capital stock to $250,000.

SPARTA ILL.—Five applications have been filed by Messrs. J. M. Jenkins, George K. Kobusch, Judge J. C. McCoffy and H. B. Hawes, all of St. Louis, for franchises for telephone, electric light, gas service, water works and a trolley car system. Should the franchises be granted, it is proposed to run a suburban line to Coulterville, 7 miles distant.

BRAZIL, IND.—The Central Union Telephone Company has moved into its new exchange.

HUNTINGTON, IND.—Plans are forming for an independent telephone system in this city, to replace the United Telephone Company, which was recently absorbed by the Bell Company.

OAKDALE, IND.—The Oakdale Light, Heat & Power Company has incorporated to build a new plant. The capital stock is $50,000. R. H. Bauslog, A. N. Dukes and R. A. Edwards are directors.

TERRE HAUTE, IND.—The Central Union Telephone Company is asking for the right to put its wires underground. It offers to grant the city the free use of one duct in each of the conduits for fire and police alarms.

BROAD RIPPLE, IND.—The Central Union Telephone Company has opened a new exchange in this place. New country lines are also being built in all directions. The new exchange board has a capacity for about 150 telephones.

FORT RITTER, IND.—The Tri-County Fort Ritter Telephone Company has incorporated to build an exchange in Fort Ritter. The capital stock is $5,000. The directors are H. S. Dixon, W. P. Holland, J. P. Allen and W. H. Reed.

NORTH MANCHESTER, IND.—Application has been made for the appointment of a receiver for the North Manchester Telephone Company. The application is made by the minority stockholders, who claim that the majority stockholder is using up the revenue in salaries and mismanagement.

LEOPOLD, IND.—A new telephone company, to be known as the Leopold & Reno Telephone Company, has been organized here. The company has leased the Leopold and Branchville line from the Cumberland company. A. J. Meunier, Dr. Tayler, James Ward and J. J. Jennett are directors.

LEBANON, IND.—A representative of the Central Union Telephone Company worked a week soliciting the privilege of placing telephones in residences and business houses for his company with the agreement that the service should be free until 300 telephones had been contracted for. He finally gave up the task, the citizens being opposed to a second system. The independents have everything their own way in Lebanon.

DAVENPORT, IA.—The Richland Telephone Company has increased its capital stock to $20,000.

EARLHAM, IA.—The Adams Township Mutual Telephone Company has been organized. Capital, $2,000.

MALVERN, IA.—The Mills County Telephone Company has been chartered by M. W. Sells and others. Capital, $50,000.

EXIRA, IA.—The Wakefield & Case County Telephone Company has been formed. Capital, $2,000. Incorporated by A. F. Anderson, president; J. C. B. Anderson, secretary.

JOHNSON, IA.—Application has been made for a receiver for the Johnson County Telephone Company, operating in Johnson and adjoining counties in Iowa, with a capital of $50,000. The application states that the company was organized in 1901, that no dividends have been paid, and that its affairs have been grossly mismanaged.

MUSKOGEE, I. T.—The Pioneer Telegraph & Telephone Company is just completing one of the most modern plants in the Southwest at a cost of about $50,000. The company erected its own building, and is installing new apparatus throughout.

SULLIVAN, KY.—The Sullivan Telephone Company has been incorporated by several citizens of this place.

LOUISVILLE, KY.—The Home Telephone Company has purchased a franchise for telephone system in Pewee Valley. The franchise was sold by the Board of Trustees of Pewee Valley, and purchased by D. H. French for the company.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company will erect an addition to its exchange on Madison avenue, near Robert street, and will install switchboards, increasing its capacity to 12,000 telephones. The [illegible] in the Gilmor exchange will also be increased 12,000 capacity.

GLADWIN, MICH.—The Gladwin County Telephone Company has been [illegible] a line 11 miles long. The officers are: President, Fred Powell; secretary, H. L. Dow; treasurer, William Neely. These, with L. S. David and Guy E. Smith, comprise the board of directors.

NEW RICHLAND, MINN.—H. Jaehning has sold the exchange here to Capt. Milo Hodgkins.

JERSEY CITY, N. J.—The United Pay Station Telephone Company has been chartered with a capital stock of $50,000. Incorporated by H. O. Coughlan and Thomas F. Barrett.

PATERSON, N. J.—At the annual meeting of the Paterson, Passaic and Suburban Telephone Company officers were elected as follows: H. R. Swartz, president; George A. Post, first vice-president; W. S. Hancock, second vice-president; Barker Gummere, Jr., treasurer; J. W. Lindsay, secretary; Wayne Dumont, counsel; F. A. Demarest, general superintendent.

TRENTON, N. J.—A receiver has been appointed for the State Telephone Company of New Jersey upon the application of two bondholders, owning $24,000 and $5,000 respectively, of bonds on which the interest has defaulted. The company owns a pole line from Trenton to Jersey City, Newark, Elizabeth, Hopewell, Somerville and other points, but it is reported that the central office can not be located, nor can any of the officers be found.

LYONS, N. Y.—The Wayne-Monroe Telephone Company has increased its capital stock from $100,000 to $200,000.

BUFFALO, N. Y.—A receiver has been appointed for the Orr Telephone Co., capitalized at $3,000,000 and organized in Arizona, but having its headquarters in Buffalo, N. Y.

WATERVLIET, N. Y.—Permission has been granted the Hudson River Telephone Company to place its wires underground. The company agrees to furnish seven telephones free, to be used by the city authorities.

MARIETTA, OHIO.—The Lowell Farmers' Telephone Company has been formed with a capital of $10,000 by John Buck and Chas. Schimmel.

CLINTON, OHIO.—The Clinton Bell Telephone Company has been formed by J. A. Smith, L. N. Oberlin, J. G. Hyde, Edward Shondel, and H. F. Lerfass.

LIMA, OHIO.—The Council has passed the Central Union telephone franchise calling for the use of certain streets and alleys for the construction of conduits.

CHAGRIN FALLS, OHIO.—The Home Telephone Company has been incorporated by T. P. Ryan, W. R. Nutt, H. J. Brown, J. T. Daniels and James Niven. Capital, $250,000.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has elected the following officers: President, Dr. J. A. Chesney; vice-president, Benj. Sherer; secretary and treasurer, J. C. F. Hull.

KENTON, OHIO.—The bondholders of the Orange (Texas) Telephone Company at a recent meeting held in Kenton, O., appointed a finance committee and a bondholders' committee to effect a complete reorganization of the company.

NEW CASTLE, PA.—The Speechly Telephone Company has been taken over by the People's Telephone Company of Butler.

DOYLESTOWN, PA.—All the lines and telephones and telegraph franchise leaseholds and all other property of the Standard Telephone & Telegraph Company will be sold at public auction Aug. 12, by order of court.

BATESBURG, S. C.—The Batesburg Telephone Company has increased its capital stock from $500 to $2,000.

PIERRE, S. D.—Articles of incorporation have been filed here for the Gary Telephone Company at Gary, with a capital of $10,000. The incorporators are H. Bassett, J. H. Greene, W. F. Gordon, T. M. Anthony, M. D. Griffing, E. B. Huffman and O. P. Vober.

LICK CREEK, TENN.—The Lick Creek Telephone Company, of Benton county, has been incorporated, with $500 capital, by I. N. Hull and others.

CHATTANOOGA, TENN.—An ordinance has been passed granting a franchise to the East Tennessee Telephone Company to construct conduits through the city streets. The city will have supervision of conduits.

BEEVILLE, TEX.—The rural telephone system at Beeville, Tex., has been sold at sheriff's sale.

MANTELL, TEX.—The Citizens' Telephone Company has been formed. Capital, $1,000. The incorporators are A. S. Baylor and T. S. Southerland, and others, of this place.

KERRVILLE, TEX.—The Kerrville Telephone Exchange Company has been sold to the Texas Telephone & Telegraph Company of San Antonio.

CORPUS CHRISTI, TEX.—The long distance telephone is to be extended from Corpus Christi to Rockport, and a local exchange established at Rockport by the Southwestern company. The Rockport connection will be ready about Oct. 1.

CRAIGSVILLE, VA.—The Craigsville & Bell's Valley Mutual Telephone Company has been formed, with J. B. Tuttle, president; D. Kunkle, vice-president; L. E. Hicks, secretary and treasurer. The capital is $5,000.

WINCHESTER, VA.—The American Telephone Association, Limited, has been incorporated by W. C. Graichen, president; R. T. Barton, secretary and treasurer, both of Winchester, Va. Capital stock: Maximum, $2,500; minimum, $300.

MADISON, WIS.—A telephone company has been formed here by three local men to build a line from Hudson to Milwaukee and between Stillwater and St. Paul. Capital, $100,000. A. S. Zimmerman and Rufus B. Smith are interested in the company.

BENWOOD, W. VA.—The National Telephone Company will shortly begin extensive improvements on its system at Benwood and through the interior of Marshall County.

Electric Light and Power.

LUXORA, ARK.—The Town Council has granted Wm. and C. B. Wood a franchise for an electric light plant.

JONESBORO, ARK.—The Jonesboro Improvement District will expend about $220,000 for the purchase of the water and lighting plants, and the construction of a sewerage system.

SAN FRANCISCO, CAL.—Mr. Drew R. Oliver, Flood Building, this city, is the promoter of the Pescadero Water & Electric Company, which has been incorporated in San Francisco, by G. W. Kaiser, J. R. Kenny, H. N. Baggs, B. F. Kohlberg and R. H. Goodwin. The capital stock is $150,000, in shares of $1 each. Pescadero will derive considerable benefit from the construction of the Ocean Shore Railway, between San Francisco and Santa Cruz.

SEYMOUR, CONN.—The Seymour Electric Light Company has received authority to increase its capital stock to $100,000.

HARTFORD, CONN.—The Eastern Connecticut Electric Power Company has received the sanction of the legislature to acquire other corporations in Windham and New London counties.

WASHINGTON, D. C.—Bids will be received August 28 at the office of the District Commissioners for furnishing and erecting switchboards, tablet boards and cabinets for the electric plant at the sewage pumping station.

PENSACOLA, FLA.—Bids will be received until August 8 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Pensacola navy yard electrical supplies, cable, telephone wire, etc. Address, H. T. B. Harris, paymaster general.

CORDELIA, GA.—John P. Emerson is preparing plans for an electric light system for Cordelia and other places.

COCHRAN, GA.—The citizens, on July 18, voted to issue $17,000 bonds for electric lights and new water mains.

THOMASVILLE, GA.—The City Council has granted the Municipal Investment Co., of Chicago, Ill., and Columbus, Ga., a franchise for an electric light plant.

FORT GAINES GA.—The Interstate Water Works & Construction Co., of Washington, D. C., which recently secured a franchise for water works and an electric light plant at Ft. Gaines, expects shortly to take bids for the construction of several water works and electric light plants.

FREEPORT, ILL.—The power and light company's plant has been destroyed by fire, entailing a loss of $100,000.

DIVERNON, ILL.—The contract for constructing an electric light plant has been awarded to the Fort Wayne Electric Works for $7,672.

WAUKEGAN, ILL.—The City Council has authorized H. Thacker, city clerk, to procure bids for furnishing 200 5-amp. arc lamps for street lighting, on a three, five or ten-year contract, the bids to be presented to Council at its first regular meeting in August.

NEWPORT, IND.—The town trustees have granted E. E. Sayler, of Saybrook, Ill., a franchise to install an electric light plant at Newport.

OAKDALE, IND.—The Oakdale Light, Heat & Power Company has been incorporated at Peru, Ind., with $50,000 capital stock, by R. H. Bauslog, A. N. Dukes and R. A. Edwards.

NORTH MANCHESTER, IND.—Dr. D. Ginther and others have secured a franchise from the city of North Manchester, Ind., for light, heat and power. The new company proposes to develop the water power at Laketon, five miles distant.

NORTH MANCHESTER, IND.—Messrs. Estep, Gunther and others have been granted a franchise by the city council to establish an electric light, heat and power system in this city. The new company will erect a modern plant and utilize the water power at Laketon, five miles away. There is an electric light company here which has a franchise running for eight years.

CLAREMORE, IND. TER.—The Claremore Light & Power Co. has been incorporated, with a capital of $25,000. The incorporators are J. M. Bayless, F. A. Neilson, W. W. Bryan, and others.

SUMNER, IA.—L. L. Stewart has secured a franchise for an electric light and power plant.

WICHITA, KAN.—The Wichita Railroad & Light Co. has secured the contract for furnishing 271 460-watt arc lights for five years, at an annual cost of $14,454. The lights will burn until 1 o'clock. The company will furnish additional lights at $66 per light per year.

RUSSELL, KY.—Bids will be received until Aug. 15 for the construction of an electric light plant at Russell, at a probable cost of $5,000.

SOMERSET, KY.—Dr. W. Godfrey Hunter has purchased the plant of the Somerset Water Works Co. and is now negotiating for the electric light plant and electric street railway franchise.

MARKSVILLE, LA.—Bids will be received until Aug. 24 by the Mayor and Board of Aldermen for constructing a system of water works and electric light. Ira W. Sylvester, Alexandria, La., is the engineer. C. Ashton Smith is mayor.

ANNAPOLIS, MD.—The Maryland Heat, Power & Light Co. will expend about $40,000 in improvements. Howard E. Crook is president.

BALTIMORE, MD.—Architects are preparing plans for a power house to be erected at Westport, for the United Electric Light & Power Co.

ATTLEBORO, MASS.—The gas commissioners have authorized the Attleboro Steam & Electric Co. to issue 450 additional shares of capital stock at $100 per share to pay for additions to plant subsequent to May 1, 1905.

NEW BOSTON, MASS.—Engineer H. F. Keith, of Mt. Washington, Mass., is here to make surveys to ascertain the cost of an electric power plant. The company proposes to sell and transmit electric power to various cities in Massachusetts and Connecticut.

AUBURN, MASS.—A 350-horse-power alternating current power and lighting plant is to be installed at the Ettrick mills at Stoneville in Auburn. Thompson & Gallagher of Worcester are the engineers. The Stanley-G. I. Electric Manufacturing Company, of Pittsfield, will furnish the electrical apparatus, and the American Engine Company, of Bound Brook, N. J., will install the compound condensing engine.

TURNERS FALLS, MASS.—The Franklin Electric Light Company at the annual meeting elected these officers: President, Capt. J. F. Bartlett; treasurer, W. C. D. Thomas; secretary, E. I. Cassidy; directors, the above and W. D. Russell, Porter Farwell, C. W. Schuler and C. W. Hazelton. The company will at once prepare for a considerable extension of its business, which is made possible by its getting power from the plant of the Turners Falls Company.

SAGINAW, MICH.—The Bartlett Illuminating Co. has secured the contract for lighting the city for five years, at $60 per light per year.

HOUGHTON, MICH.—The Superior Construction Company, of Houghton, is preparing plans and specifications for the proposed municipal lighting plant at L'Anse.

ESCANABA, MICH.—The Board of Public Works has petitioned Council for an appropriation of $14,000 to purchase additional machinery for the electric light plant.

BAY CITY, MICH.—The Thorne Electric Company has been awarded a contract to install a complete lighting system, including street and commercial lights, in Tawas City.

ANN ARBOR, MICH.—Mayor Hamilton has vetoed the five-year contract of the City Council with the Washtenaw Light & Power Company for 150 street lights at a cost of $63 per light. The Mayor believes that a combination system of electricity and gas will give a superior all-night service, rather than electricity alone.

SAGINAW, MICH.—George Delby, of Saginaw, is interested in a project to generate power from Rifle River near Standish, to be used for lighting and traction purposes in Saginaw, Bay City and other cities.

MANISTEE, MICH.—J. J. Hubble has completed a survey for the purpose of damming the Manistee River near Sherman, for the development of water power. The dam and power house are to cost $150,000. Eastern capital is back of the enterprise.

MT. CLEMENS, MICH.—Three townships have granted franchises to the Peninsular Electric Light Company of Detroit, to run its high-tension wires through the townships. The objective point of the company is Port Huron, where light will be furnished from the Detroit power house at Detroit prices. Resorts along the lake shore will also be supplied.

GRAND RAPIDS, MICH.—The capital stock of the Grand Rapids-Muskegon Water Power Electric Company has been increased from $1,000,000 to $2,000,000 and a bond issue of $5,000,000 authorized at a meeting of the company held at Portland, Me. Work is being pushed on the big dam near Big Rapids and right of way for pole lines is being secured. Contracts for business are being negotiated in Grand Rapids and Muskegon.

BROWNS VALLEY, MINN.—A committee has been appointed to investigate the question of constructing an electric light plant.

PONTOTOC, MISS.—The citizens have voted to issue bonds for the construction of an electric light plant.

JACKSON, MO.—Bids will be received until Aug. 7 for $27,000 water and light bonds. Wm. Paar is city clerk.

JOPLIN, MO.—The Spring River Power Co. is about ready to let contract for the construction of a 4000-hp. steam plant.

SKIDMORE, MO.—The question of lighting this place by electricity is under consideration.

NEWMAN'S GROVE, NEB.—At a special election the proposition to issue $6,000 bonds for the purpose of establishing a lighting plant was carried.

RENO, NEV.—The Washoe Power & Development Company has closed a contract with the Stanley Electric Manufacturing Company for a second 750-kw., 2,300-volt, 3-phase, 60-cycle generator. The plant is operated by water power, transmitting current a short distance to Reno.

NASHUA, N. H.—At the annual meeting of the stockholders in the Nashua Light, Heat & Power Company, the stockholders voted to increase the capital stock to $600,000, an increase of $100,000.

TROY, N. Y.—The Troy Gas Co. is going to put in several miles of underground electric light circuits.

TONAWANDA, N. Y., has given up gas entirely for its streets. The price paid for arc is $70 per year and $20 for incandescents.

NORTH TONAWANDA, N. Y.—The Tonawanda Power Co., of North Tonawanda, has secured the contract for lighting the city, at $75 per arc light per year for a term of two years.

YONKERS, N. Y.—The Empire State Gas & Electrical Company has a capital of $50,000 and the incorporators are W. H. Cooper and N. R. Fox, of New Rochelle; C. J. Van Syke, of New York. It is intended to furnish gas and electricity in Yonkers and Mount Vernon, East Chester, Scarsdale, Tuckahoe and Bronxville.

MOREHEAD, N. C.—The town of Morehead has opened bids for a small electric light plant.

HENRIETTA, N. C.—The Henrietta Mills are completing a 1000-hp. electric drive at the cotton mills.

CHARLOTTE, N. C.—The Southern Power Company paid, according to reliable estimates, about $175,000 for the Mountain Island power on the Catawba River.

YADKIN, N. C.—Engineer J. M. Bandy completed a partial survey looking to the development of the Yadkin River by the Southern Yadkin Development Company, the estimated cost being $2,000,000. The power is estimated at 3000 horse power. The company proposes to build a large cotton mill and supply power to High Point, Salisbury and other towns in the section named.

TURTLE CREEK, PA.—A new operating concern, known as the Rose Hill Electric Company, is in the field.

LEWISBURG, PA.—Philadelphia capitalists have purchased the plant of the Lewisburg Gas & Electric Co. and will make some improvements.

HARTSVILLE, S. C.—There is some talk of constructing an electric light plant here.

BELLE FOURCHE, S. D.—The Belle Fourche Power & Water Company has secured a franchise for an electric light plant.

BOLIVAR, TENN.—Bids will be received until Aug. 10 for furnishing material and machinery required for the proposed water and light plant. Specifications may be secured from Granbery Jackson, engineer, Nashville, Tenn. R. C. Wilkinson is the mayor.

WHITNEY, TEX.—Collier Bros. are interested in the construction of an electric light plant at Whitney.

MONTPELIER, VT.—The Consolidated Lighting Company is to increase the size of its plant at Montpelier and will install a 1,000 horse-power steam turbine and generator.

STAMFORD, VT.—The Stamford Light, Heat & Power Company has elected these officers: President, James D. Hunter, of North Adams; vice-president, H. T. Cady, of North Adams; treasurer, Col. F. S. Richardson, of North Adams, clerk, C. D. Houghton, of Stamford.

PULASKI, VA.—Bids will be received on Aug. 15 for the construction of a building and for new machinery and a 150-kw. dynamo. The present plant, 75-kw. dynamo, engine and boiler, will be offered for sale as soon as new plant is completed.

WHEELING, W. VA.—Mr. W. C. Handlan, of this city, has obtained control of the Ohio Valley Electric Light & Power Company of Benwood. This company was lately consolidated with the Home Electric Company of McMechen and the Benwood & McMechen Light Company., The capital stock is $50,000. A meeting of the stockholders will be held Aug. 4.

GRANITE FALLS, WASH.—O. Lewis, of Snohomish, has secured a franchise for an electric light plant.

WINNIPEG, MAN.—The Civic Power Committee has selected Cecil B. Smith to make preliminary investigation of the various sources of power available for the use of Winnipeg.

CHATHAM, N. B.—Steps are being taken to refit and enlarge the electric light plant at a cost of $35,000. Engineer Kelch, of Montreal, is preparing a report.

OTTAWA, ONT.—The plant and the assets of the Consumers' Electric Company have passed into the hands of the corporation of Ottawa. The deeds were handed over, the purchase price of $200,000 paid and formal possession of the property was taken by Mayor Ellis. The authority of the company ceases, the directorate dissolves, and hereafter the plant is intended to be operated as a municipal utility.

The Electric Railway.

BIRMINGHAM, ALA.—Bessemer citizens have organized a company to construct and operate an electric railway around the various suburbs of this place. The new line is intended to extend to Jonesboro, Dolomite, Ensley, Thomas and other mining and manufacturing camps in the lower part of the county. It will be used later on as a branch of a line to Tuscaloosa County.

TROY, ALA.—Troy people propose to build an electric railway from Troy to Elba, to locate the power plant at Elba on Pea River and to furnish power to manufacturing enterprises all along the line. A stock company, with $10,000 capital, one half of which has been paid in, has been organized. Col. Charles Henderson and Capt. Hansford D. Boyd, of Troy, have associated with them others in the incorporation. J. M. Garrett, of Elba, is president and Y. W. Rainor is vice-president.

TUCSON, ARIZ.—An electric street railway system will be built in Tucson by W. S. Hitt and C. K. Durbin, president and vice-presidents, respectively, of the United States Light & Traction Company, of Denver.

HARTFORD, CONN.—At the annual meeting of the Hartford & Springfield Street Railway Company, held in Hartford, it was voted to purchase the Rockville, Broad Brook & East Windsor Road and to build the same at once. The directors of the latter road met later and ratified the sale. The contract for building was awarded to the National Construction & Building Company, of New York. Officers were elected by the Hartford & Springfield Company as follows: William A. Tucker, president; Arthur Perkins, secretary; Chauncey Eldridge, treasurer; Henry S. Newton, superintendent. The stockholders of the Hartford & Springfield Street Railway Company voted to increase the capital stock by issuing [illegible] shares of the par value of $100 each, making the whole number of shares 7,000 and the whole amount of capital stock $700,000.

WASHINGTON, D. C.—Plans are on foot, it is stated, for the building of an electric railway that will connect points in Fauquier, Loudon, Fairfax and Alexandria counties in Virginia, with this city. The charter was recently granted by the Virginia Corporation Commission to the new company. M. E. Church, of Falls Church, is the president of the proposed road, and among those interested is ex-Senator John B. Henderson.

CHICAGO, ILL.—The Chicago City Railway Company has decided not to build a new power station for the present, but to buy power from the Commonwealth Electric Company. Sub-stations will be established at Twentieth and State Streets and at other points, which will be supplied with power at 9,000-volts, 25-cycles, three-phase from the large steam turbine plant of the Commonwealth Electric Company at Fisk and Twenty-second Streets.

INDIANAPOLIS, IND.—The Huntington, Columbus City & Northwestern Railway Company has in contemplation a plan for building an electric railway from Indianapolis through Elwood, Marion, Huntington, Columbus City, Syracuse and Goshen. The contract for engineering, financing and building the road has been placed with the American Engineering Company. The officers of the company are Benjamin Raupfer, Columbia City, president; J. P. [illegible], Syracuse, vice-president; W. H. Magley, Columbia City, secretary; W. F. McLallen, treasurer; Melvin Blain, auditor; A. F. Weist, Jr., Columbia City, general manager; John A. Shafer, Indianapolis, chief engineer.

COUNCIL BLUFFS, IA.—The promoters of the proposed electric railway from Council Bluffs to Griswold have organized temporarily with H. H. Van Brunt as president. The company will be reorganized and the capital stock fixed after the survey is completed. The backers of the project are now preparing to go before the City Council and ask for a franchise to use certain streets.

DAVENPORT, IA.—There is another project on foot for the construction of an electric railway to connect Iowa City and Davenport. Three companies have already been formed for this purpose, all of which have made surveys. No construction work has been done by any of the three as yet. Now the business men of Davenport, recognizing the benefit to be derived from such a line, have had a survey made, and are promoting the construction of such a line.

DES MOINES, IA.—The Central Railway Company has been organized in this city for the purpose of constructing and operating electric interurban railways in Iowa and other states. The capital stock of the company was fixed temporarily at $25,000, and Des Moines will be headquarters. The first proposed line under consideration is one from Des Moines to Ames, a distance of about 37 miles. The officers of the company are: Thomas J. Wilcox, of Clinton, president; L. E. Miley, of Chicago, vice-president; B. S. McCully, of Princeton, treasurer; D. L. Wilcox, of Des Moines, secretary, and George H. Carr, of Des Moines, attorney.

SOMERSET, KY.—Dr. W. Godfrey Hunter has closed a deal for the Somerset Water Works Company for $150,000. He is negotiating for the electric light plant and the street railway franchise, and has announced that he will erect a central street railway station in the Public Square.

PADUCAH, KY.—The public service utilities of Paducah, controlled by the Paducah Steam Heating Company, have been purchased by Stone & Webster, of Boston. The purchase price is said to have been $1,440,000, divided as follows: The Paducah City Railway Company, capital $300,000, bonds $650,000, 14.9 miles of track; Paducah Gas & Fuel Company, capital $200,000, bonds $100,000; Paducah Steam Heating Company, capital $100,000, bonds $50,000. The new owners are said to plan improvements that will aggregate several hundred thousand dollars.

LEXINGTON, KY.—Another company, with the object in view of building interurban electric lines to connect this city with surrounding towns, has been formed by local capitalists. It will be known as the Lexington Southern Railway Company. The capital stock of the company will be placed at $3,600, and the incorporators will be J. Will Stoll, Richard C. Stoll, Ernest B. Ellis, William E. McCann, Leonard G. Cox, Rudolph R. Harting and D. Gray Falconer. The purpose of the company is to construct an electric railway between Lexington and Nicholasville, and to furnish heat, light and power. The officers of the corporation will be: J. W. Stoll, president; D. Gray Falconer, vice-president; E. B. Ellis, secretary and treasurer.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company directors have voted to authorize P. H. and P. C. Dolan to build a new power house upon the recently-purchased Seymour Street property. The new plant will cost about $100,000. Engineer C. K. Stearns, of Boston, is preparing the plans.

BENZONIA, MICH.—The Business Men's Association is seeking to interest capital in a project for the building of a 20-mile electric railway along the shores of Crystal Lake, connecting the resorts, through Benzonia to Beulah and Honor.

SAULT STE. MARIE, MICH.—Sheridan F. Masters, speaker of the Michigan House of Representatives, and Game Warden Chapman are promoting a project for building an electric railway between the Soo and Bay City. A through sleeper service is to be a feature. The road will cost $350,000 to build, and will traverse a rich farming section.

SYRACUSE, N. Y.—The Syracuse, Lakeside & Baldwinsville Railroad, the 14-mile line extending north from Syracuse along Onondaga Lake to Baldwinsville, will be sold at auction.

ELMIRA, N. Y.—The Delaware, Lackawanna & Western Railroad has bought the Elmira & Seneca Lake Railroad's line between this city and Watkins.

ALBANY, N. Y.—At its July meeting the board of directors of the United Traction Company failed to declare the quarterly dividend. Stockholders believe that the passed dividend will be declared in August.

CLINTON, N. Y.—F. K. Baxter, of Utica, has completed maps and profiles for an electric railway from Clinton to Waterville, a distance of 11 miles, and in connection with the same he has completed estimates for water power to generate the necessary electric power.

ROCHESTER, N. Y.—The Rochester & Southern Construction Company has been incorporated at Albany with a capital of $100,000 to build an electric railway from Elmira to Rochester. The officers of the company are William A. Cullen, of Newark, N. J., president; Thomas Barker, of Rochester, vice-president; T. S. Mulcahy, of Rochester, secretary; George A. Engert, of New York City, treasurer and manager.

ITHACA, N. Y.—The Auburn & Ithaca Traction Company is petitioning the Board of Aldermen of this city for a franchise to construct its track through Cayuga Street. According to the engineer's plans, the Ithaca terminus of the road will be at the Cayuga Street bridge over Six-Mile Creek. Officers of the company have been elected as follows: Sherman Collins, of Ithaca, president; J. P. Hazard of Poplar Ridge, vice-president, and E. B. Mosher of Auburn secretary and treasurer. Hearings on the proposed railroad are to be given by the State Board of Railroad Commissioners soon—one in Auburn and the other in this city.

CLEVELAND, OHIO.—C. H. Hubbell and others have formed the Cuyahoga Traction Company, and propose to build a suburban line from South Brooklyn, through Parma and Middleburg, to Berea.

INDIANAPOLIS, IND. The Indianapolis & Ohio Valley Traction Company, which proposes to build from Indianapolis to Evansville, is making good progress in securing rights of way and franchises in and through the counties and cities along the proposed line. The company is agreeing not to charge more than 1¾ cents a mile.

MUNCIE, IND.—The Muncie, Hartford City & Fort Wayne Traction Company refused to accept its own price of $2,500,000 for 40 miles of road, which connects this city with Bluffton. The company has instead decided to build to Fort Wayne, regardless of what the Fort Wayne & Wabash Valley Company does. Both companies are constructing grades, and indications point to two lines connecting Bluffton with Fort Wayne. It is said that the Indiana Union Traction Company is back of the Fort Wayne enterprise in order to get a through line from Fort Wayne to Indianapolis.

EATON RAPIDS, MICH.—Because of the attitude of the citizens of Mason in refusing to give the Jackson-Lansing Electric Railway Company a franchise through the streets desired, it is probable that the road will come through Eaton Rapids and avoid Mason. That city insisted that the road should run through the main street. This would make necessary the building of two overhead bridges at a cost of nearly $50,000. The road refuses to do this. Surveyors are now laying out the right of way through Eaton Rapids.

NIAGARA FALLS, N. Y.—The Niagara Falls and Lockport Electric Railway Company, Niagara Falls, has been incorporated; capital, $200,000. Directors: E. C. Lufkin, J. N. Bradford, Buffalo, and S. P. Franchot, Niagara Falls.

PATERSON, N. J.—The project to build an electric railway to Greenwood Lake is again being agitated. It is to start at Singac and go through Wayne, Mountain View, Pompton Plains and Pompton, where a branch will run to Butler, 4 miles distant. The main line will continue from Pompton to Midvale and Hewitt, past Coopers, the Lakeside and the Ferncliffe to the upper end in Orange County, N. Y. The line, according to the plan, would be about 25 miles long.

BROOKLYN, N. Y.—The property owners in Fulton Street having withdrawn their opposition to the construction of a four-track subway in that thoroughfare, the Rapid Transit Commission has notified the contractors to at once resume work, which was practically stopped a few weeks ago owing to the refusal of the property owners to give the necessary consent to the four-track road. According to the amended plans, there are to be four tracks under Fulton Street from the Borough Hall to Bond Street; five tracks from that point to Flatbush Avenue and six tracks under Flatbush Avenue to Fourth Avenue, the extra one a double decker branching off at Fourth and Lafayette Avenues.

TOLEDO, OHIO.—The Toledo, Defiance & Southern Railway Company, of Defiance, has been incorporated with a nominal capital of $10,000, by A. K. Detwiler, T. T. Ansberry, L. R. Schenck, W. H. Edwards and P. Kettoning.

LIMA, OHIO.—Contractor Cliff Wise, of Lima, has closed a contract for the construction of 36 miles of road between Muncie and Portland, Ind. The work is for the McCullogh interests, which are said to be backed by the Widener-Elkins syndicate.

YOUNGSTOWN, OHIO.—Horace T. Smith, of Youngstown, and Robert L. Walker, of Poland, are forming a company, and have secured a right of way for the purpose of building an electric railway from Youngstown to Poland, a distance of about 8 miles.

HAMILTON, OHIO.—According to general manager Sloat, of the Cincinnati Northern Traction Company, the central power house that is to be erected in that city will cost $700,000. There will be three turbo-generators of 1000-kw. capacity each, and three 300-kw. rotary converters. There will be four substations.

COLUMBUS, OHIO.—The reorganization of the Columbus, Delaware & Marion Electric Railroad Company has been effected through the consolidation of that company with the Columbus Northern Railway, Power & Equipment Company. The last-mentioned company was formed to build a power house and improve the electrical equipment. The new company is known as the Columbus, Delaware & Marion Railway Company. It has a capital stock of $2,500,000 and a bonded debt of the same amount.

GUTHRIE, O. T.—The United Trolley Improvement Company, of Guthrie and New Jersey, with $1,000,000 capital stock, has filed its charter here. The incorporators are Ernest T. Preston, of Monmouth County, N. J.; Ernest T. Andrews, of Norfolk County, Mass., and H. W. Pentecost, of Guthrie.

EASTON, PA.—An Easton (Pa.) dispatch says a combination of trolley lines to cover 100 miles in Northampton County, which includes the lines from Walnutville to Danielsville, Nazareth to Bath, and Bethlehem to Bangor has been effected. L. B. Smith & Co., of Philadelphia, who control the Easton Transit Co., are said to be interested in the merger.

HARRISBURG, PA.—The State Department has issued charters to seven new street passenger railway companies in the vicinity of Pittsburg, with a total capital of $[illegible]. They are as follows: The Ambridge, Edgeworth & Sewickley, Ambridge, Sewickley & Osborn, Ambridge, Dixmont & Emsworth; Ambridge, Osborn & Haysville, Ambridge, Haysville & Glenfield; Ambridge, Glenfield & Dixmont, Ambridge, Leetsdale & Edgeworth.

PITTSBURG, PA.—The Pittsburg Railway Company has purchased the Beaver Valley Traction Company, and the following officers representing the new control have been elected: President, J. D. Callery; vice-president, S. L. Tone; secretary, W. B. Carson; treasurer, C. J. Braun, Jr.; assistant secretary and assistant treasurer, J. C. Lightfoot, Jr.; general manager, Gaylord Thompson. The Pittsburg Railways Company pays approximately $1,000,000 for the $1,005,000 (par value) Beaver Valley Traction Company stock and guarantees principal and interest on the outstanding bonded indebtedness.

AUSTIN, TEX.—The Gainesville, Whitesboro & Sherman Electric Railway, capital $500,000, with principal office at Gainesville, has been chartered. The incorporators are G. A. Hassinger, H. L. Lazarus, of New Orleans, H. G. Stinnett, of Sherman; O. B. Cowell, of Whitesboro, John King, and others, of Gainesville.

New Industrial Companies.

THE N. E. ELECTRIC CLOCK COMPANY, of Bangor, Me., has been formed. Capital, $100,000. President, P. S. Smith; treasurer, W. L. Curran. Directors, as above and A. M. Robinson and A. G. Curtis, all of Bangor.

THE B. & B. APPARATUS COMPANY, of Kittery, Me., has been organized for the purpose of manufacturing and dealing in electrical apparatus. The capital stock is $[illegible], of which nothing is paid in. The officers are: President, Harold P. Knowlton, of Malden, Mass.; treasurer, Jesse E. Forsyth, of Kittery.

THE ST. JOHNSBURY ELECTRIC COMPANY, which has been engaged in the electrical business in St. Johnsbury, Vt., has filed articles permitting it to buy and sell water powers, real estate and personal property, conduct electric light plants and maintain stores for the sale of electrical lighting and wiring apparatus.

Legal.

CHICAGO STREET RAILWAYS.—The Chicago City Railway has filed a bill in the United States Circuit Court for an injunction to restrain the city of Chicago from interfering with any of the company's lines.

THE WESTERN UNION ON THE RAILROADS.—The Western Union Telegraph Company has asked the United States Court at Indianapolis for a perpetual injunction restraining the Vandalia Railroad Company from interfering in any way with the company's lines along the right of way of the defendant. On Jan. 18 last the Vandalia Railway Company notified the Western Union that it must cease using the right of way by Feb. 1, 1906, when the contract between the two corporations expired, and if such use was not discontinued by the time stated the lines would be severed.

Obituary.

J. C. CHAMBERLAIN

MR. J. C. CHAMBERLAIN.—It is with deep regret that we record the sudden death last week from bronchial pneumonia of Mr. Jacob Chester Chamberlain, a well-known electrical engineer. Early in the week his friends heard of an indisposition, and were stunned at the swift and fatal march of disease. Mr. Chamberlain was born in India of American parentage on July 3, 1860, being the son of Jacob Chamberlain, M. D., D. D., and in 1872 was brought to this country to complete his education. He graduated with honors from Rutgers College, New Brunswick, N. J., in 1882. In 1883 he took a post-graduate course in chemistry; soon after he entered Mr. Thomas A. Edison's laboratory, on Goerck Street, so that he took an active part in the pioneer electric lighting work of those days. He was engaged as electrical engineer in the historic first Edison electric light station on Pearl Street, and during his connection with it he devised a number of improvements for locating grounds in the street feeders which at that time occurred frequently. About 1886 he was engaged by Mr. Henry C. Davis, then president of the Sawyer-Man Electric Co., as electrical engineer and superintendent of construction. Some of his early installations were the electric lighting of the United States Capitol, the Hudson River Tunnel, which up to that time used candles; the Mutual Life Building and other conspicuous plants. He then became deeply interested in traction, and in 1889 was engaged as electrical engineer of the Julien Traction Co., which was introducing storage battery cars. During his connection with that company he took out a large number of patents relating to the improvement and development of the storage battery system for railway work. Some of the patents relating to controllers were quite fundamental and were acquired by the General Electric Co. In connection with this work he developed and patented some special gears and pinions to reduce the loss which occurred in transmitting power from the motor to the car axle. The motors at that period were comparatively high speed, so that double reduction was resorted to. This involved the rapid depreciation of the pinion. A large business was done in this line until single reduction motors were brought out. About 1893 he took up his well known work on electric launches, and during the next seven years so thoroughly developed the design, construction and equipment of such boats as to take them from the experimental condition and make them a recognized branch of electrical industry. Soon after, he obtained entire control of the Electric Launch Co., and during the next few years did a very satisfactory business. The Electric Boat Co., seeking to consolidate the different electrical interests in marine propulsion work, bought out his interests about 1900. During the next two or three years he confined himself to his private business. In the early part of 1903 he became general manager of the Automatic Refrigerating Co., some of the directors of the company being very well known and largely identified in electrical enterprises. He had just succeeded in developing and putting the automatic refrigerating work on a practical and reliable basis and was arranging to push the introduction of the automatic refrigerating system in the market when his sudden and fatal illness overtook him. This system was recently illustrated and described in our pages. Mr. Chamberlain received the degree of Master of Science in the early part of his electrical career; he was also one of the early members of the American Institute of Electrical Engineers. He was a member of the old Electric Club and later became the chairman of the house committee. He was also a member of the Colonial Club, the Marine Field Club and a very active member of the Grolier Club, he being considered a specially good authority on first editions of early American authors, his complete and valuable collection of their works being considered by experts one of the best in the country. Mr. Chamberlain was a member of the Engineers' Club for many years, and at the time of his death was chairman of the house committee, a capacity in which he rendered brilliant and memorable service. He was also a member of the board of trustees of the club. The funeral services took place at the Collegiate Church on Fifth Avenue on July 30. Mr. Chamberlain left a widow and a daughter about nine years old. The grief of his family is shared by a host of long-time friends and admirers in all branches of the mechanical and electrical professions.

MR. H. R. PARRISH, for ten years confidential secretary to Mr. Theodore N. Vail and American representative of La Capital Tramways Company, of Buenos Aires, Argentina, and the Rosario Electric Lighting Company, died on Friday, July 28, of rheumatism of the heart. Mr. Parrish was at one time connected with the Electric Storage Battery Company, of Philadelphia. He is survived by a widow and one child. Mr. Parrish was only 44 years old.

Educational.

STATE COLLEGE OF WASHINGTON.—Although the college was not founded until the year 1890 its growth has been so rapid that it is enabled at the present time to offer courses in practically all branches of learning. Instruction is given in mathematics, chemistry, botany, zoology, agriculture, English language, literature, economic science, history, mechanical engineering, electrical engineering, modern languages, mining engineering, geology, pharmacy, veterinary science, music, business, dairying, military science and tactics. The catalogue for the past college year shows a total registration of 793 students. The expenses of the institution are met by the income from endowment funds and by State appropriations, so that tuition is free to all residents of the State of Washington.

Personal.

MR. C. S. SERGEANT, vice-president of the Boston Elevated Ry. Co., is making a few weeks' trip of combined business and pleasure in Europe.

MR. W. B. RANKINE, of the Niagara power interests, has sailed for Europe on the steamer "Zeeland," for rest and recreation during the summer.

MR. WALTER E. HARRINGTON has resigned his position as vice-president and general manager of the New York-Philadelphia Company, and of its affiliated companies.

DR. HAROLD PENDER, who is associated with Dr. Cary T. Hutchinson, in New York City, was married recently, in Syracuse, to Miss Alice Campbell Matthews, of that city.

MR. S. W. LE BARON has become superintendent of the Electric & Gas Co., of Grand Junction, Colo. He was formerly the superintendent of the Albuquerque, N. M., Gas, Electric Light & Power Company.

GEN. A. B. P. SPRAGUE, president, and Mr. W. H. Coughlin, superintendent, of the Worcester, Mass., Electric Light Company, have recently returned from a trip to Philadelphia, Wilmington and Atlantic City, on technical matters.

MR. R. B. COREY, who has represented the Bossert Electric Construction Co., of Utica, N. Y., in the Metropolitan district, for its steel outlet boxes, switches and specialties, has been appointed sales representative for Southern New York, New Jersey, Pennsylvania, Delaware and the District of Columbia.

MR. DANIEL E. CARTER, assistant chief operator of the Boston office of the Postal Telegraph-Cable Company, has been appointed manager of the company's office at Springfield, Mass. Following the announcement of Mr. Carter's advancement, he was presented with a gold watch charm, studded with diamonds, the gift of his associates. The recipient's term of unbroken service with the Postal Company covers over 22 years.

MR. PAUL DOTY, general manager and second vice-president of the St. Paul Gas Light Company, has been elected president of the Ohio Gas Association. Mr. Doty is well-known in the electrical field, and his friends therein hasten to congratulate him upon this deserved recognition. His company is in virtual control of the electric lighting system in St. Paul, as it controls and operates the Edison Light & Power Co., the St. Paul Light, Heat & Power Co., and the East Side Electric Co., and leases the St. Croix River Co., a power transmission system. Mr. Doty was prominent at the recent National Electric Light convention at Denver.

MR. F. P. FISH, President Fish, of the American Telephone Company, has returned from a trip of several weeks to the Pacific Coast and intermediate points. Mr. Fish says: "On every hand I saw evidences of normal, healthful growth. Business in the west and northwest is very good. There are no evidences of an unnatural boom, but business men and farmers are all talking confidently regarding the general business situation. I found that our western telephone managers are displaying the same energy in the development of their fields as is shown in the east. Of course, I found competition in various parts of the west. This is, of course, annoying, but not disturbing. Crops are looking very well indeed, in fact, I never saw Nebraska looking better."

MR. JOHN SPEICHER, chief of the fire department telegraphs of Jersey City, N. J., is making an effort to hold or recover that position. He started the department's telegraph service, and had been its Superintendent at $2,500 per year for more than twenty years, when, some months ago, charges were made against him. As soon as he was accused, a letter resigning his position reached the Fire Board, and he dropped out. He was brought back and put on trial. The testimony of the complainants was so contradictory that Judge Blair directed an acquittal, but the jurymen declared their belief that he was guilty and refused to obey the court's direction, and the court finally ordered the Clerk to record the verdict of "Not guilty" in the face of their protests. Meanwhile the Fire Board had taken Speicher's brother Mahlon from a similar position in the Police Department and appointed him to the vacant Superintendency. At its last meeting the acquitted ex-Superintendent surprised the Fire Board with a letter declaring that he had not resigned or authorized any one to present his resignation to the board, protesting against the "intrusion," of the other Speicher into the place, and demanding that the board dispossess his brother and recognize him as the lawful incumbent of the office. The board declared that, as it had accepted Speicher's resignation, it did not see how it could retrace its steps, but referred the letter for advice to Corporation Counsel Record. Mr. Speicher does not charge that his resignation is a forgery, but intimates that after he had written it he held it under advisement, and that while he was considering it some one carried it to the Fire Board's office and filed it.

MR. W. M. PROBASCO, the well-known technical journalist, has resigned as assistant to the president of the McGraw Publishing Company to accept the office of vice-president of the Search Light Publishing Company, of New York City, a unique organization which promises to occupy an important field in the journalistic and publishing business of this country. The company owns a file of about 2,500,000 clippings, articles and pictures on all subjects, compiled from newspapers, magazines, engineering journals, books and reports of scientific societies, classified and kept up-to-date for the use of all who require prompt and up-to-date information on any subject. As a part of its plan also the company publishes a weekly paper called *The Search Light*, which is a record of the most important events of the previous week and which covers some sixty separate departments. As a nucleus for this paper the company purchased *The Great Round World* and *The Week's Progress*, publications somewhat on the line of its own, but has improved on their plans and especially in the completeness with which the information is compiled and indexed. The company also handles the publishing and advertising accounts of important railroad, mechanical and engineering firms. The fourth department of its business is the publication of books. One of those in hand is one on Cuba and another deals with the exhibits of the Westinghouse Companies at the recent International Railway Congress. Mr. Probasco was formerly assistant general manager of the Westinghouse Companies' publishing, advertising, and exhibition interests, and in this capacity was the designer and organizer of the Westinghouse exhibits at the St. Louis Exposition, which received the grand prize as an exhibit. He was also compiler and editor of the handsome monograph recently issued for the Interborough Rapid Transit Company by the McGraw Publishing Company. Associated with Mr. Probasco in the enterprise is Mr. E. G. Handy, who with his brother had charge of the Bureau of Publicity and Promotion, of the Chicago World's Fair, and has since been a prominent newspaper man and publisher; and Mr. W. G. Jordan, who was six years editor of *Current Literature*, was later managing editor of the *Ladies' Home Journal* and subsequently editor-in-chief of the *Saturday Evening Post*, of Philadelphia.

Trade Publications.

STEAM ENGINES.—The Ball Engine Company, Erie, Pa., has just gotten out a well illustrated booklet describing side-crank, single-cylinder and Corliss engines. The side-crank engines are particularly adapted for direct connection to generators. These engines are built in the simple, or in the tandem-compound or cross-compound types. The Corliss engines are constructed in either the horizontal or vertical types, in sizes up to 1,200 horse-power.

WALLACE BARNES & CO., of Bristol, Conn., manufacturer of small springs of every description, and dealer in wire and cold rolled steel, has issued a very neat pamphlet in regard to its specialties, many of which are a necessity in various branches of the electrical arts. The catalogue not only contains illustrations and descriptive data, but a good deal of technical information and several useful tables. The cuts are singularly good and helpful in showing what the concern makes.

SINGLE-PHASE INDUCTION MOTORS.—Bulletin No. 87 of the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., describes a line of self-starting single-phase induction motors. These machines are made in two sizes: one-fifteenth and one-tenth horse power respectively. Each is provided with a centrifugal clutch, so arranged that the motor will automatically start its full load. Each motor is provided with a starting coil which is cut out automatically when full speed has been attained.

News of the Trade.

PASS & SEYMOUR, INC., announce that it is their intention to materially increase their facilities for handling orders in the territory covered by their Chicago office, and to this end have secured the services of Mr. W. F. Hessel, formerly sales manager of the Western Electric Co., at Chicago. Mr. Hessel's long experience and intimate acquaintance with the materials and needs of the electrical business are of such a character that they are more than pleased to announce his association with them, and wish to advise their customers that they want them all to feel at liberty to call upon him at any time for information not only regarding their superior line of electrical specialties, but also regarding any problem of a general nature on which his past experience will be of service. Mr. Hessel's headquarters will be at 130 West Jackson Blvd., Chicago, Ill.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society.. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelphia. Next meeting, Bethlehem, Pa., Sept. 18, 19 and 20, 1905

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Municipal Improvements.. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

American Street Railway Association. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next convention, Philadelphia, last week in September, 1905.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

California Independent Telephone Association.. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Glenwood Springs, Col., Sept. 18, 19 and 20, 1905.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electrical Association of North Dakota. Secretary, S. J. Fuller, Larimore, N. D.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 16, 1906.

Electrical Trades Society (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electrical Association. Secretary, D. Davis, Litchfield, Ill. Next meeting, Peoria, Oct. 5 and 6, 1905.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Erie, Pa., Aug. 23, 24 and 25, 1905.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Electrical Association. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

Kansas Gas, Water & Electric Light Association.. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Oct. 14 and 15, 1905.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

Massachusetts Street Railway Association.. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Oct. 10, 1905.

Missouri Independent Telephone Association. Secretary Frank S. Leach, Sedalia, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y.

National Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in Jan., 1906.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Hotel Victory, Put-in-Bay Island, Aug. 16, 17 and 18, 1905.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio.

Pacific Coast Electric Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association.. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa. Next meeting, Pittsburg, September, 1905.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

Southwestern Electrical and Gas Association. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, C. B. Fairchild, jr., 114 Liberty St., New York.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Virginia Street Railway & Electric Association. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 25, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

794,981. TIME LIMIT CONTROLLER FOR CIRCUIT BREAKERS; Edward M. Hewlett, Schnectady, N. Y. App. filed June 23, 1903. A single instrument is adapted for use with a plurality of circuits. Each circuit has a magnet-controlled gear segment which is engaged with a continuously rotating worm under conditions of excessive current. After a certain time the rotation is sufficient to open the circuit. If the excessive current is not of sufficient duration, the worm and gear segment will be disengaged before the circuit is opened.

795,285. SWITCH; William S. Jackson, of Hoboken, N. J. App. filed August 27, 1904. A trolley switch in which a swinging bar depends from a portion of the trolley wire so as to be moved in one direction or the other by the trolley wheel, thereby throwing an appropriate switch. The bar serves to guide the trolley wheel while the parts are in contact.

795,312. RECEIVING APPARATUS; Harry Shoemaker, of Jersey City, New Jersey. App. filed Feb. 13, 1905. A detector for wireless telegraph systems in which a galvanic cell is employed in place of the usual coherer. The antenna element of the cell is extremely small and is made of fine platinum wire, coated with silver. An excitant of sulphuric or nitric acid is used.

795,313. SELF-PLAYING MUSICAL INSTRUMENT; Harold W. Shonard, of Newark, N. J. App. filed May 22, 1900. Relates to the control of automatic piano players and involves features to prevent sparking of the contacts at the perforated sheet, and means for modulating the tone of the instrument. Employs a plurality of "vails," which are independently actuated to simultaneously make a series of contacts to vary the volume of tone of certain ranges of notes.

795,314. SIGNALING SYSTEM; Howell W. Souder, of Tamaqua, Pa. App. filed Sept. 27, 1904. A signaling system adapted to protect a single track section into which a plurality of cars are admitted, and in which the signal is not cleared until all the cars have left the block. Has a star-wheel which is stepped around in one direction or the other by separate operating magnets.

795,318. ANNUNCIATING MECHANISM. Charles E. Trump, of Philadelphia, Pa. App. filed July 28, 1904. A system for use in hospitals, in which a signal is displayed at a patient's room until answered, and a corresponding annunciator is operated in the superintendent's office.

795,322. RAILWAY BLOCK SIGNAL SYSTEM; Ludwig S. Walle, of Brooklyn, N. Y. App. filed Dec. 29, 1903. An overlap system in which the usual track rails are employed. Pole changers are included in the apparatus at each station, so as to secure the overlap. The semaphore arm has a sprocket wheel and chain and a series of solenoids are successively energized to move the chain and set the semaphore arm.

795,323. APPARATUS FOR ELECTROTHERMAL TREATMENT; Daniel M. Watson, of Portland, Ore. App. filed Dec. 7, 1904. A sort of crib or frame has two hinged sections, with rows of incandescent lamps thereon, and can be folded together so as to enclose a patient.

795,325. GALVANIC BATTERY; D. L. Winters, Chicago, Ill. App. filed Nov. 2, 1904.

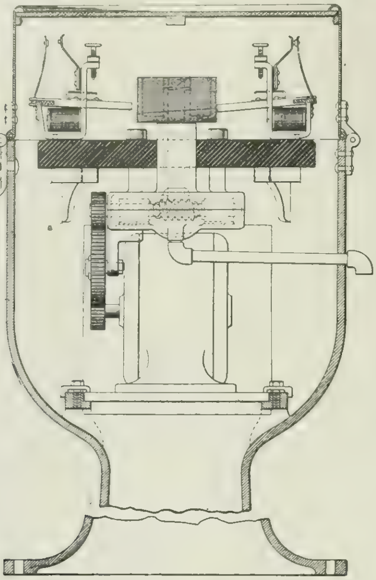
795,340. CIRCUIT CLOSER; Eugene R. Carichoff, of East Orange, N. J. App. filed August 25, 1900. The circuit is broken at carbon contacts after the metallic knife blade contacts have been separated, and a pair of electric magnet coils are automatically thrown in the circuit to blow out the arc at the carbon contacts. The switch is actuated by a solenoid.

795,369. AUTOMATIC CONTROLLER; Ernest Schattner, of Schenectady, N. Y. App. filed July 8, 1904. An apparatus to warn a consumer that he is using more than the contract number of lamps. The excessive current energizes a solenoid which switches a single display lamp in series with all the other lamps, dimming the latter and indicating the reason for the disturbance. Means are provided for rendering the controller inoperative when desired.

795,392. AUTOMATIC REGULATOR FOR ALTERNATING CURRENT MOTORS; G. H. Hill, Schenectady, N. Y. App. filed Jan. 15, 1904. (See Current News and Notes.)

795,402. TELEGRAPH AND LIKE CABLE; Oliver J. Lodge, of Birmingham, England. App. filed Dec. 9, 1904. In order to avoid the sluggish action of the usual submarine cable, the electrostatic wave is dissipated and the electromagnetic wave strengthened. For this purpose the conductor is surrounded by an iron sheathing of high magnetic permeability, and a comparatively poor insulator is used so as to dissipate the electrostatic charges.

795,432. POLARIZED ARMATURE APPARATUS; Martin Fischer, of Zurich, Switzerland. App. filed Sept. 1, 1904. An electromagnet has bevelled holes so formed that a pivoted armature cannot lie against both simultaneously. The poles are normally magnetized with same polarity by a permanent magnet. When current passes, one or the other pole is strengthened according to the direction of the current, and the armature correspondingly tilted.



794,981.—Time Limit Controller for Circuit Breakers.

795,436. SNAP SWITCH; Henry Geisenhoener, of Schenectady, N. Y. App. filed Feb. 19, 1902. A switch designed to secure a vibratory motion of the switch blades by rotary movement of the operating handle. The handle and switch blades have cranks of unequal length, which are connected by a link.

795,462. ELECTRIC CONTROL APPARATUS; William A. Turbayne, of Lancaster, N. Y. App. filed Sept. 15, 1904. Relates to controllers in which the rheostat arm is operated by the motor which runs the exciter. In order to prevent the drop in potential due to the extra load upon the motor, the exciter fields are included in series with the motor armature so that the extra current used will strengthen the exciter fields and compensate for the lower speed.

795,467. ELECTRIC TERMINAL BOND; Henry J. Wessinger, of Duluth, Minn. App. filed April 15, 1904. A copper bushing screw-threaded into the rail can be expanded therein by a conical plug, having a nut on its small end.

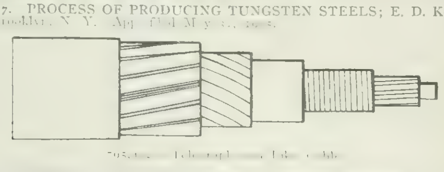
795,473. ANNUNCIATOR; S. B. Bankson, San Francisco, Cal. App. filed July 26, 1904.

795,481. DYNAMO ELECTRIC MACHINE; Henry Chitty, of London, England. App. filed April 11, 1905. Is designed to prevent distortion of magnetic field under heavy loads involving shifting of the commutator brushes. A series of iron sections are formed to bridge between adjacent pole pieces and shunt a portion of the magnetic field. These become saturated under normal loads so that they do not take an increased flux under heavy load conditions.

795,492. INCANDESCENT ELECTRIC LAMP; Timothy G. Dinneen, of St. Louis, Mo. App. August 6, 1904. The lamp has three and separate filaments each of each can be switched into circuit when the others have burned out.

795,512. ELECTRIC RAILWAY SIGNAL; Charles F. Hoover, of Lockport, N. Y. App. filed Jan. [illegible], 1904. The semaphore arm is moved by a solenoid magnet directly energized from an insulated section of the trolley wire. A mark is simultaneously made on a clock-driven paper strip so as to note the time of the actuation.

795,517. PROCESS OF PRODUCING TUNGSTEN STEELS; E. D. Kendall, Brooklyn, N. Y. App. filed May [illegible].



795,[illegible].—Telephone Cable.

795,520. STRAIN INSULATOR; James S. [illegible], of Rochester, Arthur S. Watts and Walter T. Goddard, of Victor, N. Y. App. filed March 6, 1905. Is adapted to be supported by [illegible] beams so as to give greater strength against lateral strain. The insulator has triple porcelain petticoats above and below the [illegible].

795,521. INSULATOR; John S. Lapp, of Rochester, N. Y. App. filed Feb. 20, 1905. Relates to modifications of the above, in which a central porcelain sleeve has an integral petticoat [illegible] at one end and a separate annular petticoat [illegible] bears against the opposite end of the sleeve and is secured thereto.

795,532. SELECTIVE SIGNALING APPARATUS; F. R. McBerty, Evanston, Ill. App. filed April [illegible].

795,533. TELEPHONE EXCHANGE APPARATUS; F. R. McBerty, Evanston, Ill. App. filed Sept. 28, 1903.

795,538. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS. Joseph J. O'Connell, of Chicago, Ill. App. filed July 20, 1904. A lightning arrester in which a pair of carbon blocks are separated to the required gap by being imbedded in an insulating cement of sulphur. The blocks are separated a greater distance at their bases than at the spark gap, so as to avoid short circuiting by dust and moisture.

795,541. APPARATUS FOR ELECTRIC WELDING; John C. Perry, of Clinton, Mass.; William S. Perry, executor. App. filed March 23, 1901. A device for welding reticulated iron grills, etc., in which a pair of clamping jaws press together a plurality of portions of the grill at one time. The circuit is broken by the "average upset" of the weld.

795,551. SERVICE METER FOR TELEPHONE LINES; C. E. Scribner, Jericho, Vt. App. filed Sept. 26, 1904.

795,558. CUTOUT; Charles W. Snyder, of Hudson, N. Y. App. filed Nov. 15, 1904. It is designed to make an electric lamp glow dimly for a short time after the switch has been turned. A heat coil is cut into series with the lamp filament, and after a predetermined heating effect is effective to break the circuit altogether.

795,570. CURRENT CONTROLLER; Swen G. M. Anderson, of Chicago, Ill. App. filed Jan. 27, 1904. An arrangement of circuits for motor controllers in which resistances can be cut into series and parallel with both the armature and field circuits.

795,577. PRINTING TELEGRAPHY; George A. Cardwell, of New York, N. Y. App. filed Dec. 9, 1903. The different transmitting keys send currents of different polarity, strength, and wave form, and at the receiving end of the line the printing key operating magnets are energized only by a predetermined character of current. Each sub-circuit at the receiving end has at least three gaps which must be closed in a predetermined order to actuate the particular magnet.

795,600. SIGNAL SYSTEM; W. S. Franklin and W. R. Whitehouse, Bethlehem, Pa. App. filed April 18, 1905. (See Current News and Notes.)

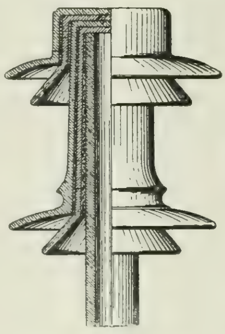
795,668. FLOOR BOX; David R. Waters and William McGuineas, of Chicago, Ill. App. filed July 20, 1904. A metallic casing is inserted in the floor and has a porcelain chamber therein in which are screwed the terminals. The plug is directed through a tube into the porcelain chamber.

795,670. ELECTRIC CONTROLLER; William R. Whitehouse, of Bethlehem, Pa. App. filed March 28, 1905. The controller arm moves through a complete circumferance and has a spring attached thereto to draw it to off position. A second spring prevents the arm stopping on a dead centre. The controller arm cannot be held in any position except by a special spring roller, which is effective only after certain predetermined motions of the arm.

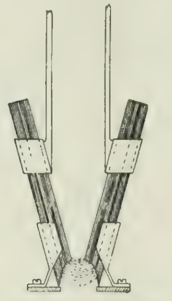
795,681. ELECTRIC ARC LIGHT; Heinrich Beck, of Meingen, Germany. App. filed Jan. 21, 1904. The carbon electrodes are directed toward one another at an acute angle. Both have longitudinal ribs on their outside edges which contact with a pair of supports so as to hold both carbons in a certain relation.

795,689. DEVICE FOR INFLUENCING ELECTRIC ARCS; Tito L. Carbone, Berlin, Germany. App. filed Jan. 31, 1905. The carbon electrodes are maintained at an acute angle to one another, and a magnetic field is created to direct the arc to the extreme outer ends of the electrodes.

795,726. ELECTRIC AND PNEUMATIC GOVERNOR; William H. Nightingale, of Philadelphia, Pa. App. filed July 16, 1904. A cut-out for air-pump motors in which the air-controlled diaphragm moves a contact arm having roller contacts thereon so as to obviate the effect of arcing. The motor cut out switch is actuated by a solenoid in the usual way.



795,520.—Strain Insulator.



795,681.—Electric Arc Light.

795,747. RESISTANCE UNIT; Charles Wirt, of Germantown, Pa. App. filed Oct. 28, 1904. A pair of sheet metal parts are stamped to telescope together in a special way so as to form a ventilated support for the spiral resistance conductor, which is wound thereabout. Asbestos is interposed between the winding and the core.

795,762. WIRELESS TELEGRAPHY; Manuel R. Garcia, of Paris, France. App. filed Jan. 10, 1901. A system for sending wireless signals in a particular direction, in which waves are transmitted from a separate antenna at different points, so as to give a node or wave-interference in one direction.

795,780. ALTERNATING CURRENT MOTOR; Morris Milch, of Schenectady, N. Y. App. filed Jan. 2, 1904. Auxiliary field coils are energized at certain times so as to permit the brushes to be shifted to obtain increased generator action and to raise the power factor of the motor. The auxiliary windings generate an e.m.f. in the idle portions of the rotor windings which neutralizes the self induction therein.

795,789. ELECTROMECHANICAL SELECTING DEVICE; Richard P. Elliott and Anson G. Cox, of Boston, Mass. App. filed June 10, 1902. A typewriter or typesetting machine keyboard in which the keys are selected by dropping into aligned notches of six longitudinally movable bars, any desired permutation of which can be arranged by six electromagnets.

795,802. FIRE ALARM BOX; Patrick J. Corbett, of Albany, N. Y. App. filed Feb. 20, 1904. The act of turning the handle to send in an alarm throws together a pair of jaws which act as a handcuff to hold the person sending the alarm.

795,803. ELECTRICAL RESISTANCE; Elise Vedovelli, of Paris, France. App. filed May 23, 1904. A sort of fabric is built up by threading the resistance wire through small insulating beads so that the complete resistance is a reticulated structure having the appearance of a woven fabric.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, AUGUST 12, 1905. No. 7.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....1139 Monadnock Block
PHILADELPHIA OFFICE....929 Chestnut Street
CLEVELAND OFFICE....402 Cuyahoga Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue 13,000 copies are printed. Total circulation for 1905 to date, 445,000.

NEW YORK, SATURDAY, AUGUST 12, 1905.

CONTENTS.

Editorial.... 253
Telegraph and Telephone Arrangements at the Peace Conference.... 256
Programme of the Ohio Electric Light Association Meeting.... 256
A Municipal Ownership Investigation.... 256
A Criticism of the Detroit Municipal Lighting Figures.... 257
Assessments of Indiana Telephone Companies.... 257
Vulnerability of Trusts.... 257
Lodge and Muirhead Wireless Telegraph Patent.... 258
Boilers and Mechanical Stokers.... 259
Losses in an Electric Transmission.... 259
Value of Natural Gas Production.... 259
The Indiana Telephone Situation.... 260
Current News and Notes.... 260
Electrical Engineers of the Times XXII. S. M. Kintner.... 262
Hydro-Electric Development at Turners Falls.... 263
Armature Losses in Double-Current Generators. By Alfred Still, M.I.E.E. 265
The Production and Utilization of Ozone. By Arthur W. Elwell, Ph.D.. 266
Data on Electric Baking with Niagara Power.... 268
Subsidiary Apparatus of the Telefunken System. By A. Frederick Collins 269
A Method for Determining the Size of Transmission Circuits. By C. W. Stone.... 271
Recent Electrochemical Developments.... 272
LETTER TO THE EDITORS:
Booster Field Control. By Carl P. Nachod.... 272
Digest of Current Electrical Literature.... 273
Book Reviews.... 277
Curtis Steam Turbines for Japan.... 278
Power Factor in Induction Motors. By A. A. Averett.... 278
A New Electrical Measuring Instrument. By W. P. Snyder and H. Herzberg.... 278
Large Electric Magneto Watchman's Clock for Boston.... [illegible]
New Type of Direct Current, Power Circuit Lamp.... [illegible]
Automatic Self Adjusting Clutch.... [illegible]
Electrical Exhibits at the Portland Exposition.... 281
Heating and Ventilating the Majestic Theatre, Boston.... 283
Pendant Switches.... [illegible]
Industrial and Commercial News.... [illegible]
General News of the Week.... [illegible]

STATE LIGHTING COMMISSIONS.

The New York State Lighting Commission has been organizing this week, and will soon be dealing with the work that awaits it, and that has been accumulating for some months. It is needless to say that the manner in which this body will approach and execute its duties is a subject of deep interest to the lighting corporations doing business in New York State as well as to the electric lighting industry in general. A short time ago we presented a synopsis of the law forming the Commission and showing the respects in which it differs from the kindred Massachusetts law. As our readers are aware, the New England body has been at work for some years—its twentieth annual report was issued this year—so that a long interval occurred between the initiative work there and the imitation of it in New York. The attempt has been made now to improve on the older law and practice. It is hard to own up the results in New England, although we propose soon to make an effort to summarize its leading features. A difference of opinion exists as to these results. We know that among Massachusetts electric light and gas managers a feeling prevails that the law has not protected them as they expected against undue competition and injurious rate reductions. On the other hand, some people in the State allege that it has been extremely hard to beat down the barriers that the Commission has put up against new competition, so that the old companies have been entrenched and fortified in their position by the law, and have had a virtual monopoly created. The real truth probably is that the Commission has done good work for the public, and a steady perusal of its reports and documents throughout the whole term of its existence inclines us to believe that such is indeed the case. It will now be the turn of the New York commission to focus attention and to show how well it can administer the delegated powers of the State and build up on broad foundations of equity proper relations between the corporations and the public.

GOVERNMENT ELECTRICAL CONTROL.

An illustration of the manner in which the electric lighting industry of Great Britain has been trammeled in the past, and even at the present time, by government control, is afforded in proceedings now under way to obtain consent for a change of the voltage of a London central station service. Until 1896 no change could be made in a house supply pressure without the consent of every consumer; so that no matter how great the advance in the art which involved a change of voltage, a single consumer could veto adoption of the improvement. In 1901 this regulation was modified in two respects: First, the central station in the case of non-assenting consumers connected prior to 1896 has the right of appeal to the Board of Trade, and upon appeal that body is required to appoint an arbitrator; and second, in the case of consumers connected subsequently to 1896, the change in pressure has to be sanctioned by the London County Council. In the present instance, out of 1,700 consumers connected to the service prior to 1896, some 40 consumers have refused their consent to a change of voltage to 200 volts, and as a result proceedings in arbitration have been instituted and are now under way. This is only one example of numerous regulations which have tended to hamper so seriously, not only the electric lighting but also the electric railway industry, in Great Britain. If in this country the electrical industry during its period of development had been similarly trammeled by government regulations, we would probably at present be lingering under conditions now considered archaic. Curiously enough, the public is, at least in the case of an art under rapid development, almost inevitably the victim of governmental restrictions, for its members are not only deprived of the benefit of ameliorations, but also of the decreased cost of service almost invariably incident therewith.

THE MEMORY OF FRANKLIN.

Next January 17 will be celebrated the two hundredth anniversary of the birth of Franklin, and steps are already being taken to make the occasion an interesting one, particularly in Massachusetts and Pennsylvania. We are glad to understand that in such exercises as may take place the American Institute of Electrical Engineers and the New York Electrical Society—the oldest body and the national body—have been invited to assist. Franklin was not only one of the fathers of the Republic, but one of the founders of modern electricity. His fame and glory as an electrician have been lessened by his wider claims to recognition, but the fact remains that Franklin will always hold a high and distinct place in the history of the science. Next year it will be timely for electrical engineers to refresh their memories as to his work, to review his theories and researches, to note what definite progress has been made since his day, and to place fresh laurels on his serene philosophic brow.

PROGRESS IN ELECTRIC HEATING.

Any one who heard the discussion on the status of electric heating at the last N. E. L. A. convention could not but feel that gratifying progress is being made in the introduction of electric heating devices by the more enterprising central stations. While it is generally true that the high cost of operating electric heating devices as compared to doing the same work with gas or coal has kept down the use of such appliances, the great convenience of electrical heat has outweighed the cost in many instances. Furthermore, there is a constant downward tendency of prices charged for current by central station companies. Every reduction in price means that much greater chance to introduce electric heating. The figures cited by some of the members from actual experiences on the cost of ironing by electric heat were probably a surprise to many and led to recognition of the fact that electric heating is to be reckoned with in the future possibilities of the central station business. During the N. E. L. A. discussion on this subject, the importance of central station men themselves installing and using in their own homes all types of electric heating devices was emphasized, that they may know from actual experience how the costs will run and just what can be done with these appliances. There is no better way for central station men to familiarize themselves with this business and to come to a realizing sense of its advantages in a way which will cause them to talk it up enthusiastically to a customer, than by thus having these appliances in their own homes. We fear that it has been too often a case of the shoemaker's wife going without shoes.

SOULLESS CORPORATIONS.

We printed last week an abstract of the report of the Merchants' Association of New York on its telephone investigation in this city. The report pointed out that while the reductions in rates called for by its committee amounted to at least $1,000,000 a year, the New York Telephone Company not only acquiesced in this as it had agreed to do, but has carried out a rate policy involving a reduction of $1,525,000. We have not seen any commendation of this liberality in the daily papers, although there may have been. Perhaps the papers think that the policy is dictated by shrewd self-interest; but even from that point of view it seems worthy of notice.

At any rate we desire to signalize it, and while doing so to direct attention to another piece of kindred liberality in this city by a large electrical corporation, which has certainly not been overburdened with praise in the public prints. The New York Edison Company has put in force the legislation compelling it to reduce the price of current to ten cents per kilowatt-hour. This means a reduction of income of at least $1,000,000 a year, but in spite of that the company is continuing its policy of furnishing free arc lamp supplies and all incandescent lamp renewals. No legislation could compel this, for while rates may be regulated, neither the constitution nor the courts recognize laws that would force a man to give up actual, real, tangible goods without any "consideration." But the New York Edison Company in announcing a rate of 10 cents for light and one of 7½ cents for power current, throws in these accessories and necessities free gratis. Once again, it might be contended that this is only enlightened self-interest, but whatever else it may be, it far outruns the dictates of the law, and gives the public much more than the Legislature sought to exact in its behalf; and we are glad to commend and distinguish such an action.

A FIELD FOR INVESTIGATION.

The electrically-driven automobile has not yet taken the prominent place which its friends would wish for it, but nevertheless the automobilist is generally painfully dependent upon the electrician. We believe that the modern machine in spite of all attempts to simplify it and to render it reliable, still shows itself capable of supplying more diabolical surprises to its operator than anything else of human contrivance. And not a little of its infinite resource comes from the sparking devices. As a source of current about everything in the electrical armory has been tried from dry batteries stuffed with old newspaper, like one we once dissected, to direct-connected alternators. We have communed and condoled from time to time with the users of all, and have reached the conclusion that at the end of a season one always wishes he had tried the other kind. And quite apart from the source of current stands the spark coil, which no one but the second mate of a coaster seems able fittingly to characterize. Now there are unquestionably very good as well as very bad sparking arrangements, and when the good ones are ill-used and the bad ones well used there is often little to choose between them. The chauffeur generally knows about as much of electricity as he does about Aztec picture writing, and when things go wrong there is the deuce to pay.

It is high time that the subject were taken up in its entirety and thoroughly investigated from every standpoint of view. The problem is to secure steady and reliable sparking with the minimum complication and waste of energy. The parts of the apparatus may be well made individually, but unless they are skillfully designed to work together the results will be very different. To begin with, something ought to be known regarding the actual e.m.f. and energy required to explode the charge with a given spark-gap under the most unfavorable circumstances reasonably to be expected. Then the coils should be designed to furnish the energy with the maximum efficiency, and should be definitely marked with the primary e.m.f. required and the working current which should not be exceeded. At present precious little is known about the nature of the demand for primary energy, much less of its amount with different spark plugs and under different circumstances. In particular, data should be accumulated showing the watt-hours and ampere-hours required with a given coil and plug, let us say per million sparks In other words, the rate of working required from the source should be definitely known for the ordinary standard coils and plugs. This cannot be told by guessing, but it is strictly determinable. These data once accumulated, it should be an easy matter to design a proper source of supply. As it now is, the coils have to be designed without accurate knowledge of the requirements, the plugs are made without any reference to the coils and both are supplied from any source that comes handy. Consequently nobody knows what is the best thing to do, or what performance to expect or to demand from batteries or sparking dynamos. And naturally there is an indefinite amount of trouble from sparking apparatus.

It is not enough that sparking should be powerful and regular without undue call for energy or deterioration of the contacts. The facts can be ascertained and they are just as necessary to correct design of the equipment as is the output required of any other electrical apparatus to its proper proportioning. It should then be entirely possible to say definitely what duty can reasonably be expected of a given battery, and at what output or under what conditions it is advisable to use a special dynamo. And if batteries are to be tried, then of what characteristics? We are disposed to think that with a proper understanding of the conditions ignition could not only be rendered completely reliable, but could be accomplished at a greatly reduced expenditure of energy, and hence with a minimum of trouble and expense. Some of our engineering schools could well undertake the investigations necessary to place the subject upon a scientific basis, and it is surely a more important and interesting study than most of the current topics for theses. The apparatus required would be merely a typical automobile engine mounted for steady running and the ordinary instruments available in a good laboratory, and the only difficulty would be that due to the diversity of conditions under which experiments should be made —at different speeds and compressions with different loads and different grades of gasoline. We have no doubt that automobile manufacturers would be glad to co-operate by supplying the necessary engines, and the sparking apparatus makers likewise. These latter are anxiously striving to put out good material, but they have to work very much in the dark at present. Certainly, the automobiling fraternity will be deeply indebted to any one who can gather the data for the solution of the ignition problem, which is ever present and just now pretty badly muddled.

INTERNATIONAL COMMISSION ON ELECTRICAL UNITS AND STANDARDS.

We are very glad to learn that the Elektrotechnische Reichsanstalt has called a conference, as a preliminary to the meeting of the International Commission of Electrical Units and Standards. This is in line with the recommendations of the International Electrical Congress of St. Louis, which urged, as the outcome of its deliberations, that the differences which existed in the laws relating to electrical units or their interpretations, should be considered by an international commission. The preliminary conference will be held in Berlin about the end of October next, those invited being the heads of the government electrical bureaus in America, England, Belgium, Austro-Hungary and France, besides several other prominent electro-physicists, among whom is included Prof. H. S. Carhart. The essential point to be hoped for as the result of the work of such an international commission would be a permanent channel of communication between the various government electrical bureaus whereby the concrete standards of electromotive force, resistance, current and capacity may be maintained uniform within the limits of appreciation of commercial laboratories. The concrete standard volt as maintained at the National Bureau of Standards in Washington, the Board of Trade Laboratory in London, or the Reichsanstalt in Berlin, should be the same to at least one twenty-fifth part of one per cent., and, if possible, to one-fiftieth of one per cent. The concrete standard ohm as kept at the same institutions should be uniform among themselves to at least one-fiftieth of one per cent., and, if possible, to one-hundredth of one per cent. If these two concrete standards are kept in accord, to the desired degree of uniformity above mentioned, of one-fiftieth and one-hundredth of one per cent, respectively, then the ampere as preserved by reference to primary standard electrogravity balances will have to be within at least one thirty-third of one per cent among themselves in order to check with their local volt-ohm standards.

Every one will admit that it is of much greater importance for industrial purposes that the concrete standards of the national bureaus of the different countries should be in agreement with each other to commercial limits, and all in error by a reasonable amount, than that one set, say those at Paris, should be rigidly correct, but the others not quite in conformity therewith. This is for the same reason that in dealing wih the international metre, we all seek for concrete standards of length that shall be as nearly alike in the different national bureaus as it is practicable to copy or reproduce them, even though all are a little short of the original geodetic definition. This is industrially of much greater importance than to have one nation with a metre which should be hypothetically accurate according to definition, but the other national metres slightly differing therefrom. At the present time the volt of America as determined according to United States laws, following the recommendations of the Chicago Congress, is nearly one-tenth of one per cent smaller than the volt that is standard in the official electrical bureaus of some other countries. Although the great bulk of engineering operations would regard this discrepancy as trivial and ignorable, yet it is a discrepancy that becomes commercially appreciable in dealing with devices so sensitive to voltage as incandescent lamps. Moreover it is a discrepancy that is readily appreciable upon the scale of any good laboratory standard voltmeter. Such a discrepancy is unworthy of the development attained to-day either by electrophysics or by electrical engineering. Any such error tends to perpetuate itself indefinitely, by permeating disadvantageously all kinds of standard physical determinations based upon electrical units.

We hope that ultimately there may be a permanent international commission on electrical units, so related to the various national bureaus that, at stated intervals, concrete standards may be circulated among the latter for direct comparison with those in service, in such a manner that no appreciable discrepancy between the ohms, volts or of different countries can ever arise. In this way a certificate from any one national bureau, such as the Washington Bureau of Standards, issued upon a first-class standard measuring instrument, would convey, by implication at least, the authority of the international electrical commission. Our units are called international electrical units. Their name should be made good by the appointment of an international commission to determine that they are really international. Without such supervision the units tend to become degraded from an international to a national basis, except as the national bureaus may be able by sporadic effort to do individually, and at much effort, what a central commission should accomplish universally and with minimum effort. A permanent international electrical commission, dealing with electrical units, would form another bond of union between civilized countries tending to bring them nearer together in ideals, in purposes and in accomplishment.

Telegraph and Telephone Arrangements at the Peace Conference.

Complete facilities for the handling of telegraph and telephone messages in connection with the Russo-Japanese Peace Conference have been prepared at Portsmouth, N. H., by the Western Union Telegraph Company, the Postal Telegraph-Cable Company, and the New England Telephone & Telegraph Company. The large amount of press matter and the official communications anticipated between the envoys and their respective governments called for unusual means of handling the situation, and on Saturday, August 5, two days before the arrival of the Russian and Japanese plenipotentiaries, the arrangements were practically finished.

Both the Western Union and Postal Companies have established auxiliary telegraph and cable offices at the Hotel Wentworth, Newcastle, the hostelry which will receive the envoys as guests. The Western Union office is equipped with four quadruplexes, three duplexes and eleven single loops, besides special private loops in the Japanese and Russian suites, where direct communication will be maintained with the Atlantic cables at Heart's Content, Newfoundland via Canso, and also with the Western Union offices in New York, whence the Japanese diplomatic matter will be sent via land lines to San Francisco over a direct circuit. This circuit will be maintained during the night and early morning hours via Chicago, Omaha and Ogden, Utah. From San Francisco messages will be transmitted via the Pacific cable through Honolulu, Midway, Guam, Manila and Hong Kong to Japan. Facilities for the work of 25 extra operators are available at the Hotel Wentworth, which is connected by direct wire with the Halifax-Rye Beach cable station at Rye Beach, N. H., as well as with the land lines of the Western Union Company. The bulk of the Western Union work will be focussed upon the company's main offices on Daniel Street, Portsmouth, which are connected with the Hotel Wentworth by a temporary aerial cable of 19 wires. An extra office, largely for the use of newspaper correspondents, has been set up in the Elk's Hall opposite the main office on Daniel Street. About 1,500 cells of gravity battery are installed in this building and 25 extra operators can be put at work if necessary, besides 15 operators in the main office. Two special circuits for the use of the envoys and their staffs have also been installed between the Portsmouth Navy Yard and the main office.

The Postal Telegraph-Cable Company's arrangements correspond closely to those made by the Western Union. An auxiliary office at the Wentworth with four quadruplexes, three duplexes, ten single loops and private loops to the envoys' suites is installed, the hotel being connected with the main office on Congress Street, Portsmouth, by a 22-wire aerial cable about 3½ miles in length. All the Wentworth service is looped through this main office, which is connected by direct wires with the Postal and Commercial Cable offices in New York. Russian messages will probably pass via the Commercial cables through Canso and Japanese via the Postal Telegraph land lines to San Francisco and thence via the Pacific cable, which the company controls, to Hong Kong and Japan. In the main office at Portsmouth, under Manager G. E. Morrill, tables with writing facilities have been prepared for the convenience of despatch senders, and this office contains the company's famous "portable quads," which are transported from place to place in order to meet emergency calls, and also three 1/16-kw portable dynamos mounted on boxes equipped with rollers. These dynamos are supplied with 125-volt, direct current from the Rockingham County Light & Power Company's station in Portsmouth and are designed for 115 volts primary and 380 volts secondary current. Fifty extra operators can be accommodated if necessary at the Postal offices and two navy yard circuits are also in place for Postal service.

The New England Telephone & Telegraph Company has doubled its trunk line facilities between Portsmouth and Boston, making a total of eight circuits available. It has also placed in commission one special toll circuit between Portsmouth and Worcester, Mass., for New York and Washington traffic. Two additional recording operators are ready for business at the Portsmouth central offices, an additional station has been set up at the Hotel Wentworth and three extra stations at the Navy Yard for the exclusive use of the conference. The large use of these facilities by the press is already indicated in the copious news dispatches in the great dailies.

Programme of the Ohio Electric Light Association Meeting.

The eleventh annual meeting of the Ohio Electric Light Association is to be held at Hotel Victory, Put-in Bay, on August 16, 17 and 18, for which an admirable programme has been provided of papers and entertainment. The regular sessions will begin at 9.30 a. m., Wednesday, August 16, and the programme will be substantially as follows: First session—President's address; "Central Station By-Products," J. A. Bendure, Lima; "Notes on Use of Barriers in Alternating-Current Switchboard Construction," H. L. Wallau, Cleveland; "Mercury Arc Rectifier," P. D. Wagoner. Second session, 2 p. m.—"Effect of Large Alternating-Current Motors on Plants of 1,000 Kilowatts and Less," E. H. Best, Youngstown; Leo Phillips, New York City; "Electric Motor Applications," J. Henry Flinck, Pittsburg, Pa.; "Conditions Under Which It Has Been Found Advantageous to Use Potential Regulators," W. E. Richards, Toledo.

Thursday, Aug. 17.—First session, 9.30 a. m.—"Pole Line Construction," B. L. Chase, Columbus, Ohio; E. E. Noble, Cleveland; report of committee on "Cost Determination," E. J. Bechtel, Toledo, Ohio; M. C. Hull, Columbus. Second session, 2 p. m.—"Methods of Selling Current as Applied to Cities of 20,000 Inhabitants," H. C. Ayers, Greenville; "Methods Employed in Getting New Business and Retaining Present Business When Gasoline and Natural Gas Competition Exists," W. E. Russell, Massillon; R. L. Johnston, Akron; J. R. Maxon, Gallipolis.

Friday, Aug. 18.—First session, 9.30 a. m.—"Wiring Moderate Size Residences," J. Kermode, Cleveland; "Meter and Billing Records," F. E. Valentine, Piqua; D. W. Low, Alliance; C. E. Inman, Warren; George Hayler, Joplin, Mo.; election of officers. Second session, 2 p. m.—High Efficiency in Lighting Units—"The Tantalum Lamp," William Ambler, Cleveland; "The Nernst Lamp," E. R. Roberts, Pittsburg; "High Efficiency High Candle-Power Incandescent Lamps," F. W. Willcox. Question Box. Third session, Friday evening—Illustrated lecture on "Illuminating Engineering," W. D. O'Ryan, Lynn, Mass., followed by banquet.

A Municipal Ownership Investigation.

The National Civic Federation has appointed a commission to make an investigation in this country and Europe of national and municipal ownership and operation of public utilities. A statement made on behalf of the Civic Federation on the subject of the appointment of the commission says in part:

"The scope of this inquiry will cover the relative advantages of public ownership and operation as compared with private ownership and operation. Each system will be examined with regard to its effect upon, among other topics, wages, hours and conditions of labor, collective bargaining, cost and character of service, political conditions, civil service, spoils system and municipal corruption, financial results, taxation."

The commission will meet early in the fall to arrange upon a plan of operation. Among the members are:

New York City—Isaac N. Seligman, John G. Agar, president of the Reform Club; Oscar S. Straus, Frank A. Vanderlip, Albert Shaw, Robert W. De Forest, Austen G. Fox, Timothy Healy, president of the International Brotherhood of Stationary Firemen; Prof. E. R. A. Seligman, Prof. Frank J. Goodnow, Prof. Alexander C. Humphreys, William J. Clark, of the General Electric Company; Hamilton Holt, editor of the *Independent;* Laurence F. Abbott, editor of the *Outlook;* R. R. Bowker, of *Publishers' Weekly;* M. R. Maltbie, T. C. Martin, editor of the ELECTRICAL WORLD AND ENGINEER; Edward A. Moffett, Charles A. Conant, V. Everit Macy, Marcus M. Marks. Boston—John F. Tobin, president of the Boot and Shoe Workers' Union; James Duncan, secretary of the Granite Cutters' National Union; Prof. F. W. Taussig, P. F. Sullivan, Charles L. Edgar, Louis D. Brandeis, Frank Parsons, James F. Jackson, F. E. Barker. Chicago—Franklin MacVeagh, Alexander H. Revell, Walter L. Fisher, Samuel Insull, Graham Taylor, E. B. Smith, George E. Hooker, George C. Sikes, Slason Thompson. Cincinnati—Melville E. Ingalls, John P. Frey. Indianapolis—S. M. Sexton, Alfred F. Potts, John Mitchell, president of the United Mine Workers; George F. McCulloch, John F. McNamee. Philadelphia—Prof. Leo S. Rowe, Walton Clark, Talcott Williams. Miscellaneous—W. D. Foulke, of Richmond, Va.; Edward Rosewater, of Omaha; Charles W. Knapp and Frederick N. Judson, of St. Louis; C. H. Salmons, Horace E. Andrews, D. L. Cease and Edward W. Bemis, of Cleveland; H. W. Goode, of Portland, Ore.; Samuel Gompers, president of the American Federation of Labor, and P. F. McNulty, of Washington; Thomas Lowry, of Minneapolis; J. C. Hutchins and Daniel J. Keefe, of Detroit; E. E. Clark, Cedar Rapids, Iowa; Prof. J. W. Jenks, of Cornell; Prof. Henry W. Farnham, of Yale; Prof. Carroll D. Wright, of Worcester, Mass.; Prof. J. R. Commons, of Madison, Wis.; Prof. Henry C. Adams, of Ann Arbor, Mich.; Prof. J. H. Gray, of Evanston, Ill.

A Criticism of the Detroit Municipal Lighting Figures.

It has been the custom of the Electrical World and Engineer to make an annual review and critique of the report of the Detroit Municipal Lighting Commission. In this intention for the current year, we are, however, anticipated to some extent by the *Michigan Investor*, and we give below its pertinent discussion of the subject:

"The Public Lighting Commission of the city of Detroit has just made public the results of its operation for the year ending June 30, 1905. It appears from the deductions of Secretary Bowler that, whereas, during the year 1903-1904 the public arc lights of Detroit each cost $40.16 per year, during the year just closed the cost per lamp has been reduced to $34.99, a claimed saving of $5.17 per arc lamp. If the price of producing electric light for the city of Detroit continues to be reduced at this rate, it will be brought down to nothing in 6 years and 281 days. This may be a bit optimistic, but it is the only deduction that can be reasonably made from the queerly made-up reports, with which the lighting commission deceives the public of which it is the servant. We use the word deceive advisedly and with the intention of its being applied in its broadest sense, for the reason that last year's report was carefully analyzed by *The Michigan Investor*, its false character explained and that explanation brought to the notice of the commissioners. So that the members of the commission can no longer plead ignorance of the elements of cost which are deliberately left out in making up their statement to the public.

As if anticipating criticism of the methods of the commission, the *Detroit Free Press*, in commenting upon the report declared that the managers of private electric plants will find fault with the methods employed in preparing the report, and then gravely adds: "For the lighting commissioners and the people it is enough that the amount of money spent on them be divided by the number of lights in use and the result set up as the cost per lamp."

"Very well, *The Investor* will apply the *Free Press'* method of analysis of the cost per lamp to the figures presented and then we shall see where we come out. The commissioners show the following:

Total expenditure, 1904-1905	$218,665.23
Interest on the investment of $824,021.24, at 3½ per cent, which the commission never charges against the cost of lighting	28,840.78
Depreciation at 3 per cent, on investment of $824,021.24, which Commissioner Hinchman says is too low a depreciation percentage	24,720.63
Total	$272,226.64

"Now for this much money the commission kept an average of 2,818 arc lamps going last year, and enough incandescent lamps to have cost $22,755.17. Deducting the credit for incandescent lighting from the total cost we have a net cost for the arc lighting of $249,471.47, for 2,818 lamps, or $88.53 per lamp, for the year ending June 30, 1905.

"The *Investor* well knows that the rejoinder of the commission, if it makes any, will be that not all of its expenditures were for the cost of operation. It extended its plant $91,523.48 worth, according to its own statements and claims to have that much added capital investment. But we do not give it credit for having added that much to the value of the plant. We believe that an expert examination, of the kind which the lighting commission dared not permit during the present year by competent and unprejudiced persons would show that the money which it says was spent for permanent improvements was really expended to take up the results of depreciation, and as such is properly chargeable to operation. The fact remains that the city of Detroit last year spent in actual money paid by the lighting commission, in interest paid in part through the controller's office, and in part not charged, and in the depreciation of the plant at a ridiculously low rate the sum of $249,471.47, and for that has had 2,818 lamps kept in service, or at the rate of $88.53 per lamp. The commissioners ought to be able to hire the same service done by private parties at not more than $65 per lamp.

"The dishonesty of such reports as those of the Public Lighting Commission has bad effects outside the community in which they are published. They are used as the "come-alongs" of unscrupulous politicians and "fly" salesmen to get other communities into the same business on false pretences. As a basis for municipal investment they are absolutely unreliable, but just in proportion to their lack of reliability are they used as authority with other cities for the purpose of building up new machines and providing new contracts with employment."

Assessments of Indiana Telephone Companies.

The Indiana State Tax Commissioners have reported in favor of a decrease in assessments on the property of some of the telephone companies operating in the state, the most notable reduction being in favor of the Central Union Telephone Company from $54 to $40 a mile, making a total decrease in valuation of about $813,000. Another liberal decrease was made in the case of the Indianapolis Telephone Company, the assessed valuation being dropped from $160 to $100 per mile. The assessment of the New Long Distance Telephone Company, on the other hand, was increased from $30 to $40 a mile. The American Telephone Company, carrying the long-distance business for the Central Union, remains the same, $40 a mile. The assessment of the Cumberland Telephone Company doing business in the southern part of the state was reduced from $60 to $50 a mile. The independent companies did not fare as well as did the Bell companies. The assessment of the United Telephone Company, of Bluffton, was increased from $70 to $110 a mile; Delaware & Madison County Telephone Company, of Muncie and Anderson, from $105 to $135; South Bend Telephone Company from $90 to $100, and the Logansport Home Telephone Company from $30 to $35. The assessments for all the other companies remain practically the same as those of last year.

The assessment on the Fort Wayne Postal Telegraph Company and the Postal Telegraph & Cable Company were left as last year, $50 and $25 a mile, respectively, while the Western Union's assessment was raised from $40 to $44 a mile, making a total increase of about $184,000 in this year's assessment.

The Vulnerability of Trusts.

A paper was read last week at Niagara Falls, before the Commercial Law League of America, by Mr. Henry Wollman, of New York, on "The Mortality of Trusts." In the course of this interesting paper he remarked:

The men at the head of great combinations are men who by fierce fighting captured the situation. As a rule they are comparatively new men, who through superiority obtained their positions of leadership. In many instances they drove others out of the business or forced them into their combinations. What the men now at the head of the great trusts and combinations of this country have done to bring about their own leadership others may do to them. If they have the ability to successfully meet the attack, their institution will live; if they have not, it will go down. A trust that is started with the idea that having absorbed all competition no new competition can arise, is on very dangerous ground. The purchase of opposition as fast as it arises is a perilous price to pay for peace. The best basis for a trust is to know that by the combination it has introduced such economies and obtained such manufacturing genius and such facilities for marketing its products that it can successfully protect itself against all comers.

The strength of many combinations to-day is due to the fact that they are bulwarked behind important patents. As long as men have restless brains we will always have new and almost revolutionary inventions. If the combinations obtain and utilize them, they will contribute to their longevity; if they fail to get them and they are of sufficient importance to reduce the price of the manufactured product below what the combination can afford to make it at, that will be the end of the combination.

In every line substitutes for the commodities made by the trusts, or for the basic material out of which those commodities are manufactured, will, to a greater or less extent, from time to time, be found. If these reduce the cost of production and the combination quickly avails itself of them, its success will be continued. If its managers have not the foresight, the elasticity or ability to bring these substitutes into the combination, and if they are of sufficient importance, and get into the hands of others, they may end or destroy the life of the corporation.

No one can foresee what changes may take place in the personnel of the management of a trust. You can take the best managed company, with a record of, say, fifteen years of unbroken success, and turn it over to three incompetent, overbearing, short-sighted or visionary men, and they will wreck it in five years. Let the management of any trust pass into the hands of arrogant weaklings, and its end will be near. . . . Trusts will live, not because they have great capital, not because they have blotted out competition, but because they are conscientiously, economically and ably managed. Those that do not pursue the correct principles of business will go down. Those that are fortunate enough to do so will last. Those trusts that serve the public the best will survive; the others will perish off the face of the earth.

Lodge and Muirhead Wireless Telegraph Patent.

A patent was issued August 1 to Sir Oliver Lodge and Dr. Alexander Muirhead on an application filed March 21, 1902, having the title "Syntonic Space Telegraphy." It is stated that in the invention three discoveries made by Sir Oliver Lodge are utilized, and reference is made to papers published in the *Proceedings* of the Royal Society in *Nature* relating to these. One publication describes a "recoil kick" experiment wherein a long wire attached to a discharging Leyden jar circuit was thrown into violent oscillation in synchronism with the jar; another experiment, called that of "overflow," wherein a long wire appendage was used to set up oscillations in the Leyden jar circuit and to cause it to overflow, and an experiment wherein the oscillations of one discharging Leyden jar or condensing circuit set up similar feeble oscillations in a distant Leyden jar or condenser circuit precisely attuned to the first. For the long-wire appendage referred to in the second experiment an antenna is used for the sender and the overflow is detected in the receiver by means of a coherer.

In carrying out the invention the coherer employed as a detector is connected to the receiving Leyden jar or condenser so as to feel and detect the overflow and at the same time be protected from the direct action of the aerial conductor or of any pulse or sudden jerk collected by it about which there is no tune. In the accompanying diagrams Fig. 1 represents the transmitting station, Fig. 2 the receiving station and Fig. 3 a modified form of receiving circuit.

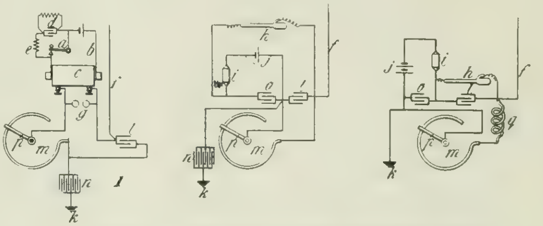
In the transmitting station there is employed in the emitting circuit a condenser, *l*, the opposite terminals of which are connected through a suitable self-induction, *m*, which may be a simple wire or may be a coil, with a spark gap, *g*, which is excited in the ordinary way by the induction coil, *c*, and trembling break, giving one spark for dot and two or more sparks for dash when the primary circuit, *b*, of the said coil is closed by means of a key, *a*, and which may be operated manually or automatically. One terminal of the condenser, *l*, has the aerial conductor *f* of appropriate length and capacity area reaching up to a considerable height connected to it, and the other terminal of the said condenser is connected either to earth direct or through another condenser, *n*, to earth as shown in Fig. 1. In the receiving circuit there is a similar condenser, *l*, closed, through a similar self-inductance, *m*, but without any spark gap, so that oscillations of great feebleness can begin in it and work up to something perceptible. The condenser, *l*, when used for receiving, like the other when used for emitting, has an aerial conductor or capacity area, *f*, connected to it and reaching up to a considerable height to catch the pulses from the distant station and by means of them to excite and promote oscillations in the circuit of the condenser, *l*, to which it is attached, the other coat of the condenser, *l*, being earthed as usual. The receiving condenser, *l*, is provided also with an overflow path, in which the coherer, *h*, is inserted for the purpose of detecting the overflow with the battery, *j*, the telegraphic receiver, *i*, and a subsidiary condenser, *o*; for by this arrangement the telegraphic instrument, *i*, is able to indicate every cohesion caused by every overflow, provided the coherer, *h*, is kept constantly automatically tapped back by clockwork or other mechanism.

The object of the subsidiary condenser, *o*, is to act as a shunt to battery and receiver so far as sudden electric changes are concerned, and thus afford an easy path for overflow from the main condenser, *l*. It does not necessarily form part of the oscillating circuit, and the amount of its capacity is immaterial so long as it is large enough not to throttle or interfere with the oscillations or with the free overflow of the condenser, *l*, into the coherer, *h*, and so long as it is small enough to help protect the coherer from undesired disturbances collected by the aerial conductor, *f*.

In order to provide efficient tuning or synchronism between the sending and receiving circuits, the length or self-induction of each condenser circuit is capable of adjustment within certain limits by means of an arrangement such as sliding contacts or a revolving arm, *p*, or it may be done in any ordinary way as by approaching or receding the spirals of a coil or two portions of a coil, *q*, in Fig. 3.

Sometimes between the aerial conductor and earth there may be inserted, as shown in Fig. 3, the two condensers, *l* and *o* (of suitable capacity for their respective functions) in series, and also the adjustable self-induction *m*. Only one of these condensers is intended to overflow, and with this one the terminals of the coherer are connected directly, as shown in Fig. 3, instead of through the supplementary condenser, as in Figs. 1 and 2.

The condensers employed in connections with the emitting and receiving circuits are sometimes made of stout glass plates coated with tin foil and the whole embedded in paraffin wax, or preferably of metal plates or cylinders submerged in oil or other insulating liquid.



FIGS. 1, 2 AND 3.—LODGE AND MUIRHEAD SYNTONIC SYSTEM.

The self-induction *m* in most cases consists merely of an almost complete circle of thick copper wire, as shown, the circuit being closed by means of the spring copper revolving arm, *p*, which rotates about the center of the circle merely varying its length for the purpose of the fine adjustment of tuning. For coarse adjustment this circular strip of copper is supplemented by an open spiral of thick copper wire, as shown at *q* in Fig. 3, or by any additional self-induction adjustable in any well-known way.

The action of the emitter upon a receiver is as follows: The induction coil, *c*, of the emitter charges the condenser, *l*, of the emitting station and discharges it at the spark gap, *g*, thus setting up oscillations in the circuit of the condenser, *l*, through the self-induction, *m*, the frequency of which can be adjusted by varying the amount of self-induction thereof. The elevated conductor, *f*, which is attached to the discharging condenser circuit through *l*, *m* and *g*, is at the same time thrown into violent electrical oscillation in synchronism with the condenser, *l*, and these oscillation impulses are reflected by the elevated conductor at its upper end in a series of recoil-kicks, each of which communicates to the other a considerable disturbance, resulting in electric waves which travel through space. On reaching the distant station, Fig. 2, these waves set up oscillations in its elevated conductor, *f*, which is attached to a condenser circuit similarly attuned to that of the emitting station, but without the spark-gap, wherein are set up similar oscillations, which work up gradually in strength until they become strong enough to break down the resistance of the coherer, which happens so soon as the maximum potential attained by these oscillations in the condenser circuit is high enough to cause an electrostatic overflow through the coherer, *h*, the result being a diminution in the resistance of the latter and the formation of a signal on the receiving instrument, *i*, as is well understood. The battery, *j*, and receiver, *i*, in the overflow circuit are shunted by a supplementary condenser, *o*, so as not to let them form an obstruction to the easy overflow into the coherer. The novelty in this part of the invention is the mode in which the coherer, *h*, is connected to the receiving condenser, *l*, so as to feel and detect the overflow and at the same time to be protected from the direct action of the elevated conductor, *f*, or of an pulse or sudden jerk collected by it about which there is no tune. It is found that the concentration of the stimulus on needle-points instead of on surfaces of finite magnitude as in the construction of coherers hitherto is advantageous.

The specifications state that the patentees are aware that it has before been suggested to employ condensers in systems of syntonic Hertzian-wave telegraphy for other purposes, such as the adjustment of the effective amount of inductance in transformers or self-inductance coils, but the function of the principal condenser, *l*, as explained, is entirely different therefrom, it being employed in series with a self-induction of suitable amount to form a tuned, closed condenser circuit required in the system of syntonic telegraphy based on the principles of the "recoil kick" in the emitting circuit and the "overflow" in the receiving circuit.

The claims are for a condenser and a self-induction of suitable amount forming an attuned condenser circuit closed through such self-induction, an overflow path, a coherer in such overflow path, and a subsidiary condenser in shunt to the receiving instrument and its battery, or in series with the main condenser and also in the attuned circuit, and in shunt to the receiving instrument and its battery.

◆

Boilers and Mechanical Stokers.

One of the valuable features of the "Question Box" of the N. E. L. A. resides in the fact that the answers come from men having knowledge acquired by actual experience. The differences in the opinions that are expressed serve to show that experiences differ according to the conditions of operation. The combination of the numerous opinions is thus of much greater value than the opinion of one man, however well qualified technically, but with necessarily limited experience.

In answer to the question, "Are mechanical stokers recommended for small plants of, say, from 100 to 500 hp? Of 2,500 hp?" one person says, "No; and it is an open question as to the actual benefit of stokers for large plants," while another replies, "Our opinion would be that mechanical stokers are economical for almost any size of plant." The other answers received agree that for plants smaller than 500 hp mechanical stokers should not be used, but that for plants as large as 2,500 hp stokers are to be recommended. The query "Is there an actual saving in using stokers, irrespective of cost or quality of coal?" elicited nine replies. Of these three express doubt as to any saving, while from the others it appears that there is a saving in labor. It is learned from six replies to a query as to the effect on the efficiency of a boiler that this is only slightly increased by the use of mechanical stokers, but that they permit the burning of a cheap grade of coal. Six replies relating to smoke consumers serve to show that what the device actually does is to produce more perfect combustion and thus to prevent the formation of smoke. While opinions seem to differ as to the advisability of blowing flues with steam, two negative and eight affirmative answers being received to a question concerning this process of cleaning tubes, the consensus of opinion is that if the tubes are blown while hot the steam is not injurious.

Twelve answers were received to the question, "Is it better to expand boiler tubes with boiler full or empty?" Eight of these recommend having the boilers empty, two state that if the boiler is of the proper type it can be full, and two intimate that either method can be used. Three engineers make three different suggestions as to an appropriate method for keeping the external surfaces of tubes free from soot in a water-tube boiler, other than the ordinary method of blowing with steam or air. These are as follows: "Feed the blower with dry sand while blowing," "Forced draft will tend to keep the boiler surfaces clean," and "Use the broom." A query as to the best method of keeping in good condition a boiler that is not in use, brought forth twenty replies. Fourteen recommend drying out the boiler thoroughly, using lime to absorb the last traces of moisture; two suggest keeping the boiler full of water, two intimate that either method is satisfactory, while two state that unless the feed water is exceedingly good, it is best to steam the boiler at least once a month. The ten answers to an inquiry as to the best method of procedure when it is discovered that the pressure of a 100-pound boiler has increased to 175 pounds are variously expressed, but none is contrary to the one which states, "Under the circumstances suggested in this question, the safety valve should never be touched. A safe method to let off the pressure would be to bank the fire heavily with green coal and to blow off very gently through the blow-off pipe."

Six answers were received to the question, "What are the results of storing heat or steam in a large boiler plant by banking all the fires but one and supplying steam from that one to maintain pressure in the idle ones?" Five of these state that the boilers with banked fires act as condensers, and that the method is not economical. The sixth answer intimates that fuel can be saved if the fires under the idle boilers are lightly banked in such a manner that each boiler makes some little steam, the one boiler being used to supply steam to the load. The composite reply to a query concerning the deterioration in axles and wheels of gravity bucket continuous coal-and-ash conveyor systems is that the cause can be attributed to sulphuric acid, and that a cure can be found in removing the rust and covering the surfaces with graphite paint.

◆

Losses in an Electric Transmission.

The calculation of losses in power transmission is always an important part of distribution work, and the results of actual tests on transmission lines are interesting. An example drawn from practice on a New England street railway operating through several adjoining towns may be cited as pertinent.

The apparatus tested consisted of a 300-kw alternator direct connected to a 450-hp engine. The alternator supplied three-phase current at 380 volts to three 90-kw transformers, which raised the potential to 13,000 volts for a 13-mile, three-phase transmission over three No. 2 aluminum wires to the substation, where the voltage was cut down to 380 by three 90-kw transformers and converted in a rotary to 600 volts direct current. The frequency of the system was 25 cycles.

With 530 i.h.p. (395 kilowatts) at the engine the direct-current output at the substation was 268 kilowatts, corresponding to about 32.1 per cent loss, or 67.9 per cent efficiency. The losses between the engine cylinders and the high potential bus bars in the generating station came to 12.9 per cent; the line loss was 5.5 per cent, and the substation losses 13.7 per cent. The striking point in the figures is the loss incurred in the transformers and rotary converter in comparison with the transmission line. It would seem to have been better practice to have omitted the step-up transformers in the power station and to have purchased an alternator wound directly for the line potential. The belief is increasingly held that the elimination of step-up transformers is desirable for moderate transmissions. The danger of a shutdown on account of lightning is generally considered not serious enough to preclude placing the generator directly across the line, and the gain in operating efficiency is well worth while in a steam plant.

◆

Value of Natural Gas Production.

The approximate value of the natural gas produced and sold in the United States, as reported to the United States Geological Survey, is shown in the following table:

State.	Value.
Arkansas and Wyoming	$6,515
California	114,195
Colorado	14,300
Illinois	4,745
Indiana	4,342,409
Indian Territory and Oklahoma	40,665
Kansas	1,517,643
Kentucky	322,404
Missouri	6,285
New York	522,575
Ohio	5,315,564
Pennsylvania	18,139,914
South Dakota	12,215
Alabama and Texas	14,682
Utah	——
West Virginia	8,114,249
Total	$38,496,760

The Kentucky item includes a small quantity produced in Tennessee. The total does not include the value of natural gas produced in Canada and consumed in the United States. This appears not to pay duty and is not brought to account in any definite manner

The Indiana Telephone Situation.

President George W. Beers, of the Indiana Independent Telephone Association, has publicly declared that all the independent telephone companies would discontinue toll-line service with the United lines within a week. The United Telephone Company, over the Ohio line, has already been disconnected. The United Telephone Company, Mr. Beers states, has violated its contract in throwing its toll business to the Bell Company, while incoming business over the independent lines shows an increase.

Similar complaints of discrimination come from Frankfort, where the Bell has recently gained a foothold, and it is not believed that present arrangements to divide the toll line business will last very long.

◆

CURRENT NEWS AND NOTES.

TELEGRAPHERS' STRIKE.—The telegraphers on the Northern Pacific lines of railroad went on strike last week, but the system has remained in operation without any serious inconvenience to the public, and it is said by the management that freight is also being handled successfully.

FRANKLIN IN PARIS.—The city of Paris is to have a statue of Benjamin Franklin. Mr. John Marjes, the donor of the fine statue in Philadelphia, has offered a duplicate of this to Paris, and it has been accepted. It will be placed at the corner of the Rue Franklin, opposite the Trocadero Museum.

LIGHTNING DAMAGE.—On the night of Aug. 6 lightning damaged the plant of the Trenton Falls Power Company, Trenton Falls, N. Y. It is stated that the switchboard was damaged and the interior of the station wrecked. The damage is estimated at $15,000. The high-tension wires on the line were snapped by the lightning.

WIRELESS IN SCOTLAND.—A cable dispatch from Edinburgh, of August 5 says: "The latest form of American enterprise in Scotland is the erecting of a wireless telegraphic station at Machrihanish, in the Western Highlands. A tower 400 ft. high is being raised on six acres of land leased by the National Electric Signaling Company, of Pittsburg. The Brown Hoisting Company, of New York, has the contract. Communication is to be made with Boston and a revolution in the cost of sending messages across the Atlantic is looked for. In three months' time the instruments should be at work."

THE POPE'S TELEPHONE.—A cable dispatch from Rome of August 5 says: "The Pope has adopted the telephone habit. The Vatican is now as elaborately wired as any great financial institution or hotel in the United States—house, local and long-distance telephone in every room. The long-distance telephone most often used by the Pope is the wire connection with Venice, his old place of residence and useful activity. From Venice come stories of all sorts of people who are occasionally called up by Pius for a moment's chat or some personal instruction. The Pope himself selected the telephone apparatus used in the Vatican."

A. S. R. A. MEETING.—The annual convention of the American Street Railway Association is to be held in Philadelphia in the South Building of the Philadelphia Museum, on September 25-30. The Mechanical and Electrical Association and the Claim Agents' Association will meet on September 25 and 26. The Accountants' Association will meet on September 28-30. The report of the reorganization committee and a new constitution will be presented. Papers are to be presented on gas engines, single-phase railways, etc. There will be a very large exhibit of street car material. Headquarters will be at the Bellevue-Stratford.

STARTING OF POLYPHASE INDUCTION MOTORS.—In order to be able to decrease to a minimum the secondary resistance of a polyphase induction motor whose starting characteristics are obtained by inserting resistance in the secondary circuit, Mr. Leo Schuler, according to a patent issued August 1, would employ an auxiliary short-circuiting device connected in parallel to the usual three-point variable resistance. The construction of the secondary member differs from the standard coil-wound type in being provided with a shunting device similar to that employed with the familiar self-starting single-phase repulsion-induction motor.

STATE LIGHTING COMMISSION.—The new State Lighting Commission of New York has organized this week and finds itself busy. It has to meet once a month at Albany, but will have an office in New York City. The members are F. E. Gunnison, chairman; John C. Davies and L. L. Shedden. Under the law which created the commission all lighting and power companies desiring incorporation or changes in their charters or wishing to increase capital stock or issue new bonds, must make application to the commission and secure its approval before complying with the terms of the stock incorporation law. Just before the law went into effect there was a rush made by a large number of companies from all over the State to incorporate under the old laws. Since then several companies have filed applications with the commission for permission to increase their capital stock and issue bonds.

VARIABLE-SPEED INDUCTION MOTOR.—A patent issued August 1 to P. Jigouzo has for its object to produce an induction motor suitable for operating roller bridges, lifts, winches, etc. The motor comprises three concentric parts, one of which moves between the other two, which are fixed parts. The movable part carries a squirrel-cage secondary winding. There are two primary windings on one fixed part and one primary winding on the other fixed part. Each primary winding is arranged for a certain number of poles different from that of each of the other windings. One winding, having a medium number of poles, is used for starting purposes. A second winding, having a small number of poles, is used for ordinary operation, while the third winding, having a large number of poles, is intended to assist in bringing the rotor quickly to rest when desired.

MOTOR METER.—A patent issued August 1 to C. P. Steinmetz relates to the application of the retarding-coil principle in the construction of a motor meter. The primary member of the motor is wound with two sets of coils, in one of which the current is proportional to the e.m.f. of the supply mains and the other of which is connected in series with the load circuit and carries the load current. The fluxes due to these two currents are displaced in time-phase on account of the difference in the time constants of the two circuits. A third flux, dephased from each of the others, is obtained by the use of a retarding coil on a portion of the core material which is subjected to the m.m.f. of the shunt current. This third flux lends a starting torque sufficient to balance friction at no load, thereby doing the work of a special starting coil, and it also serves to slow down the meter when the lag increases in the circuit so as to maintain the registration proportional to the true energy consumed in the circuit.

THE GOVERNMENT AND TELEGRAPHS.—Attorney-General Moody has requested the United States District Attorneys at Madison, Wis.; Milwaukee, St. Paul, Fargo, N. D.; Helena, Mont.; Boise, Idaho; Spokane, Wash.; Seattle and Portland, Ore., to investigate the facts as to the interruption of telegraphic service on the Great Northern and Northern Pacific Railroads, in view of the government's duty to keep unobstructed the avenues of interstate commerce. The Western Union Telegraph Company, in connection with the inquiry, announced that that company and its employes are in no way involved in the strike of the railroad telegraphers. The following is the telegram of the Attorney-General to the district atorneys: "I am informed that for several days the transmission of interstate, foreign and government messages over the Western Union lines which follow the Great Northern and Northern Pacific Railroads has been seriously interrupted. In such a situation, if it exists, the government, whose duty it is, by all means at its command, to keep open and unobstructed the avenues of interstate commerce and to protect its own communications, has grave concern. You will immediately investigate with all possible speed the facts, and if you find the interruption exists endeavor to ascertain the reason, reporting to me fully by wire."

WIRELESS ON OIL SHIP.—The Standard Oil Company's sailing ship *Astral*, plying out of San Francisco, has been equipped with a wireless telegraph plant, enabling her to communicate with the various wireless stations on the Coast.

THE KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION will hold its next annual meeting in Kansas City., Kansas, October 14 and 15 next. Mr. James D. Nicholson, of Newton, Kan., is the secretary of the association.

AMERICAN ELECTROCHEMICAL SOCIETY.—The next meeting of the American Electrochemical Society will be held at Bethlehem, Pa., Sept. 18, 19 and 20 next. The association on this occasion will be the guest of Lehigh University. Mr. S. S. Sadtler, Philadelphia, Pa., is secretary of the association.

JAPANESE PURCHASES.—Japan has just bought in this market for immediate delivery 150 locomotives, from the Baldwin Works, to cost $2,225,000; 350 steel bridges from the U. S. Steel Corporation, to cost $500,000, and 2,000 steel cars, to cost $2,000,000. Apparently this mass of material is for work in Korea and Manchuria.

ST. PETERSBURG TROLLEYS.—A cable dispatch of August 3 from St. Petersburg refers as follows to what has now become a very old story: "The newspapers state that a $15,000,000 contract for the equipment of 14 St. Petersburg street car lines with electricity will be awarded shortly. German, French, and Belgian firms, and one American concern, the Westinghouse Company, are competing for the concession."

CONEY ISLAND DEVELOPMENT.—A further step is being taken in the creation of great amusement centers at Coney Island. The Brighton Beach Development Company is now to spend $2,000,000 on a new resort, including a mile-long pike. The Brooklyn Rapid Transit system will build a new station and special lines connecting Coney Island with Brighton. The Brighton Beach Park will be a permanent amusement exposition. Venetian canals will extend through the grounds and an electric observation tower will form part of a great gateway at one end of the Pike.

A TALL TELEPHONE POLE.—What is thought to be the tallest telephone pole, if not the tallest pole of any kind, in the world, is located on the south side of the Chehalis River, about a mile east of Aberdeen, Oregon. It is 116 feet high and was cut from a tree nearly 200 feet tall. The object in having the pole so high is that the wire span will not be caught by passing ships as it crosses the harbor to the north side and rises above a hill covered with pretty good sized trees on the east banks of the Chehalis. The pole was made from a fir tree. It belongs to the Sunset Telephone Company.

WIRELESS IN ALASKA.—A special dispatch from Tacoma, Wash., of July 24 says: "The Federal Government is preparing to install the wireless telegraph system throughout the Lower Yukon country, replacing land lines that have proved failures to a large extent. The greatest difficulties have been encountered in maintaining the land system in the face of forest fires, floods, cold weather and other obstacles. Capt. Wildman, the Government wireless expert, is now on the Yukon experimenting with the wireless between Fort Gibbon at the mouth of the Tanana River and Nome. He was in constant communication with St. Michael's on the trip up the river to Fort Gibbon. St. Michael's in turn was connected with Nome."

CHICAGO CITY TROLLEY SCHEME.—It is stated from Chicago that Mayor Dunne, in his revised propaganda for "ultimate" and not immediate municipal ownership, is following the advice given in the letter of James Dalrymple, the Glasgow expert, which the Mayor suppressed. Mr. Dalrymple finds a special obstacle in the valuations of existing lines, based on what the present owners paid for them. Therefore, he recommends that the city, while announcing its intention to take over the lines in the future, allow the traction companies "to continue to operate in the streets for a sufficient time to work out their present franchise values." This is the plan of the tentative ordinance. The nature of Mr. Dalrymple's advice is the reason why the administration, which invited him to Chicago, has kept it secret. Mr. Dalrymple warns Mayor Dunne that it would be out of the question for the city to make a success of municipal operation under present political conditions.

THE CHICAGO FREIGHT SUBWAY.—President A. G. Wheeler, of the Chicago Subway Company, in discussing the future of the company, says: "At present we are handling 7,000 tons of freight daily, and we still expect that this amount will be increased to 30,000 tons daily by January 1. It is a great task to connect our tunnels with all the railroad freight terminals. We are connected with a few, but cannot say just when all will be able to ship their freight through the subway. We are independent of outside criticism to the extent that we believe we have a gigantic proposition that will fulfill every expectation. I may say that we expect to pursue a conservative policy as to dividends. Earnings will be put back into improvements as needed and the equipment maintained at a high standard so that there will be a splendid basis for profits for shareholders." The city has demanded the books of the Chicago Subway Company and will enforce the collection of 5 per cent of gross receipts in accordance with the terms of the franchise. Two thousand men are at work in the tunnels completing connections with railroads.

COURSES IN TRANSPORTATION.—Continuing its good work of last year, the Polytechnic Institute of Brooklyn announces a series of evening courses for the year 1905-1906, in transportation, steam engineering, water supply, structural design, draughting, mathematics, chemistry and electricity, with laboratory practice and testing. These lectures are designed to be concisely practical in their treatment of the subjects. Problems illustrating the subject will be announced by the lecturers and encouragement given to those desiring to solve them to present reports in professional form. Those wishing to enter as candidates for a degree will receive credit, upon the requirements for the degree, for the reports so filed, upon previous arrangement to that end with the president and the professor in charge. The fee for the course on transportation is $15. The fees for the other courses are at the rate of 40 cents an hour for 100 hours or under, 35 cents an hour for 100 to 200 hours, and 30 cents an hour for 200 or more hours. A number of prominent men will lecture from October 10 to April 24, including Messrs. Stott, Lardner, Calderwood, Mershon and Barstow, and Mr. Mailloux will give a special course of fifteen lectures on train movement.

AN ELECTRIC CITY.—A correspondent of the New York *Sun* furnishes this excellent pen picture: "Schenectady is a busy city these days. Long lines of freight cars loaded with electric machinery and locomotives for all parts of the world pull out of the yards every day. Between 6 and 7 o'clock each morning the streets are full of men and women hastening to their places of work. Then between 7.30 and 8 o'clock follow the office contingents. More than a thousand work in a single building. Street cars pass rapidly—almost one a minute—loaded to the steps and on the steps with cheerful workers, sure of continuous work at good wages and a regular weekly payday. In June the Schenectady Railway Company broke all records in the number of passengers carried, namely, 1,001,685, an increase of 42,830 over the same month last year. This volume of street railway traffic for a city of about 60,000 people is remarkable, even allowing for the people carried to and from their work in Schenectady who live in Albany, Troy, Ballston, Amsterdam, Gloversville or other of Schenectady's many suburbs. At 5.30, when the big factories close, the streets and cars are fairly black with the crowd of nearly 20,000 tired but happy workers hastening to "home, sweet home." Then an hour's quiet for supper, and again the streets are crowded with thousands bent on a few hours of enjoyment. "Early to bed and early to rise" is a well-practiced motto in Schenectady. By 10 o'clock the streets are again almost as quiet as they were for the twenty-four hours of each day in the years before industrial activity struck the town. Still, even at night and all night (except Sundays) the factories are still alive with a thousand or more workers doing extra work and getting things in shape for the thousands of day workers."

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION.—At the executive session of the Pacific Coast Electric Transmission Association, held at Portland, Ore., June 30, Mr. George P. Low was elected president and treasurer; Mr. H. H. Sinclair, of the Edison Electric Company, Los Angeles, Cal., was elected vice-president. and Mr. Samuel G. Reed, of the Portland General Electric Companl, was elected secretary.

TROLLEY LOTTERY TICKETS.—In a recent issue of the *Mexican Herald* a description was given of the scheme by which the tramway company operating in the city of Mexico popularizes its cars by having the fares punched on tickets, which are afterwards good for drawings in a lottery. There is also a plan under way by which the tickets may be accepted in part purchase of commodities bought at certain stores, which enter into an agreement to accept them to the extent of say 5 or 10 per cent on all purchases.

FUNERAL BAKED MEATS.—The Japanese and Russian peace envoys, who are seeking to bury the sword, are in conference this week at the Navy Yard, Portsmouth, N. H. The commissariat department is on a luxurious scale, but the meals for the envoys are to be cooked outside the building, and then kept heated or rewarmed by an electric kitchen supplied with current from the navy yard plant. Thus everything can be served piping hot at a moment's notice, no matter how great the wait or delay.

ACCIDENT GRAFTERS.—Street railway companies have been great sufferers from accident "fakers" and "grafters," and organized steps are now being taken against the evil. An association has been formed including in its membership the big accident insurance companies, the largest street railway corporations of the East and Middle West and many of the steam railroads, for the purpose of furnishing information as to the schemes and identity of professional accident grafters and to follow up their prosecution regardless of expense.

MORE ATLANTIC CABLE.—The cable steamship *Colonia* sailed from England on August 5 with 2,400 miles of Atlantic cable on board, to be laid for the Commercial Cable Company, between Ireland and Nova Scotia, and Nova Scotia and Newfoundland. The New York *Tribune* remarks: "Marconi's splendid work, which has been before the world at least three years, seems to have had little influence upon the submarine cable companies. New wires are being manufactured and laid under the ocean every year. Probably half a dozen enterprises of this kind have been carried into execution within the last thirty-six months. One of them is for communication between San Francisco, Hawaii and the Philippines. Next week the operation of stretching still another cable across the Atlantic from Ireland to Newfoundland will begin."

U. S. MAGNETIC SURVEY.—A magnetic survey of the North Pacific Ocean will be begun within the next few days by the Department of International Research in Terrestrial Magnetism of the Carnegie Institution at Washington. A wooden sailing vessel, the brig Galilee, has been fitted for the purposes of the expedition at this port, and it is expected that she will sail the latter part of the week on her first season's work. The director of the work is Dr. L. A. Bauer, who likewise is in charge of the magnetic work of the United States Coast and Geodetic Survey. The scientific leader and commander of the Galilee will be J. F. Pratt, of the United States Coast and Geodetic Survey. The members of the scientific corps are Dr. J. Hobart Egbert, magnetic observer, surgeon, and naturalist; J. P. Ault, magnetic observer, and V. W. Whitney, magnetic observer and watch officer

FRENCH CABLE IN VENEZUELA.—The Federal Court of Cassation of Venezuela on August 4 gave final judgment in the matter of the proceedings instituted against the Compagnie Francaise des Cables Telegraphiques, confirming the dissolution of the contract of the government with the company. Last March 31 President Arnal, of the highest Venezuelan court, decided that the French Cable Company had forfeited its contract by failure to fulfill its terms. The decision rendered now is by the entire court. The differences between President Castro and the French Cable Company have existed for some years. As set forth by Francisco Arroya Parejo, Attorney General of Venezuela, the grounds on which the original decision was rendered were as follows: The company contracted to construct a submarine cable between La Guayra and the United States, but it built a land line over Santo Domingo, and repeated Domingan revolutions interrupted it, causing loss to Venezuelan commerce. The company also contracted to construct national coastwise cables, but made the line international from Puerto Cabello to Coro by touching the Dutch Island of Curacao.

Electrical Engineers of the Times.—XXII.

S. M. KINTNER.

Samuel Montgomery Kintner was born in New Albany, Ind., December 11, 1871. His early education was received in the public schools of New Albany and he entered Purdue University in the fall of 1890. This was the period at which most of the young "Gentlemen from Indiana" who have added to such to the reputation of that State were passing through college. The classes of Purdue during this period were especially strong, and many members have achieved professional eminence. While at Purdue Prof. Kintner took an active interest in athletics, playing on both football and baseball teams. He was graduated in 1894 with the degree of Electrical Engineer and later took special work in mathematics and physics at Cornell.

Prof. Kintner's first electrical work was done in constructing and operating telephone systems for the independent companies at Shelbyville and Frankfort, Ind. In September, 1895, he was appointed to the position of assistant professor of electrical engineering of the Western University of Pennsylvania, now the University of Pittsburg. In 1897 the assistant professorship of mathematics became vacant and he was appointed to fill the position and later in 1900 succeeded Prof. Fessenden in the chair of electrical engineering.

S. M. KINTNER.

During these years Prof. Kintner made a great many scientific investigations in connection with the magnetism of iron, high-vacuum phenomena, and electrical oscillations, a great deal of this work being of a highly original and valuable character. Some of the results of these investigations were presented before the Engineers' Society of Western Pennsylvania and the Pittsburg Academy of Science and Arts. In addition to the purely scientific work a considerable amount of technical work was undertaken for clients during these years.

In 1903 he resigned from the Western University of Pennsylvania in order to accept a position with the Westinghouse Electrical & Manufacturing Company, where his great familiarity with and his extensive theoretical knowledge of electrical oscillations and high-potential phenomena have resulted in many valuable improvements in connection with the transmission of electrical energy at high potentials. A great many investigations have been carried out by Prof. Kintner on line disturbances, insulation details, static phenomena, etc., which have been most fruitful in results and for many of which patents are now pending.

From time to time Prof. Kintner has written scientific papers on various subjects and recently at the Asheville meeting of the American Institute of Electrical Engineers he presented a paper upon a novel and interesting type of static voltmeter which appears to have solved one of the most difficult problems in connection with high-voltage measurements.

Hydro-Electric Development at Turners Falls.

THE Connecticut River flows 375 miles and drops 2,038 feet from Third Lake, in northern New Hampshire, to Long Island Sound. Along the greater part of its length the river forms the boundary between Vermont and New Hampshire, and then it flows across Massachusetts and Connecticut. The drainage area of the Connecticut above its mouth is 11,085 square miles, and the upper part of this area is forest-clad to a large extent. Down between the Green Mountain and the Granite State, the course of the river lies mostly in a narrow bed of hard rock with high hills on either side that rise abruptly, in some cases to as much as 1,000 feet above the water surface. These conditions of the river valley continue down into central Massachusetts, and are found at Turners Falls, where the water power development, which forms the subject of this sketch, is located.

It is hardly necessary to say that a river bed of nearly continuous ledge, and high rocky banks on either side, has ideal conditions for the development of water power, when they occur in connection with a natural fall and a series of rapids. These are the natural conditions at Turners Falls that have been developed by a masonry dam, a canal about a mile long, and a station with turbine wheels and generators for the development of electric power. Water power development is not a new thing in Turners Falls. For some years a dam there has diverted the water of the Connecticut into a short canal parallel with the river, and between this canal and the bank of the main stream, a paper mill, a cutlery works, a textile plant, and other manufactures have been established. Power for these plants is obtained by drawing water from the canal and discharging it through turbine wheels into the river, at heads that vary with the locations of the wheels downstream from the dam. Like many other points where large water powers have been developed, but not supplemented by electric distribution or transmission, Turners Falls has not attracted enough manufacturing enterprises to use more than a fraction of the water that comes down stream, and on a recent visit there by the writer most of the river seemed to be going over the dam.

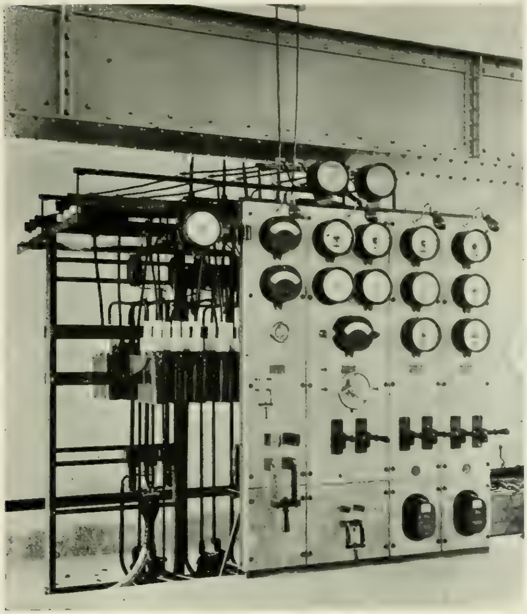


FIG. 1.—SWITCHBOARD.

But this waste of energy that comes rushing down from the Granite Hills and Green Mountains is to be stopped. The old canal has been widened and lengthened, thus making available a greater head and volume of water at its down stream end. Instead of the old wooden gates there are now eight of steel covered by a substantial brick gate house at the head of the canal. At the lower end of the canal, between it and the river, stands the new electric power house with its concrete foundation sunk below the river level and pierced by the arched tail races of the turbines. In this power house space is provided for six sets of turbine wheels and six alternators with a combined capacity of 4,600 kw.

Industrial developments are based on law. Penetrate Darkest Africa, find a race so savage that the will of the majority is never impressed on the individual, where every man is a law unto himself, and each member of that race, like the monkeys around him, will control only so much of material things as he can carry about. So, too, in a land where personal rights in property are created and protected by law, the forms which property takes and the uses to which it is put depend on the same system of law by which the rights are created. This electric development of water power at Turners Falls is a case in point. In that small village the probable extension of power consumption at profitable prices is very moderate. During nearly a score of years the rulings of the Gas and Electric Light Commissioners have excluded competition from the electric field in Massachusetts. Without the legal right to supply consumers over a large territory, the electric water power development at Turners Falls was not, and probably would not have been made. In 1903, a great water power company with a location some miles down stream from Turners Falls, went before the Legislature and got authority to invade some of the best electric markets of the State. Following this lead the company owning the water power at Turners Falls called at the state house, in 1904, and took away a charter to transmit and sell electric energy throughout Franklin and Hampshire counties, certain towns excepted. A result has been the erection of the new hydro-electric plant above mentioned. No opinion is expressed here as to the wisdom of this legislation, but the development at Turners Falls is simply pointed out

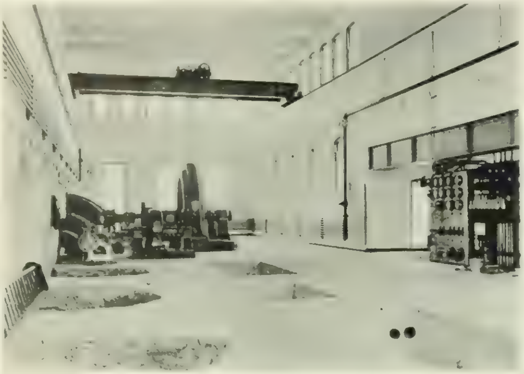


FIG. 2.—VIEW OF INTERIOR OF STATION.

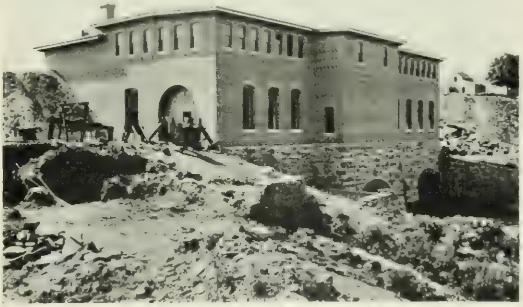


FIG. 3.—VIEW OF EXTERIOR OF STATION.

as one of the things to which it has led. One of the places in which the energy developed at Turners Falls may be sold is Northampton, a city of 18,643 persons, in 1900, which is served by a prosperous electric light company. This company has come down from the days, some nineteen years ago, when the Thomson-Houston and the now forgotten Schuyler arc systems, one operated by a planing mill engine, and the other by the steam plant in an abandoned machine shop, were hot competitors for public favor and municipal franchises. Here, too, is Smith College, where young ladies learn things. As the train stopped at the Northampton depot the other day, just as the dear girl graduates were departing, it was a little pathetic to note the difference in their baggage. Some pieces were large and substantial, with polished leather and brass mountings. Other pieces, including even the discarded grocery box with rope handles, were very small and poor, telling of the struggle for a college education.

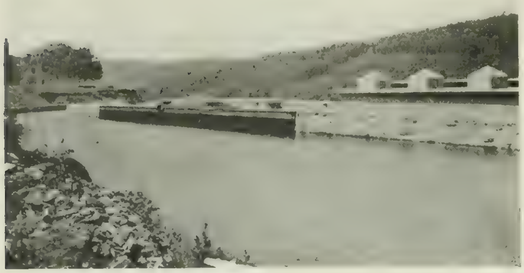


FIG. 4.—VIEW OF CANAL.

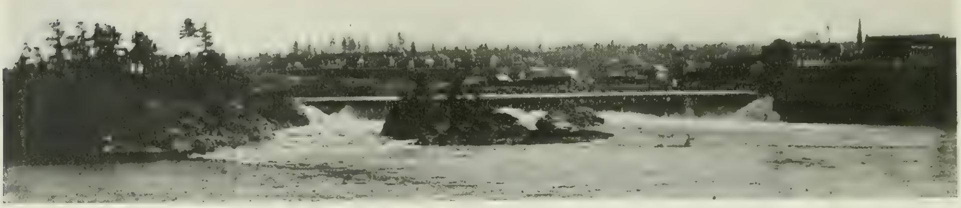


FIG. 5.—DAM AT TURNERS FALLS.

Besides the right to distribute electric energy for any purpose in all parts of Franklin and Hampshire counties, save in the towns of Orange, Greenfield, Amherst, Buckland, Sherburne, Deerfield and Bernardston, the company at Turners Falls may sell current to any street railway with tracks in Franklin County.

The new electric plant at Turners Fall is a substantial one-story brick building on a foundation of concrete arches, and sits with its longer sides parallel with the canal and the river. On the canal side of the station is the room for the horizontal turbine wheels, and on the river side of the station and separated from the turbines by a thick masonry wall is the room containing the electric generators and switchboard. Space and penstocks have been provided for eight pairs of turbine wheels and eight generators. Two of these generators will be used as exciters, and the other six will develop alternating current. Of these six alternators two will have a capacity of 300 kw each, and four will be rated at 1,000 kw each, giving an alternator capacity of 4,600 kw. A single pair of horizontal turbines is direct-connected to each 1,000 kw generator, and is designed to operate at 200 r.p.m. with the head of 39 ft. maintained by the canal. One exciter and one 1,000-kw alternator are now in position. These machines are of the Bullock make, and the alternator is rated at 2,300 volts, 60 cycles, three-phase. In strong contrast with this equipment is the first dynamo erected in Turners Falls, a 50-lamp incandescent machine that went into service 19 years ago.

As far as can be learned, the present equipment is not to include any step-up transformers, but with the voltage just named it is obvious that no extended transmission can be carried out. The power development at Turners Falls has, however, at command the entire discharge of the Connecticut River, at the head of 39 feet, named above. Of this discharge an apparently small, but unknown, quantity is used by the local manufacturers, and the remainder will be available at the electric plant. At Holyoke, 36 miles down stream from Turners Falls, the discharge of the Connecticut River is materially greater than it is at the latter place, as the Deerfield River and a number of smaller streams join the Connecticut between these two points. During 1896, the minimum amount of water drawn from behind the Holyoke dam in any one day was in August, when it fell to 450 cubic feet per second. For that entire month the average discharge of the river was 2,965 cubic feet per second, or 182,311 acre feet in all. In 1897 the minimum discharge at Holyoke was 1,300 cubic ft. per second, on an October day, and the average discharge in that month was 3,668 cubic feet per second, amounting to 225,536 acre feet during the month. In April, 1896, the average discharge of the river at Holyoke was up to 42,363 cubic feet per second, and, in April, 1897, it was 35,478 cubic feet. The minimum monthly discharge of 3,668 cubic feet per second at Holyoke, in 1897, if reduced by 30 per cent to represent the approximate discharge at Turners Falls, will develop 11,100 gross horse-power under the head of 39 feet. With good efficiency in canal, wheels and generators, 60 per cent of this, or 4,995 kilowatts, may be developed as electric current. It is not possible to say whether there is enough storage capacity behind the Turners Falls dam to make the entire minimum monthly discharge of the river available for power.

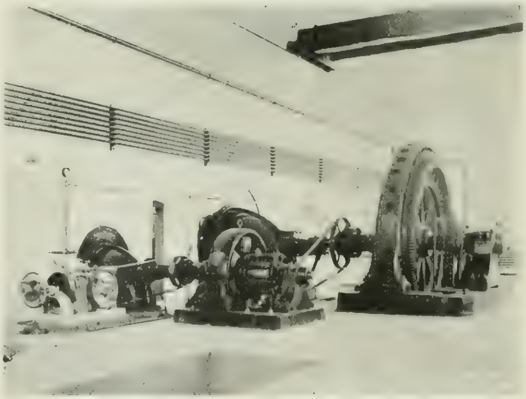


FIG. 6.—1000-KW ALTERNATOR AND EXCITER.

Armature Losses in Double-Current Generators.

By Alfred Still, M. Inst. E.E.

When a single conductor is used to carry both an alternating and a direct current, the losses due its resistance will, at every instant be equal to the square of the sum of the two currents multiplied by the resistance. The mean total I^2R losses will, therefore, depend, not only upon the proportion which the virtual value of the alternating current bears to the total current, but also upon the shape of the current wave. If this be known, and the curve showing the instantaneous values of the alternating current be drawn in the usual way, it is merely necessary to lower the horizontal datum line by an amount representing the (steady) value of the direct current, to obtain a new curve, the ordinates of which, at every instant, represent the instantaneous value of the current in the conductor carrying the one current superimposed upon the other.

In the accompanying diagrams, curves of this kind have been drawn, and the I^2R losses calculated therefrom, with the object of giving a clear indication of what takes place in the armature windings of a double-current generator.

These curves give a graphical representation of the manner in which the armature losses diminish as the alternating current lags behind the e.m.f. induced in the windings, as the *power factor* is reduced, notwithstanding that the amount of the alternating current, or the *apparent* total output remains unaltered. This is a point that is well known to designers of double-current machines, but not always realized by the users.

Although the curves here reproduced no doubt indicate a graphical method of calculating the armature losses in double-current machines, it is not suggested that such a method would be practicable, being inconvenient and tedious; but, as already mentioned, it is believed that they will serve a useful purpose in illustrating the manner in which the current varies in the armature sections, and how the total armature losses are reduced with the shifting of phase at the lower power factors.

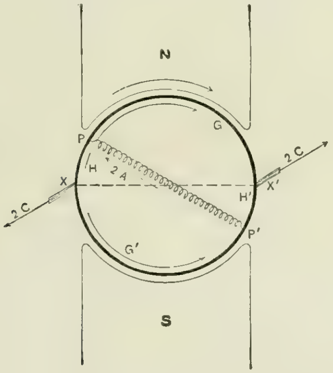


FIG. I.—RELATION OF CURRENTS IN ARMATURE.

Although the effects are the same generally whether the machine gives polyphase, or merely single-phase currents, the very simplest case has been taken in order to avoid complication in the construction of the diagrams.

In Fig. 1 the heavy circle is intended to represent the armature windings of a two-pole dynamo in which the brushes are placed at each end of the horizontal diameter XX^1, the magnetic flux being in the vertical direction. The two slip rings, from which the alternating current is collected, are permanently connected to the opposite points, P and P^1, of the armature winding.

The armature is supposed to revolve in a clockwise direction, as indicated by the arrow on the pole face.

At the instant when the point P is under the left hand brush at X, the e.m.f. in the alternating-current circuit is at its maximum. As P moves round to X^1, the e.m.f. will gradually die down until, when the points PP^1 lie on the vertical diameter, it will be zero; it will then rise again, to reach its maximum value in the *opposite* direction when P comes under the brush, X^1, i. e., when the armature has gone through half a complete revolution.

Assuming the load on the alternating current side to be non-inductive, the current will be in phase with the e.m.f., and its maximum value will, therefore, be reached when the diameter PP^1 coincides with the line XX^1. But if the load is more or less inductive, the current will lag behind the induced e.m.f. and its maximum value will only be reached after the point P has traveled a certain distance from the point X. Under the extreme condition of a wattless load, i. e., a power factor of zero, and an angle of 90°—the maximum value of the alternating-current will only be reached when the points PP^1 lie on the vertical diameter.

Consider, now, the manner in which the current will divide itself in the armature sections.

If $2C$ be the total current in the direct-current circuit, independently of the alternating-circuit output—as flowing in the armature conductors between the brushes X and X^1 equally in the upper and lower parallel sections of the winding, as indicated by the arrows (Fig. 1). When an alternating current of $2A$ amperes is taken from the slip rings, this will also divide itself to right and left between the points P and P^1. It follows that the resultant current in sections H and H^1 of the armature windings will be $C—A$, while in sections G and G^1, it will be $C + A$.

Algebraically, if H, G, H^1 and G^1 stand respectively for the corresponding instantaneous values of the resultant current in the four sections, and bearing in mind that the total of all currents flowing towards a given point must necessarily equal the sum of all the currents flowing away from the same point, there is obtained

$$2C - H - G^1 = O \qquad (1)$$

$$-2C + H^1 + G = O \qquad (2)$$

$$2A + H - G = O \qquad (3)$$

$$-2A - H^1 + G^1 = O \qquad (4)$$

Adding together (1) and (3) we get,

$$2(C + A) = G + G^1 \qquad (5)$$

and subtracting (2) from (4),

$$2(C - A) = H + H^1 \qquad (6)$$

Also, owing to the symmetry of the arrangement, it is evident that $G = G^1$ and $H = H^1$; hence,

$$H \text{ (or } H^1) = (C - A)$$

and

$$G \text{ (or } G^1) = (C + A)$$

The diagrams of Figs. 2, 3 and 4 may now be drawn. The same values of e.m.f. current and armature resistance will be assumed throughout, the only variable being the power factor of the alternating current circuit.

In Fig. 2 the power factor ($\cos \theta$) is taken as unity (load non-inductive). In Fig. 3 it is .71 (angle $\theta = 45°$) which might apply to a load of induction motors, although the power factor would rarely, in practice, be quite so low, and in Fig. 4, the extreme case of a power factor of zero has been taken. The alternating current in all cases is supposed to follow the sine law, and it is constant in virtual value, the *apparent* load or volt amperes on the alternating-current side remaining unaltered in the three examples.

In Fig. 2 the curve A has been drawn to represent half the total alternating current; its virtual value has been assumed equal to half the total direct current and its maximum ordinate will, therefore be $\sqrt{2}$ times C, or 1.41 C. Moreover, this maximum value will occur at the instant O, when the point P (Fig. 1) coincides with the point X. The horizontal distance from O to the vertical centre line represents half a complete period, i. e., the time occupied by the point P in traveling from X to X^1.

With regard to the horizontal line C C, this has been drawn below the datum line O O^1 at such a distance as to represent the value of half the total direct current.

If, now, we add the ordinates of the curves A and C we shall obtain the current curve indicated by the vertical section lines, and a little consideration will make it clear that the left hand half of this represents $(C - A)$, or the current in section H, while the right-hand half represents $(C + A)$, or the current in section G, the interval of time in each case being half a complete period. (It is understood that this time is measured from left to right between O and the vertical centre line for the current in section H, and between this centre line and O^1 for the current in section G. At the start—when the point P of Fig. 1 coincides with the point X—the current in the example chosen will be 41 amperes in section H and 241 amperes in section G, while at the end of the half revolution it will be 241 amperes in section H and 41 amperes in section G.) We are not concerned with the direction of the resultant currents, since this is of no consequence in the determination of the I^2R losses.

Observe, now, that as the point P travels away from X, the resistance of the winding in section H steadily increases from zero to a maximum amount, equal to twice the total armature resistance measured between brushes, while in section G it decreases from this same maximum value down to zero, which value will be reached by the time the point P has traveled round to X^1.

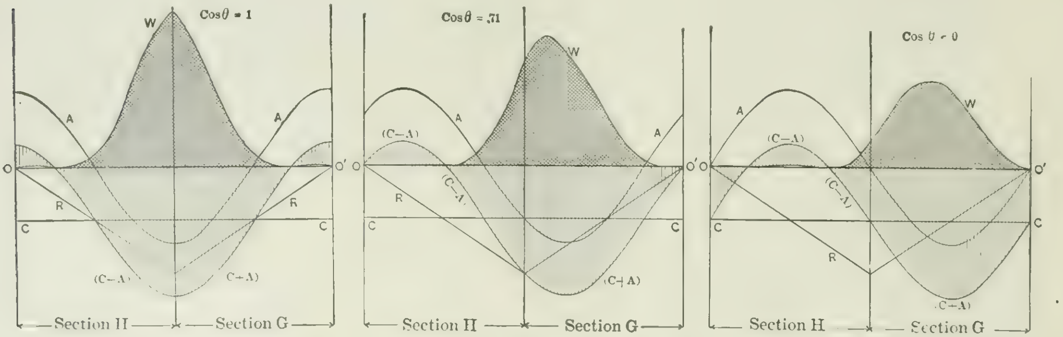
If, therefore, we draw the straight lines marked R R through the points O and O^1, as shown in Fig. 2, such that the maximum ordinate representing, in this example, .02 ohms—falls on the vertical centre line, we shall be able to scale off the diagram the resistance in either of the two sections, H or G, which corresponds to any instantaneous value of the resultant current.

We are now in a position to draw the watt curve marked W on the diagrams. The ordinates of this curve are equal, at every point, to the square of the instantaneous value of the resultant current multiplied by the corresponding value of the resistance. The area of this curve will evidently be an indication of the amount of work done in heating the conductors of one-half of the armature; the portion to the left of the vertical centre line referring to section H, while the portion to the right refers to section G.

The average ordinate of the curve W for section H, added to the average ordinate for section G, gives the mean watts, or the mean rate at which work is being spent in heating the armature conductors forming the upper half of the winding between the brushes X and X^1. The same losses occur in sections H^1 and G^1, and the total watts lost in armature conductors will, therefore, be twice the above amount.

The following is the assumed data upon which the curves have been plotted:

Total armature resistance (between brushes) = .01 ohm.
Total direct current output ($2C$) = 200 amps.
Total alternating-current output ($2A$) = 200 amp.
Direct current pressure = 141 volts.
Alternating-current pressure = 100 volts.
Hence, direct current output = 28.3 kw and apparent alternating-current output = 20 kw, making a total of 48.3 apparent kw output, which is constant for all three diagrams.



FIGS. 2, 3 AND 4.—DISTRIBUTION CURVES AT ANGLES OF LAG 0°, 45° AND 90°.

These diagrams, Figs. 2, 3 and 4, show at a glance the appreciable reduction in the total I^2R losses which takes place as the power factor of the alternating-current decreases. The figures worked out from measurements taken on the diagrams are as follows:

For $\cos\theta = 1$ (Fig. 2.)
Total real output = 48.3 kw.
Mean I^2R loss in section H = 370 watts.
Mean I^2R loss in section G = 370 watts.
making total for armatures = 1480 watts.

For $\cos\theta = .71$ (Fig. 3.)
Total real output = 42.5 kw.
mean I^2R loss in section H = 150 watts.
mean I^2R loss in section G = 410 watts.
making total for armature = 1120 watts.

For $\cos\theta = 0$ (Fig. 4.)
Total real output = 28.3 kw.
mean I^2R loss in section H = 30 watts.
mean I^2R loss in section G = 370 watts.
making total for armature = 800 watts.

The following figures are also interesting for the purpose of comparison:

If the total output of 48.3 kw. were taken out on the direct-current side only, the I^2R losses would be 1170 watts.

If, on the contrary, this same total output were all on the alternating-current circuit, the I^2R losses would be exactly double the above amount, or 2340 watts.

Again, if with output on the direct-current side only, this were reduced to 28.3 kw, corresponding to the real output in the previous example with $\cos\theta = 0$ the total watts lost would be 400, or half the amount calculated from Fig. 4.

The Production and Utilization of Ozone.

By ARTHUR W. EWELL, PH.D.

OZONE, an allotropic form of oxygen containing three atoms of oxygen, may be produced by three different methods: direct chemical reaction, electrolysis, and by the passage of electricity through oxygen gas. Ozone was supposed to be produced when oxygen was heated to a very high temperature, until disproved by Clement.[1]

A number of chemical reactions produce some ozone, particularly the slow oxidization of phosphorus. Moissan's method,[2] employing the action of fluorine on water, is the most promising, and if fluorine could be cheaply produced electrically, this might become an important method.

The electrolytic method has been carefully studied by Targetti[3] and Grafenberg.[4] Grafenberg found that sulphuric acid was the best electrolyte and Targetti that the best strength was 22° Baumé (or specific gravity 1.18). Any change in the nature of the cathode was found to be of little importance, but lead proved the most efficient material for the anode, and the production of ozone was found to be directly proportional to the anode current density and independent of the temperature when below 17° C. With a lead anode 1 cm. long and .5 mm. in diameter, in sulphuric acid of the above dilution, an e.m.f. of 7 volts gave a current of 2 amp. and 5.4 mg. of ozone were produced at the anode per hour. This is equivalent to 2.73 grams of ozone per hp-hour, which is far inferior to the results obtainable with the methods which will now be considered.

The direct electrical methods may be subdivided in two ways. First, as regards electrodes. The electrodes may be plates, wires or points or complex combinations. Secondly, they may be classified according to the method for preventing sparking and arcing, an obvious difficulty, since several thousand volts are required to force a suitable current through a gas.

The simplest apparatus is that of Tindal, which consists of two

---

(1) *Ann. der Physik.*, 14, 1904, p. 334; (2) *Centralblatt.*, 1899, II, p. 929; (3) *Nuovo Cimento*, 4, 9-10, '99, p. 300; (4) *Centralblatt*, 1903, II, p. 863; (5) *Electrical Review* (London), 55, p. 314; (6) *Elec. Rev.* (London), 55, p. 807; (7) *Journal fur Gasbeleuchtung u. Wasserversorgung*, 1901, 30 31; *Electrochemical Industry*, 1903, p. 179; (8) *Elec. Rev.* (London), 55, p 1052; (9) *Electrochemical Industry*, 1904, p. 426; (10) *Electrochemical Industry*, 1904, p. 511; (11) U. S. Patent 754,261, Mar. 8, 1904; (12) *Journal of the Society of Chemical Industry*, 1898, p. 1173; (13) *Centralblatt.*, '97, I, p. 777; (14) *Electrician* (London), 1895, p. 213; (15) *Elec. Rev.* (London), 55, p. 1053; (16) *Journal for Gasbeleuchtung u. Wasserversorgung*, 1901, 30 31; (17) *Electrical Review* (London), 56, p. 3; (18) *Zeit. fur Electrochemie*, 1904, Jan. 1; (19) See also Ohio *Sanitary Bulletin*, Jan.-Mar., 1905) (20) *Centralblatt.*, 1902, II, p. 667; (21) *Centralblatt.*, 1904, I, p. 9; (22) *Berichte d. Deutch. Chemish. Gesell.* XXXVI, p. 12; (23) *Ann. der Physik.*, 1902, 9, p. 1286.

parallel metal surfaces connected to the poles of a 50,000-volt trans- this air, partially transforms the oxygen into ozone. The efficiency is low, however, the yield being but 3 to 4 grams of ozone per kw-hour, and this method is not in use at the present time.[5]

An apparatus with wire gauze instead of the plates has been developed by Rosenberg and an output of 250 grams per kw-hour is claimed,[6] but as the air was not dried before entering the apparatus considerable nitrous oxide might have been formed and mistaken for ozone.

The Siemens & Halske apparatus differs from the Tindal in that one of the plates is covered with glass or mica, and the other plate is grounded and cooled by water. The plates, cylindrical or plane, have an area of several square yards. A difference of potential of from 8,000 to 15,000 volts is used. The apparatus is claimed to give an output of between 20 and 30 grams of ozone per hp-hour, with an ozone concentration of 2 grams per cubic meter of air.[7]

The Elworthy apparatus is similar to the Siemens & Halske except that both (cylindrical, concentric) electrodes are covered with glass and the air passes over each in succession. An output of from 60 to 70 grams per kw-hour is claimed, but the figures are doubtful, since the air was not dried.[8]

The Marmier-Abraham ozonizer has parallel, glass-covered, water-cooled electrodes, one meter square, at a difference of potential of 40,000 volts (alternating current). Air dried with pumice and sulphuric acid flows between the plates and 20 grams of ozone are said to be produced per hp-hour.[9]

In the Otto ozonizer one electrode consists of revolving beveled-edge discs. For half a revolution they are about an inch from an outer electrode and for the remainder the outer electrode is farther away and covered with glass. This increase in distance, together with the glass and the removal of two sectors of the discs, prevents arcing. A potential of 25,000 volts is used.

The very successful Vosmaer ozonizer remains to be described. One electrode is plane and grounded. The other carries a great number of points. A difference of potential of 10,000 volts (alternating current) is used and an output of 15 grams of ozone per kw-hour is obtained with an ozone density of 3 grams per cubic meter.[10] The air, previously dried with chloride of calcium, flows between the points and plate and the electric current (a small fraction of an ampere) partially ozonizes the oxygen.

An ozonizer must guard against sparking and arcing. The ozone is produced by a quiet electric current through the air. A spark, however, decomposes the ozone, and an arc destroys the apparatus. In the Siemens ozonizer glass plates are interposed between the electrodes. This necessitates a higher potential and an annoyance from breakage of the glass. The Marmier-Abraham apparatus uses an external spark-gap, the Otto a revolving electrode and the Tindal an external choking coil. Vosmaer uses the choking coil together with a condenser in shunt with the ozonizer and succeeds in obviating both sparking and arcing.[11]

Ozone has been tried with considerable success in ageing wines, in purifying beer kegs, in bleaching sugar, in purifying petroleum, in the manufacture of organic products, and most important of all, in purifying water. It is too expensive for a general bleaching agent,[12] it fails to completely decolorize sugar and molasses,[13] and it is unsatisfactory for purifying air.[14]

The Otto apparatus is used in France in the manufacture of organic products and has recently been installed in an experimental water purification plant at Niagara Falls.

The Marmier-Abraham ozonizer is in use in a brewery at Marseilles and at Lille in a water purification plant, which has been in operation since 1898, and which has been taken over by the city. The capacity of the plant is nearly a million gallons a day and the cost of purification is about $10 per million gallons.[15]

The earliest Siemens & Halske water purification plant was erected at the company's works at Martinikenfelde, near Berlin, to supply purified Spree water for a population of about 5,000. The water trickles through a tower filled with stones five meters high and one meter in diameter, while the ozonized air enters at the bottom and rises. Analyses by Dr. Erlwein[16] of the water before and after purification for a period of several days gave (per c.c.): Bacteria, before purification—maximum, 200,000; minimum, 2,300; average, 80,000. Bacteria after purification—maximum, 34; minimum, 0; average, 8. There was an increase of 12 per cent in air and 38 per cent in oxygen. All pathogenic germs were destroyed.

A similar plant was erected at Wiesbaden (Schierstein a Rh.),[17] but given up on account of a troublesome precipitate which the ozone formed with iron present in the water. Another Siemens & Halske plant has been in successful operation at Paderborn since August, 1902, supplying all the water for the town (about half a million gallons a day). About 1.3 grams of ozone is used per cubic meter of water and the total cost (interest and depreciation included) is about $15 per million gallons. Dr. Erlwein estimates that for a similar plant with a capacity of 10,000,000 gallons a day the total cost would be but $7 per million gallons.[18] For comparison the total cost of purifying a million gallons of water by either slow or mechanical sand filtration is about $10 (estimate for Pittsburg, Pa.[19]). Sand filtration removes about 97 to 99 per cent of the bacteria.

The Vosmaer system has been in use at Nieuwersleuis, Schiedam and Rotterdam, Holland, and at Philadelphia. The crude water passes through a rough sand filter to remove suspended matter and enters the top of a tower about 30 ft. high; the ozonized air, forced through small holes in the bottom, rises in very small bubbles and comes into intimate contact with all the water. Special openings are provided for the outflow of the water at the bottom and the escape of the air at the top. Sufficient ozone is supplied to have a small excess in the escaping air. This system uses from one to five grams of ozone per cubic meter of water, depending on its condition, and the cost of operation is from $3 to $7 per million gallons of water.[20] Dr. H. J. van't Hoff (a prominent Dutch engineer, and a brother of Prof. van't Hoff) studied this system and found that the bacteria were reduced from 200-20,000 per c.c. to 1. Color and taste were removed from the water. Any residual ozone quickly decomposed. The amount of oxidizable matter in the water was greatly reduced. In brief, this purification appeared to remove practically everything except industrial contamination. The reliability of the apparatus has been illustrated at the Schiedam plant, which was in continuous operation with no interruption, eleven hours a day, for two periods of six months each. The Philadelphia plant is in the heart of the city and successfully purifies a million gallons a day of the very polluted Schuylkill River water. It is owned by the United Water Improvement Company, which holds the American patents of Vosmaer and Lebret. One of the towers is of glass and the process of purification may be clearly seen. Dr. Rivas, of the Water Department of Philadelphia, has recently made a careful test of this plant. He found that the number of bacteria was reduced from about 1,500,000 per c.c. to 38-55, when 10,000 gallons were being purified per hour, and that these remaining bacteria were all harmless, disease germs being totally destroyed. This selective action of ozone is very interesting and important. Such action is not found in sand filtration.

The present applications of ozone point to greater importance in the future, but the wide diversity in apparatus and efficiencies (claimed) suggest still more extensive possibilities when the nature of the production is better known.

Probably ultra-violet light is an important factor in the electrical production of ozone. Certainly it strongly absorbs ultra-violet light[21] and is produced in considerable amount outside a tube in which an electric discharge is occurring if the tube is of quartz, which is permeable to ultra-violet light, while outside a tube of glass, which is impermeable, little ozone is produced.[22]

Ozone is not a stable gas, but gradually decomposes to oxygen. Prof. Warburg[23] has shown that the deozonizing increases with the temperature and the concentration. The greatest concentration ever obtained was 85 per cent, by Ladenberg, by fractional distillation of liquefied, ozonized oxygen. Prof. Warburg's results show that at ordinary temperatures about 1 per cent of ozone of such a concentration would decompose in two hours and 50 per cent in about ten days.

As the ozone breaks down into oxygen rays are emitted very similar to the rays from radium, since they act on a photographic plate, make air electrically conducting, and cause fluorescence.

Wireless for Train and Steamer.

The Midland Railway system of England has installed wireless telegraphy for its service between the coast of England and the Isle of Man. There is a great deal of holiday and excursion travel, rendering it necessary to watch closely the movements of train and steamer, regardless also of fog. The installation has been made with Lodge-Muirhead apparatus, and the results are reported as being satisfactory. The system is worked in connection with regular telegraph land lines.

Data on Electric Baking with Niagara Power.

ELECTRICITY bakes a pound of bread with a consumption of 3,685 watt-hours in the plant of the Natural Food Co. at Niagara Falls. To bake the same weight of bread in an oven heated by combustion the company uses 0.3306 pound of anthracite coal. Bread in this case is the entire wheat kernel, shredded, and then baked without the addition of any other substance. The bread baked with coal is known simply as "shredded wheat biscuit," and the electric baking produces "triscuit."

All of the processes necessary to transform the best Genesee Valley white wheat into the finished product are carried on with the aid of electric energy in the factory of the Natural Food Company at Niagara Falls. The plant has already been illustrated and described in the Electrical World and Engineer, but a few items may be here recapitulated. This factory is located on Buffalo Avenue, adjoining the State Reservation and facing Niagara River. The building is 466 feet long by 66 feet wide and four and five stories in height. All mechanical power in this plant is supplied by electric motors, all lamps are electric, and a large share of the baking is done with that form of energy. This electric energy comes from the plants of the Niagara Falls Power Company, about 3,500 feet distant, in the form of 2-phase, 25-cycle, 2,200-volt current, and is received in 18 transformers of 2,300 kilowatts total capacity. Four of these transformers, rated at 75 kw each, deliver current for incandescent lighting at 115 volts and 25 cycles. Another four transformers of 150 kw each supply 440-volt current to induction motors, and also current for a rotary converter of 220 volts. For the electric ovens there are ten transformers of 140 kw capacity each. Two of these transformers are required for each oven, and there is thus one extra pair. Machinery throughout the plant is driven by 87 induction motors that range from 1 to 40 horse power in individual rating and have a combined capacity of 560 horse power. Besides motors of the induction type there are several taking direct current at 220 volts from the rotary converter, and operating elevators. A 12-kw motor generator charges storage batteries for electric bells and telephone circuits. Some parts of the factory operate day and night, and the electric load from about 6.30 p. m. to 6.30 a. m. remains nearly constant at 210 kilowatts. Within an hour after 6.30 in the morning the load rises to more than 700 kilowatts, and, with the exception of a drop during the noon hour, ranges from that figure to more than 800 kilowatts until about 5 p. m. After that time it falls in an irregular way to the minimum of 210 kilowatts. From all this it may be seen that the mechanical processes through which the wheat passes require rather large powers.

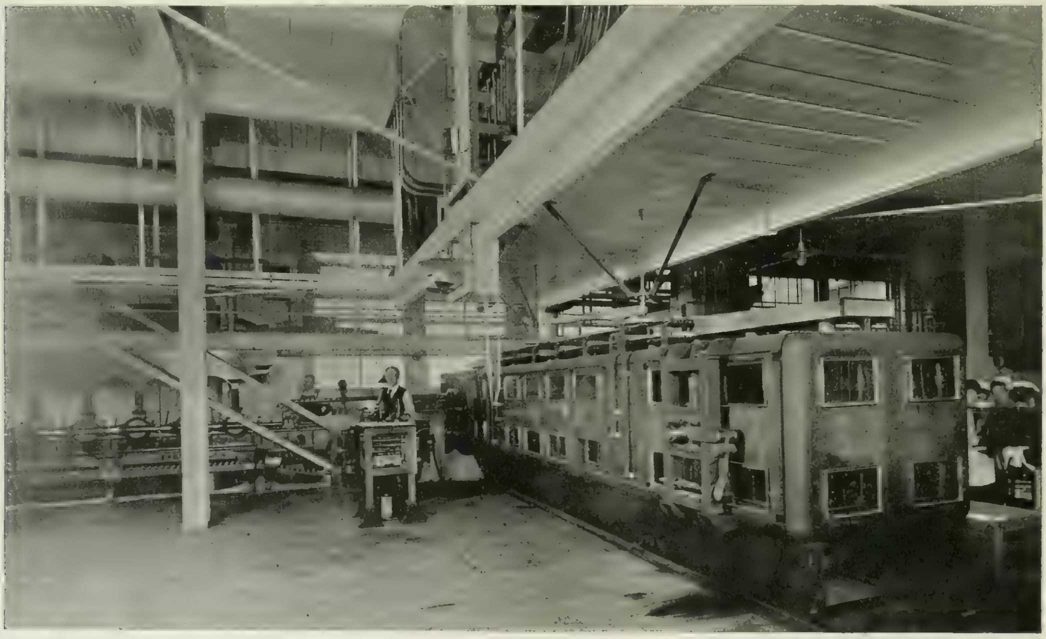


Fig. 1.—View of End of Electrical Oven. Transformers Located on Platform Above.

Perhaps the single operation that consumes more power than any other is that of shredding the wheat, which is done by passing it between pairs of steel rollers. One roll of each pair is smooth and the other has twenty circular corrugations per inch, so that wheat in passing between the two is spun into shreds. Before it goes to the shredder the wheat is steamed for 35 minutes in revolving wire kettles, and from the shredder it drops to an endless belt and is carried to the electric oven, or else goes to the cutter and is divided into biscuit for the oven that is heated by combustion. During a certain period the number of shredded wheat biscuits baked by combustion was 1,169,344 dozen. The weight of each of these biscuits when quite dry was nearly one ounce, or substantially 887,000 pounds for the entire lot just named. Biscuits baked with the heat of combustion really pass through two ovens. In the former the biscuits are placed on wire pans which are suspended in a sort of Ferris wheel, so that they revolve slowly for 30 minutes over a great bed of coals, in air and gases that have a temperature of about 450 deg. F.

After this baking process the biscuits are carried slowly through a drying oven that is about 150 feet long and has a temperature of 200 to 300 degrees. The trip from end to end of this second oven takes about one and one-half hours, so that the entire baking process in an oven heated with fuel consumes about two hours. During the same period in which the 887,000 pounds of shredded wheat biscuit were baked there were burned in the first or high temperature oven 169,000 pounds of anthracite coal, stove size, and for the second or drying oven 120,960 pounds of anthracite pea coal. The total weight of anthracite coal consumed to completely bake the 887,000 pounds of shredded wheat was thus 289,960 pounds, or 0.3306 pound of coal per pound of wheat product. Of this 0.3306 pound of anthracite coal 0.1927 pound was stove size and 0.1379 pound was pea size. If the anthracite stove coal cost $5 per short ton and the pea coal $3 per short ton, the cost of the fuel consumed to bake one pound of the shredded wheat was 0.0687 cent.

One of the electric ovens for baking the shredded wheat in the form called triscuit turns out about 2,483 triscuit per hour. The weight of these triscuit is substantially one-half ounce each, which gives the hourly product a total weight of 77.6 pounds. Energy consumption in the electric oven varies a little in rate, according to the velocity at which the triscuits are moved through it between series of electrically heated links that do the baking. For each oven there is an ammeter in each phase of the two-phase circuit that supplies the electric energy to the transformers at 2,200 volts. While one of the electric ovens was automatically turning out triscuits at the rate above named, the writer and Mr. W. C. Marlow, electrical engineer of the Natural Food Company, read the ammeters and found their approximate indications to be 60 and 70 amperes, respectively. At 2.200 volts these readings represent an input of 286,000 watts at the primary sides of the two transformers. This rate of work was baking 77.6 pounds of triscuits per hour, and the consumption of energy was therefore 3,685 watt-hours per pound, including the losses in the transformers. One watt-hour is the equivalent of 3.4383 heat units, so that the 3,685 watt-hours required to bake one pound of triscuit must develop 12,670 units of heat. With perfect combustion one pound of anthracite coal yields about 12,000 heat units, and on this basis the 0.3306 pound of coal consumed in baking one pound of shredded wheat biscuit would develop heat to the extent of 3,967 units. But combustion is never perfect in an ordinary furnace, and as much as 25 per cent of the heat actually developed escapes with the flue gases in most cases. It seems most probable, therefore, that not more than 70 per cent of the latent heat of the coal does any useful work in baking the shredded wheat. This assumption reduces the useful heat to 2,777 units per pound of wheat. If electric energy operating on same material of high resistance was to replace coal in the furnaces where the shredded wheat is baked by exposure to radiant heat and to hot air, the entire equivalent of the electric energy would be as useful as the 70 per cent of the latent heat of coal named above. Seventy per cent of the latent heat of the 0.3306 pound of coal necessary to bake one pound of shredded wheat, amounting to 2,777 units, is the equivalent of 807 watt-hours. The assumed cost of this coal was 0.087 cent, and the rate for electric energy to replace the coal at an equal cost is 0.0840 cent per kilowatt-hour. In favor of the electric heat is the fact of a saving as to the labor of handling coal. On this suggestion the shredded wheat would continue to be baked by radiant heat and hot air, and not by contact with heated surfaces.

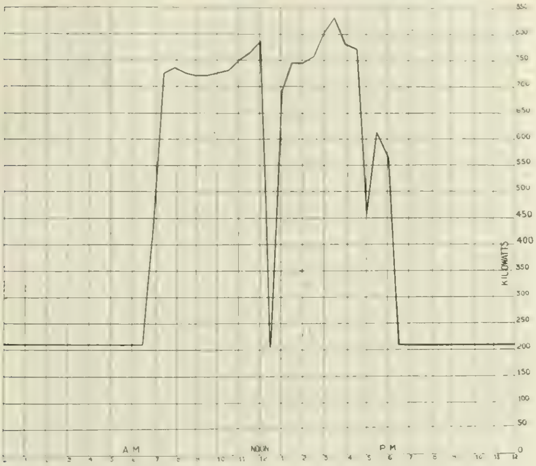


FIG. 2.—CONSUMPTION CURVE.

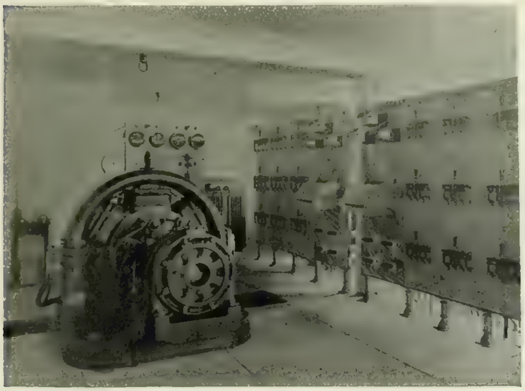


FIG. 3.—EAST TRANSFORMER ROOM.

Subsidiary Apparatus of the Telefunken System.

By A. Frederick Collins.

THE combination of the Braun, Siemens & Halske and Slaby-Arco systems of wireless telegraphy not only required a rearrangement of the oscillator and resonator circuits, as indicated in a prior article in these columns, but many of the devices were redesigned to fit the new order of things, and hence are not without their especial interest.

In the Telefunken system the induction coil with a simple spring vibrating interruptor has been retained for stations where the range to be covered is not more than 150 kilometers, and this type answers satisfactorily where the initial energy does not exceed 350 watts and the primary can be wound for potentials up to 110 volts direct current.

Where greater distances are to be bridged an induction coil that takes from 350 watts to 1.5 kilowatts is employed, and this is operated on either a 50-cycle, single-phase current or an interrupted direct current; in the latter case a mercury turbine interruptor, with a suspension system, where used on board ship, is employed. In the first case a rotary converter consisting of the usual direct-current motor and alternating-current generator is used, although in practice the direct-interrupted curent has met with favor, for the dynamo is not subjected to the dangerous strains that so frequently disrupt the latter.

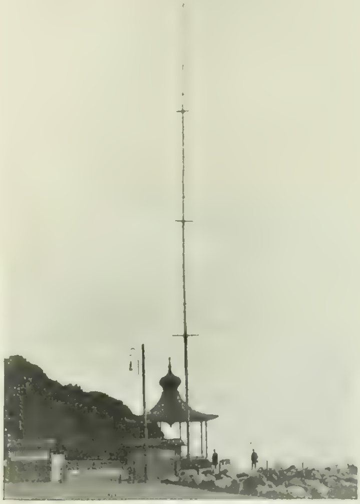


FIG. 1.—MAST.

In portable stations, or where a suitable current is unavailable, a motor-generator set is installed, but where a converter is used the motor is provided with a starting commutator so that when the operator is receiving, the motor is not only cut out, but stopped as well; and before transmission is again possible, the commutator must be returned to its original position.

The key for breaking the primary current into the signalling code still retains the proportions originally given it by Marconi, but the

German make is fitted with an electro-magnetic blow-out or with an automatic minimum current cut-out, i. e., the circuit is shunted by a coil of wire having a small cross-sectional area. In stations utilizing large currents of more than 40 amperes a number of platinum contacts are connected in multiple.

The spark-gap furnished with this system is of the multiplex type—that is, they are subdivided; for portable stations these consist usually of three air-gaps and are not enclosed, while for permanent station work the discharger is enclosed in a felt casing so that the sounds may be deadened, but provision has been wisely made so that the interior is ventilated.

The high-frequency or excitation circuits, which are made up of the multiplex discharger, the Leyden jar battery and variable inductance are similar to those introduced by Dr. Slaby; that is, the Leyden jars are contained in a case, the coil is wound on the outside and the spark-gap located on top so that the three devices form a compact unit. The standard station type, which has proven so very successful on board ship, permits the wave length to be charged from 120 meters up to 1,000 meters.

In the portable type of oscillators only two wave lengths may be produced and this is accomplished by means of plugs or spring jacks. To the circuit exciters of either type there is attached an aerial switch for cutting out the oscillator systems from the aerial wire and switching in the resonator circuits, thereby changing the radiator into an antenna.

The coherer that has been adopted as best able to withstand the constantly changing meteorological conditions that work havoc with the average detector, is of the granular steel type and has a V-cut so that the degree of sensibility may be varied, and in this way rendered equally suitable for short or long-distance work. Moreover, this coherer possesses remarkable constancy and exceptional permanence, which are among the first requirements for commercial telegraphy. Its design is such that it can be easily and quickly replaced by another, for projecting from the supports of the tapper are two spring clips and all that is necessary is to draw out the one and insert the other.

The coherer is used in connection with a carefully balanced polarized relay previously tested in a circuit of 1.4 volts and which includes a resistance of 100,000 ohms. Two of the most serious difficulties found in polarized relays have been overcome, namely, the "dead" movement and the effects of the constant tapping of the coherer. The decoherer is actuated electrically but operates mechanically, so that the strength of the stroke is always uniform. The spring motor of the tapper has been reduced in size and the movement of the vibrator has been greatly increased.

In all the different forms of receiving apparatus where there are movable parts, it has been the aim of the makers to avoid delicate mechanisms that have heretofore characterized the construction of wireless telegraph appliances, for herein lies the weakness and instability of nearly all other systems; on the other hand, the German company has striven above all things to produce a set of instruments that will stand the treatment usually accorded them by the average telegrapher and yet work the same to-day, to-morrow and every day thereafter.

Proper switching devices largely contribute to the accuracy and wear and tear of the instruments; for this reason a main switch on the receptor is introduced to cut out all the internal circuits of the receiving station and to exclude the current energizing the transmitter. By employing polarization cells and ohmic resistances sparking at the relay and other contact points is entirely obviated.

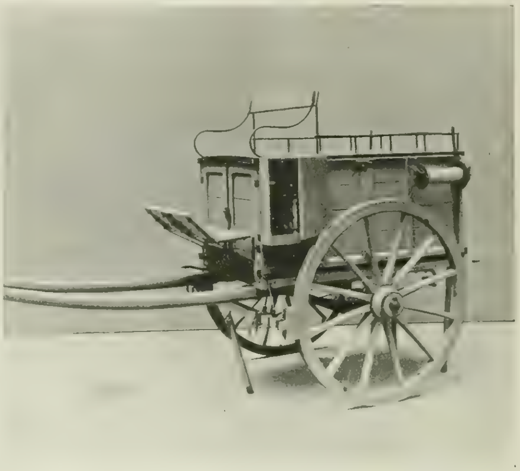
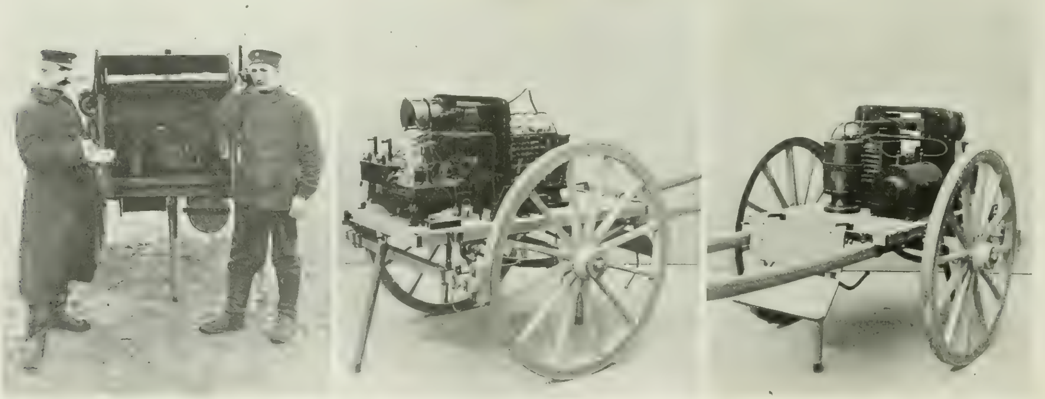


FIG. 5.—FIELD OUTFIT.

The receivers of the ship sets are fitted with springs to take up the vibration due to the engines. The transformers for transfering the energy of the oscillations from the open to the closed circuit of the receivers consists of a single layer of wire equipped with sliding contacts so that any number of turns may be rendered inductive. Of this type of transformer there are three sizes made, the smallest of which may be adjusted to a wave length of from 50 to 200 meters; the intermediate size, which is the kind supplied to the United States Navy's ship sets, has a range of from 200 to 600 meters and the largest make from 600 to 3,000 meters.

With these transformers tuning to the desired wave length of the transmitter is easily effected. Where only a given wave length is required, the resonator transformers are furnished with a movable primary winding and any degree of sensitivity from zero to maximum may be had, in the first instance by withdrawing the primary from the secondary, and in the second case by adjusting the coils so that their mutual inductive effects will be greatest.


FIGS. 2, 3 AND 4.—TELEFUNKEN FIELD OUTFIT.

The coherer and writing indicator may be replaced by an electrolytic detector and a pair of head telephone receivers, as described in these columns of March 11, 1905. Ondameters for measuring the wave-length, also previously described, accompany the sets, so that tuning to resonance is not left to the mere judgment of the operator but may be determined with absolute precision.

Aerial wires for permanent stations are preferably made of phosphor-bronze in virtue of its mechanical strength, and these are insulated at the upper extremity by porcelain heads instead of ebonite, since the latter material has not proven very durable in places where moisture is present. The lower portions of the aerials leading to the interior of the stations are insulated to a greater or lesser extent, according to the potential employed; the aerials are directly earthed through a lightning switch which during a thunder storm saves the instruments from its destructive action and it also acts as a conductor for equalizing the difference of potential that exists between the air and the earth.

Equipments of the foregoing system have been installed throughout the world and the German, United States and Swedish navies have equipped ships with it. Italy and England are the only other powers that have adopted a specific make of apparatus, these using the Marconi system, while Russia and Japan have purchased equipments from nearly every company engaged in their manufacture. In nearly every civilized country, too, experiments are going on with portable wireless sets, and German instruments are at work in every climate, be it frigid, temperate or tropical.

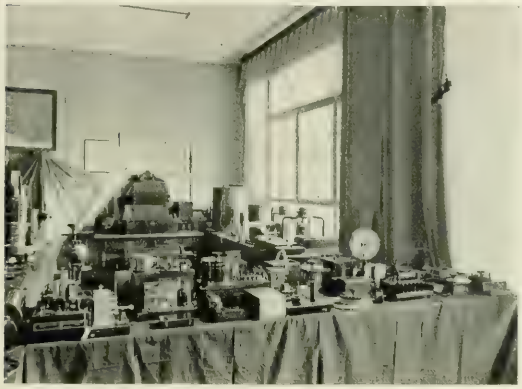


FIG. 6.—APPARATUS OF THE TELEFUNKEN SYSTEM.

As the primary object of the German instrument makers was to provide appliances for the army and navy, the Telefunken system has been developed under the eyes of the military authorities, and since the devices have met the severe demands made in warfare it is reasonable to believe that they would be no less serviceable in the field of commercial activities.

One of the most difficult tasks the wireless telegraph engineer has to perform is planning and estimating the size and power required to bridge specific distances. These vary within wide limits, due chiefly to the character of the country between the stations, the atmospheric conditions and especially to the presence or absence of water. Instruments are usually standardized by the distance they will cover across water.

Even under such circumstances any figures that are given must be treated as provisional, as some factors must of necessity be ignored, such as the vertical length and number of the wires forming the aerials, the nature of the weather, etc. As an illustration, one of the signalling sets designated by the company as No. 100 has a range of 100 kilometers over water between ships when the aerial of each has a height of 40 meters and is composed of two or three parallel wires. Now, if the same equipment is used and the aerial is formed of 15 or 20 wires spread out in the form of a fan, it then becomes possible to telegraph nearly twice the distance.

Again, an apparatus of the above type may operate satisfactorily in fair weather to a distance of 100 kilometers, and during foggy or damp night air the range will be increased 30 or 40 meters, while in excessively dry and hot weather the signalling distance may fall off 30 or 40 meters. In purchasing apparatus all these variations from the normal should be fully considered and the data given by the manufacturers should be taken to represent the mean distance.

Where the transmission is to take place across land, the variations are even greater, and it is practically impossible to determine sizes of apparatus and calculate the power required unless the conditions of the land between the stations are known. If the country is well built up or heavily wooded or the profile as the crow flies is rugged, then the apparatus for signalling must be of sufficient size and power to telegraph three or four times as far as over water.

Oppositely, if the country is open, flat and moist, the energy required to bridge a given distance may be roughly assumed to be the same as for an equal distance over water. In sparsely-settled countries, as Alaska, the wireless telegraph may be utilized to advantage, but under usual circumstances it is unable to compete with the wire telegraph or telephone. Its mission is to supplement these modes of transmission, not only between ship and ship and ship and shore, but between fixed stations in competition with the cable, where the distance is not too great, when its initial cost and subsequent upkeep will be found to be very much less than that of the submarine cable.

A Method for Determining the Size of Transmission Circuits.

By C. W. Stone.

It is believed that the short method given below for determining the size of conductors necessary for three-phase transmission lines, which experience has shown to be of considerable value, will prove of sufficient interest to justify its publication.

The tabulation is based on the transmission of 100 kw, and there has been assumed an energy loss of 10 per cent and a power factor of 85 per cent. Ten per cent energy loss has been assumed as being approximately the maximum which would ordinarily be allowed. The value assumed for the power factor is fairly close to that found in the average transmission circuit.

The formula which has been used for calculating the values given in the table is as follows:

$$D = \frac{P E^2 A}{C W}.$$

D = Distance one way in feet.
P = Percentage of energy lost in the line.
E = Delivered voltage.
A = Cross-section of each wire in circular mils.
W = Number of watts delivered.
C = A constant whose value depends upon the power factor.

The value of C for a three-phase circuit operating at a power factor of 85 per cent is 1,500. On the basis of these assumptions the distances of transmission have been determined for the various voltages commonly employed and for the different standard sizes of wire, from No. 6 B. & S. to a conductor having an area of 500,000 circular mils, as is indicated in the table on the next page.

The method of using the table can best be illustrated by an example:

Example.—500-kw to be delivered 12 miles with 10 per cent of energy loss, at 85 per cent power factor; the delivered potential to be 6,000 volts.

As the tabulation is based on 100 kw, it will be readily seen that in the case assumed there is five times the amount of power to be transmitted. Referring to the formula, it will be noted that 100 kw can be transmitted over a circuit five times as far as 500 kw under the same conditions with the same losses. In this case there is 500 kw. to be transmitted 12 miles. Thus if 12 be multiplied by 5, there is obtained a value which is equal to the distance to which 100 kw can be transmitted over a certain size of wire, with losses as given above. Referring to the table under the column "6,000," there is found a value 60.44, which is opposite No. 00 wire, which is the size of wire to be determined. In other words, 100 kw can be transmitted for 60.44 miles with an energy loss of 10 per cent at a power factor of 85 per cent, with 6,000 volts at the receiving end, or 500 kw can be delivered at the end of a 12-mile line with the same losses and with the same delivered potential over the same size wire.

In case it is desired to allow a smaller percentage of energy loss, it is only necessary to take the ratio between the energy loss and the 10 per cent energy loss on which the table is based. For instance, if it is desired to allow only 5 per cent loss, it would be necessary in the above table to multiply the value 60 by 2, which equals 120. Again referring to the table under the 6,000-volt column, it will be noted that it will require a wire between 250,000 and 500,000 circular mils. In most cases this size of wire would be prohibitive, and it would be necessary to use a higher voltage. If there be selected a delivered potential twice as high, i. e., 12,000 volts, it will be noted that under the 12,000-volt volumn a value 120.16 is found opposite No. 2 wire, which is the size to be determined.

Number of wire. B. & S.	Area, wire C. M.	Distance of Transmission for Various Potentials at Receiving End.											
		2000	3000	4000	5000	6000	8000	10000	12000	15000	20000	25000	30000
6	26250	1.32	2.98	5.28	8.27	11.92	21.12	33.1	47.68	74.50	132.4	206.75	298
5	33100	1.66	3.75	6.64	10.40	15.00	26.56	41.6	60.00	93.75	166.4	260.00	375
4	41740	2.10	4.74	8.40	13.15	18.96	33.60	52.6	75.84	118.50	210.4	328.75	474
3	52630	2.54	5.96	10.16	16.55	23.84	40.64	66.2	95.36	149.00	254.8	413.75	596
2	66370	3.33	7.51	13.32	20.85	30.04	53.28	83.4	120.16	187.75	333.6	521.25	751
1	83690	4.21	9.48	16.84	26.32	37.92	67.36	105.3	151.68	212.00	421.2	658.00	948
0	105500	5.29	11.92	21.16	33.10	47.68	84.64	132.4	191.72	298.00	529.6	827.50	1192
00	133100	6.71	15.11	26.84	41.97	60.44	107.36	167.9	241.76	377.75	671.6	1049.25	1511
000	167800	8.45	19.04	33.80	52.85	76.16	135.20	211.4	304.64	476.00	845.6	1321.25	1904
0000	211600	10.62	23.92	42.48	66.42	95.68	169.92	265.7	382.72	598.00	1062.8	1660.50	2392
	250000	12.58	28.33	50.32	78.67	113.32	201.28	314.7	453.28	708.25	1258.8	1966.75	2833
	500000	25.17	56.66	100.68	157.35	226.64	402.72	629.4	906.56	1416.50	2517.6	3933.75	5666

* * *

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES.

In the Hall process of making aluminum, the electrolyte is a solution of alumina in a fused mixture of croylite and aluminum fluoride as solvent. The anodes are made of carbon. The electrolytic reaction decomposes the alumina and gives aluminum as cathodic product and carbonic oxide as anodic product. In this process it is important to have a pure electrolyte. Anson G. Betts, in a recent patent, endeavors to make the electrolytic production of aluminum analogous to the process of copper refining and as a special advantage of his process he claims that it is not necessary to purify the ore before the metal is reduced from its oxide. His cell consists of three layers of fused materials separated from each other by the differences of specific gravity. The highest and lightest layer is fused aluminum, forming the cathode, the middle layer is the fused electrolyte and the lowest and heaviest layer is the fused aluminum ore with its impurities, which forms the anode. Since aluminum is most easily oxidized of the metals present in this mixture, it alone dissolves from the anode so that the resultant electrolysis is that pure aluminum is deposited at the cathode while fresh aluminum passes from the anodic mixture into the electrolyte. If the aluminum is deposited on a cathode of zinc, tin or aluminum bronze so as to form a liquid alloy at a temperature below the melting point of aluminum, other baths than the fluoride bath of the Hall process may be used, for instance, an electrolyte of fused sodium-aluminum chloride.

The same inventor has taken out a patent for parting precious metals. It is, of course, well known that electrolytic copper refining gives not only very pure copper, but leaves the anode slime in such a condition that silver and gold may easily be extracted from the same. Two processes—those of Moebius and Balbach, respectively—are in commercial use for this purpose. A. G. Betts patents the use of an electrolyte consisting of a strong non-oxidizing acid, together with the silver salt of this acid with a very small addition of such substances as gelatine and gum arabic to prevent the growth of trees. The silver is deposited on the cathode, the gold remains back at the anode (which it is not necessary to wrap up in cloth) while bismuth, etc., go into solution. When the solution has taken up sufficient of the impurities it is withdrawn. As a suitable electrolyte a solution of silver methyl sulphate and methyl sulphuric acid is mentioned.

C. M. Hall patents a stopper for the tap hole of pots containing fused electrolytes. It consists of a tapering metal plug which is driven into a body of plastic material of powdered carbon and tar previously placed in the tap hole. The plug is driven into a plastic body before the latter has become hard. The method of tapping is stated to be greatly facilitated by this apparatus.

MISCELLANEOUS.

E. D. Kendall patents a process of making tungsten steel free from carbon by reducing tungsten ore with zinc dust and alloying the reduced metallic tungsten with variable proportions of iron by one operation in an electric furnace.

D. R. S. Galbraith patents a process of making steel from iron sand, oxide of iron, etc., in an electric resistance furnace. As noticed in the Digest of this issue, his furnace was recently exhibited in London.

E. Langguth patents mechanical details of an electromagnetic ore separator, while a patent of D. L. Winters refers to mechanical details of construction of primary cells.

Nearly forty years ago Berthelot discovered that when powerful sparks from an induction coil are passed through a mixture of acetylene and nitrogen, prussic acid is produced and carbon is separated, but the efficiency is very low. W. Muthmann has recently patented a process which is a modification of that of Berthelot. He produces prussic acid by passing a gaseous mixture of nitrogen and hydrocarbons (cheap ones) through a high-voltage flame and immediately removing the products formed.

E. C. Paramore has patented a process by which he states the bleaching properties of ordinary chlorine gas are increased, while it is divested of its disagreeable odor. To this end he subjects streams or currents of dry chlorine gas to electric discharges of high tension passing through dielectric partitions with an exclusive passing of air.

A recent patent of R. M. McFarland relates to details of construction of a safety electric switch system for blast furnace hoists.

* * *

English and German Trolleys.

Discussing the relative importance of English and German electric street railway development, the London *Electrician* says: "While 510 miles of new route were added to the traction system of Germany between October 1, 1899, and October 1, 1900, the corresponding figures for the next years fell to 143, 180, 190 and 60 miles respectively. On October 1, 1904, up to which date the German tables have been corrected, the total length of single track of electric traction of all descriptions amounted to 3,525 miles. According to our own traction tables (published February 3, 1904), which refer to the state of conditions in the United Kingdom on January 1st of this year, the total length of track of electric tramways and railways came to, approximately, 3,000 miles. We are thus not so far behind Germany in this matter as people would have us believe; in fact, when the size of the two countries is taken into account, we are far in advance. In the United Kingdom there are 0.025 miles of electric tramway or railway per square mile, in Germany only 0.017. Probably also the British electric tramways and railways already carry more passengers per annum than the German ones."

* * *

Letter to the Editors.

Booster Feed Control.

To the Editors of Electrical World and Engineer:

Sirs:—If Mr. Lamar Lyndon will kindly refer to my article in the issue of June 24 he will see in the second line that there is no claim for originality (merely because the arrangement is so self-evident, although it happened never to have been brought to my notice). Nevertheless, the method was unknown on the test floor of a large electrical manufacturing company until introduced there by myself more than two years ago, in the form of two rheostats, one as a potentiometer, the other as a series resistance; and this arrangement, by dispensing with the large number of rheostats formerly used, and by giving a quick control of the field, has since been generally adopted.

Pittsburg, Pa. Carl P. Nachod.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Double-Field Alternating-Current Generators.—ZIEHL.—A paper read before Association of German Electrical Engineers on a new type of alternating-current generator. The essential feature is that both rotor and stator participate in the generation of energy. To explain the action of the machine the author first discusses the behavior of slip-ring induction motor, the rotor of which is not permitted to assume its natural speed, but which is driven with a certain speed from the outside. If z_1 is the frequency in the stator winding, z_2 the frequency in the rotor winding, $2\ p$ the number of poles and n the relative speed per second of the rotor with respect to the stator, then $z_2 = z_1 + p\ n$. There n is counted positive if opposite to the direction of rotation of the rotary field. If $n = 0$, $z_2 = z_1$, the machine acts as a transformer. With increasing n (positive, i. e., the rotor being driven opposite to the rotation of the rotary field), the frequency z_2 in the rotor increases and the machine acts partly as transformer and partly as generator, i. e., the fraction $z_1 \div z_2$ of the total electrical energy generated is supplied from electrical energy from the stator transformer action and the fraction $p\ n \div z_2$ is supplied from mechanical energy (generator action). If the stator is revolved in the same direction as the rotary field (n negative), z_2 first decreases with increasing absolute value of n, it becomes zero, for $z_1 = p\ n$, and then its absolute value increases again and z_2 becomes equal to z_1 when the speed of rotation of the rotor is twice the speed of rotation of the rotary field, i e., $p\ n = 2\ z_1$. This fact that the frequency in the stator becomes equal to the frequency in the rotor in this case, suggests to use both stator and rotor for generation of energy. Now, let us assume both stator, *a*, and rotor, *b*, each with identical three-phase windings to be at rest, as in Fig. 1 A, and let us assume that by some means we bring a revolving magnetic field into the machine (direction to the left). Then the instantaneous current values are as plotted in the diagram at the right hand. In Fig. 1 *B* the field has progressed 30 degrees from the position in Fig. 1 *A*, and in Fig. 1 *C* further 30 degrees more. It will be seen that the currents are equal and in phase and may therefore be connected in parallel, as shown in Fig. 1 *B* and *C*. While in Fig. 1 both rotor and stator are at rest, we will now assume that the rotor *b* revolves in clock-wise sense with a speed double that of the field and opposite to the same. The stator windings are then cut by a magnetic field which revolves in a direction opposite to that assumed in Fig. 1 (at rest). The e.m.f.'s are reversed and the currents flow in reversed direction. Fig. 2 represents this case of revolving rotor and shows that the currents in the rotor winding are the same as in Fig. 1, while the currents in the stator are reversed. To connect the windings in parallel, a different method is now required, as indicated in Fig. 2: the rotor phases are reversed and the stator phases 2 and 3 are exchanged. Under these conditions the phase currents in the two windings of stator and rotor are opposite to each other and there can be no armature reaction whatever; the machine is naturally compensated. The author then gives the analogous considerations for two phase and single phase. Now the problem is to bring a revolving field into the machine as required. The simplest method is to provide a special winding for this purpose. This is shown as 4, 5, 6 in Fig. 3, where the winding is placed on the rotor. But it might just as well be placed on the stator, or preferably on both stator and rotor. This excitation winding consumes only so many watts as are required for itself and the machine acts as a pure generator, transforming the total mechanical energy (less the losses) into mechanical energy. This was proven experimentally to be correct.

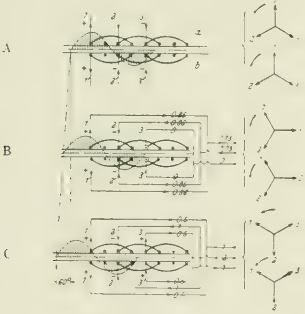


FIG. 1.—DOUBLE-FIELD, ALTERNATING-CURRENT GENERATOR.

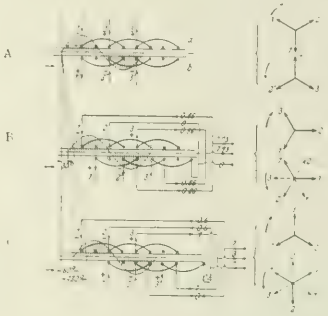
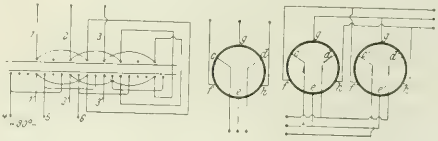


FIG. 2.—DOUBLE-FIELD, ALTERNATING-CURRENT GENERATOR.



FIGS. 3, 4 AND 5.—DOUBLE-FIELD, ALTERNATING-CURRENT GENERATOR.

Moreover, it is not necessary to provide these special excitation windings, if the main windings are closed windings. As shown in Figs. 4 and 5, the excitation current is supplied at $c\ d\ e$ and $c^1\ d^1\ e^1$ (the former referring to the stator, the latter to the rotor in Fig. 5), while the main current is taken off from $f\ g\ h$ and $f_1\ g_1\ h_1$. If a machine arranged according to Figs. 3, 4, 5 is connected in parallel with a network of given voltage, it acts as a generator running above synchronism and is excitated from the network. The author gives some results of tests made with experimental machines. In summing up, he thinks that the generator will be mainly used for supplying currents of a given frequency to a network; the excitation requires polyphase currents of the same frequency and the speed must be either double the speed of the field or the number of poles must be twice that in ordinary generators. The relation of speed to number of poles is given as follows: For a frequency of 50 the speed is 6,000, 2,000, 1,000, 500 and the corresponding number of poles is 2, 6, 12, 24. With a frequency of 25 the speed is 3,000, 1,000, 500, and the corresponding number of poles, 2, 6, 12. The machine, would, therefore, appear to be especially useful for high speeds, like in turbo-generators.—*Elec. Zeit.*, July 6.

Single-Phase Motor With Large Torque.—ZWEIGBERGH.—An abstract of an English patent in which the inventor first refers to the impossibility of designing alternating-current motors of the induction type or with a commutator for a very large starting torque and then proceeds to explain an arrangement by which this may be achieved if two single-phase series motors (or a multiple of two) are available. Instead of two motors, one double-wound motor, with two commutators, answers the same purpose. If the first motor is called the "A" motor, its two field coils being denoted by a_1 and a_2, and if the second motor is called the "B" motor, its two field coils being b_1 and b_2, then he connects the four field coils and the two armatures to form a closed circuit, the order being a_1, *A*, a_2 b_2, *B*, b_1, the latter being also connected to a_1. In this circuit there is also a small continuous-current generator. The alternating supply is connected at the junction of coils a_1 and b_1 and of coils a_2 and b_2. Supposing the single phase current to enter at the junction of a_1 and b_1, it will flow through the two motors in parallel, leaving the closed circuit again at the point where a_2 and b_2 meet. Now it is apparent that the alternating current will be aided—at a particular moment—by the continuous current in one branch and opposed in the other branch. This means that the self-inductance is reduced in the one branch and increased in the other. In the former a large current is now able to flow, and a correspondingly large torque is exerted. In the next moment the alternating current has reversed, and the other motor gives a large torque.—*Lond. Elec.*, July 14.

Testing Alternators.—S. P. Smith.—An article in which the author refers to different suggestions which have been made by Mordey, Ayrton and Behrend as to the best means of testing a single alternator in some way akin to the Hopkinson test for direct-current machines. The chief idea is to circulate full-load current through the machine without dissipating the full power. The author enumerates about a dozen possible modes of connecting up an alternator so that full-load current, at normal speed, may be caused to flow through its windings with a small expenditure of actual power. The methods of Mordey, Ayrton and Behrend appear as special cases of the general problem. Electrically, there is not very much to choose between the various kinds of connection, but for mechanical reasons a number of combinations have to be rejected. These methods are discussed by the author, who reaches the following general conclusions. For every ratio of generator to motor coils the respective fields should be symmetrically spaced all round the armature to avoid magnetic unbalancing and consequent mechanical disturbance. On account of armature reaction, it is in all cases desirable to use at least half the field coils as generator, obtaining a more equal distribution of flux round the armature, since the generator and motor lines per pole will more nearly equal one another, whilst the excess of resultant generator flux over resultant motor flux will be able to provide the necessary e.m.f. to drive the armature current. If it is decided to have unequal generator and motor-exciting currents, then the best combination is to divide up the field coils equally between the two and space the respective fields symmetrically round the armature. If it be decided to use equal field currents in motor and generator coils, then 60 or 70 per cent of the coils should be made to generate, whilst the rest should be equally interspaced to act as motor. The best combination can only be found in any particular case by trial—that is, when full-load current is obtained by normal field excitation. It is proposed to carry this method of testing alternators further, and to investigate more particularly how core losses and armature reaction are affected by thus dividing the field.—Lond. *Elec.*, July 14.

Electricity Meters.—Gerhardi.—A continuation of his illustrated serial. The author describes the Hookham and the Mordey-Fricker prepayment meters.—Lond. *Elec.*, July 14.

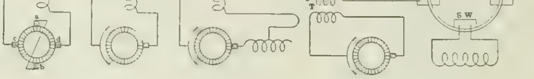
Power.

Driving of Rolling Mills.—An illustrated article on two modern rolling mills electrically equipped by a German company. The installation at the Bethlen-Falva iron and steel works in Germany is first described. There are three electrically-driven rolling mills, and the Ilgner system is employed. Three-phase currents at 5,800 volts and 25 cycles per second are brought by the works from a power plant and are fed directly to a 600-hp induction motor, which is coupled to a 500-kw compound-wound, continuous-current dynamo, a cast-steel flywheel—weighing 18½ tons and having a peripheral speed of 260 ft. per second—being keyed to the shaft between motor and generator. The synchronous speed of the motor is 375 revs. per min. and the speed of the set varies between 300 and 365 revs. per min., according to the load. When the load on the motor-generator increases, resistance is automatically inserted into the rotor winding of the 600-hp induction motor. This increases its slip and lowers its speed, and thus affords the rapidly-rotating flywheel the opportunity of supplying part of the load. When the load drops, resistance is cut off of the rotor circuit; the rotor now speeds up, storing energy in the heavy flywheel. The continuous-current generator is connected to 500-volt bus bars, from which the three motors are supplied, which drive the roughing-down rolls, the intermediate rolls and the finishing rolls. Another installation in an Austrian plant is remarkable for the size of the motors employed. The mills are of the reversing type with one housing, and the rolls have a diameter of no less than 5 ft. 9 in. Blooms weighing 4,000 lbs. are delivered to the rolls and in 21 operations are converted into rails 100 ft. long and weighing 63 lb. per yard; also into beams 75 ft. long and weighing 190 lb. per yard. The rolls are driven without the intervention of any gearing by two motors, which are coupled together, having a combined normal rating of 3,600 hp and capable of developing for short periods anything up to a maximum of 9,000 hp. These motors run at a maximum speed of 110 revs. per min., and the speed control as well as the stopping and reversing is effected by a special 3,000-kw starting dynamo, designed to give a wide range of voltage by shunt regulation. This starting dynamo, together with a heavy cast-steel flywheel, is directly driven by a high-speed, three-phase motor.—Lond. *Elec.*, June 16.

Gas Engines.—Mathot.—An article on methods for the starting of the gas engine, pointing out the simplicity and certainty of compressed air starting devices.—*Eng'ing Mag.*, July.

Traction.

Single-Phase Traction Motor.—An illustrated description of a single-phase traction motor, made by Bruce Peebles & Company, in Edinburgh. It is of the compensated repulsion motor type. Fig. 6 represents diagrammatically a bipolar, compensated, repulsion motor having four brushes at right angles. By short-circuiting the brushes a and b, the stator reactance is reduced owing to the armature ampere turns. A short-circuit current flows from a and b and back through the armature. This current reacts on the field flux in the direction cd produced by the main current, and a torque is produced. When the armature rotates, an e.m.f. is induced between a and b in its winding, due to the latter cutting through the field flux. This e.m.f. multiplied by the current, represents the motor output. The stator winding, S, though shown in the diagram as a single coil, is actually a distributed winding. In order to reduce the complication of brush gear and so on, the firm employs the modification shown in Fig. 7. Three brushes only are needed in the new arrangement, whose action otherwise is precisely the same as for the motor of Fig. 6. Fig. 8 shows another arrangement, which allows the motor speed to be varied within wide limits by strengthening or weakening the field flux. No series resistances are required at starting. The diagram, Fig. 9, shows a further development of the system, an induction regulator being used in this instance for the control of the field, while the stator winding is carried out on the high-tension principle; the transformer, T, allowing the commutator to be fed with current at a low voltage. The field winding is regulated by the position of the secondary winding, SW, of the induction regulator, and the compensating winding, CW, which is short-circuited, serves the purpose of annulling the self-induction in the primary of the regulator—so that only the ohmic losses in the same need be taken into account—and, further, of allowing additional speed regulation. It is claimed that in simplicity, lightness and efficiency the equipment is equal to any, while the power factor is believed to be higher than in any existing single-phase apparatus.—Lond. *Elec.*, July 14.



FIGS. 6, 7, 8 AND 9.—SINGLE-PHASE TRACTION MOTOR.

Motor Vehicles.—Garnus.—The first of a serial of illustrated article on commercial motor vehicles. The present article deals with steam-motor vehicles.—*Cassier's Mag.*, July.

Installations, Systems and Appliances.

Financial Results of German Central Stations.—Hoppe.—There are invested in the 1,028 German central station at least $172,500,000. Concerning the financial results obtained in these stations exact figures are available only from about 10 per cent of all stations. These have been compiled and are discussed by the present author. All the figures refer to the year 1903. The first cost of installation is given in the first column of table I, the stations being divided into seven different classes, according to their sizes.

TABLE I.

	Capital invested per kw. capacity.		Cost of operation per $1000 capital inv'sted
Over 5000 kw	$345		$60.0
Between 2000 and 5000 kw	365		65.0
" 1000 " 2000 "	340		72.0
" 500 " 1000 "	365	(385)	66.0
" 250 " 500 "	392.5	(417.5)	64.4
" 100 " 250 "	442.5	(450)	62.0
Below 100 kw.	610	(565)	56.5

In the four classes of smallest sizes some data as to the capital invested were available on gas-engine stations; the figures referring to these gas-engine driven stations are given in parenthesis. While the available data are somewhat scarce, it would seem that for stations above 100 kw, steam plants are somewhat cheaper in their first cost. The second column of the same table gives the cost of operation per thousand dollars of capital invested. It will be seen that the yearly cost of operation is in average 6 to 7 per cent of the capital invested. About one-third is expended for fuel, one-third for salaries and wages, and the last third for other expenses. This cost of operation covers only the direct expenses for running the plant and does not include any capital charges. About one-third of the cost of operation might be assumed as fixed charges.

TABLE II.

	Cost of oper't'n per 1-kw. capy.	per kw.-hour sold
Over 5000 kw.	kw $20.75	cents 2.5
Between 2000 and 5000	" 23.75	3.0
1000 " 2000	" 24.50	3.25
500 " 1000	" 24.25	3.5
250 " 500	" 25.25	3.75
100 " 250	" 27.50	4.00
Below 100 kw.	" 34.50	5.
Average	$25.80	

Table II shows again for the seven classes of stations, the cost of operation per 1-kw capacity and the cost of operation per kw-hour sold. In average 700 to 800 kw-hours have been sold per kw-capacity installed. In very many cities the direct cost of operation is considerably below 2.5 cent per kw-hour sold (the lowest figure is given for upper Silesia and is 1.12 cent per kw-hour sold). In many stations this cost of operation is, however, above 5 cents. It appears that in general in cities with large stations in operation for several years the cost of operation is lower than in newer and smaller stations. The author then compares this cost of operation with the total receipts and gives the difference in percentage of the capital invested. If the station is to work economically this difference must be high enough to pay interest for the capital and amortization. If the difference between the receipts and cost of operation is not more than 10 per cent of the capital invested, the station cannot be considered to be economical. This seems to be indeed the case for most of the stations discussed by the author, as shown in table III. This table gives first data arranged according to the rate charged for light and for power and finally the average surplus. The figures given are the difference of receipts and expenses in percents of capital invested. It will be seen that only the larger stations may be considered to be economical. Out of 83 stations there were only in 31 stations the difference between receipts and expenses more than 10 per cent of the capital invested, which is satisfactory; in 22 stations the result was very unsatisfactory, the difference mentioned being below 5 per cent of the capital invested; in the other 30 stations the difference was between 5 and 10 per cent. Of the 31 stations which work economically 20 were municipal and 11 owned by private companies. Of the 22 stations with very bad results seven were municipal and 15 were owned by private companies. The author emphasizes that it is absolutely wrong to charge for current for power purposes less than the net cost. He emphasizes that the capital invested should be as low as possible and that the construction should be simple and solid. The greatest economy in working is necessary. The conditions for making connections should be made as easy as possible and the meter rent should be as low as possible. Without exact calculations and investigation it is wrong to consider every consumer of current for power purposes a priori as a good acquisition. The general manager of an electric station should be at least as well versed in business affairs as in engineering.—*Elek. Zeit.*, July 20.

TABLE III.

	Lighting rate per kw.-hour.			Power rate per kw.-hour.			
	15 c.	above 15 c.	below 15 c.	above 5 c.	= 5 c.	less than 5 c.	Average "surplus" in percent of capital invested
Over 5000 kw.	——	12.0	8.6	6.7	10.1	——	10.5
Between 2000 and 5000 kw.	13.8	11.8	11.9	14.2	12.1	9.6	12.4
1000 2000	11.6	6.9	5.2	8.5	9.2	4.7	8.0
500 1000	8.0	9.1	7.6	8.9	7.8	8.7	8.4
250 500	——	7.9	7.3	8.4	3.2	6.3	7.6
100 250	6.4	6.1	4.8	7.9	4.2	4.0	5.5
Below 100 kw.	——	4.4	3.8	3.1	4.2	——	3.9

Works Accounts. From the annual report of the Manchester municipal electric station it appears that the new lamp connections during 12 months were equivalent to 52,080 lamps of 8 cp, and the new motor connections to 75,851 lamps of 8 c-p. Great progress has been made in the motor-hiring business, the motors on hire numbering 348 and totalling some 1,422 hp. It is stated that the percentage increase of power units for the year, amounting to no less than 74 per cent, must be directly attributable principally to the motor-hiring scheme. On the other hand, it is pointed out that the low rates charged for hire involve a certain amount of risk to the department, and very strict supervision, over the consumers as well as the motors, is required. The total kw-hours sold during the year were 33,686,710. The costs per kw-hour sold were as follows: Generating costs 1.000 cent, distribution costs 0.506 cent, total works costs 1.506 cents, management charges 0.432 cent, total costs excluding capital charges 1.938 cents, total costs including capital charges 3.696 cents. From the annual report of the Salford station it appears that 9,002,310 kw-hours were sold. The cost per kw-hour sold were as follows: Generating costs 0.754 cent, distributing costs 0.232 cent, total works cost 0.986 cent, management charges 0.378 cent, total costs excluding capital charges 1.364 cents, total costs including capital charges 3.130 cents.—Lond. *Elec.*, July 14.

WIRES, WIRING AND CONDUITS.

Cable Laying.—A communication from a German company arguing that for iron-sheathed cables, "freed" coal tar (a product obtained by dissolving coal tar pitch in anthracen oil) should always be employed. It is also thought that it should be employed for unarmored lead cables, since it offers greater security for the life of the cable than is possible where crude tar is used.—Lond. *Elec.*, June 23.

Zinc-Plated Iron.—Szirmay.—An account of experiments in which he tested the resistance against rusting of zinc-plated iron and steel wires, in order to compare the efficiency of hot plating with electro-plating. To test the resistance against atmospheric influence he placed his test wires under a globe into which air was introduced with sulphurous fumes and carbonic acid under pressure. He found that electroplated wires resist much better than any hot-plated wire, on account of the better adherence and the greater purity of the electrolytic deposit Similar results were obtained with other zinc-plated iron and steel ware, since the electroplated ware stands better bending and machining.—*Zeit. f. Elektrochemie*, June 2.

Rapid Electrodeposition of Copper.—Cowper-Coles.—A paper in which the author discusses the various processes for using a high current density in copper deposition. They are revolving or moving of the cathode, burnishing the copper during deposition, insulating the growths on the copper so as to prevent further increase, rapid circulation of the electrolyte, revolving mandrel at a critical speed. The last-named process is the author's own centrifugal process. The mandrels are suspended vertically and are provided with Pelton wheels, which are driven by the electrolyte impinging against them. In the most recent form, however, a tubular vat is used and hollow mandrels suspended on ball bearings, through the middle of which run the spindles. These are driven by a worm gearing from below. By using a mandrel in which a V groove has been indented the spiral deposit that results can easily be pulled away and then drawn down at once into wire, which can thus be made from crude copper in what is practically one operation.—From advanced sheets of a *Faraday Society Paper.*

Electric Steel Furnace.—An account of a recent demonstration in London of the Galbraith electric furnace. It is entirely of graphite, being built up of several units one on top of the other. Each unit is in shape of a box with top and bottom removed, and a number of graphite bars of rhombic section protrude through the box from front to back. In the furnace shown there were four bars in a horizontal plane, these bars being connected in front and back so as to constitute a grid. Altogether there are about eight such grids in the furnace ,one above the other, and the bars of any one grid are staggered with respect to the bars of the grid immediately above and below. Low-voltage, alternating current is sent through the graphite bars in parallel, which thus become incandescent, their temperature rising to some 1,600 deg. C. Ironsand, just as it came from the huge deposits on the beach of New Plymouth (New Zealand), was heated in crucibles with powdered coal dust previously to the demonstration, and was then fed continuously into the furnace from the top. The following is an analysis of New Zealand ironsand: Peroxide of iron, 67.04; protoxide of iron, 30.17; manganese peroxide, 0.22; aluminium oxide, 0.16; silica, 0.50; calcium, trace; magnesium, trace; titanium, 1.60; undetermined, 0.31. This sand has always been considered to be practically free from phosphorus. The aim of the inventors is to produce steel directly and practically without a flux. The process is still in the experimental stage.—Lond. *Elec.*, July 21; Lond. *Eng'ing.*, July 21.

Heat Insulation.—HUTTON AND BEARD.—A Faraday Society paper on heat insulation, particularly with regard to materials used in electric furnace construction. He first describes a method for determining the absolute value of the heat conductivity of refractory materials. Tests of various substances show that light calcined magnesia and infusorial earth have the lowest heat conductivity. They are not suitable, however, directly as refractories since they shrink at the very high temperatures of the electric furnace. They can often be used, however, to advance in conjunction with some more stable though less good insulating material which serves for the internal lining of the furnace. — *Electrochem. and Met. Ind.*, August.

Action of Ammonia on Electrolyte of Storage Batteries.—VICAREY. An account of an investigation which shows that ammonia must be considered a dangerous impurity, the total absence of which, however, cannot be absolutely insisted upon. The presence of ammonia in the surroundings or neighborhood of the cell must be carefully guarded against, and the percentage actually present in the cell must be kept as low as possible by the use of water and acid of the purest quality. The effects of ammonia in its various combinations appear principally in two distinct forms: First, it causes an excessive disintegration or shedding of active material at the positive (PbO_2) plate; secondly, it becomes deposited upon the negative (spongy) plate, and finally closes up the pores of the active material, thereby causing a decrease in the ampere-hour capacity or efficiency varying from 10 to 60 per cent in about twelve months. The use of water taken from the steam boiler and termed "distilled" is mentioned as a dangerous practice that is common in central stations.—From advanced sheets of a *Faraday Society Paper.*

Electric Production of Nitric Acid.—CARVETH AND RAND.—A summary of the various processes which have been proposed for the production of nitric acid by passing electrical discharges through air. The following table gives results obtained by various experimenters, the figures giving the grams of nitric acid obtained per kw-hour:

1897	Rayleigh	40.1	grams HNO_3
1901	McDougal and Howles (best yield)	33.8	" "
1902	De Kowalski	55.0	" "
1903	Muthmann and Hofer	70.0	" "
1897	Crookes	74.0	" "
1902	Bradley and Lovejoy	83.0	" "
1904	Birkeland and Eyde	110.0	" "

The calculations of Muthmann and Hofer indicate 157.5 grams of nitric acid per kw-hour as the theoretical maximum efficiency.—*Sibley Jour. of Eng'ing,* May.

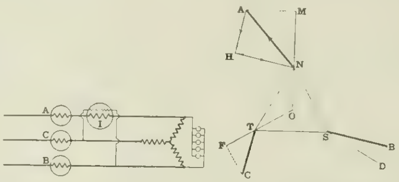
Electric Endosmosis.—REIFF.—An article giving a summary of the investigations of Wiedemann on endosmosis or cataphoresis, which is the phenomenon of the bodily transfer of the liquid through a porous diaphragm during the passage of a current, which phenomenon is distinctly different from the migration of the ions. Cruse has recently determined the influence of temperature of endosmosis and found that the electric endosmosis of distilled water through a porous diaphragm of clay increases with increasing temperature to a maximum which is reached at 35 or 40 deg. C.; afterward the endosmosis decreases. Schwerin has tried to utilize this phenomenon for separating water from peat.—*Elec. u. Polyt. Rund.*, July 1.

Osmotic Experiments.—BARLOW.—An account of osmotic experiments on mixtures of alcohol and water. The author has repeated with great care the experiment of Pickering which the latter considered as a crucial one against the dissociation theory and in favor of the hydrate theory. The present author shows that this conclusion is thoroughly unwarranted. Nevertheless, he agrees that some kind of hydrate theory seems necessary, but in this sense it must not be regarded as excluding dissociation.—*Phil. Mag.*, July.

Voltage Series.—DANNEEL.—An account of experiments which appear to show that, while at ordinary temperatures calcium is more negative than sodium, their relative position in the voltage series is reversed at higher temperatures.—*Zeit. f. Elektrochem.*, April 7.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Three-Phase Power Measurement Without Wattmeters.—A communication first referring to the case that the load consists of induction motors only. The load is then balanced and a single ammeter in any one of the three conductors, together with a single-phase indicating device, enables the calculation of the total three-phase power. If the load consists partly of induction motors and partly of incandescent lamps, the load will in general no longer be balanced. In this case it is possible to find the total power with the aid of three ammeters in each of the three phases and a single wattless-current ammeter, arranged as shown in Fig. 10. In the vector diagram (Fig. 11) draw the equilateral triangle $N S T$ to represent the three pressures between terminals, the length of the side being supposed proportional to the voltage E. From the center O draw the three equivalent star vectors through the points N, S and T, respectively. Now, from the readings I and A of the wattless-current ammeter and the ammeter in series with same calculate the energy component of the current by means of the formula $M N = \sqrt{A^2 - I^2}$. This gives the point M on the prolongation of the vector $O N$, and by completing the right-angled triangle $N M A$, with the length $M A$ to represent the wattless current, the direction of the vector $N A$ is obtained, which represents the current in the ammeter A (Fig. 10). The two other current vectors $S B$ and $T C$ are now easily drawn because the vectorial sum of all three currents must necessarily be equal to zero. From the point N as a center describe an arc of circle of such a radius as to represent the current indicated by the ammeter B, and from A as a center describe another arc of radius $A H$ equal to the current C. These circles will intersect at the point H, and the triangle $N A H$ will, therefore, represent the closed polygon of the current vectors. Draw $T C$ equal and parallel to $A H$ and $S B$ equal and parallel to $H N$; also drop the perpendiculars $C F$ and $B D$, respectively, on the prolongations of the pressure vectors $O T$ and $O S$. The diagram is now complete and the total power is given by the expression: Watts $= \sqrt{3} E (N M + T F + S D)$ — Lond. *Elec.*, July 21.



FIGS. 10 AND 11.—THREE-PHASE POWER MEASUREMENTS.

Alternating-Current Meter.—An official statement from the *Reichsanstalt* concerning admission for calibration of the "Isaria meter" for single-phase current made by the Luxsche Industriewerke. It consists of a magnetically braked induction motor and a counting device. The motor consists of the light revolving disc A_S of aluminium in Fig. 12, the shunt magnet N above the disc, while below the same four main-current magnets F_1, F_1, F_2, F_2, are provided. The iron core of the shunt magnet N is almost completely closed, so that

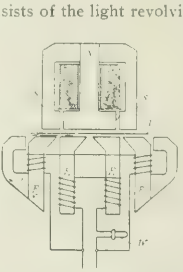


FIG. 12.—ALTERNATING-CURRENT METER.

there is strong self-induction, on account of which the shunt current lags, $a = 70°$, behind the voltage at the terminals. The slits $S\ S$ produce stray fields which cut the aluminium disc. This is the shunt field H_1, which is proportional to the supply voltage, but lags in phase behind it by 70°. The main current when entering the meter divides itself into two branches, of which the first passes around the cores $F_1 F_1$; this circuit contains essentially non-inductive resistance on account of the wide air space between the cores and the non-inductive resistance W. The second branch is around the cores $F_2 F_2$ and contains a high self-induction on account of the attached parts J. The main current, therefore, consists of two components, of which the one passing through $F_2 F_2$ lags in phase behind the other, which passes through $F_1 F_1$. The direction of the windings in F_1 is opposite to that in F_2. The total main field H_2 produced by both together leads in phase before the main current; the self-inductions and resistances are so chosen that the angle of lead is 20°. Now, if H_1 and H_2 are the shunt field and the main field, respectively, the torque exerted on the disc is proportional to the product of H_1 and H_2 and to the sine of the phase difference between the two. This phase difference is 90° minus the phase difference between supply voltage and current; H_1 is proportional to the supply voltage and H_2 to the main current; hence the torque is proportional to the power. The disc revolves between the poles of a magnet, and the braking effect is proportional to the instantaneous speed, so that the number of revolutions which are counted by the registering device is approximately proportional to the power. The construction of the meter and the method of calibrating are described in great detail. A three-phase meter, based on the same principles, is also described.—*Elek. Zeit.*, June 29.

Measuring Efficiency of Dynamos.—BOEHM-RAFFAY.—A description of Swinburne's method of determining the efficiency of a dynamo from its separate losses, when an auxiliary source of electricity of lower voltage than the normal voltage of the tested dynamo is available.—*Elek. Neu. Anz.*, June 15.

Cable Steamer.—An illustrated description of the twin-screw cable steamer *Cambria,* which, though not one of the largest, is said to embody all the qualities of an ideal telegraph steamer.—Lond. *Elec.*, June 16.

Central Battery System.—MUELLER.—The first part of an illustrated article on the use of the central battery system in Austrian telephone exchanges.—*Zeit. f. Elek.* (Vienna), July 9.

Management of Industrial Organizations.—WILLIAM H. NICHOLS. His presidential address before the Society of Chemical Industry. He deals in great detail with the management of a large chemical industrial organization and discusses the duties of the different departments. He especially deals with the operating department, the construction department, the investigation or research department and the statistical department. The latter he considers absolutely essential for a company owning several works. The statistical department has to do with the combination of facts and the deduction from them. This department of his own company is not only able to advise the officers within a reasonable time after the end of each month of the cost of every product and step, but also of the profit or loss on each article and the total profit or loss of the company. These results have been so exact that for several years the profits determined by public accountants at the end of the year have not varied 1 per cent from those compiled by the statistical department month by month.—*Jour. of the Soc. of Chem. Ind.*, July 15.

Biographical.—A biographical sketch, with portrait of Alexander Jay Wurts, with reference to his recent appointment to the faculty of the Carnegie Technical Schools.—*Elec. Jour.*, July.

BOOK REVIEWS.

MOODY'S MANUAL OF RAILROADS AND CORPORATION STATISTICS. 1905. New York: Moody Publishing Company. 2,580 pages. Cloth, $10.

This interesting and valuable manual covers literally the entire field of corporation investment, and the effort to add to its utility is manifested in the addition of 80 per cent of contents over the matter furnished last year. A good deal of the new data belongs to the electrical field, which is doing its share in providing new opportunities for shrewd and careful investors. While there are other sources of reference for railroads and lighting companies, this is in point of fact the only one for allied industrials and for telegraph and telephone companies. An excellent feature also is the inclusion of membership lists for the 25 stock exchanges of the United States. As our readers are probably aware, not only are the financial data furnished as to any given corporation, but the names of its officers and directors and other details in regard to which there is constant inquiry. The full indexes make all the material handy for swift reference and study. The Manual is, indeed, a birdseye view of the vast development and condition of corporate investment industry and personnel in the United States.

ENTWURF UND KONSTRUKTION. By Ernst Schulz. Hannover: Gebruder Janecke. 132 pages, 110 illustrations.

This little work of 132 pages, containing 110 cuts, is a very interesting study for a designing engineer. It presupposes not only a fair knowledge of the methods of designing direct and alternating-current motors, but a familiarity with the subject. The author points out that competition forces manufacturers and more particularly the smaller ones, to use the material more economically and ventilation more freely than formerly. He goes further in many respects than many makers would, by suggesting and using the same frames for polyphase motors as for direct-current motors. By so doing the cost of manufacture is lowered as the same patterns, gauges, bearings and end plates for both types of motors would be identical. He illustrates his assumptions on examples which are well carried out in detail.

He makes use of and refers to the very latest publications of Profs. Arnold, Niethammer, Sengel, Mr. Hobart, Fischer-Hinnen and others, comparing their formulæ in a very interesting and instructive way, although the engineer who does not possess these other works will have trouble in more than one place to follow the author, as the measuring of some of the letters of these other authors is not to be found in the key given at the beginning of the book.

It is divided into two parts. Part I treats on direct-current motors. In Chapter I the proper selection of armature diameter to length parallel to the shaft is considered. He shows Prof. Arnold's curve which was published in the *Elektrotechnische Zeitschrift* in 1903 and appears also in his masterly works recently published. In a table the author compares diameter and length of armatures of from 3 to 150 hp as found from the Arnold formula and that of Sengel. The dimensions derived by means of the former formula lead to a more economical design all the way through. The chapter closes with a discussion on length and width of field magnet coils. Chapter II deals with the selection of the number of poles; Chapter III judging the quality of a machine by means of modern theory. In this chapter he discusses Hobart's article on the commutation of dynamos, which appeared in the *Elektrotechnische Zeitschrift,* 1901, and especially the reactance determination; also the methods of Rothert, Niethammer and Fischer-Hinnen, pointing out their differences and discrepancies.

Chapter IV deals with the shapes of pole shoes and their materials, while Chapter V discusses yokes, forms and material. The design of machines for production in quantities is treated in Chapter VI, and in VII examples are enumerated and arranged in form of tables of types which can be built with the same punchings; they having the same diameter, slot number and shape, while the axial core length is varied. The pressures selected are 110, 220 and 440 volts, the speeds vary from 1,200 to 300 r.p.m., and the capacities from ¾ hp to 5 hp.

Throughout his determinations the author uses the formulæ of several well-known engineers, such as Arnold's and Fischer-Hinnen, and points out the differences in the results, which is very instructive. The first part closes with the determination of the cost price of a line of machines so designed.

The second part which follows, treated on similar lines, is very interesting. Chapter IX deals with the selection of diameter and core length of the rotor of a polyphase motor. Also here the curve of Prof. Arnold is used and its suitability pointed out. Although heretofore larger dimensions were used, makers more and more use smaller dimensions and better ventilation.

In determining the leakage coefficient σ he shows that Behrend's so-called constant is not a constant, and that the table of Hobart's article for the determination of leakage lines published in the *Elektrotechnische Zeitschrift* in 1903, pages 933 and 934, is of greater importance than the curves given in the article because the latter can lead to entirely wrong values if not used with a great deal of discrimination.

The author is correct in his arguments that the slot opening of the punching is no criterion, and that it is of vital importance to compare this slot opening with the length of the air-gap. Authorities such as Arnold and Benischke hold similar views as the treatment of this subject in their recent contribution to the technical literature indicates. An example is given to illustrate this point.

Chapter X treats the subject of the slot number of stator with regard to manufacture in quantity. In the determination of suitability of slots the author is guided by the greatest number of times a given punching can be used for either a single, two or three-phase motor of 4, 6, 8, 10, 12, etc., poles.

In Chapter XI the details and determinations of a 4, 5 and 6-hp, three phase motor are given which are well carried out, although the relative selection of 48 stator slots and 36 in the rotor is not considered the best practice.

The subject is followed by a short description and illustrations of modern direct and polyphase motors of well-known European makers of capacities below 10 hp. The author shows by means of these illustrations that the dimensions of polyphase motors are approaching those of direct-current motors, and that the task of simplifying the manufacture by utilizing as much as possible the same parts for direct current as well as polyphase machines can be accomplished.

Power Factor in Induction Motors.

By A. A. Averrett.

The question whether three-phase or two-phase induction motors have the higher power factor, other features being equal, has often been discussed. The following considerations show that a three-phase motor always has the advantage of a higher power factor than a two-phase motor having an equally good arrangement of copper and the same maximum output and efficiency.

Three-phase and two-phase motors are actually wound six-phase and four-phase (60 deg. and 90 deg. windings), respectively. The operating conditions for induction motors are somewhat similar to those for six-phase and four-phase rotary converters, in which the six-phase winding gives better results than the four-phase winding.

The reason for the superiority of the three-phase, 60-deg. winding lies in the fact that the ratio of effective turns to actual turns is as the chord to the arc. This ratio is $\frac{3}{\pi}$ in 60 deg. windings, while in two-phase (90 deg.) windings the ratio is $\frac{2\sqrt{2}}{\pi}$. In other words, the 60 deg. winding has 95.6 per cent of the actual turns effective, while the 90 deg. winding has only 90 per cent of the turns effective. Fig. 1 graphically presents this advantage of the three-phase over the two-phase winding, by showing how the length of the chord approaches the length of the arc more nearly in the chord which subtends an angle of 60 deg. than in the chord which subtends an angle of 90 deg.

FIG. 1.—DIAGRAM SHOWING THE RATIO OF EFFECTIVE TURNS TO ACTUAL TURNS FOR TWO-PHASE AND THREE PHASE.

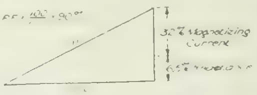


FIG. 2.—METHOD OF FINDING POWER FACTOR.

A representative General Electric three-phase motor having a power factor of .90 at full load and .83 at half load will have about .32 magnetizing current, .165 reactance, and a stationary impedance current of about 5.75 times full load current. The same motor if wound two-phase will have .36 magnetizing current and the same reactance (.165) at full load, which will give a power factor of .89; while the half load power factor will be .80.

The following table gives the values of power factor at full load and half load, and of per cent magnetizing current and per cent reactance at full load, for "moderate-speed" and "slow-speed" three-phase and two-phase motors. In computing these results, the energy losses, which would affect the results but slightly, have been neglected. The power factor at full load may be found by the approximate graphical method shown in the example, Fig. 2, knowing the per cent magnetizing current and per cent reactance.

Type of Motor.		% Power Factor.	% Mag. Current.	% Reactance.
3-Phase Mod. Speed	Full Load........	90	32	16.5
	Half Load........	83		
2-Phase Mod. Speed	Full Load........	89	36	16.5
	Half Load........	80		
3-Phase Slow Speed	Full Load	84	45	20
	Half Load......	69		
2 Phase Slow Speed	Full Load........	82	50.5	20
	Half Load........	65		

While these results are approximate, the same degree of approximation is obtained in each case, so that a comparison of the results gives a fair idea of the relative values of the two types of motor. The power factors and magnetizing currents in the above table show the superiority of the three-phase 60-deg. winding over the two-phase 90-deg. winding. It will be noted that the advantage of the three-phase over the two-phase winding is somewhat greater in the slow speed than in the moderate-speed motor.

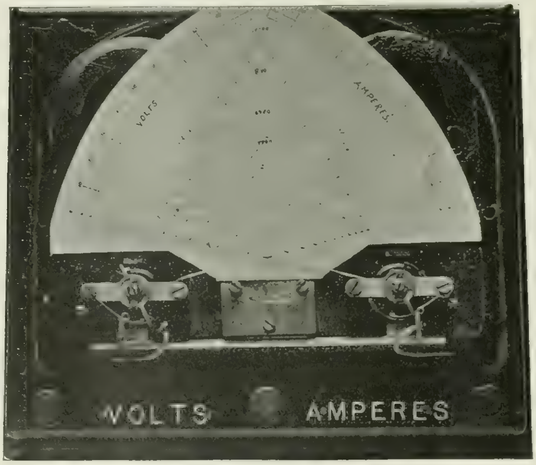
The above considerations show that two-phase motors have inherently a lower factor than three-phase motors. The data fairly represent good modern induction motors. It is possible to make as favorable a power factor showing for the two-phase as for the three-phase winding by the use of an excessive amount of material and at the expense of efficiency.

A New Electrical Measuring Instrument.

By W. P. Snyder and H. Herzberg.

In the accompanying illustration is indicated the general construction of a type of instrument which serves simultaneously for measuring the amperes, volts, watts and horse-power in an electrical circuit. The instrument consists of a voltmeter and an ammeter so housed in the casing that the individual pointers while moving along their respective scales must always cross each other. The points of intersection of the pointers are graduated from the product of the readings indicated on the voltmeter and ammeter scales, so that each point corresponds to a certain definite value of watts.

By joining these points at various positions over the scale which corresponds to 746 watts, there is obtained a line every point of which corresponds to one horse-power. Similar lines are drawn for various values of watts corresponding to any desired values of horse-power, so that the instrument is graduated to read it in horse-power as well as in watts. The location of the horse-power lines will be noted from an inspection of the accompanying illustration.



HORSE-POWER METER.

It is interesting to note that, while each horizontal line corresponds to a definite value of power, and each vertical line which is inclined to the right corresponds to a definite value of current, and that each vertical line which is inclined to the left corresponds to a definite value of e.m.f., each point on the surface of the chart corresponds simultaneously to a certain value of volts, of amperes, of watts and of horse-power.

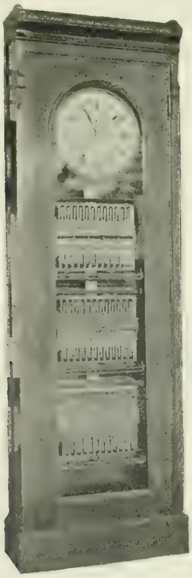
The instrument is intended for use on direct-current circuits. It contains the complete actuating parts of both an ammeter and a voltmeter, but the two being combined in one case it is considerably more compact and convenient than would be true of two separate meters, while the power meter features are obtained without additional equipment or complications. It is evident that the instrument is advantageous for use in any direct-current installation. It possesses special advantages, however, for the electric automobile with which a power meter has not heretofore been used on account of the added complication and expense, the voltmeter and ammeter being required in any event. As a portable instrument for testing purposes the new meter should prove of great value to the electrician.

This instrument which is called a horse-power meter by its inventors, W. P. Snyder and H. Hertzberg, is now being exhibited by Griffin & Bernhard, 277 Broadway, New York.

Large Electric Magneto Watchman's Clock for Boston.

A 150-station electric magneto watchman's clock, probably the largest in the world, has recently been built for Messrs. Jordan, Marsh & Co., of Boston, by the E. Howard Clock Co., of that city. As shown in the illustration, the recording magnets are banked in three vertical sections of 50 pairs each, dividing the clock as far as recording purposes are concerned into three separate clocks of similar design. The clock is 8 ft. 6 in. high, 33 in. wide and 14 in. deep over all dimensions, and the mechanism is installed in a handsome solid oak case with hinged door and plate glass front. It is guaranteed to keep within 30 seconds per month of correct time and is driven by weights with pendulum and jeweled escapement. The weight of the clock complete is 250 lbs.

Above each of the three double banks of magnets is a spool upon which the recording strip of paper, 15 in. wide, is placed, the capacity of each spool being sufficient for a week's run. The paper passes from the reel through a guide rod to the perforating bar in the centre of each group of 50 magnets, whence it goes to two milled wheels mounted on a horizontal shaft that is bevel-geared to the mechanism of the time clock above. The movement of the clock draws the paper downward, and it then passes over a knife edge below the magnet group which perforates it, dropping in a long roll into the bottom of the case unless it is torn off by hand as it traverses the knife edge.



MAGNETO WATCHMAN'S CLOCK.

The magnets are fitted with armatures to which small brass levers are attached, the fulcrums of the levers being located for each set of magnets in the horizontal supporting bar nearest the latter. One of these supporting bars or light trusses is located on each side of the perforating bar, the arrangement being the same in all three sections of the recording mechanism. The armature or striking levers each carry a needle point at the end which perforates the paper as the watchman at any particular station rings in his visit. The magnets are operated without batteries, the current being forced through them by the alternating e.m.f. generators in the magnets at the station boxes. Each box is connected by a single wire with its corresponding magnet pair, a common return wire being used for all the stations. The resistance of each coil is about 20 ohms, two coils of No. 26 B. and S. silk-covered wire being used on each electromagnet. All wires which pass over metal work are encased in rubber tubing to prevent abrasion and resulting short circuits or breaks. Lever springs are used on the backs of the armature connecting bars to hold the needles away from the paper when there is no current in the electromagnets.

An important advantage of the clock lies in the facility with which the records can be read, in comparison with the usual circular dials. Ordinarily, also, paper rolls have to be replaced every 12 hours. The continuous record of the new Howard clock, extending over a week's time, enables records to be made at any hour of the day and night and does away with interruptions in business hours, as well as the expense and inconvenience of Sunday and holiday replacements by a specially named employe. Clocks of this description are now made in various sizes with the foregoing as a maximum, the prices of complete installation varying from about $500 to $1,500. A 30-station clock of this type has recently been placed in service in the new Post Office Square Building, Boston.

New Type of Direct-Current Power-Circuit Lamp.

The General Electric Company has recently placed on the market a direct-current power-circuit arc lamp similar in design to the parallel-rod edgewise-wound multiple lamp. This new lamp, which is shown in the accompanying illustrations, embodies all of the advantages of the parallel-rod design and at the same time has distinctive features which are considered to make it more desirable than the usual differential power circuit type of lamp.

The new lamps are designed for use two in series on 220 volts or five in series on 550 volts, and they can also be operated singly on 110 volts by removing the regulating weight that forms part of the mechanism of each lamp. This type of lamp is recommended for use on 220 volts, where permissible, in preference to the 220-volt multiple lamp, on account of its higher efficiency and better quality of light.

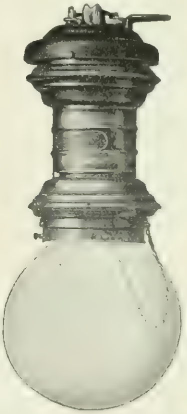


FIG. 1.—EDGEWISE-WOUND LAMP.

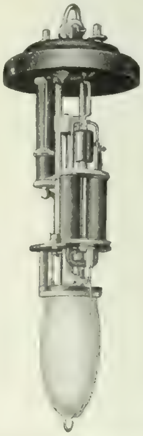


FIG. 2. VIEW OF LAMP WITH COVER REMOVED.

The parallel rod construction for arc lamps has been well known for some time, and many thousand lamps of this design are in successful operation. The lamp has obtained its name from the fact that the two main castings, top and base, are connected by two parallel steel rods. The magnets are mounted upon the base of the lamp, and the adjusting resistance is supported between the top and the base. The magnets and resistances are all parallel to the main connecting rods, an arrangement which presents a most attractive appearance. All who have had experience with the multiple lamp will recall the novel construction of the coils for the magnets and resistances. These coils are produced by winding ribbon wire on edge, and insulating the consecutive turns with non-combustible material. This construction, which has been followed in the new power-circuit lamp, is practically indestructible.

In the design of the new lamp, the number of insulating and other parts has been reduced to a minimum. All necessary insulating pieces have been so designed as to insure mechanical strength as well as good insulating qualities. Particular attention has been paid to the insulation of the frame from the current-carrying parts. The insulating pieces are of porcelain, the number of small bushings and mica washers having been reduced to a minimum. The absence of lead wires is very noticeable, there being in the lamp only one flexible cable (insulated with glass beads). With this construction, the insulation of the lamp is nearly ideal.

To adapt the parallel-rod lamp to operation in series on power circuits, an improved mechanical device has been designed to maintain the proper voltage relation among the various lamps of the series. Suspended from a lug in the lamp top, and projecting downward, is a bell-crank lever having one arm weighted and the other attached through a connecting link to the top of a frame that is carried by the magnet armature. The distance of the weight from the fulcrum of the lever is adjustable. The object of this weight is to counteract any tendency toward unequal arc lengths among the lamps caused by so-called "stealing of voltage." By this simple mechanical device, the regulation of the lamp is obtained without the employment of shunt magnets

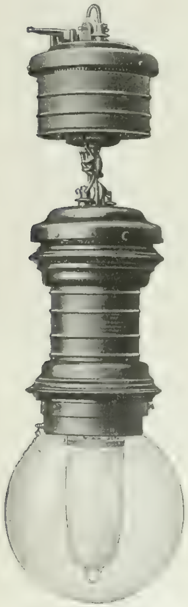


FIG. 3.—VIEW OF LAMP WITH EXTERNAL CUT-OUT.

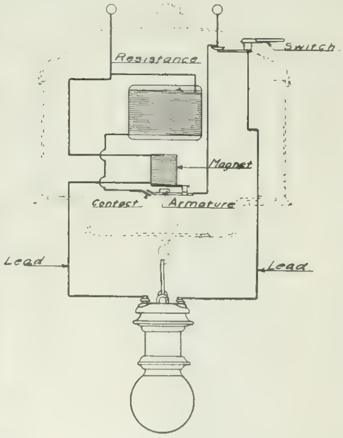


FIG. 4.—CONNECTIONS OF AUTOMATIC CUT-OUT AND RESISTANCE.

The only resistance used with the new power-circuit lamp is an adjusting resistance, the cut-out resistance, which is so common with other lamps of this type, having been omitted. While the failure of any lamp of a series unprovided with cut-outs will cause the entire series to go out, such failure is extremely unlikely with the new power-circuit lamps, as the simple construction of the lamp renders it thoroughly reliable. However, an individual cut-out is furnished when desired. The cut-out, which is an entirely separate device from the lamp itself, is connected in series with the lamp and hung directly over it, as shown in Fig. 3. In operation, a small controlling magnet, in series with the lamp, releases its armature when the lamp goes out, thereby placing the cut-out resistance in circuit. The arrangement and connection of this cut-out is shown in the accompanying diagram, Fig. 4. The device constitutes a very compact form of resistance, which can readily be substituted for the lamp if required. The simplicity of the construction of the parallel-rod lamp insures a low maintenance cost.

Automatic Self-Adjusting Clutch.

A clutch that grips automatically with the load and cannot slip when fully engaged; that is self-adjusting until worn out; that will accelerate a load from rest to full speed uniformly under absolute control entering a locked or positive engagement—such a clutch is a desirable piece of mechanism and is said by the American Automatic Clutch Company, of Akron, Ohio, to be represented in their device herewith illustrated in Figs. 1 and 2.

In Fig. 1 a sectional view of the automatic clutch is shown in the disengaged or off position. *A* is the operating sleeve which carries the pins, *B* and *C*, shown in section, which fit between the faces of the cavity in the keyed member, *D*. Loosely placed between the pins *B* and *C* is a lever, *E*, which extends between the ends of the expansion ring, *F*, which is surrounded by the cup or loose member, *G*.

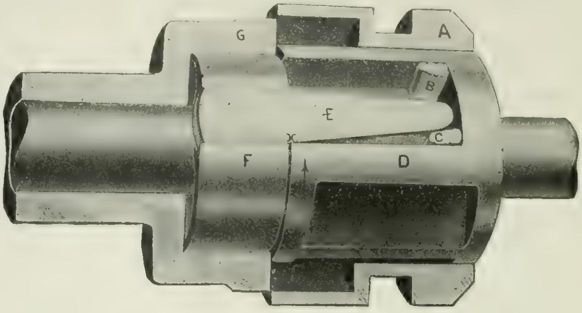


FIG. 1.—SECTIONAL VIEW OF CLUTCH.

Now if the keyed member, *D*, be rotating in the direction indicated by the arrow, the ring is freely revolved by the lever, *E*, which is driven at point *x*, as pin *C* is free of the lever; and pin *B* operates on the lever only when the member *D* is revolving in the opposite direction.

When the clutch is engaged the sleeve *A* is moved to the left and pin *C* gradually relieves the bearing point, *x*, on the lever, and the member *D* drives the ring by the lever through the pin *C*. This causes the lever *E* to expand the ring *F* within the cup *G*, with such pressure that the friction caused exceeds the force on the lever, so that the greater the load the tighter the grip.

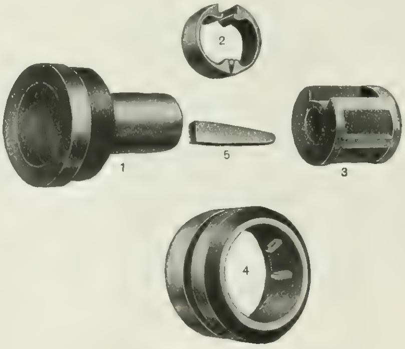


FIG. 2.—ELEMENTS OF CLUTCH.

This small and compact clutch is simple also, consisting in all of five parts, and contains no toggles, links, bolts, etc. These five parts are shown in Fig. 2 separately, 1 being the loose member or cup forming the hub, 2 the self-adjusting expansion ring, 3 the tight member which is keyed to the shaft, 4 the operating sleeve, and 5 the expanding key or lever.

General View of Illumination at Portland Exposition.

Electrical Exhibits at the Portland Exposition.

Reference has been made in previous articles in these pages to the electrical features of the Portland, Ore., Exposition. We are now able to give below some general notes on the leading electrical exhibits:

The exhibit of the Northern Electric Manufacturing Company, of Madison, Wis., in the Machinery, Electricity and Transportation Building at the Lewis and Clark Exposition, Portland, covers some 800 sq. ft. of display space situated near the main entrance to the building. A special feature in connection with this exhibit and one which attracts attention is the number of motors and motor-driven machines in actual operation. Diametrically opposite and facing the main entrance to the building is a pedestal tool-grinding machine operated by a Northern Electric 220-volt, 20-amp., direct-current motor. A 35-hp elevator, direct-current motor and a vertical type 2-hp motor on a stand near by are seen immediately adjoining one of the main aisles of the hall. A pedestal polishing machine, obtaining power from a 220-volt, 2-hp motor, running at 3,000 r.p.m., is in another section near by, while the center of the display contains a 125-volt gasoline engine, direct-connected to a 125-volt, 48-amp., direct-connected generator with a 48-in. ventilator fan running at 500 r.p.m. and direct-connected to a 220-volt, 25-hp direct-connected motor. A 2-hp motor direct connected to a triplex pump with a motor-generator set and several types of small motors completes a display of machinery which is all, with the exception of the elevator motor, seen in actual motion, a fact which adds immensely to the effective exploitation of the uses of electricity.

The American Bell Telephone Company's exhibit in the Machinery, Electricity and Transportation Building, besides being of general interest as a display of the company's system of telephone service throughout the continent, is utilized in part, at least, for actual service in the grounds. In the operating room of the pavilion built by this company for the Exposition, is a switchboard with a capacity of 500 lines, some 135 or so being in use at the present writing and requiring the services of three operators for the day and one for the night work. Adjoining the switchboard are the batteries, main and intermediate frames, charging and ringing machines, etc., showing the complete mechanism for operating a modern telephone system. To the left of the operating room, in a separate apartment, is the Bell automatic telephone, limited to 100 switches, together with switchboards for the same and some types of their private exchange boards. A reception booth comfortably furnished with carpets, tables and easy chairs, and having a private telephone room, is located on the other side of the operating room and is open during the day for the use of visitors. Telephones are installed in the Fair Grounds at regular city rates and long-distance service can be obtained at the pavilion when desired.

Among the attractive displays in the Machinery, Electricity and Transportation Building, that of the Western Electric Company, of Chicago, is particularly noticeable. It occupies a display space of some 2,400 sq. ft., every available portion of which is utilized by exhibits typifying the various products of the company. Situated in the center of the exhibit is a 500-kw, single-phase, revolving field, engine type Western Electric generator, while on a pyramidal frame adjoining are shown the different types of motors manufactured by the company, and ranging in size from a 1/12 horse-power to a 50-horse-power. Opposite the motors is a section devoted to the display of arc lamps from ⅜-in. carbon to the series alternating lamps in operation, suspended from iron trees, and capable of being lowered for closer examination when desired. This section includes, among others, five series multiple, 500-volt lamps, 220-volt, 2-in. series multiple lamps, and 110-volt multiple alternating and direct-current lamps. Encircling the entire display space of the Western Electric Company and hung about 8 or 9 ft. from the floor, are 50 alternating enclosed arc lamps, with transformers and regulators, making an exceptionally fine showing. In another section near by, arranged on display board and stands are the various supplies handled by the company, among which may be mentioned Bryant and Perkins' goods, Thomas high-potential porcelain insulators, Electrose overhead railway material, D. & W. enclosed fuses as well as ventilator exhaust, desk and ceiling fans, several of which are in operation. A Rateau steam turbine direct connected to a 15-kw Western Electric 220-volt, direct-connected generator is soon to be added to the display and will, no doubt, prove a valuable adjunct to this already interesting and instructive exhibition.

The Fairbanks-Morse Company, of New York City, N. Y., have a very large exhibit in the southern portion of the Machinery Building, and covering in the neighborhood of 5,200 sq. ft. of floor space, every available portion of which is utilized to display the heterogeneous variety of machinery manufactured by the factories of the company. Opposite, and to the right of the main entrance to their exhibit, the management have installed a 50-hp multiple cylinder, vertical type gas engine belted to a dynamo on the same base, which proves a most efficient factor for supplying the illumination of the electric sign clusters, and lights for their display. Near this unit are the vertical and horizontal types of the Fairbanks-Morse Co.'s gas, gasoline, kerosene and crude oil engines, the 2 and 4-cycle marine engine operated by gasoline or kerosene, also combined gasoline engine and air compressor, combined gasoline engine and hoist, combined gasoline engine and dynamos. Next to the gas engines are the motor-driven duplex pumps and duplex steam pumps, also farm engines for grinding and pumping. The display of their railway department was very thorough in every detail comprising gasoline motor cars, push cars, railroad jacks and general track tools and a 100-ton railroad scale with printing beam. The display of scales made by the company comprised everything from a grocery to the above-mentioned 100-ton railroad scale. A unique feature in connection with their scale display is the fancy scale situated at the main entrance to their exhibit attended by a weight boy handing visitors their weights printed on a neat ticket. Across the aisle is the mining department exhibit, showing in motion the Nissen 2-stamp battery for quartz and their Elspass 4-roller quartz mill and an automatic ore dump. Outside the building at the main entrance to the exhibit are shown the windmills and irrigation goods, and on the Trail a Fairbanks-Morse Company's horizontal engine running on kerosene and belted to a centrifugal pump raising 2,000 gal. per minute against a 26-ft. head completes a display of machinery of which the company's management may feel justly proud.

The General Electric Company's exhibit covers 6,000 sq. ft. of space in the Machinery, Electricity and Transportation Building, this being the largest space assigned to any exhibitor in the grounds. The display comprises a multifarious collection of machinery covering the various classes of electrical apparatus manufactured by the company. In the center of the exhibit is a colonial office and reception booth comfortably and tastefully furnished and carpeted, while radiating from it are several aisles passing through different sections of the exhibits and leading to the various exits and entrances to same.

Near one of the many entrances is a 60,000-volt oil switch in operation, also a 4-motor equipment of the General Electric 67-hp motors mounted on Brill trucks with controllers, this equipment being identical with that supplied to the Washington Water Power Company, of Seattle, Wash. The power machinery comprises new types of single and three-phase alternating current motors and types of direct-current motors, as well as a Curtis direct-current turbo-generator set. Those especially interested are given the privilege of inspecting the new power house of the Portland General Electric Company, in which has lately been installed two 1,500-kw, three-phase Curtis turbo-generators, which supply all the current used for illuminating and operating the Exposition. The display of street railway appliances is very thorough in every detail, comprising all classes of line and track specialties as well as high capacity street railway switchboard equipments. In the southern portion of the exhibit and near one of the side entrances, is an 8-ton electric mining locomotive with special cable reel, operated by either reel or trolley, on a 30-ft. track. Exhibits of wire, cable sockets, fuses, lightning arresters and porcelain specialties occupy another section, and near by is a complete line of indicating and recording instruments mounted on display boards where the operating parts may be readily inspected. A 30-amp. mercury arc rectifier changing 220-volt, 60-cycle alternating-current into 110-volt, direct current, is seen in operation near the reception booth and a complete display of the incandescent lamps manufactured at the company's works in Harrison, N. J., is located in an adjoining section. In the department of motor applications, the General Electric Company, in conjunction with a number of manufacturers, have a very instructive and interesting display. The exhibit which would more particularly attract the casual sightseer in this section is probably the generator direct-connected to a 30-in. Pelton water wheel in operation so arranged as to show the perfect absorption of the energy in the water by the wheel buckets. A three-phase induction motor is shown direct-connected to a Platt Iron Works triplex pump, and an electric hoist manufactured by the Willamette Steel & Iron Company, Portland; a Price centrifugal pump direct-connected to an induction motor, as well as motor applications to horse clippers, printing presses, sewing machines, emery wheels and buffers, etc., etc., go to make up one of the most exhaustive exhibits of electric machinery and appliances at the Exposition.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., exhibit in the Machinery, Electricity and Transportation Building a typical display of their electrical manufactures, particular prominence, however, being given to their single-phase machinery. The display comprises numerous types of individual single-phase, 60-cycle motors ranging in capacity from [illegible]-hp to 7½ hp. Immediately adjoining the motors a good assortment of transformers are shown arranged consecutively according to their capacity, from 6-10 kilowatts to 15 kilowatts. Here also are exhibited switchboard appliances of various kinds, recording and indicating apparatus, among which may be mentioned 0 to 150-volt type F direct-current voltmeter, 60 to 110-volt power factor indicator with condenser, ammeters with series transformers, three-phase ammeters, fuse blocks, etc., etc., the whole going to make up a particularly distinctive and attractive display.

The Standard Underground Cable Company's exhibit comprises a typical display of cables, insulated wires, etc., manufactured by the company. Four large showcases are exhibited, side by side and facing the main entrance to their exhibit, each being devoted to the exploitation of a distinctive branch of cable manufacture. In the two center cases are shown samples of street railway material comprising bare and insulated wire and wire cables, wire for telegraph and fire alarm service, respectively, while to the left is a case containing samples of electric light and power cables, pole lines, etc., the remaining case being devoted to the various types of wire necessary for the modern telephone system. A short distance in front of the showcases are two spools of insulated and trolley wire having between them a pyramid of eight or ten different types and sizes of insulated wire. The display space is tastefully decorated with photographic views of the company's factory in Oakland, Cal., and gives one a comprehensive insight into the many and varied uses of wire rope and cables.

The Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., displays a splendid assortment of electrical machinery and appliances. The 1,500 sq. ft. of space allotted to this company is literally covered with machinery and apparatus. The section devoted to their display of power machinery is particularly attractive, a very prominent feature being a Westinghouse-Parsons steam turbine direct-connected to a 400-kw generator set up immediately adjoining the main entrance to the exhibit, and so arranged as to show the interior mechanism of the turbine. Several types of smaller generators and a small Ohmen high-duty steam engine direct-connected to a 2-kw type "S" Westinghouse generator are situated in the western section of the display space and facing one of the main aisles of the building, while the interior is occupied by more power machinery, comprising among others, a motor-generator set. In the extreme southern portion, the Sanitary Devices Manufacturing Company display in conjunction with this exhibit a complete sweeper outfit driven by a type "S" motor. Near by is a hoist having for motive power a type "F" induction motor with controller and requisite appliances. The rear section contains some distinctive types of the Westinghouse transformers, a special feature in this connection being a 110-kw air blast machine. Immediately adjoining on the floor and suspended against the wall type "O. D." transformers ranging in capacity from ¼ kw to 25 kw, Standard switchboard instruments mounted on display boards and comprising voltmeters, wattmeters, ammeters, power factor indicators, etc., so arranged to exhibit their mechanical operations, are also seen in this vicinity. The display of the company's street railway appliances gives one a thorough insight into their standard street railway traction apparatus; among the machines here exhibited being a No. 92 direct-current railway motor of 50-hp capacity, showing the interior construction as well as an alternating-current, single-phase street railway motor of 75-hp capacity, having the commutator thrown back and a unit switch system of multiple control on a stand and with the cover off. The portable instruments manufactured by the company are displayed in a showcase opposite the main entrance to the exhibit, and directly in the rear is a type "C" three-pole, 33,000-volt, electrically operated circuit-breaker, a type "B" circuit-breaker for 2,300 volts, lightning arrester choke coil, a static interrupter, also a type "D" double-throw oil switch with fuses arranged on display boards. The display space is surrounded on three sides by enclosed Westinghouse arc lamps, hung on artistically designed iron goose necks, and in this connection it may be mentioned that the Machinery, Electricity and Transportation Building is illuminated by Westinghouse lamps of similar pattern.

Curtis Steam Turbines for Japan.

With the industrial awakening of the Island Empire has come a need for electric power not only for manufacturing purposes, but for transportation and for lighting. Japanese engineers are wide-awake, and their enterprise is nowhere more clearly indicated than in their adoption of steam-turbine electric-generating units. On July 29, 1904, the first shipment of steam turbines arrived in Japan via the steamship *Korea* from San Francisco. They were of 500-kilowatt capacity of the Curtis type, and were for operating the Shigai Railway in Tokio. Four weeks from their arrival they were in full operation. As significant of the success of these first units there have been ordered by the Japanese from the General

Electric Company, of New York, 37 Curtis steam turbines with electric generators with a total normal capacity of more than 35,000 horse-power. Of these, 11 units are now installed and in satisfactory operation.

The Japanese are not slow in adopting the electrical systems which will improve their manufacturing and transportation facilities and give the people better lighting service. They are using electricity for operating the street railways of their cities and for indoor and street lighting. In the use of electric power for machine shops, they are following only the best American practice, which, as a rule, requires electric motors mounted on each tool. The coal mines of Japan will eventually be operated electrically. Some of the turbines mentioned above are intended for the Miike coal mines on the Island of Kyushu. These are owned by Mitsui & Company, and will use two 1,000-kw Curtis steam turbines.

The Osaka Electric Light Company, which furnishes electricity to the city of Osaka, which has a population of over 800,000, is equipped entirely with American electrical apparatus, including six steam turbines of the same make. One of the largest electrical interests in Japan which has ordered some of the machinery referred to above, is the Tokio Street Railway Company, which furnishes transportation facilities for the city of Tokio, which has a population of 1,440,000. Its Japanese name is Tokio Shigai Tedsudo. Its franchise runs until 1952. Apparently, the municipal ownership idea has obtained some weight in Japan, for this franchise provides that after the year 1932 the municipality may purchase the property of the Company by paying a proper price for it. Although some English and German material is being used by this road, practically all the electrical equipment is American made. This includes five 2,000-hp. Curtis turbo-generator units, with power-house equipment and railway motors furnished by the General Electric Company, wheeler condensers and Brill trucks. Besides a small amount of German and English machinery, such as boilers and trucks, there are a few small dynamos which were made in Japan.

Heating and Ventilating the Majestic Theatre, Boston.

In the design of the heating and ventilating plant in the new Majestic Theatre in Boston, Mass., particular attention was given to securing and distributing evenly the fresh air supply, and arranging the vents so that they may be closed and the air re-circulated locally when the theatre is not in use. Considerable economy is thereby effected. The usual plenum chamber method is employed with branch delivery ducts leading to all portions of the auditorium. The chamber is formed by the open space or basement area beneath the sloping dress circle floor, into which the large blower delivers fresh air directly. The openings into the lower portion of the auditorium are made through the floor, while delivery to the balconies is similarly made through ducts leading to a supplementary plenum chamber beneath its floor. Vent connections are carried from the dressing and various other auxiliary rooms in the basement and from all portions of the auditorium to the gathering chamber beneath the floor, from which the air is exhausted by power.

The fresh air for the ventilating system is taken through inlets in the outside wall of the building about 30 ft. above the street. From these it is led downward through ducts built in the wall to a large horizontal concrete duct containing the heating coils for cold weather use. The fan is a 7-ft. three-quarter-housed blower, built by the B. F. Sturtevant Co., Boston, Mass., with a direct-connected motor of 10-hp. capacity, and is located in one corner of the plenum chamber, into which it delivers directly. The air is cleansed by a series of filters of cheese cloth upon light pine frames hung at the bottom of the vertical fresh air flues.

The air passes first through a large primary or tempering heater, and thence to the blower through the main heater, which may, however, be by-passed by the mixing dampers. The primary heater consists of eight sections of coils, six of which have 180 sq. ft. of heating surface and other two 160 and 140 sq. ft., respectively. The main heater is composed of 1,872 linear ft. of 1-in. pipe.

The principal delivery of fresh air to the auditorium proper is made through holes in the floor beneath the chairs. The chair legs away from the aisles are of a special design to cover these openings, which are distributed to the proportion of about one to every three chairs. There are about 300 of these openings in the main floor, each of which has a cross-section of about 27 sq. in. A similar distribution is made from the balcony floor, there being an auxiliary plenum chamber in the space underneath it, which is supplied from the main plenum chamber by two large galvanized iron ducts, each having a cross-sectional area of 650 sq. in. From this chamber air is admitted to the balcony through ½-in. holes in the risers, of which openings there are about 1,200, which gives an even distribution throughout the balcony.

The foul air is vented from the auditorium through openings in the ceiling, while for the spaces beneath the balcony and gallery there are vent openings in the side walls and ceilings, which connect with a Sturtevant motor-driven 60-in. exhauster, of special construction, located in the roof.

A novel feature of the ventilating system is the arrangement for circulating the air in the theatre when not in use. The fresh air inlet ducts leading to the heating coils and blower are provided with openings into the stage area, which are controlled by dampers in connection with those admitting air to the gathering chamber above the auditorium; by closing the latter and opening the connection from the cold air duct to the stage (which closes the connection with outside air) the air within the theatre travels in a closed circuit through the heating coils, plenum chamber, etc., with very economical results in the initial heating of the theatre in cold weather. The dampers in the ceiling of the auditorium, as well as the main damper in the roof opening, are controlled from the stage.

Pendant Switches.

Among the many electrical devices used in connection with electric lighting, the pendant switch is one on which improvements are made. The Sarco Company, of 906 Sixth Avenue, New York City, has just bought out a new device of this character. The Sarco pendant switch has no parts that get out of order. In appearance it is very neat, and is octagonal in shape. The inlet bushing is so arranged that it will take the regular lamp cord, and if reinforced cord is desired the bushing is unscrewed, which leaves a second bushing large enough for the heaviest style cord made. The shell is taken off in a second's time by simply unscrewing, and a small catch keeps the two shells locked in position. The contacts are quick-make and quick-break. They cannot burn out, even if ten amperes of current is used. The working parts and contacts are contained in a heavy porcelain housing, which prevents any short-circuiting or grounding. The contact screws are large and so arranged that the cord is readily connected.

PENDANT SWITCH.

For operating the switch there are two buttons. One is inlaid with white pearl for lighting, and the extinguishing button is depressed so as to prevent the finger from slipping. A gentle pressure of the finger is all that is required.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Maturing crops exert a favorable influence on trade and industry. Fall business is improving, and the Western trade is opening a little earlier than it did last year. Weather conditions have favored crop growth and harvesting, fear of rust damage to spring wheat has disappeared, corn promises a record yield, and both demand and collections have improved as the result of early wheat crop movement in the Souhwest. Midsummer quiet, so-called, is less than ordinarily manifest this year in trade, industry and financial operations. Bank clearings for July break all records for that month, failures are strikingly few for a normally dull period, and railway earnings show progressive gains on the best summers of previous years, with an increase of 8 per cent over July, 1904; the fiscal year showing 5 per cent advance in gross and 4 per cent gain in net over the preceding year. Best trade reports come from the Southwestern sections, where the new winter-wheat crop has been good and is moving freely. Demand and collections in that section embracing Oklahoma, Kansas, Missouri and Nebraska have all improved. Chicago reports many sales of new stocks to Southwestern buyers. In the Northwest trade sentiment is stronger, now that rust damage is no longer feared. Trade in the South is irregular. In Texas and Arkansas crop prospects tinge trade reports with pessimism; in the lower Mississippi Valley shotgun quarantines affect demand and shipment, but in the South Atlantic States and in the industrial centers the feeling is quite cheerful and fall business is looking up. Baltimore reports the advance guard of Southern buyers in town, while at New York and Boston buyers are numerous, with cotton goods selling most freely. Finished lines in iron and steel show increasing demands from the country reflected in continued active operations in most departments. Rail sales have been numerous, and all that can be delivered this year are already booked. Steel billets are firmer, and talk of premiums for deliveries is heard. A number of tinplate mills will resume operations next week. Some quietness in sheets and pipe is still noted, but the scrap market has strengthened after months of weakness, and old material is firmer. Furnace interests are free buyers of coke and ore. The lake ore traffic in July was in advance of any preceding month in the country's history. The tone of Southern iron is better at the leading Southern market. *Bradstreet's* reports 178 business failures during the week ending Aug. 3, as against 197 the week previous and 179 the corresponding week last year. The same authority states that the failures during the month of July were fewer than in any month this year and the lightest of any July for the past 12 years. The total number for the month was 704 against 771 in June and 774 in July last year. Copper advanced on heavy buying by domestic consumers. Lake and electrolytic are quoted at 15⅝ for spot and 15⅜ to 15½ for October deliveries.

PLANT FOR WASHINGTON.—Sealed proposals (in duplicate) will be received and opened by the U. S. superintendent Capitol Building and grounds, Mr. Elliott Woods, on Saturday, September 30, at 2 o'clock P. M., for furnishing all material, labor and other appliances, and erecting and putting in operation, in a building and on foundations to be provided by the United States, and in locations within the Capitol Building, Congressional Library Building and Senate and House Office Buildings, now under construction, a complete heating, lighting and power plant, including machinery, boilers, piping, electrical transmission, cables and conduits, appliances and all other equipment in said power house building and in the other buildings named, and as set forth on plans. The necessary plans showing the general layout, and complete information and specifications containing the same, will be furnished to responsible, intending bidders, and a certified check in the sum of $50, payable to the order of the undersigned must accompany requests for plans and specifications. Information as to the amount of check, surety bond or cash to be deposited with the bid, and the subsequent bond required for the performance of the contract, will be stated in the specifications. No bid will be considered which does not contemplate the erection of the complete plant as called for under the terms of the specifications.

NEW CONDUIT FACTORY.—The new factory of the American Conduit Manufacturing Co., Pittsburg, one building of which is now completed, is considered by President Flack as giving them what is perhaps the most modern and complete equipment in the field to-day for the production of rigid iron conduit. The main building, used for finishing and storing American Conduit, is an iron clad structure, well lighted and ventilated, 80 by 120 feet. The interior arrangements are such as to assure rapidity of handling and an absence of confusion in the final and important stages of manufacture. The shoemaker's wife is not always well shod, but in this case as a protection against fire all the wires in the new building are laid in American Conduit, with the result that insurance has been reduced to satisfactory proportions.

APPARATUS FOR CHICAGO.—Sealed proposals will be received by the city electrician of Chicago, Mr. W. Carroll, at his office, until 11 A. M., Thursday, August 17, 1905, for furnishing the city of Chicago with one thousand enclosed series alternating arc lamps, with the necessary transformers and regulators, in accordance with specifications on file in the office of said official. Delivery of three hundred of these lamps, with the necessary transformers and regulators to operate them, must be made within thirty days from date of award of contract. Delivery of the remainder of the lamps, approximately seven hundred, with the necessary transformers and regulators, must be completed inside of ninety days from award of contract.

BELL TELEPHONE OUTPUT.—The subjoined is the June instrument statement of the American Telephone & Telegraph Company:

June—	1905.	1904.	1903.	1902.
Gross output	120,555	83,312	87,608	96,653
Returned	52,427	44,144	42,189	41,741
Net output	68,128	39,168	45,419	54,912
Six months—				
Gross output	897,620	591,684	600,064	589,109
Returned	283,542	247,190	235,141	226,267
Net output	614,078	344,494	364,923	362,842
Total outstand	5,094,642	4,124,011	3,515,243	2,888,854

NAVY YARD SUPPLIES.—Bids will be received until August 22 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., electrical supplies, incandescent lamps, carbons, insulating tape, wire, testing set, generating set, projector, brass and steel conduit and fittings, etc.; also on September 5 for furnishing at the navy yards at Puget Sound, Wash., and Mare Island, Cal., insulators, generating sets, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

POWER PLANT CONTRACT.—The Board of Directors of the Winchester (Va.) & Washington City Electric Railway Company opened bids last week for the construction of the dam, power house and race-way along the Shenandoah River, near Millville, Jefferson County, W. Va., which is to furnish power for electricity for Winchester and other towns in this section. E. Purcel & Company, of Harrisonburg, Va., being the lowest bidders, were awarded the contract for $56,322.50. Eight other firms competed.

SIGNAL CONTRACTS.—The Hall Signal Company has recently closed contracts for automatic block signals with the Lake Shore & Michigan Southern Railroad, between Erie and Cleveland, 97 miles of two and four-track line; the Union Pacific, 39 miles of double track; the Chicago & Northwestern, 41 miles of double track, and the Delaware & Hudson Company, additional contract for 46 miles of partly single and partly double track.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, which suffered a disastrous fire a few weeks ago, is now in full operation in all departments in a new factory building on Academy Street that city. The plant has been full equipped with the latest appliances for the manufacture of batteries, and the company is to be congratulated upon its rapid recovery from an almost total fire loss.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, has recently installed in its manufacturing plant a gas engine for duplicate power equipment, and is running its factory night and day with double shift of men, to meet the rapidly increasing demands for its telephone equipment.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has just been awarded a contract for the construction of an additional subway to the present system of the Cincinnati Bell Telephone Company in that city. The work is to be completed, so that it can be used before cold weather sets in.

APPARATUS FOR WINNIPEG.—Tenders are asked for by J. C. Gibson, fire, water and light commissioner, for a producer gas plant, and for an equipment of 2,500-hp. of engines and 500-kw. of electrical generating capacity. Bids will be received up to August 28, in separate sealed tenders.

TROLLEYS IN ADIRONDACKS.—Within a short time electric cars will be running between Paul Smith's and Lake Clear, and by next season an extensive trolley system will cover the southeastern portion of the Great North Woods, connecting Lake Champlain and Lake George with Schroon Lake, Lake Placid and intermediate points. Paul Smith has organized the Paul Smith's Electric Light & Power Company, and work on the road is well advanced. The route leads through the timber lands of the Paul Smith's Company. Lake Clear, from which the line will start, is the junction of the Adirondack Division of the New York Central and the Saranac Lake and Lake Placid branches of this road. The distance to be covered is about seven miles, and the road is being constructed so that Pullman cars may be drawn from Lake Clear Junction to the hotel company's grounds. Freight also will be carried on the trolley, making a big reduction in the cost of handling. In lumbering operations log trains will be at hand. A network of electric lines is to be built at once by the recently incorporated Ticonderoga Union Terminal Railroad Company. New York, Philadelphia and Chicago capitalists are backing the venture. With the expectation of hauling large quantities of pulpwood, the trolley lines will be constructed on a freight basis, but they also will be provided with passenger facilities. In Ticonderoga the ordinary trolley system will be used, but on account of the forest preserve laws, which forbid steam or third-rail systems in the woods, electric locomotives will be used, each having four 200-hp motors. The officers of the Ticonderoga Union Terminal Railway Company are: President, Northrup R. Holmes, of Troy; first vice-president, Altus B. Adkins, formerly Sheriff of Essex County; second vice-president, I. Rothschilds; treasurer, W. W. Richards, cashier of the National Bank of Ticonderoga; secretary, Frank T. Locke, president of the Ticonderoga Machine Company; auditor, Mortimer V. Drake; chief engineer, Frank B. Gridley, assistant city engineer of Troy. Options have been obtained by the company on all the electric power plants along its proposed routes. Dams for the development of power will be erected in the vicinity of Ticonderoga. It is expected that construction will be begun within six weeks.

PENNSYLVANIA RAILROAD.—Rumors have come from Pittsburg in regard to plans of the Pennsylvania Railroad to electrically equip its lines in the neighborhood of that city and compete with the traction lines for suburban passenger business. These reports have no present foundation, it is stated. There has been no discussion by the highest officials of Pennsylvania of any scheme of electric operation of the company's lines in the Pittsburg district and nothing of the kind seems at all likely to be taken up for some time.

SUPPLIES FOR PENSACOLA NAVY YARD.—Bids will be received until August 29 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Pensacola navy yard electrical supplies, incandescent lamps, etc.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was strong and there was a slight increase in activity at the close of the week. Good crop news from the west and the approaching sessions of the peace conference contribute to keep up bullish feeling among the professionals, while good earnings and favorable prospects for railroad traffic, together with the continued ease of money, check selling. Some new high-price records were made by leading railway stocks, notably Lackawanna, while various industrials, particularly American Smelters, were also strong. Bonds are steady, without much activity. All of the traction stocks, except Interborough Rapid Transit, were weak and closed with net losses. Brooklyn Rapid Transit's last quotation was 69½, which is a decline of ⅛ point, and Metropolitan Street Railway lost ⅜, closing at 127⅝. Interborough Rapid Transit closed at 219¼, which is a net gain of 5 points. The electric stocks took a downward turn and comparatively little business was done. Allis-Chalmers common and preferred both closed with fractional declines, the last prices being 18⅜ and 62, respectively. General Electric dropped from 181 to 178 and closed at the latter figure, which is a loss of 1¾ points. Westinghouse also closed at the lowest figure of the week—168—thus losing ½-point. Electric Storage Battery was an exception to the general run of electrical securities and made a net gain of 1½ points; closing at 83½, and Western Union also has a net gain of ⅛-point to its credit, the closing price being 93½. The curb market was generally higher at the close of the week, compared with a week ago, with the volume of business about the same as the previous week. The active feature was Chicago Subway, in which total transactions amounted to about $100,000 shares. After a rise of 4½ points, it broke sharply, losing all the improvement, then rallied somewhat, under what looked like manipulation by the interests which have been engaged in putting it up for some weeks past. The sharpest rise on the curb was made in Interborough, which gained more than 8 points, crossing 220, though unattended with any new developments. This was in line with the advance of high-priced shares on the Stock Exchange. Following are the closing quotations of Aug. 8:

NEW YORK

	Aug. 1	Aug. 8		Aug. 1	Aug. 8
Allis-Chalmers Co	18	18¾	Electric Vehicle pfd	25	25
Allis-Chalmers Co. pfd	62	60⅛	General Electric	179	179⅛
American Tel. & Cable	90	90	Hudson River Tel	.	.
American Tel. & Tel.	137	138	Interborough Rap. Tran	215	218
American Dist. Tel	29	29	Metropolitan St. Ry	127⅛	127⅝
Brooklyn Rapid Transit	68⅞	69⅝	N. Y. & N. J. Tel		..
Commercial Cable		..	Marconi Tel	.	..
Electric Boat	20	22	Western Union Tel	93	93⅝
Electric Boat pfd	60	67	Westinghouse com.	165	166
Electric Lead Reduction		..	Westinghouse pfd	..	..
Electric Vehicle	18	19			

BOSTON

	Aug. 1	Aug. 8		Aug. 1	Aug. 8
American Tel. & Tel	138½	138½	Western Tel. & Tel. pfd	*99	99
Cumberland Telephone	117¼	117	Mexican Telephone	1¼	1¼
Edison Elec. Illum	244	246	New England Telephone	135	136⅛
General Electric	180	179	Mass. Elec. Ry	17½	17⅛
Western Tel. & Tel.	18	*18⅛	Mass. Elec. Ry. pfd	61	60

PHILADELPHIA

	Aug. 1	Aug. 8		Aug. 1	Aug. 8
American Railways	51	52⅛	Phila. Traction	..	..
Elec. Storage Battery	82	82	Phila. Electric	8¾	8⅞
Elec. Storage Battery pfd	..	..	Phila. Rapid Trans	27⅜	29⅛
Elec. Co. of America	11⅛	11⅝			

CHICAGO

	Aug. 1	Aug. 8		Aug. 1	Aug.
Central Union Tel	.	.	National Carbon pfd	117	115
Chicago Edison		..	Metropolitan Elev. com	24	24
Chicago City Ry	*196	*196	Union Traction	..	..
Chicago Tel. Co		.	Union Traction pfd	..	..
National Carbon	63	60⅛			

* Asked.

CENTRAL STATES TELEPHONY.—The Central Union Telephone Company has shown a great deal of activity lately. In Illinois twelve larger exchanges have been re-equipped, as follows: Alton, Belvidere, Canton, Centralia, Decatur, Edwardsville, Jacksonville, Kewanee, La Salle, Moline, Mount Vernon, Ottawa and Streator. Indiana has received eleven complete new exchanges at Auburn, Brazil, Crawsfordsville, Elkhart, Garrett, Lafayette, Lebanon, Mishawaka,, Newcastle, Peru and Shelbyville. Adequate outside facilities have been provided at each exchange. Additional switchboard sections have been installed at Butler, Indianapolis and South Bend. The work in Ohio has included the entire rebuilding of six large exchanges, as well as increasing the capacity of a dozen others. The smaller exchanges over the state, and, in fact, over the three states, have received all the improvements which their quota of business would at all justify. During the last few months the company has been absorbing independent telephone companies as follows: The entire 1,000 shares (par $50) of the Central Energy Telephone Company, of Franklin, Ind. (1,300 telephones), has been purchased for $115,000. Arrangements have been madt to sub-license all the independent exchanges in Jackson County, Ohio, the Jackson County Company adopting the Bell instrument in its exchanges, a total of about 1,800 subscribers. The United Telephone Company, of Bluffton, Ind., which owns the exchanges and toll lines in Wells, Grant, Blackford and Huntington counties, Ind., and has 5,000 subscribers, has become a sub-licensee of the Bell, using its instruments. The United has $480,000 bonds and $300,000 stock outstanding. The Citizens' Telephone Company, of Kokomo, has applied, or will apply, to the city authorities for an amendment of its franchise permitting it to enter into a contract with the Central Union.

INGERSOLL-RAND DRILL.—The Ingersoll-Rand Drill Company has been incorporated to take over the plants of the Rand Drill Company and the Ingersoll-Sergeant Drill Company. The new company will have an authorized capitalization of $3,000,000 in 5 per cent bonds, $5,000,000 in 6 per cent preferred stock and $5,000,000 in common stock. The Rand Company was acquired by the new company on the basis of $41.33 in bonds, $86.08 in preferred stock and $60.75 in common stock for each $100 of stock of the old concern. The Ingersoll-Sergeant Drill Company's preferred stock received $7.50 for each £1 share and Ingersoll-Sergeant Drill Company common stock received $10 preferred stock and $10 in common stock for each £1 share. The Ingersoll-Sergeant debentures will be paid off in the next fifteen months, the proceeds being raised by issue of Ingersoll-Rand new bonds. The new Ingersoll-Rand Company will have an outstanding capitalization of $2,000,000 bonds, $4,500,000 preferred stock and $3,000,000 common stock, application to list which on the Stock Exchange has been made. The earnings of the new corporation are expected to be about $650,000 annually, which will mean an earning capacity of 8 or 10 per cent. on the new common stock. No dividends will be paid on the common stock, however, for the present.

THOMSON-HOUSTON SECURITIES.—The trustees of the Thomson-Houston securities, Series D, have disposed of all the securities held in trust, and will make a division of the funds in their possession Aug. 28, 1905, on surrender of stock certificates, which will terminate the trust.

BROKERAGE OF ELECTRICAL PROPERTIES.—There is an increasing willingness on the part of the public to invest in public service properties, but the investor often experiences difficulty in learning about such properties if they are not quoted on the exchanges, while in that event they are too big a proposition to be considered seriously and singly by any individual, even if he be a millionaire. We are interested to note, therefore, that a definite announcement as to its engaging in brokerage work in regard to such properties is made by the Gas & Electric Development Company of Philadelphia and New York. This company buys and sells public service properties of the nature indicated, its compensation being based on a percentage of the selling price, and that percentage being determined by the value of the property, whether it be electric light, trolley, telephone or gas. It is needless to say that such work has to be done very judiciously and that unnecessary and harmful publicity has to be avoided. Reputable brokers have as much to lose through a plant being hawked around promiscuously and becoming stale as the plant owner himself. The Gas & Electric Development Company is composed of men who have been interested in public service properties for many years, and though they have been organized as a company for less than a year, they have already negotiated a number of sales in a manner satisfactory to both buyer and seller. The company has offices at 1328 Chestnut Street, Philadelphia, and 82 Beaver Street, New York City. The officers are: Harry C. Case, president; A. B. Beadle, vice-president and engineer, and W. W. Levering, secretary and treasurer.

SPRINGFIELD (MASS.) UNITED.—The report of the Springfield United Electric Light Company to the Gas and Electric Light Commissioners for the year ended June 30, 1905, shows clearly the large improvements made in the steam plant of the company during the past year. At the time of the closing of the state report a little over $175,000 had been put into this steam plant in the year. The electric plant had been increased not quite $30,000, while the electric lines, transformers and meters, in which items, of course, are included the underground conduit work which the company is forced by law to undertake, had increased in value during the year over $100,000. The company lays aside, as usual, $50,000 in its reserve for depreciation. The profits shown have increased from $81,286 to $88,604.29. The comparative statements for the two years follow:

	1905.	1904.
Assets.		
Real estate	$259,841.30	$256,367.95
Steam plant	272,727.91	95,169.13
Electric plant	334,149.19	305,794.93
Electric lines, etc.	643,355.99	540,250.07
Stock and merchandise	40,314.38	66,224.00
Sinking fund	61,000.00	52,500.00
Investments	457,800.00	457,800.00
Cash and debts receivable	47,999.69	47,209.03
	$2,117,188.46	$1,821,315.11
	1905.	1904.
Liabilities		
Capital stock	$800,000.00	$800,000.00
Debts	586,814.69	356,893.84
Profit and loss	88,604.29	81,268.47
Reserve for depreciation	285,000.00	235,000.00
Sinking fund	61,000.00	52,500.00
Capital stock premium	95,000.00	95,000.00
Bonds	200,000.00	200,000.00
Guarantee fund	709.48	....
Deposits		652.80
	$2,117,188.46	$1,821,315.11

CHICAGO PNEUMATIC TOOL.—President Duntley, of the Chicago Pneumatic Tool Company, makes the subjoined semi-annual statement of profits for the half year ending June 30, 1905:

Profits for the half year		$413,941.54
Less—Depreciation of buildings, plant and machinery, including repairs and renewals of buildings and plant	$52,905.02	
Less—Written off for experimenting and perfecting new lines of tools	4,800.00	57,705.02
		$356,236.52
Less—Bond interest for the half year	$57,500.00	
Less—Sinking Fund Reserve	25,000.00	82,500.00
Profit available for dividend		$273,736.52
Less—Quarterly dividend No. [illegible]	$61,137.83	
Quarterly dividend No. [illegible]	61,137.83	122,275.66
Balance carried to surplus		$151,460.86
Surplus Account.		
Surplus brought from 1904	$254,030.82	
Less—Appropriation [illegible] work and written off	28,593.51	$225,437.31
Surplus for the half year as stated above		151,460.86
Surplus carried forward		$376,898.17

PHILADELPHIA BELL TELEPHONE.—A Philadelphia Bell Telephone director says that he estimates the gross earnings for the fiscal year ending next December 31, 1905, at about $4,170,000, which is the rate for the first five months of the year. In the summer months the business usually falls off somewhat because of the large number of people out of town, but against this will be the 17,000 gain in the number of telephones in use since the first of the year. The gross business indicated would be an increase of over $[illegible],000 as compared with 1904. The recent merger of the several companies into the Diamond State Telephone Company was done because it is proposed to make some extensions in that territory. This was formerly covered by the local sub-licensee companies, but as they did not care to undertake the extensions, the Bell Telephone Company, of Philadelphia, will furnish the capital and control the Delaware Company by ownership of a majority of the stock, and not by ownership of all the stock as in the case of the Delaware & Atlantic. The Delaware territory extends over the Peninsula, south of Wilmington, from the Chesapeake Bay to the Delaware Bay, and is contiguous to the Cumberland Telephone Company. Treasurer Peirsol, of the Bell Telephone Company, of Philadelphia, says all of the new stock was subscribed for except a few odd fractional shares. This is a pleasing result and indicates the faith of stockholders in the company.

BONDS OF PARIS (ILL.) PLANT.—A. H. Bickmore & Co., of 30 Pine Street, New York, offer at par and interest $55,000 first mortgage 5 per cent 20-year gold bonds of the City Gas & Electric Company, of Paris, Ill., guaranteed by the National Light, Heat & Power Company. The total issue authorized is $150,000, of which $130,000 have been issued and $75,000 taken by local banks and investors. The National Light, Heat & Power Company, which controls and operates several public service corporations, guarantees the bonds of the constituent companies both as to principal and interest. The combined net earnings of the companies for 1904 were sufficient to pay the interest charges on the total present issue of bonds, 5 per cent on the preferred and about 4 per cent on the stock of the National Company, issued in acquiring the properties.

OPPOSITION NEW YORK TELEPHONES.—It is alleged that when Comptroller Grout returns from Europe the Atlantic Telephone Company will probably be given a franchise to operate in New York City. The company was organized under the laws of the State of New York, and has a present capital of $5,000,000. Its authorized capital is $25,000,000, and the directors of the company have also authorized the issuing of bonds to the amount of $15,000,000. The officials of the Atlantic Company expect to connect with the Interstate Telephone Company of New Jersey, a consolidation of North and South Jersey independent lines, which, it is claimed, will give it independent long-distance connection for more than 1,500 miles.

AMERICAN TRACTION & LIGHT shows as follows for the six months ended June 30:

	1905.	1904		Changes
Gross	$549,080	$496,823	Inc.	$52,257
Expenses	16,500	13,500	Inc.	3,000
Net	$532,580	$483,323	Inc.	$49,257
Year ended June 30:				
Gross	$1,203,761	$1,050,375	Inc.	$153,386
Expenses	21,993	31,500	Dec.	9,507
Net	$1,181,768	$1,018,875	Inc.	$162,893
Dividends	715,940	598,920	Inc.	117,020
Surplus	465,828	$419,955	Inc.	$45,873

DIVIDENDS.—The directors of the Niles-Bement-Pond Company have declared the quarterly dividend of 1½ per cent on the preferred stock, payable August 15. They also declared 3 per cent on the common stock, 1½ per cent payable September 20 and 1½ per cent on the preferred stock, payable December 2. The directors of the Pratt-Whitney Company, an allied concern, have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable August 15. The Woonsocket Electric Machine & Power Company has declared a quarterly dividend of 1¼ per cent.

CONSOLIDATION AT PADUCAH, KY.—The Stone & Webster Company, of Boston, Mass., has bought the Paducah City Railway Company, capital $300,000, bonds $650,000, 14 9/10 miles of track; Paducah Gas & Fuel Company, capital $200,000, bonds $100,000; Paducah Steam Heating Company, capital $100,000, bonds $50,000. They are interested with a number of Louisville people, represented by Mr. Charles Dallam, of Louisville, Ky. The local stockholders of the concerns will retain 30 per cent of their stock.

NATIONAL LEAD NEW STOCK.—The National Lead Company is increasing its capital stock from $30,000,000 to $50,000,000, presumably for the purpose of absorbing the United Lead Company. Negotiations looking to this have been under way for about a year. A short time ago the stockholders of the National Lead Company authorized the increase of capital stock, and it is expected that the announcement of the taking over of the United Lead Company will be made shortly.

LARGE LIGHTING CONSOLIDATION.—Notice of the merger of fifteen electric light and gas companies in Luzerne County, Pa., into one company, with a capital of $1,000,000 has been filed in the State Department, with the approval of Governor Pennypacker. The officers of the new concern are: C. H. Geist, Philadelphia, president; H. W. Noble, Detroit, vice-president; C. B. Kelsey, Grand Rapids, Mich., secretary and treasurer.

General News of the Week

The Telephone.

ANNISTON, ALA.—A. M. Brett and associates have applied for a franchise to construct and operate a telephone system.

EUREKA, CAL.—A telephone franchise has been sold by the City Council to W. W. Allen, an attorney, of San Francisco, for $3,000.

SOUTH MANCHESTER, CONN.—The Bolton & Coventry Telephone Company applied to the Southern New England Telephone Company to have the Bolton line connect direct with the Manchester exchange and eliminate the Bolton office. This proposition was accepted. Officers were also elected as follows: President, John Cairns; vice-president, H. T. Thompson; secretary, Andrew Kingsbury; treasurer, W. S. Pitkins.

CONWAY, ILL.—The Home Telephone Company has increased its capital stock from $6,000 to $10,000.

GENESEO, ILL.—The Geneseo Telephone Company has been formed with a capital of $2,500 by C. Tomlinson and George B. Detrich.

GALESBURG, ILL.—The Galesburg Union Telephone Company has certified to an increase in capital stock from $150,000 to $250,000.

URBANA, ILL.—The National Telephone & Electric Company has purchased the property owned by the Farm & City Telephone Company for $100,000.

PEORIA, ILL.—The Inter-State Telephone Company has opened a new exchange in Peoria. It has a metallic toll line from Princeton to Peoria, giving connection for the patrons of the Bureau County Independent Telephone Company with Peoria, Pekin, Bloomington, Streator, Ottawa and other cities.

FRANKLIN, IND.—The Central Union Telephone Company is establishing a new system in this city, which will cost $10,000.

KURTZ, IND.—The Brownstown Telephone Company has sold the Kurtz & Houston telephone plants to Dr. Bruce Fleetwood.

FRANKFORD, IND.—The New Long-Distance Telephone Company, of Indianapolis, has asked for a franchise in this city.

BOSTON, IND.—The Richmond Home Telephone Company is putting in a new exchange in this place with 40 subscribers.

CONNERSVILLE, IND.—Representatives of the Central Union Telephone Company have made flattering offers for a controlling interest in the Connersville Telephone Company. L. A. Frazer, secretary of the company, says the plant is not for sale.

KOKOMO, IND.—The Citizens Telephone Company, realizing that the amended ordinance which it had before the council was doomed to defeat, withdrew it. This ordinance would permit the company to enter into a contract with the Bell Company for long-distance service. The council was opposed to it, believing it was a step toward ultimate control of the local plant by the Bell Company.

KOKOMO, IND.—The City Council has found that the Central Union Telephone Company has a franchise after all. The Western Telephone Company was granted a franchise 22 years ago and this was afterward transferred to the Central Union (the Bell). The city clerk in revising the ordinances neglected to transfer the franchise provisions to the new ordinance. This led the Council to believe that the Bell Company had no franchise.

WABASH, IND.—The independent telephone lines of northeastern Indiana will be cut off from all connection with the 100 miles of toll lines and many important exchanges of the United Telephone Company, which has just been absorbed by the Bell. The principal points to which the independents will be denied access are Marion and Bluffton, but 60 minor exchanges will be cut off. The action is due to diversion of all toll business originating on the Bell lines from the independent toll lines to those operated by the Bell.

TAHLEQUAH, I. T.—The Pioneer Telephone & Telegraph Company has secured control of the Cherokee Telephone Company's property, and will merge the line into its own system. The length of the line is 35 miles.

EMERSON, IA.—The Mills County Telephone Company has been incorporated with $50,000 capital.

DUBUQUE, IA.—The work of installing the underground telephone system at Dubuque has begun. A new central exchange is also to be constructed.

WEST BRANCH, IA.—The West Branch Telephone Company has been organized; capital, $12,000. J. T. Butler and others are the incorporators.

DES MOINES, IA.—Plans for the new central exchange of the Iowa Telephone Company are now being drawn by Architect John Spencer, and bids will be asked for as soon as they are done. Meanwhile the work of installing the underground system in the business district has been begun, the contract having been let to the King-Lambert Company, of Des Moines.

FLINT, MICH.—The change from the old to the new system of the Michigan State Telephone Company in this city will take place this month. The change has involved an expenditure of about $50,000.

KALAMAZOO, MICH.—The City Council has given the Michigan State Telephone Company five years in which to construct its conduits and remove its poles and lines from Kalamazoo avenue. The council originally demanded that the work be done by June 15 of this year.

YPSILANTI, MICH.—The Washtenaw Home Telephone Company has opened an exchange in Ypsilanti. For more than a year the company was kept out of the city by the refusal of the Council to grant it a franchise. Finally it entered on its State rights, having previously offered several thousand dollars and a number of fire telephones in return for a franchise, but without success. An injunction secured by the city to prevent the tearing up of the streets for putting in conduits was dissolved.

BOVEY, MINN.—A franchise has been granted the Mesaba Telephone Company by the village of Bovey.

ADA, MINN.—Directors of the Norman County Telephone Company are contemplating the purchase of the Ada, Halstad, Shelly and Twin Valley lines. The Iron Range Company has offered these lines for $9,000.

ST. PAUL, MINN.—The Telephone News Company has been formed, with a capital of $10,000, by Albert M. Jennings, Chicago, Ill., and E. E. Hunt.

CARL JUNCTION, MO.—The Carl Junction Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are G. A. Welbourne, H. C. Welbourne and H. C. Robertson.

LINCOLN NEB.—The Hickman Telephone Company has been organized with a capital of $6,000, by Adam Brendle and J. F. Judah.

HARTINGTON, NEB.—The Cedar County Farmers' Telephone Company has been formed with a capital of $5,000 by A. H. Cressy and L. D. Greenwood.

JERSEY CITY, N. J.—The Merchants' & Miners' Telephone & Telegraph Company has been incorporated in New Jersey. Capital, $500,000. Incorporators: S. R. Peary, James L. Stewart and Joseph Gales, Jr.

ASHEVILLE, N. C.—The city of Asheville has passed an ordinance requiring the Asheville Telephone Company, the merger concern, to supply better service within 60 days or forfeit its charter.

DONNYBROOK, N. D.—The Donnybrook Telephone Company has been formed with a capital of $50,000, by Fred M. White and Wm. A. Sherman.

CASSELTON, N. D.—The Western Telephone Company has been chartered with a capital of $50,000. Incorporated by Oliver Dalrymple and John L. Dalrymple.

LOWELL, OHIO.—The Highland Telephone Company has been organized. J. D. Snyder is president; Daniel Henneman, vice-president; C. F. Shinn, secretary, and John Mattern, Sr., treasurer.

WILMINGTON, OHIO.—The Central Union Telephone Company is seeking a reduction of taxes. Six years ago the State Board fixed the valuation of telephone instruments for taxation at $10 a set. Since that time the patents have expired and instruments, it is stated, are now sold for $3 a set, but the tax valuation has remained unchanged.

DAYTON, OHIO.—The Central Union Telephone Company plans improvements in the future that will cost $300,000. The switchboard capacity of the exchange in the telephone building on Ludlow St. will be enlarged, and a group of cables will be extended as far west as the Home and as far north as Fairview Park. The underground system will be extended in every direction in the city and poles removed wherever possible.

HARDIN, OKLA.—The High Point Mutual Telephone Company has been chartered with a capital of $1,000. Incorporated by John H. Dickerman and J. W. Quillan.

HARRISBURG, PA.—The Woodcock Valley Telephone Company has been formed. Capital, $5,000. D. M. Summers, of Entrekin, is treasurer.

ROCK HILL, S. C.—J. H. Milling, of Rock Hill, W. S. Percival, of Ogden, and associates are organizing a company to construct and operate a telephone system from Rock Hill to Ogden.

ST. MATTHEWS, S. C.—J. E. Wannemacker, J. E. Morse and others have incorporated the St. Matthews & Cameron Telephone Company, with a capital of $1,000.

EDGEMONT, S. D.—The Edgemont Telephone Company has been formed with a capital of $5,000, by Arthur J. Colgan and John Waldron.

MEMPHIS, TENN.—The Cumberland Telephone & Telegraph Company will open a new line between Memphis and Jackson, Miss., building down the Yazoo Delta branch of the Yazoo & Mississippi Valley Railway via Lake Cormorant, Tutwiler, through Yazoo City to Jackson. The company is also building between West Point, Miss., and Meridian, which line, when completed, will give another route between Memphis and New Orleans. Connection is now available as far south as Macon, Miss. It gives connection between Memphis and New Orleans via the Illinois Central and the Yazoo and Mississippi Valley Railroads and the line via Macon and New Orleans will give the company three direct connections between Memphis and the Crescent City.

SAN ANGELO, TEX.—Robert Stein, owner of the Miles Telephone Exchange, has sold the plant and franchise to J. Evans, of Santa Anna.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will build two additional stories to its exchange in this city and make a rear extension to the building of 70 feet. The new switchboard will have a capacity of 9600 lines. The estimated cost of the contemplated improvements is $250,000.

CRAIGS, VA.—The Craigsville & Bell's Valley Mutual Telephone Company has been formed, with a capital of $5,000, by J. B. Tuttle, president, and L. E. Hicks, secretary and treasurer.

GREENWOOD, WIS. The Badger State Company is making arrangements to sell its local exchange to the local company.

MENOMINEE, WIS.—The Wisconsin Telephone Company will make improvements to its system in this city to cost $30,000.

MILWAUKEE, WIS.—Alderman Henry Smith has introduced an ordinance to grant a franchise to the Milwaukee Home Telephone Company.

Electric Light and Power.

ENSLEY, ALA.—At a mass meeting held here on July 27 it was voted to construct a municipal electric light plant. N. W. Scott is mayor.

DOUGLAS, ARIZ.—The Douglas Improvement Company has decided to improve the electric lighting service.

ANAHEIM, CAL.—An election will probably soon be held to vote on issuing $[illegible] bonds for improving the water works and electric light plant.

DENVER, COL.—It is stated that the Denver Gas & Electric Co. will expend about $150,000 in improvements.

PLAINFIELD, CONN.—An electric power plant is to be built at the Quinebaug River, near the Canterbury bridge. The water power there has been examined by some railroad men who are favorably impressed towards utilizing it for trolley purposes.

MARIANNA, FLA.—The citizens have voted to issue $9,000 bonds to construct an electric light plant.

ST. AUGUSTINE, FLA.—The citizens have voted for a municipal electric light plant and extension of water works. A franchise for electric lighting was also voted to T. R. Osmond.

COCHRAN, GA.—This town has voted for $17,000 5 per cent. bonds for water and electric lights.

SHAWNEETOWN, ILL.—A. M. Searles has received a franchise for water works and an electric light plant.

ROODHOUSE, ILL.—The Roodhouse Light, Heat & Power Company has been incorporated, with a capital of $30,000. Edmund C. Kreider, Sr., is one of the incorporators.

MATTHEWS, IND.—Charles Sampson desires to install an electric light plant in this city.

FORT WAYNE, IND.—Contractors are examining plans for the $1,000,000 power house for the Fort Wayne & Wabash Valley road, bids for which will be opened early in August

JASONVILLE, IND.—The Jasonville Electric Company has incorporated with a capital stock of $9,000. David W. Wetnight, H. L. Hyatt and H. L. Hannah who are directors.

INDIANAPOLIS, IND.—Officials of the several roads centering at this city have decided on building a power, heat and light plant southeast of the Union Station train sheds, to cost $50,000.

GREENFIELD, IND.—The City Council has decided to repair the electric light plant. The proposition to take individuals into partnership with the city was not received favorably. Neither was it thought to be advisable to combine the electric and water plants.

PORTLAND, IND.—The City Council of this city has reduced the rate for electric light current to a point lower than that of any other paying plant in Indiana. The light committee and Superintendent Baily reported that it had been found possible to grant a reduction. The new scale is: For 10 kilowatts, 8 cents per kilowatt; 30 kilowatts, 7 cents, and 60 kilowatts or more, 6 cents. The minimum charge is reduced from 75 to 60 cents, the city furnishing the meter. The old rate ran from 9 cents to 7 cents and each rate was stationary to such an extent as to make the reduction equal to 30 per cent. The committee says a sufficient profit is left to pay all expenses of the electric light department, including salaries, and give the city its 70 street arc lights free. When the city plant was under private ownership these 70 arc lights cost $80 each per year.

INDIANAPOLIS, IND.—According to recent statistics gathered by the State Statistician for the year ending June 30, 1905, 32 cities of the 84 in Indiana owned their electric light plants, and 52 cities were lighted by contract with private corporations or parties. The entire cost of lighting for all the cities was $89[illegible].44. The cost of the 32 cities with municipal plants was $32[illegible], and for the 52 cities lighted by private contract $570,388.[illegible]. The receipts from this source in the 32 cities maintaining municipal plants was $345,[illegible].40, leaving an overplus of $23,[illegible] for these cities. The average cost per city of those owning plants was $10,010.23, and of those renting the lights was $10,960.15. The average cost of the latter was $955.92 per city greater than the former. Although the number of lights of each are not given, and for this reason no true basis can be had, yet the advocates of municipal ownership are claiming a victory over private management as to cost to the consumer. The total receipts of all the cities of the State maintaining electric light plants during 1905 was $[illegible].

ELDORA, IA.—The Eldora Electric Light Company will make extensive improvements to its plant.

PANORA, IA.—The electric light company has under consideration the construction of [illegible] at Rees' Mill.

OTTAWA, KAN.—[illegible] Sharp, of Lawrence, has petitioned for a franchise for an electric light plant.

ALMA, KAN.—A company has been organized by local men at Alma, they are installing a small [illegible] alternating system.

LEWISPORT, KY.—[illegible] is interested in the construction of an electric light plant.

SOMERSET, KY.—Bids will be received until Aug. 14 by T. R. Griffin, mayor, and the board of council, for [illegible] electric light franchise.

STOUGHTON, KY.—Bids will be received until Aug. 12 by the Electric Light Committee for a 100-kw. belted 3-phase alternator; 100-kw. steam turbo-alternator; two switchboards with [illegible] constant current transformer; 50 series alternating-current enclosed arc lamps; water-wheel governor [illegible] wheels, [illegible] feed pump and heater.

[illegible], IA.—The question of [illegible] water works and an electric light plant is under consideration.

MARKSVILLE, LA.—Sealed bids for the construction of a system of water works and electric light for the town of Marksville, will be received up to 4 p. m. Aug. 24, C. Ashton Smith, Mayor.

OAKLAND, ME.—The Messalonskee Electric Company, whose incorporation was recently noted, proposes to construct an electric light plant at Oakland to cost $125,000. L. Metcalf, 14 Beacon St., Boston, Mass., is the engineer.

AUGUSTA, ME.—The Southern Power & Improvement Company has been organized at Augusta, for the purpose of manufacturing, generating, buying and selling electric energy for lighting, heating and power, etc., with $10,000 capital stock, of which nothing is paid in. President, I. L. Fairbanks, of Augusta.

OLDTOWN, ME.—The Milford Construction Company has closed a contract with Jas. B. Mullen, of Bangor, Me., to construct a dam and power-house. The plant consists of a concrete dam about 1,000 ft. long across Penobscot River at Oldtown giving about 25 ft. head and a power-house containing twelve 1,000-hp generators, direct connected to water wheels. The power produced by the new plant will be transmitted to Bangor, 15 miles away.

BALTIMORE, MD.—The United Electric Light & Power Company has awarded contracts for the equipment of its power station at Westport as follows: Eight boilers of 700 horsepower each from the Wilcox Boiler Company, of New York; four engines of 3,000 horsepower each and an overload capacity of 4,500 horsepower, from the McIntosh & Seymour Company, of Auburn, N. Y., and four generators of 200 kilowatts capacity and overload capacity of 50 per cent to the General Electric Company.

QUINCY, MASS.—The Quincy Electric Light Company may issue $50,000 stock at par, $100, to pay for additions to plant made prior to July 1.

BRIDGEWATER, MASS.—The property of the Bridgewater Electric Light Company has changed hands during the past week, the new owner being Lawrence Cleare of this town.

HUNTINGTON, MASS.—The gas and electric light commissioners have issued an order approving the issue of $5,000 of new capital stock by the Huntington Electric Light Company for the purpose of purchasing the electric lighting plant and business in Huntington, formerly owned and operated by ex-representative Henry E. Stanton.

FALL RIVER, MASS.—The Fall River Electric Light Company is to issue $250,000 capital stock, to be offered to stockholders at $130 a share. The proceeds of 190 shares must be used for the cancellation of a like amount of floating debt on account of the purchase of land, and proceeds of the remaining 2,310 shares are to be used in payment of additions made subsequent to May 1.

LEOMINSTER, MASS.—The Heat, Light and Power Corporation of Boston has made a deal for the purchase of the Leominster Electric Light and Power Company. The ratification of the deal and the transfer of stock will follow the annual meeting of the trustees of the Leominster company. The price agreed upon is about par for the capital stock of the Leominster company, which is $50,000. The Heat, Light and Power Corporation already operates several plants in Worcester county, besides others elsewhere.

SPRINGFIELD, MASS.—The Monument Mills Company, of Housatonic, which recently purchased the Callender and the old woollen company's water privileges at Glendale, is to merge the two powers. It will build a dam between the two old dams by constructing a canal about 1,600 ft. in length, which will carry water to a site just above the Callender mill, whence it will be conducted to a power-house through a steel pipe 10 ft. in diameter and about 200 ft. long. The power-house will be located on the site of the old Callender mill, and will contain at the start two units of 750 horse-power each.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company has completed arrangements for a reduction in its tariff to customers to take effect from and after Oct. 1, 1905. The basic rate for incandescent house lighting will be changed from 16 2-3 cents to 15 cents per kilowatt hour. The old rate of 16 2-3 cents allowed a reduction of 15 per cent for prompt payment, making the rate 14.17 cents net. The new rate allows a reduction of 10 per cent, making the net price 13½ cents, a saving of .67 cent. In addition the company will supply free renewals of lamps, so that the total reduction to customers will be about 10 per cent. The reduced rates will also apply to small stores and offices.

ALPENA, MICH.—Richard Collins has been awarded the contract for the power house of the new water works, at $16,055.

ROSE CITY, MICH.—Frank G. Bell and James Monaghan have made application to the City Council for a franchise for an electric lighting plant.

MUSKEGON, MICH.—The Pere Marquette Light & Power Company is negotiating with the people of Hart village for the purchase of a part of the city lighting plant.

GRAND RAPIDS, MICH.—The city authorities have been requested to open negotiations for the lease of the municipal electric lighting plant to a syndicate of eastern capitalists.

KINGSLEY, MICH.—The village has let the contract for furnishing electric lights to A. Gibbs, of Mayfield, Mich. The contract calls for five arc lights and more to be furnished as needed. Mr. Gibbs will also furnish commercial lighting.

JACKSON, MICH.—The Commonwealth Electric Company has commenced the erection of a big dam in the Kalamazoo River, near Ceresco, five miles west of this city. It is the purpose of the company to furnish more direct power for the Jackson & Battle Creek Traction Company, and it is thought that 1,000 horse-power can be obtained from the dam.

BENTON HARBOR, MICH.—The power at the Buchanan village dam, which is controlled by Charles A. Chapin, is to be transferred in part to Benton Harbor and St. Joseph. Another dam will be constructed at King's landing, where Chapin has a large site. A recent decision of the Supreme Court gave Chapin the right to sell the power where he desired, despite the exclusive contract with Buchanan.

CLARE, MICH.—The village has renewed its contract with the Clare Electric Company for lighting the streets for five years at $4.90 per month for each light. Senator Doherty desired a contract to the end of his franchise nine years hence and offered light for $4.75 a month if the longer contract was granted. The city expects to be in shape to take over the lighting plant at the end of the five-year contract. The rate established will make the cost of lighting the streets $800 a year.

ST. LOUIS, MO.—The Board of Public Improvements will receive bids on Aug. 15 for furnishing electricity at the city institutions for one year from September 1. During the present year the expense has been $22,000. The contract includes power for all of the fire engine houses and other city buildings.

FORT OMAHA, NEB.—Bids will be received until Aug. 21 by Maj. M Gray Zalinski, Constructing Q. M., Army Building, Omaha, for an electric lighting system at Fort Omaha.

RENO, NEV.—A deal for the consolidation of Reno's two electric companies has been pending for some time, but H. C. Cutting, its promotor, has left the city, and it is believed that the project is now off.

CONCORD, N. H.—The Concord Electric Company has closed its plant at Sewall's Falls for repairs and improvements and is supplying electricity from its steam plant on Bridge St. and from Garvin's Falls.

KEARNY, N. J.—The Kearny Common Council has discovered that it has no power to issue bonds for a municipal lighting plant, and has instructed its Lighting Committee to make a contract with the Public Service Corporation to light the streets for one year only at the reduced price offered by the company—$97 a year for arc lights and $15 a year for incandescent lights. The reduced offer made by the corporation was for a term of five years, and it is probable that the company will refuse to renew the contract, which expires on Aug. 1 for a year at the reduced prices, and will compel the town to pay $100 a year for arc lights and $16 for incandescents.

CARLSBAD, N. M.—A large power dam has been finished to replace the one destroyed by the storm last fall, and this town is again lighted by electricity.

LAKE PLACID, N. Y.—The date of opening of bids for constructing an electric light plant has been extended from Aug. 3 to Aug. 14.

CHATHAM, N. Y.—The electric light plant at Chatham has been sold to the Lindewald Light & Power Company, which is composed of Chatham capitalists.

SALAMANCA, N. Y.—This village proposes to take over the present water and lighting plants on Jan. 1, 1906, if it is voted to do so at the special election, to be held soon.

SOUTHPORT, N. C.—The town of Southport is considering the question of a municipal electric light plant. Several bids for the plant have been received.

WINSTON-SALEM, N. C.—The Winston-Salem Power Company, with $125,000 capital, has been chartered in North Carolina, and will develop electrical properties, etc. F. H. Fries and others are the incorporators.

GREENSBORO, N. C.—The State has authorized the Greensboro Electric Company to increase its capital stock from $250,000 to $500,000, the additional issue being of preferred stock. John Kerr is the president of the company.

CHARLOTTE, N. C.—The development of the Catawba River by the Southern Power Company, of Charlotte, will, it is predicted, result in the establishment of many new small industries at points reached by the lines of the new $7,500,000 concern. A total of 75,000 horsepower will be developed.

URBANA, OHIO.—Architect Wm. Miller, of Springfield, is preparing plans for the $5,000 electric lighting plant, to be erected here.

LOCK HAVEN, PA.—The Electric Light Company has in contemplation the enlargement of its plant on E. Church St.

WOMELSDORF, PA.—Wm. H. Dechant, 536 Penn St., Reading, is preparing plans for the construction of an electric light plant at Womelsdorf.

HARRISBURG, PA.—The Harrisburg school district will install an engine and generator in the addition to the technical high school. Mr. H. E. Todd can give information.

READING, PA.—The Reading Illuminating Company is making preparations to construct a power plant and install the necessary equipment in the way of wires, cables, conduits, etc.

MILLERSBURG, PA.—Dreibelbis & Co., Reading, are completing plans for the construction of a 50,000-hp. plant about a mile north of Millersburg, along the Susquehanna River. The probable cost of the proposed work is $1,500,000.

SUMTER, S. C.—The Sumter Electrric Light Company has been incorporated, with a capital of $200,000.

ESSEX JUNCTION, VT.—L. M. Farnham, of Boston, has, with Mr. Nash, of Burlington, been in consultation with S. A. and C. W. Brownell regarding the development of the water power on the south side of the river for an electrical plant. Plans have been submitted and are under consideration.

STAUNTON, VA.—It is stated that a receiver has been asked for the Augusta Electric Company. The company has failed to pay interest, but claims a contract whereby forfeiture will not lie, and to test this point application has been made for a receiver.

TACOMA, WASH.—The Mountain Home Electric Company has been incorporated with a capital of $30,000, by J. J. Hewitt, of Tacoma, and Seymour H. Bell, of Sumpter, Ore.

SHAWANO, WIS.—The Flattock Water Power Company, of Shawano, has been incorporated, with a capital of $50,000, by H. C. Zachow, Chas. H. Hartley and Frank S. Baker.

FOND DU LAC, WIS.—The Independent Light, Heat & Power Company, of Fond du Lac, has been incorporated with capital of $25,000, by Robert Free, G. R. Hoffman and Frank D. Fulton.

LARAMIE, WYO.—W. C. Sterne, of Littleton, Col., is interested in the construction of an electric light plant at Laramie.

WINNIPEG, MAN.—Bids will be received by J. C. Gibson, chairman fire, water and light committee, until Aug. 28, for the supply of a producer gas plant, of a capacity of 2,500 continuous engine brake horse-power; also a 500-kw electric generating plant. Specifications may be obtained upon application to H. N. Ruttan, city engineer.

MOOSE JAW, N. W. TER.—Bids will be received until Aug. 21 by John D. Simpson, secretary-treasurer, for a 200-hp boiler, 350-hp engine, condenser, feed pump and heater, 225-kw. alternating current generator, exciter and switchboard.

NAPANEE, ONT.—Bids will be received until Sept. 1 by W. A. Granger, town clerk, for $35,000 electric light bonds.

The Electric Railway.

SAN FRANCISCO, CAL.—The Vallejo, Benicia & Napa Valley Railroad Company, which recently completed its line from Vallejo to Napa, contemplates an extension through the Napa Valley to Calistoga and thence into Lake County. J. W. Hartzell, the promoter, is endeavoring to arrange for a bond issue to provide for building an electric road from Vallejo to Suisun, Vacaville and Winters. It is the intention to connect with the Vallejo, Benicia & Napa Valley near Napa. The Monticello Steamship Company will make connections at Vallejo for San Francisco.

NEW BRITAIN, CONN.—Within a few weeks the Connecticut Railway & Lighting Company will abandon its central power station on Chestnut Street. The work of placing the cables so as to change the power system from the direct to the alternating current is now being pushed. When it is completed all the power for the operation of the trolley and electric lighting business in the New Britain district will be received from the plant of the New Milford Power Company at Bulls Bridge on the Housatonic River. It will come through the sub-station at Black Rock.

BOISE, IDA.—It is announced here that a company will shortly be organized for the purpose of constructing an electric railway from this city to Big Creek. The company will be incorporated with a capital stock of $10,000-000.

KANKAKEE, ILL.—The Kankakee Electric Street Railway System and Electric Park have been sold to a syndicate consisting of E. D. Risser, of Paxton, R. A. Cracken and others. The company's capital has been increased from $60,000 to $100,000.

ALTON, ILL.—The Edwardsville & Granite City Railway Company will increase its capital stock from $10,000 to $30,000, in order to enable it to absorb the Edwardsville, Alton & St. Louis Railway, which was organized to construct an electric railway from Mitchell to Edwardsville. The new line to Edwardsville is nearing completion.

FORT WAYNE, IND.—The plans for the $1,000,000 power house to be erected at Fort Wayne, Ind., by the Fort Wayne & Wabash Valley Traction Company, specify 10,000 horse-power to be furnished by turbine engines. A large electric crane will be part of the equipment. The building will be of pressed brick with the interior of glazed white tile.

FORT WAYNE, IND.—The extension of the Toledo & Indiana Electric Railway into Fort Wayne is now assured. The financing of the road is now completed with Lawrence, Barnum & Company and Patrick Hirsch, New York, as backers. The new company will be known as the Toledo, Fort Wayne & Western. The incorporators are the same men who filed an application for a line from Toledo to Cincinnati.

MAYSVILLE, KY.—The Maysville, Carlisle, Millersburg & Paris Traction Company has been formed with a capital of $30,000.

EASTON, MD.—There is a well-defined movement on foot to establish a peninsula electric railway through Elkton, Chesapeake City, Chestertown Centerville, Easton, Cambridge, Princess Anne, Salisbury, Berlin and Snow Hill to Ocean City. Back of the enterprise are capitalists from New York, Philadelphia and Baltimore. A right of way will be asked of the next Legislature, and, if it is granted, engineers will be put to work next April.

ATHOL, MASS.—It is said that consideration is being given here to a project to build an electric railway from Barre to Baldwinsville, running through Petersham, Phillipston and Templeton. In furtherance of this project, it is stated that J. H. Hutchins, of Athol, has secured control of excellent water power having its head in Queen Lake, Phillipston.

GREENFIELD, MASS.—The Connecticut Valley Street Railway Company will establish a power plant and contract for additional power to supply the whole system. The contract has not been signed, but it is understood it will be very soon, with the Greenfield Electric Light & Power Company. This movement contemplates the construction of a new transmission line from Greenfield to Hadley, a distance of 23 miles, which will be entirely independent of the present station in Hadley. The machinery for the sub-station will be supplied by the Stanley Electric Company of Pittsfield, contracts having been awarded. This improvement contemplates an outlay of some $50,000 for both the new line and the new plant.

GRAND LEDGE, MICH.—An electric railway between Grand Ledge and Lansing is being considered by the business men of the village.

BATTLE CREEK, MICH.—H. M. Griffin, president of the Battle Creek-Coldwater Electric Railway, announces that contracts are let for the construction of the road, steel bridges, brick and cement depots, cars and power.

ALPENA, MICH.—D. W. Closser and O. O. Black, working in the interests of capitalists, are securing right of way for an electric railway from Alpena to Long Lake. A stock company with a capitalization of $100,000 is to be organized.

YPSILANTI, MICH.—The Detroit, Ypsilanti, Ann Arbor & Jackson Railway Company is preparing for improvements in the plant here. The height of the smokestacks in the chimneys of the power house is to be doubled. New cars are being built, sheet iron being used on the exterior almost exclusively.

JACKSON, MICH.—The Jackson Consolidated Traction Company has promised to build a line to the city limits to meet the line of the Jackson & Lansing Traction Company. The Detroit, Ypsilanti, Ann Arbor & Jackson Railway will change its routing into the city next summer. The new routing will give a loop for local service between Jackson and Jackson Junction.

MANISTIQUE, MICH.—A committee of the Merchants' and Manufacturers' Association of this city has investigated the possibilities of an electric road to connect Manistique and Garden. The Manistique Light & Power Company offers to furnish power for operating the road, if it is built, for $10 per horsepower per year. E. E. Coombes, auditor of the Manistique, Marquette & Northern Railroad, estimates the total cost of the road at $600,000.

MARSHALL, MICH.—The Commonwealth Power Company has commenced the erection of a dam across the Kalamazoo River at Cresco to furnish power to the Jackson & Battle Creek Traction Company, which operates the line between Battle Creek and Jackson. Power has been obtained from Allegan, but frequent breaks in the high-tension wire between Allegan and Battle Creek have led the company to secure power nearer to the line.

SAGINAW, MICH.—The Saginaw & Southwestern Railway Company has changed its name to Saginaw Bay & Southwestern Railway. The terminus has been changed to include Bay City. The capital stock is increased to $100,000. The new company will take over the franchises, property and rights of way of the Saginaw Southern Railway Company and of the Bay City & Caro Railway. A. S. Courtright, of Lansing, has been appointed supervising engineer.

SULLIVAN, MO.—The Sullivan City Railway Company has been formed with a capital of $50,000 by J. B. Titus and W. A. Searle.

ST. LOUIS, MO.—The United Railways Company of St. Louis has notified the Postoffice Department that it will discontinue carrying the mails on street cars unless the rate of compensation is increased. The United Railways Company receives 13½ cents a mile, earned $32,950 for the 244,000 miles covered during the fiscal year ended June 30, and wants the rate increased to 25 cents a mile.

GRAHAM, N. C.—The Alamance Street Railway Company, of Graham, is issuing bonds for a street railway. An electric light plant is also being erected at Graham.

ALBANY, N. Y.—The Niagara Falls & Lockport Electric Railway Company has been formed with a capital of $200,000. Edward Michael and Clark L. Ingham are interested.

GLENS FALLS, N. Y.—The Hudson Valley Railway Company directors have elected the following officers: A. B. Colvin, president and general manager; J. W. Herbert, first vice-president; G. A. Heimie, second vice-president; W. L. Kiley, secretary; C. A. Gardiner, general counsel.

TROY, N. Y.—It is reported that work will be started within a month on an extensive system of electric railways connecting Lakes Champlain and George with Schroon and Placid Lakes. The company was recently incorporated under the name of the Ticonderoga Union Terminal Railroad Company, and is promoted by New York, Philadelphia and Chicago capitalists. The company intends to erect dams for the development of power. Options have been secured on desirable water-powers. The directors are I. Rothschild, A. B. Adkins, A. H. Wood, F. B. Wickes, M. V. Drake and W. W. Richards, of Ticonderoga, and Frank B. Gridley and N. R. Holmes, of this city.

ST. CLAIRSVILLE, OHIO.—The franchise for the Wheeling Traction Company's up-the-river line has been granted.

NEWARK, OHIO.—The Council will be asked for a franchise for the Newark, Martinsburg & Mt. Vernon Electric Railway.

WARREN, OHIO.—The Youngstown and Ohio River Traction Company, which was promoted two years ago by Max P. Good, and some other Cleveland people, is to be built.

BARBERTON, OHIO.—The resolution authorizing the mayor and clerk of the city to advertise for bids for the construction of a street railway line in this city has been adopted.

CLEVELAND, OHIO.—The new trolley line to be built from Erie to Cambridge Springs, and known as the Erie, Cambridge, Union & Corry Railway Company, has been incorporated.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Interurban Railroad is to be extended to Bucyrus. The company has been incorporated with a capital of $500,000. John C. Webb is president.

OKLAHOMA CITY, O. T.—The Oklahoma Electric Railway Company, of Tecumseh, O. T., has been incorporated, with $25,000 capital stock, to build 10 miles of electric railway out of Shawnee, in Pottawatomie County. The incorporators are: Alfred Hare, E. H. Milburn, E. T. Fullerton, E. J. Dickerson and Chas. Blickenderfer.

WAYNESBORO, PA.—Surveys for the proposed Waynesboro-Hagerstown trolley line have been completed, and franchises from the various towns along the route will now be sought. As soon as these are all obtained construction work will be commenced.

SCRANTON, PA.—The Scranton, Factoryville & Tunkhannock Railway has sold its franchise to the Northern Railway Company. The franchise gives the right to construct a road to Tunkhannock. Former Mayor W. L. Connell is president of the Northern Company.

YORK, PA.—The plant of the Delta Electric Light Company, located along Muddy Creek, has been purchased by the York Furnace, Pequa & Lancaster Electric Railway Company. The purchase was made for the purpose of furnishing power for the proposed new trolley extension into York County.

CHAMBERSBURG, PA.—It has been practically decided by the Chambersburg, Greencastle & Waynesboro Electric Railway Company to build the extension between Greencastle and Chambersburg. Surveys have been made of the route and estimates of the cost presented to the board of directors.

HARRISBURG, PA.—A charter has been issued at the State Department to the Johnstown Terminal Street Railway Company, capital $10,000. John G. Gilbert, of this city, is president, and the directors are: James C. Thompson, Jacob T. Snyder, William S. Tunis, Edward Holbert and John G. Gilbert.

WEST CHESTER, PA.—The West Chester Street Railway Company has filed papers for two extensions. One begins at a point on the West Chester-Lenape-Kennett line, between Unionville and Kennett Square, and runs to Unionville, London Grove and Avondale. The other extension is from a point near Pocopson to Kennett Square.

SCRANTON, PA.—Prospects for the early building of the line of the Scranton, Factoryville & Tunkhannock Electric Railway, between this city and Tunkhannock, with a spur to Lake Winona, are much brighter now that the Northern Electric Railway Company has obtained control of 90 per cent of the stock of the company. A. J. Connell is president of the Northern Electric Company.

PHILADELPHIA, PA.—The properties and franchises of the Lehigh Valley Traction Company and its affiliated corporations bought at the several foreclosure sales have been conveyed to the Lehigh Valley Passenger Railway Company, the Philadelphia & Lehigh Valley Passenger Railway Company and the Allentown & Slatington Passenger Railway Company, respectively. The boards of these several reorganized companies met for organization and the following directors and officers were elected: Directors, Tom L. Johnson, Arthur F. Newbold, Harry C. Trexler, E. B. Smith, George Q. Albright, William F. Harrity and George H. Frazier. The boards elected the following officers: President, Harry C. Trexler; vice-president, Edward M. Young; secretary and treasurer, George H. Frazier; general manager, Warren S. Hall, and auditor, C. M. Walter. This action is a step toward the merger of all the properties into one company the Lehigh Valley Transit Company. The organization of this company will take place shortly.

New Industrial Companies.

THE DODD & STRUTHERS COMPANY, of Des Moines, Ia., has been formed with $750,000 capital, to manufacture copper cable, lightning rods, etc.

THE BURN-PETERIT MANUFACTURING COMPANY, of New Haven, Conn., has been formed with a capital of $300,000 paid in, $400,000 specified, to make gas and electric lighting fixtures. This concern will occupy a portion of the plant already taken by the W. S. Burn Company in Fair Haven.

THE CUBA EASTERN TERMINAL COMPANY has been organized at Portland, Me., for the purpose of constructing, maintaining and operating railroads, telegraph and telephone lines, gas and electric works, etc., with $200,000 capital stock, of which $500 is paid in. Officers: President, H. L. Cram, of Portland; treasurer, B. L. Stewart, of Portland.

THE DELANY HOLDING COMPANY has been organized at Augusta, Me., for the purpose of acquiring the United States rights for the system of rapid automatic telegraphy devised by Patrick Delany, of South Orange, N. J., and to manufacture and deal in all kinds of electrical machinery, apparatus, devices, supplies and materials, with $1,000,000 capital stock, of which nothing is paid in. Officers: President, A. P. Bibber, of Augusta; treasurer, E. E. Penney, of Augusta.

THE STANDARD METALWORK COMPANY has been formed by the G. H. Bushnell Press Company, Thompsonville, Conn., for the purpose of conducting the manufacture of large pipe bends with improved joints for high pressure steam service and difficult metal work generally, including steam superheaters, condensers, feed water heaters, as well as appliances for refrigerating, evaporating, distilling, etc., Mr. James A. Colvin is proprietor, Mr. Mark Worth Bushnell, business director, and James Acton Miller, mechanical engineer and director, the latter having been engaged a number of years in this class of special work.

Legal.

THE LA ROCHE ESTATE.—Surrogate Fitzgerald of New York has reserved decision in an action brought to determine just how the estate of Frederick A. La Roche, the electrical engineer and automobilist, should be distributed. Mr. La Roche died in March last, and when it was found that he had made no regular will to dispose of his estate, estimated at a million dollars, his wife produced a letter at the Surrogate's office, offering it as a will. The letter had been written by Mr. La Roche to his wife two years before he died, at a time when he was about to start in an automobile race. He wrote that in case he met with an accident and died she, his wife, was to receive all of his possessions, which he named in detail in the letter. The husband's relatives, who claim a share of the estate, contended that the letter was practically worthless, as it was intended simply for use in case Mr. La Roche met with an accident at the time the letter was written. As the race did not result in his death, his relatives, including his aged father, two brothers and three sisters, now want the letter-will pronounced void.

Obituary.

MR. C. S. DILL, superintendent of the municipal lighting plant at Goshen, Ind., was electrocuted there on the night of August 4 through some inadvertence while testing an arc lamp.

DR. A. M. BELL.—The death occurred at Washington, on August 7, of Dr. A. M. Bell, father of Prof. Alexander Graham Bell. He was born in Scotland in 1819 and all his life was distinguished as an expert on articulation, vocal expression, elocution, phonetics, etc. In 1881 he permanently settled in Washington, D. C., and engaged in literary work. His numerous publications treating of elocution, vocal physiology and defects in speech, dating from 1845 to 1898; also on phonetic and visible speech, 1866 to 1898, and also on phonetic shorthand writing, 1852 to 1857, are accepted authorities on these subjects. In 1885 Prof. Bell was elected a fellow of the American Association for the Advancement of Science. He was an active member of the Modern Language Association, and of various scientific and educational organizations in the United States. He also held a fellowship in the Educational Institute in Scotland, and in the Royal Scottish Society of Arts.

Personal.

MR. J. R. McCOLL, who was until the close of the last college term, associate professor of Steam Engineering at Purdue University, has decided to take up commercial lines, and has accepted a responsible position in the engineering department of the American Blower Co., at Detroit.

DR. ALBERTO PIRELLI, of Milan, Italy, who has been making a trip of several weeks in this country, visiting rubber works, insulated wire factories, etc., sailed on Tuesday for England by German liner. It is his hope that many American electrical engineers will visit the great Milan Exposition next year.

MR. H. SOMMERS has been made general superintendent of the Rocky Mountain Bell Telephone Company. He was formerly superintendent of the Montana division, with headquarters at Helena. From Helena he was transferred to Salt Lake, to be superintendent of that division. He has proven himself worthy of his several rapid promotions, and is one of the most efficient officials of the company.

MR. EDWARD ROSEWATER, the famous old-time telegrapher and veteran editor of the *Omaha Bee*, one of the leading newspaper properties of the West, has recently contributed to that journal a brief batch of personal recollections of some of the men he has met in the electrical field. The list includes Prof. Joseph Henry, T. A. Edison, A. G. Bell, M. I. Papin, Anson Stager, P. B. Delany, James D. Reid. Mr. Rosewater established for Henry the first weather bureau west of the Mississippi River.

MR. W. M. LEWIS for a number of years superintendent of the gas and electric interests of the Public Service Corporation's plants at Raritan, Somerville, Finderne and Boundbrook, N. J., has resigned, and has become the general manager of the Rockville Gas & Electric Co., of Rockville, Conn. Mr. Lewis has acquired an enviable reputation as a gas and electrical manager, and is expected to accomplish noteworthy results in his new sphere of activity.

MR. PAUL J. CHALLEN, assistant to the manager of the Green Fuel Economizer Company, has recently accepted a position with the Stirling Company at their Philadelphia office. Mr. Challen has been connected with the Green Fuel Economizer Company since they started manufacturing in this country, 13 years ago. As designing and constructing engineer he has had a large experience and opportunity to study various types of boilers and their operation.

MR. S. M. KINTNER.—Mr. Samuel M. Kintner, for some years professor of electrical engineering at the Western University and for years the associate of Professor Reginald A. Fessenden in his experiments in wireless telegraphy, has been tendered the position of associate professor of electrical engineering in the Carnegie Technical School, with Mr. A. J. Wurts, for many years technical expert at the Westinghouse Electric & Mfg. Company. Mr. Kintner is now expert with the Westinghouse Company.

MR. HOWARD M. POST has just taken the position of advertising manager for the Kellogg Switchboard and Supply Company of Chicago. His experience in the telephone field dates back to 1899, when he entered the telephone installation department of the Western Electric Company, in which department he remained for three years, installing exchanges in different parts of the country. He resigned this to accept a position as assistant telephone engineer with the Kellogg Switchboard & Supply Company in 1902, which he has held until the present time. During this interval he has made a number of telephone inventions, which were assigned to the company. He is therefore well equipped to handle intelligently the extensive advertising of this company.

Trade Publications.

THE SARCO COMPANY, 906 Sixth Avenue, New York City, has issued a neat little memorandum book in the shape of its new pendant switch. Copies will be furnished to electrical contractors free on application.

THE AITON MACHINE COMPANY, 126 Liberty St., has just issued its bulletin 79, illustrating one of its horizontal types of cabling or closing machines for laying up large cable. Specifications and quotations will be cheerfully furnished upon application at the New York office of the company.

AMERICAN BLOWER CO., of Detroit, Mich., issues as its illustrated sectional catalogue No. 18, a special pamphlet descriptive of its A. B. C. exhaust fans for heating and drying plants, removal and conveying of dust and shavings, handling of wool and cotton, etc. Several of the types are shown equipped with electric motor, making a compact, economical and efficient outfit. Data are given as to these in all sizes.

News of the Trade.

THE L. B. ALLEN CO., INC., 1332 Columbia Ave., Chicago, Ill., maker of the Allen soldering sticks, paste, salts, etc., has opened an office at 97 Warren St., New York, in charge of Mr. A. Hall Berry.

THE NATIONAL TUBE CO. has placed a large and important order for immediate execution, with the American Blower Co. of Detroit. The contract embraces heating equipment for their five new butt weld mills at Lorain, O.

THE PRATT & WHITNEY COMPANY, of Hartford, Conn. has made arrangements with the C. T. Patterson Company, Ltd., of New Orleans, La., to represent its small tool department on the Southwest territory. The Patterson Company has a very complete line of the small tool product, and is in a position to fill orders from its New Orleans establishment.

THE MOLONEY ELECTRIC COMPANY has opened an office in the Old Colony Building, Chicago, and has placed it in charge of Mr. Francis Raymond, formerly of the General Incandescent Arc Light Company. The Moloney Electric Company has found it necessary to take this step owing to the large transformer business which it has worked up in the Chicago territory.

THE ATWATER KENT MANUFACTURING WORKS, of Philadelphia, manufacturers of ignition specialties, formerly located at 112 North Sixth Street, are now located in their new home, a modern, fireproof building at 42, 44 and 46 North Sixth Street, where they have a considerable increase in floor space. Their new facilities promise a great increase in the output of the ignition specialties which they make.

COOKSON STEAM TRAP AND SEPARATOR.—The D. T. Williams Valve Company, Cincinnati, O., has concluded arrangements for the exclusive manufacture and sale of the Cookson steam trap and separator, formerly manufactured by the Cookson Steam Specialty Company, of Cincinnati. It has purchased the patents, patterns and good will of Thomas J. Cookson, and the exclusive right to manufacture his trap and steam specialties. This trap is very well known throughout the country, and is handled by the majority of jobbers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUGUST 1, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

795,820. SYSTEM FOR THE SELECTION OF ELECTRIC CIRCUITS; Anson G. Cox, Boston, Mass. App. filed Jan. 27, 1902.

795,821. UNDERGROUND CONDUIT; Henry T. Craven, Vineland, N. J. App. filed May 24, 1904. The conduit is provided with specially arranged drainage grooves, and has in addition a flexible protecting strip which lies in the usual groove or slot, and is temporarily raised therefrom by the passage of a car.

795,836. SELECTIVE CALL APPARATUS; John A. Hulit, Topeka, Kan. App. filed Sept. 3, 1904.

795,838. ASYNCHRONOUS ELECTRIC MOTOR; Paul Jigouzo, Vanves, France. App. filed Dec. 1, 1902. (See Current News and Notes.)

795,843. SYNTONIC SPACE TELEGRAPHY; Oliver Joseph Lodge, Birmingham, and Alexander Muirhead, Shortlands, England. App. filed March 21, 1902. (See Page 258.)

795,851. SYSTEM FOR SELECTING ELECTRICAL CIRCUITS; Albert D. Neal, South Boston, Mass. App. filed Oct. 18, 1901.

795,852. ELECTRICAL RELAY; Albert D. Neal, South Boston, Mass. App. filed Mar. 4, 1902. A pole changing relay comprising a pair of separate magnets which are energized successively. The energization in one order of succession makes connections of opposite polarity to those made when the magnets are energized in the opposite order.

795,857. METHOD AND MEANS OF SIGNALING; Frank W. Prentice, Braddock, Pa. App. filed Nov. 19, 1902.

795,861. ALTERNATING-CURRENT INDUCTION-MOTOR; Leo Schuler, St. Louis, Mo. App. filed July 16, 1904. (See Current News and Notes.)

795,864. REVERSING MECHANISM; Judson Shoecraft, Eskridge, Kan. App. filed Dec. 27, 1904. A semaphore arm is operated by a pneumatic cylinder to which air is admitted at either end by a two-way cock. The cock is connected to a motor-driven gear wheel which is turned in opposite directions according to which way the current traverses the motor.

795,867. ELECTRIC HAND LAMP; Herman F. Stakelbeck, Philadelphia, Pa. App. filed Dec. 16, 1904. Relates to a construction of hand lamp in which the wires are guided by a split insulating ferrule, or bushing, which clamps the wires when the handle is screwed in place.

795,872. TELEPHONE-EXCHANGE; Harry G. Webster, Chicago, Ill. App. filed Nov. 16, 1904.

795,886. MAKING ALUMINUM; Anson Gardner Betts, Troy, N. Y. App. filed April 1, 1903. (See page 272.)

795,887. ELECTROLYTICALLY REFINING SILVER; Anson Gardner Betts, Troy, N. Y. App. filed March 8, 1905. (See page 272.)

795,910. CONDUCTOR SUSPENSION DEVICE; George F. Hagerman, Chelmsford, Mass. App. filed Nov. 22, 1904. Is made from a single piece of resilient wire, and has a cable supporting ring depending from a pair of short helical sections which surround the guide wire and serve to suspend and hold the ring in place.

795,956. PROCESS OF ELECTRICALLY HEATING; Eugene A. Byrnes, Washington, D. C. App. filed Dec. 10, 1904. The water is made to traverse a porous cup, composed of graphite silica and a bond of any suitable clay. The cup is simultaneously traversed and heated by an electric current.

795,958. CONTROLLER FOR ELECTRIC CIRCUITS; Fred Cedergren, Chicago, Ill. App. filed Dec. 17, 1904. A small rheostat especially adapted for medical batteries. Has a pair of controller arms, one of which is turned to suit the general strength of the battery, and the other of which is manipulated according to the requirement of the patient.

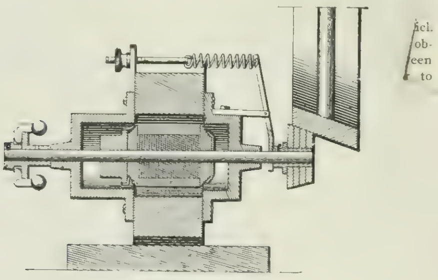
795,961. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin, Chicago, Ill. App. filed Sept. 3, 1904.

795,983. SPARKER; Alpha R. Joy, Wapello, Iowa. App. filed Sept. 1, 1904. An ignition dynamo for gasolene engines in which a conical pulley is moved away from the driving wheel by a centrifugal governor when the speed exceeds a certain amount.

796,022. CUT-OUT FOR TELEPHONES; John Andrew Tornquist, Clinton, Ia. App. filed Oct. 6, 1904.

796,029. PLUG SWITCH; James I. Ayer, Cambridge, Mass. App. filed Aug. 12, 1904. A floor switch in which an insulating cup is inset into the floor and has a pair of spring blades which are aligned with corresponding openings in the cover. The plug has projecting studs which pass through the openings and engage the blades.

796,031. ELECTRICAL MEASURING INSTRUMENT; Thomas Duncan, Chicago, Ill. App. filed June 26, 1901. This and the following 30 patents belong to a single series issued to the same party, and relate generally to electric meters. This particular patent and the one following relate to a phase-measuring device, and have coils at different angles in which a definite amount of lag is produced by impedance windings, whose effect is strengthened to turn the indicating pointer in an appropriate direction by variations in the working current lag.



795,983.—Sparker.

796,032. ELECTRICAL MEASURING INSTRUMENT; Thomas Duncan, Chicago, Ill. App. filed June 26, 1901. In this patent the coils are mounted co-axially, two of them being stationary and in planes at right angles to one another, while the other two are movable and located in planes at right angles to one another.

796,033. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed June 26, 1901. The series of ten patents beginning with this number, all relate to systems of gearing within the meter by which the latter is made to directly indicate in dollars and cents, the amount of current consumed, and to automatically apply the discounts, rebates and excess charges, according to the contract, depending on the way in which the lamps are used.

796,034, 796,035 and 796,036. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 3, 1901.

796,037 to 796,042, inclusive. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 11, 1901.

796,043. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901. The series of 18 patents, beginning with this number, relate generally to meters for charging storage batteries. The meters are arranged to register in the proper direction when the battery is charging or being discharged. Among other special features is one in which a spring exerts a constant torque upon the movable part of the meter so that the latter rotates very slowly even when no current is being used. This corresponds to the amount of leakage of the battery, so that the meter automatically shows when the battery needs recharging.

796,044. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901.

796,045 to 796,048, inclusive. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901.

796,049 to 796,056, inclusive. ELECTRICAL MEASURING INSTRUMENT; Thomas Duncan, Chicago, Ill. App. filed Aug. 26, 1901.

796,057. METER; Thomas Duncan, Lafayette, Ind. App. filed Jan. 2, 1902.

796,058 and 796,059. METER; Thomas Duncan, Lafayette, Ind. App. filed Jan. 8, 1902.

796,060. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Jan. 8, 1902.

796,061. INDICATING INSTRUMENT; Thomas Duncan, Lafayette, Ind. App. filed Jan. 8, 1902. Has a permanent magnet with a curved pole piece over which moves a coil carried by the pointer. Screws are provided to shunt the magnet circuit and are adjusted from time to time to compensate for the weakening of the magnet.

796,062. METER; Thomas Duncan, Lafayette, Ind. App. filed Jan. 8, 1902. A coin-controlled meter in which the coins unlock a star wheel and permit a one-tooth rotation thereof.

796,063. AUTOMATIC SWITCH FOR STORAGE BATTERIES; Thomas Duncan, Lafayette, Ind. App. filed Jan. 8, 1902. This patent and the following one relate to an automatic switch by which a storage battery is cut out of circuit when the battery has been sufficiently charged. They involve a mechanical attachment on the meter register which throws a circuit breaker.

796,064. AUTOMATIC SWITCH FOR STORAGE BATTERIES; Thomas Duncan, Lafayette, Ind. App. filed Jan. 8, 1902.

796,065. METER; Thomas Duncan, Lafayette, Ind. App. filed Apr. 28, 1902.

796,066. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed July 26, 1902. A multi-rate meter in which the current is directed through the meter armature by an auxiliary magnet to a greater or less extent, according to the load on the circuit.

796,067. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Feb. 26, 1904. A magnetic suspension for the movable part of a meter comprising an iron disc in proximity to a magnet thereabove. A jewel-bearing takes the upward thrust.

796,068. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed Feb. 26, 1904. Relates to a means for preventing the action of lightning upon the armature circuit. Employs inductance coils in close proximity to ground connections so that lighting discharges are caused to encounter impedance.

796,069. ELECTRIC METER; Thomas Duncan, Lafayette, Ind. App. filed July 13, 1904. A construction of brush which is axially revolvable so as to adjust new surfaces into contact with the meter commutator.

796,070. THREE-WIRE METER; Thomas Duncan, Lafayette, Ind. App. filed Oct. 10, 1904. A special construction of meter having two field coils in the different branches of the three-wire circuit and a single armature wound with two coils in shunt across the two branches of the three-wire circuit.

796,089. TELEPHONE-EXCHANGE APPARATUS; Elias E. Ries, New York, N. Y. App. filed May 20, 1904.

796,100. ELECTRIC CABLE; Charles E. Wilson, Philadelphia, Pa. App. filed Apr. 8, 1903. The cable has an iron core with two longitudinal grooves on the surface thereof. The telephone line wires are carried in these grooves. The effect is to dissipate capacity charges and to increase the magnetic inductance so that the usual relay induction coils ordinarily used at periodic intervals are made unnecessary.

796,114. ELECTROTHERAPEUTIC APPARATUS; Herschel E. Currey, Baker City, Ore. App. filed June 14, 1905. A cup designed to be applied to the body has means for exhausting the air therefrom. The cup has a separate chamber for x-ray discharges, which are more effective on the surface of the body which is surcharged with blood by the vacuum.

796,146. POWER BRAKE; Louis Pfingst, Boston, Mass. App. filed Oct. 24, 1904. A brake lever is located at the base of the usual controller and is affected to throw a friction clutch which connects the brake applying means to a power connection from the electric motor.

796,254. PHOTOPHONE; Bruno Saenger, Berlin, Germany. App. filed Sept. 15, 1904.

796,259. ELECTROMAGNETICALLY OPERATED RECIPROCATING TOOL; Harry S. Sherman, Denver, Col. App. filed Apr. 22, 1904. The solenoid coils are wound so as to leave a free circulation between the windings, and the whole is surrounded with oil which constitutes the insulating medium.

796,269. PIPE CAP FOR OUTDOOR WIRING; Wheeler H. Vibber, New London, Conn. App. filed Mar. 20, 1905. A cap for protecting wires within the vertical iron pipes ordinarily used in exterior wiring. The cap has a downwardly directed orifice through which the wires issue.

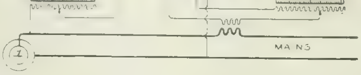
796,287. ELECTRICALLY CONTROLLED SHIFTING SYSTEM FOR TRACK SWITCHES; Thomas Bovey, Chicago, Ill. App. filed July 11, 1904. The track switch has a pair of separate motor magnets, the circuits of which are alternately completed by the motions of the switch point. For either position of the switch point that magnet is energized which tends to move the point to the opposite position, so that the switch point moves alternately.

796,295. COMBINED BRAKE AND TAKE-UP MECHANISM FOR TROLLEYS; Henry B. Clarke, Chicago, Ill. App. filed July 9, 1904. The trolley cord is deflected by guiding pins on a lever which controls an air brake. A very abrupt movement of the lever sets the air brake and holds the cord against movement, while a moderately abrupt movement applies a lesser braking force.

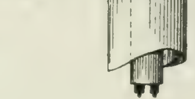
796,296. TROLLEY RETRIEVING DEVICE; Henry B. Clarke, Chicago, Ill. App. filed Oct. 31, 1904. A spring impelled gear for retrieving the trolley is normally held inactive by a magnet energized through the trolley circuit. When the trolley leaves the wire the magnet is deenergized and the retriever thrown into operation.

796,297. AUTOMATIC RESTORING THERMAL PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed Dec. 9, 1904. A thermal protector in which the revoluble element is normally held stationary by a heat susceptible material, which is softened when the coil receives an excessive current. The parts automatically re-solder themselves into the new position and can be returned to their normal or operative relation by a form of friction ratchet which engages only in one direction.

796,312. APPARATUS FOR THE REDUCTION OF IRON-SAND, IRON OXID AND OTHER SUITABLE SUBSTANCES; David Ranken Shirreff Galbraith, Auckland, New Zealand. App. filed Oct. 27, 1903. (See page 272.)



796,032.—Electrical Measuring Instrument.



796,269.—Pipe Cap for Outdoor Wiring.

796,325. STOPPER FOR ELECTROLYTIC POTS CONTAINING FUSED BATHS; Charles M. Hall, Niagara Falls, N. Y. App. filed April 30, 1902. (See Page 272.)

796,343. ELECTRIC GAS LIGHTER; Joseph Mlada, Manitowoc, Wis. App. filed Jan. 2, 1904. Attached to the ordinary gas cock is an arm which moves to make a sparking contact above the burner when the gas cock is turned.

796,360. ELECTRIC SWITCH; Joseph H. Rusby, Nutley, N. J. App. filed June 1, 1904. A wall switch having a pair of buttons which move the switch arm in opposite directions. A cam roller is effective to hold the switch arm at either extreme position of its movement.

796,368. MOTOR-METER; Charles P. Steinmetz, Schenectady, N. Y. App. filed Nov. 21, 1896. (See Current News and Notes.)

796,378. APPARATUS FOR MAKING ARMORED CABLES; Marcus M. Waterman, Troy, N. Y. App. filed Jan. 28, 1905. The cable is led between three rotating grooved rollers which guide a pair of binding wires thereto in such a way that the wires interlock together.

796,403. ELECTRIC-WAVE-TELEGRAPH RECEIVER; Charles L. Fortier, Milwaukee, Wis. App. filed April 17, 1903.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, AUGUST 19, 1905. No. 8.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE	1139 Monadnock Block
PHILADELPHIA OFFICE	929 Chestnut Street
CLEVELAND OFFICE	402 Cuyahoga Building
EUROPEAN OFFICE	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue 13,000 copies are printed. Total circulation for 1905 to date, 458,000.

NEW YORK, SATURDAY, AUGUST 19, 1905.

CONTENTS.

Editorial 293
The Franklin Celebration 296
Statistics of Street Railway Development 296
Municipal Ownership in a German City 296
Electrical Developments in Connecticut 296
The French Cable in Venezuela 297
Advance of the Rural Telephone 297
Prof. Darwin on Radium 298
Electricity in the Mining of Marble 298
Duncan Meter Patents 298
The Passenger Traffic Problem in London 300
Current News and Notes 300
Electrical Engineers of the Times. -XXIII. Max Loewenthal 302
An Italian 40,000-Volt Transmission Plant. By Franz Koester 303
Inter-Relation of Ballast and Glower in the Nernst Lamp. By Lewis A. Terven 305
The Electrical Equipment of Manaos Harbor, Amazon River. By Charles J. Seibert 308
Regulation of Gas and Electric Rates in Massachusetts.—I. By Alton D. Adams, LL. B. 310
New Telephone Patents 311

LETTERS TO THE EDITORS:

Self-Excited Alternators. By A. Heyland 312
Single-Phase vs. Polyphase Traction. By C. L. de Muralt 312
Digest of Current Electrical Literature 313
Book Review 317
Recent Improvements in Switchboard Details. By E. P. Edwards 318
Pressed Steel Buckets 319
"Commercial" Induction Motor 320
The Subways in Chicago 320
Electrical Sales in the Far East 320
New Type of Revolving Field Alternator 321
Exhaust Steam for Station Auxiliaries 321
More Exhibits at the Portland Exposition 322
Industrial and Commercial News 323
General News of the Week 326

TRAFFIC IN GREAT CITIES.

The balance sheet of the Interborough system of New York shows very clearly how essential an element the Subway already is among the transportation facilities of the city. Together the elevated roads and the Subway earned $14,000,000 in the year, with expenses of $6,000,000. The Subway division for the June quarter earned $1,349,871, and from October 27 to June 30, no less than $3,638,987, with expenses of $1,850,358. This is a striking demonstration of the ability of electricity to reclaim lost travel and develop new, for under the steam regime the Manhattan Elevated was really a losing game, and yet the population of the city was yearly in worse plight as to transportation. .Large as these earnings are, they will soon be much larger, for the travel on the Manhattan Elevated will grow and the Subway has only begun to touch the possibilities, although on many trains the sign of "standing room only" might well be hung up.

"S. R. O.", as theatrical managers know it, is, indeed, the chronic condition of traveling facilities in great cities; and while the metropolitan street cars have been neglected a bit for the Subway, they, too, will soon be as crowded as of old. In London the same problems confront, as well as in Paris and Berlin, and the report of the Royal Commission on London Traffic—noted elsewhere—finds its echo in all the big urban centers. There is an abundance of work yet left in them for the electric car to do, whether on the surface, overhead, underground and underwater. The newer subways in New York or across it will hardly be ready any too soon for the floods of travel that will rush through them.

ELECTRIC AUTOMOBILES.

In a recent issue we commented on the progress made in electric heating apparatus and urged upon central station managers the desirability of greater interest being taken by them in the subject. Aside from the steady improvement in such apparatus, the fact that there is an equally steady reduction in the price of current, should make it a matter of duty on the part of every central station manager to acquaint himself personally with the merits of the devices. In smaller communities there is a business to be done in selling flatirons, stoves, chafing dishes, curlers, griddles, etc.; and in all places, large and small, there is the possibility of building up a new demand for current. If we are to believe, as we do, the accounts given by some manufacturers of heating apparatus, the indifference displayed by some local lighting concerns is nothing short of extraordinary. This may be attributable, perhaps, to the lingering idea that the apparatus is expensive and unreliable, and that the cost of operation puts it beyond the reach of the ordinary consumer. It is needless to say that the special instances in which electric heat has the advantage over other methods are already very numerous and increase in variety daily. It would seem that there is in store an adequate reward for each lighting company which will systematically endeavor to introduce the heating devices by lending to possible buyers such apparatus as may be connected directly to the lamp sockets and requires no additional house wiring. The most convincing argument to the customer is to be found in the willingness of the company to allow a free trial. In the majority of instances the convenience of the device will prove the determining factor, the cost of the power being given but small consideration.

These remarks apply very directly also to electric automobiles, those of the industrial and the pleasure types alike. We may say that a great many people in the electrical field have no idea of what is doing in this branch of the industry or imagine that the present predominance of the gasoline vehicle is permanent and puts the electric forever beyond consideration. Now there is absolutely no warrant at all for any pessimism in regard to electric automobiles, and no reason for "getting cold feet," as the slang goes. While the electric type may not yet have arrived fully, it sees steady improvement, and all the arguments in its favor become stronger as years go by. Mr. Edison has lately made some announcements as to his battery that are most encouraging, and he does not take back a word of any previous utterances as to his faith in the ultimate supremacy of the electric automobile. But even if the Edison battery never became so thorouhly available as its persistent inventor imagines it will, there will still be advances made and progress to be recorded. As matters stand, our opinion is that the electric, size for size and work for work, is quite as cheap and enduring as the gasoline. Perhaps the "sticking point" as to electrics is the high price of the batteries, but here we look for a lower range as the quantity of production increases and things become standardized. Current will also be cheaper and daily becomes more so, while on the other hand we can see no promise in the future for cheaper gasoline, but on the contrary look for a steady raising of the price.

We doubt whether twenty-five per cent of the central station managers in this country have ever yet taken enough interest in electric automobiles to get one, either for pleasure or for business. As a matter of business, there is a lot of work an auto can do around a station as a patrol, in handling lamps and supplies, and in various other ways; and we are almost inclined to go so far as to say that there is hardly one of the four thousand local companies that would not find it worth while to make the investment in such a machine. They would be encouraging their own industry, learning something about the subject, and setting a good example to many possible customers.

◆

MUNICIPALISM IN GREAT BRITAIN.

We have referred a number of times to the growing uneasiness of Great Britain on the subject of municipal trading, which recently has there become a matter occupying general public attention to a very marked degree. Indeed, to combat what has been termed the evil of municipal speculation, an "Industrial Freedom League" has been instituted and has organized a propaganda to curb its course. One of our London contemporaries says in a recent issue that merchants, manufacturers and shopkeepers are actually at present feeling the pinch of high taxes resulting from the prodigal expenditures by local authorities, and at the same time the working classes, who were cheated in the hope of municipal employment at fancy rates of wages, are finding it increasingly difficult to obtain any kind of employment. It adds that it is practically the unanimous opinion of the managers of England's industry that unsound municipal speculation is threatening the foundation of national prosperity. The situation in Great Britain with respect to the municipalization of public utilities is one deserving the most careful attention on the part of those who follow the municipal movement in this country or are affected by its course. The rapidly growing opposition to municipalism in Great Britain is based upon economic grounds, no charge being made that municipal plants give rise to graft, and in most cases it appears to be admitted that such plants are well conducted. The situation now under such earnest discussion in Great Britain would, if municipalism were as widespread in this country, be enormously intensified by the presence of the political factor with all of its possibilities of graft and mismanagement. When such an ardent believer in municipal trading as Mr. Dalrymple, of Glasgow, becomes convinced that these latter considerations render it impracticable for American municipalities to follow in the footsteps of British cities, it is certainly time for us to realize the gravity of the situation presented by the present agitation for municipal ownership, which has recently been so greatly forwarded by the example of Chicago with respect to electric traction and by that of New York through authorizing a municipal street lighting plant.

◆

A STUDY OF THE NERNST LAMP.

As is well known, the predominating characteristic of the glower of the Nernst lamp resides in the fact that the glower is a good insulator when cold and becomes a good conductor when hot. If such a material is connected across a source of constant e.m.f. and subjected to a gradual increase of temperature, a current flows tending further to increase the temperature. When the temperature exceeds a certain critical limit, the current taken by the material will be of a value such as to increase automatically at an augmented rate, on account of the increase of temperature due to its own presence, and the final result would be the destruction of the glower were not some check applied. Obviously, therefore, when the glower is operated alone on a constant-potential circuit, it is in all respects unstable. It is apparent, however, that by connecting a resistance in series with the glower, the current can be limited to any desired value, and the operation on a constant-potential circuit can be rendered as stable as necessary.

Objections to the use of a resistance of constant ohmage in series with the glower are found in the excessive energy dissipated in the resistance when the glower is operated at a current which produces stability, and in the impossibility of compensating satisfactorily for changes in e.m.f. Consideration of these facts has led to the use in series with the glower of an iron wire which possesses the desirable characteristic of increasing in resistance at an augmented rate with increase of temperature. Evidently the problem of selecting the proper value of resistance for each glower and of so arranging both the glower and the ballast resistance that each operates under the most advantageous conditions, is one requiring considerable study. An interesting outline of such a study is to be found in an article by Mr. Lewis A. Terven on page 305 of this issue. One of the most detrimental conditions to which a lamp can be subjected is a fluctuation in the supply voltage. It is worthy of note that with the combination used in the Nernst lamp an increase in e.m.f. of supply circuit may result in an actual decrease in voltage across the glower, due to the excess of drop across the ballast resistance with the increase in current through the lamp.

◆

ELECTROMAGNETIC WAVES IN WIRELESS TELEGRAPHY.

Prof. Fleming's second "Tyndall" lecture on "Electromagnetic Waves," delivered recently in London, was reported in abstract and contains a number of statements bearing upon wireless telegraphy at this date. The Poldhu Marconi station is stated to have an aerial consisting of nearly 400 wires, forming an inverted cone, suspended from a framing 200 ft. high. Messages from Poldhu have been received westward across the Atlantic and southeastward as far as Malta and Southern Italy. In describing the various forms of receiving instruments or detectors used, an incandescent lamp of special form is one recently developed by Prof. Fleming himself. It is well known that an ordinary incandescent lamp, when glowing, develops a tendency to throw off particles of matter from the cathode. If a small plate electrode be inserted in the lamp chamber a current of electricity can be taken from the electrode due to the bombardment of electrified particles from the cathode. By placing such an electroded lamp in a local receiving circuit connected inductively with the air wire the oscillating impulses from the air wire produce unidirectional impulses of current between the cathode and electrode. The presence of these unidirectional impulses can be detected on an ordinary galvanometer. It would seem as if the same rectification should be capable of being effected by a mercury vapor lamp.

An instrument called a cymometer, for measuring the length of the wave emitted by an air wire, was exhibited. It consisted of a local oscillation circuit having adjustable inductance and capacity, with a neon vacuum tube across the terminals. A neon tube is particularly sensitive to alternating e.m.f. and glows visibly at the relatively low e.m.f. of from 300 to 400 volts. By this means it is stated that the length of a 300-meter wave can be measured to 1 per cent. In the case exhibited at the lecture there were two adjustments of the circuit at which the neon tube lighted up, one corresponding to a wave length of 1,300 ft. and the other to a wave length of 900 ft., showing the coexistence of both series of oscillations. It is well known that when a primary oscillating circuit is magnetically linked with a secondary, two rates of oscillations will, in general, be set up in both. Another cymometer exhibited consisted of an ebonite rod 6 ft. long wound with 10,000 turns of fine wire. A grounded traveling contact permitted this solenoid to be tuned to the aerial. The neon tube held opposite to the solenoid indicated the presence of stationary waves of e.m.f. By laboratory measurements the speed of wave transmission along the solenoid was about 200 times slower than that of light, or roughly 1,000 miles per second. The solenoid cymometer was stated to be less well adapted for wave length measurement than the local oscillation circuit; for the latter could be removed from metallic connection with the tested aerial, while the former could only be used in such close connection as to affect the electric condition of the aerial appreciably.

It was pointed out that a common length of wave for signaling at sea was about 100 meters, corresponding to a frequency of three millions per second. This would not do, however, for land service, as houses were not transparent to such short waves, but were very fairly transparent to waves of 1,000 ft., or say, 300 meters, corresponding to a frequency of one million per second. From this it would seem likely that walls of brick and stone are opaque to all frequencies of light from three millions up to eight hundred trillions per second, or more, the latter being the frequency near the violet end of the spectrum. It should be possible before long to determine the actual attenuation of waves of different frequencies over long distances of land and sea. It is reasonable to expect considerable differences in the attenuations of waves of different lengths even over a smooth ocean, owing to differences in absorption into the water below, or into the air above.

THE SIZE OF GENERATING UNITS.

Recent developments in steam turbine and steam engine practice have made a profound change in the situation with respect to the size of the units employed. In the earlier direct-connected sets there was a very considerable difference between half-load and full-load efficiency, so great that it must be made the chief factor in planning the station. Of course, going back to the old-belted stations, this condition existed in the most aggravated form, but we are referring to days later than those. The steam turbine, of course, with its very light friction is nearly as economical at half load as at full load, and it is therefore a matter of small consequence whether it is worked close to full load or not. The same is the case with respect to reciprocating engines which are properly designed for the purpose, quite contrary to the popular belief on the subject. It has therefore become a fact that in an electric generating station of really modern design there need be no subdivision of units for the purpose of adjusting their number to the requirements of partial load. There is, of course, a species of irreducible minimum below which the number of units cannot be brought, but this depends to-day merely upon the question of safety in operation and not upon light-load requirements. To our minds this change of conditions is one of the most important and interesting of recent years.

One is never safe in planning a station with so few units that the disabling of one of them will cripple the output. This means practically that $(n-1)$ machines must aggregate enough of unused overload capacity to equal one unit. As the present tendency is to rate generators fairly high—in other words, to cheapen them per kilowatt of rated output—there is small danger of getting dangerously few units. Ordinarily about four would constitute a minimum for economical working, assuming that there is no machine really held in reserve. Now and then three or five might be advisable, but seldom fewer or more so far as mere security against breakdown is concerned. Now with three or four modern direct-coupled units, any ordinary distribution of load can perfectly well be taken care of without at any time getting away from the economical range of the machines. For instance, with three units, worked as usual with a slight overload at the peak, station loads down to 12 or 15 per cent of the peak can be dealt with without ever running a unit below half its rated load. With four units, there is a still wider range, and the upshot of the matter is that with a station designed with proper reserve against breakdown, the question of partial load may practically be neglected, assuming that the units are interchangeable. If a station of, say, 12,000-kw capacity is built with, say, four 3,000-kw units, it will probably turn out its total energy more cheaply than if it were equipped with eight 1,500-kw units. The cost of the former arrangement would be so much less than that of the latter in machinery, switchboard and foundations as to more than offset any difference in light-load efficiency.

In fact, in this hypothetical case the loss in light load efficiency by using the larger units would probably be almost negligible in a well-managed plant. This improved situation in plant design has come about not only by improvement in the light load working of the prime-movers, but by the improved methods of distribution which have rendered one class of units applicable to all classes of work. These, to be sure, have not yet been utilized to the fullest extent, so that a good many crude methods are still in use; but the fact that thoroughly first-class service can be given to-day with but a single type of generator in the power house, and that in large units, over a distributing system free of all intermediaries is one that speaks volumes for the progress in the last decade. Even so little as ten years ago the interior of a new generating plant looked more like a machine shop than a power station. If indeed the plant were not a maze of belts it was certainly lumbered up with half a dozen sizes and kinds of machines, destined to be scraped within the next few years. To-day there is a reasonable prospect that the large direct-connected generators now installed may not have to be discarded for a much longer period, although we venture to predict that some of the installations made within five years will be obsolete much sooner than the owners think. At least the station to-day can be relatively simple and efficient, of few and large units easily cared for—the fewer and larger the better within the limits of security in operation. The weakest point of central station working to-day is the complicated and fussy distribution system generally remaining as the heritage of partial reconstructions and reorganizations.

The Franklin Celebration.

In regard to the proposed celebration next year of the two hundredth anniversary of the birth of Franklin, Mr. Barr Ferree, secretary of the Pennsylvania Society of New York, writes:

Franklin was a many sided man, whose talents were developed in what was then the metropolis of America, Philadelphia. Most of the interests with which he was concerned are to-day represented by important organizations having headquarters in New York. It is fitting, therefore, that this metropolitan city should adequately commemorate the 200th birthday of one of the greatest of Americans, a man whose interests were so varied and so highly developed, and who did so much for his country both at home and abroad.

Pennsylvania is proud to claim this distinguished man as her greatest son; for while born in Boston, he reached maturity in Pennsylvania, and as a Pennsylvanian rendered his most notable services to his country. The Pennsylvania Society has therefore proposed to a number of learned, literary and scientific societies in this city a plan for a joint Franklin commemoration, in which all these organizations would be equally interested, and which would thus represent Franklin's own interests in a very complete way.

This plan has already received hearty expression of approval from most of the organizations before which it was brought, and while no definite programme has yet been determined upon, the outlook for a suitable commemoration of the Franklin bicentennial on January 17 next seems excellent. The plans under discussion at present involve a general memorial meeting, with exhibitions of Franklin books, portraits and other relics.

A preliminary meeting of representatives of a number of interested organizations has already been held, and a very great deal of interest manifested in the proposal. The co-operation of all bodies which might be interested in this anniversary is earnestly solicited.

◆

Statistics of Street Railway Development.

The annual statistics of street railway development in the United States and Canada are given this month by the *Street Railway Journal* in the usual valuable table, which constitutes a document of very interesting character. The grand totals for the United States showed 993 roads or systems, with 30,187 miles of track, 75,904 cars, and capital obligations of $3,217,091,971. The table divides the country into five territorial groups. The Central States have the most electric track mileage and the Southern States the least. Of the individual States, Ohio leads, with 3,181 miles; New York is second, with 3,175, and Pennsylvania, with 3,142, is third. Each of these States has more electric mileage than the aggregate of the entire Western group of 17 States and Territories. Except for California none of this Western group has as much as 350 miles, and only seven of the 17 have as much as 100 miles. Every State and Territory is now represented, although in 1903 South Dakota, Nevada and New Mexico had no electric mileage. South Dakota had only four miles in 1904, and Nevada five miles. The nine Central States have over seven times as much mileage as the nine Southern States. Not less than 97 per cent was worked by electricity in 1904, the chief instances of horse, cable or dummy lines being in New York, Chicago and San Francisco. The average capitalization, total of stocks and bonds, per mile of track throughout the country, was $108,876; the average capitalization in Massachusetts was $49,158.

The capital liabilities were constituted by stock and bonds or funded debts, the stock amounting to $1,761,571,812, or an increase for the year of $68,181,514. The funded debt amounted to $1,455,520,159, or an increase of $66,055,810. The total increase in capital liabilities for the year was $134,839,324, while the cars had increased 1,606 and the track mileage had grown 1,731 miles.

The figures for Canada are also interesting. The cars numbered in 1904 were 2,639, a gain of 135, and the track mileage was 900, as compared with 920 in 1903, the change being due apparently to previous duplication. The total capital obligations were $69,404,192, a gain for the year of $10,055,554. The funded debt was $28,571,050, a gain of $3,423,492, and the capital stock was $40,833,142, a gain of $6,632,062.

The insular possessions of the United States reported six systems, 81 miles of track, 188 cars, $3,181,500 of capital stock, $1,930,000 of funded debt, and a total capital obligation of $5,111,500. Cuba made a good showing with two systems, 55 miles of track, 160 cars, capital stock of $13,500,000, funded debt of $8,550,000, or total capital obligations of $22,050,000.

As already noted above, the adoption of electricity is going on apace, and is already so far advanced that it stands for 97 per cent of the industry in round figures. Moreover, these statistics for the first time group steam, horse and cable under one head, it being no longer useful or worth while to treat these items separately. The increase of electric track mileage was from 27,754 to 29,548 in 1904; of motor cars from 58,141 to 59,625, of trail cars from 5,868 to 6,900, and of service cars from 4,214 to 5,475.

◆

Municipal Ownership in a German City.

It had been supposed that Glasgow headed the list of cities with a multiplicity of municipal enterprises, but Freiburg, Germany, runs it a close second. The following is a little list of some things it does for a population apparently incapable of doing much for itself:

1. Four hundred cottages, each with a little garden. Over $370,000 has been spent by the city to give the poorer citizens better homes.
2. Electric street cars. The fare to any part of the city is 2½ cents.
3. Fifty advertising boards. All outdoor advertising is controlled by the city. The rate is 10 cents a day per square foot.
4. Pawnshops. The city owns all the pawnshops and charges a low rate of interest. It does not try to make any profit, but runs the pawnshops at cost.
5. Savings bank. The city owns the only savings bank in Freiburg. It has over $5,000,000 in deposits.
6. Theatre. The principal theatre at Freiburg is owned by the city. The citizens regard the theatre as part of their educational system.
7. Restaurant. There are public restaurants in Freiburg which serve breakfasts and suppers for 5 cents and dinners for 6½ cents. The citizen can get a good cup of coffee and two thick slices of bread for 2½ cents.
8. Burial of the dead. The city has taken over the undertaking business. The cost of a funeral in Freiburg runs from $5 to $32.
9. Farms and forests. The city has bought large tracts of land near the city, so that work may be given to any workmen who need open-air jobs for their health.
10. Correct time. A $5,000 electric clock has been placed in the City Hall. This clock connects with eighty-five other clocks in different parts of the city.
11. Electric light. The city manufactures all its own electricity, both for light and power.
12. Architects. Freiburg pays a salary to the best architect in the city as a kind of building department.

◆

Electrical Development in Connecticut.

The following review is made of the recent developments in Connecticut of plans for light and power: An examination of the laws enacted during the recent session of the General Assembly shows a considerable body of legislation concerning gas and electric companies. Several lighting and power corporations were created. The Uncas Power Company, of Norwich, which has an authorized capital stock of $1,000,000, and which is granted large powers, was incorporated. The Glastonbury Power Company was chartered to manufacture and sell electricity in several towns; to erect a dam on Roaring Brook, and to construct a street railway from Glastonbury to Manchester. Its authorized capitalization ranges from a minimum of $350,000 to a maximum of $800,000. The Rocky River Power Company, of New Milford, received a franchise to manufacture and sell electricity for lighting and power purposes in specified areas of Litchfield and Fairfield Counties, and to construct a dam and storage reservoirs on Rocky River. It is empowered to issue capital stock up to $500,000. Another incorporation is the Sterling Power Company, which is authorized to manufacture and distribute electric power and light in the towns of Sterling, Plainfield, Killingly and Brooklyn. Its maximum capital stock is $500,000. The Northern Connecticut Power Company, of New Hartford, which has rights to operate in Litchfield, Hartford and Tolland Counties under certain restrictions, and which is to develop water power on the Farmington River, and also the North Haven Gas & Power Company, which has a charter to supply electric light and power to Durham and a part of North Haven, are additional corporations which were created by the Legislature.

The charters of several companies were amended with respect to bonds and capital stock. The New Milford Power Company, of New Milford, which has a thirty-years' contract to supply electricity to the Connecticut Railway & Lighting Company for traction and illuminating purposes, was authorized to issue $2,000,000 bonds. Of this $1,000,000 is to be used for refunding. The company is also authorized to absorb any other electric light, power or street railway company, or to merge with any such corporation. The Derby Gas Company, of Derby, was empowered to increase its capital stock from $400,000 to $1,000,000. The Seymour Electric Light Company was authorized to increase its capitalization by an amount equivalent to three-fourths of its capital stock.

A summary of the miscellaneous legislation affecting lighting and power companies is as follows: Authorizing the Putnam Light & Power Company to engage in business in Pomfret; authorizing the People's Light & Power Company, of Danielson, to extend its business into Brooklyn; authorizing the Litchfield Electric Light & Power Company to operate in Washington; authorizing the Branford Lighting & Water Company to extend into East Haven; extending until July 1, 1907, the time for perfecting the organization of the Newtown Electric Light & Power Company; authorizing the Eastern Connecticut Power Company to purchase any existing electric company in New London and Windham Counties outside the city of Norwich; authorizing the Torrington Electric Light Company to extend its lines into Goshen; authorizing the Sharon Electric Light Company to operate in North Canaan and parts of Salisbury, and authorizing the Burkshire Power Company to erect a dam at the toll bridge in North Canaan and to acquire land to flood for reservoir purposes.

The French Cable in Venezuela.

As noted recently in these columns, the Federal Court of Cassation of Venezuela has annulled the contract of the French cable system—the Compagnie Francaise des Cables Telegraphiques. The decision has attracted considerable attention, and several interviews have appeared on the subject. The Caracas correspondent of the *New York Herald* says: I have had an interview with M. Desiré Brun, representative of the French Cable Company here, in regard to the judgment. He said: "The final judgment of the Court of Cassation establishes nothing new. You must notice that the attorney general, Senor Parejo, has not presented any brief either before or after the reception of the brief of M. Planchart, although the latter appealed from the judgment of March 31. The judgment of August 4 proves that by a system of partial quotation the documents presented by the company were made to give a contrary meaning, qualifying the concessions on the part of the company. Therefore, as no appeal was admitted, the company considers itself the victim of demagogue justice and will appeal to the French government to defend and sustain the present situation, obtained at great cost. The company has protested to the French Legation, and, not recognizing the judgment, continues fulfilling the terms of the contract. Intervention is not expected by the company until it is molested in its rights. It will oppose any attempt to interfere with its privileges."

The government will leave the company undisturbed, it is believed, until the arrangement of the new concession. It is considering granting a new wireless concession from Macareo to Trinidad. Possibly this will be a government moponoly. The officials are already experimenting.

M. Wiener, the French minister, negotiated an arrangement with the government in April on condition of the withdrawal of the suits against the company, ceding the coast cables to Venezuela, promising the establishment of direct cable communication, the removal of the office from Caracas to La Guayra and reduction in the tariff. The company did not accept this scheme, asserting that M. Wiener had abandoned their interests. Señor Madueno is now in Paris trying to convince the government by means of alleged documents of the complicity of the company in the revolution, that it is not worthy of the support of France and that it had posed as a victim while aiding Matos.

An interview that appears to throw some light on the situation is one with M. Sauvage-Monet, who remarks:

"Having belonged to the company nine years, I have never lost interest in its work. I think—and in this I am in accord with numerous specialists and politicians—that the French company has lacked progressive management.

"The whole secret of the non-success in France of an industry in which the English, North Americans and Germans prosper consists in the fact that since its foundation the French company has had heads of bureaus who have not been prepared, either by their studies or by their preliminary work, to carry on this delicate enterprise. The result is that these people see in the work only the financial end and neglect the technical part, of which they are besides, totally ignorant. Founded in 1888, the company every year has had difficult balance sheets.

"Having in general badly chosen their points to be dealt with (except Venezuela, Brazil and Hayti), the places where the company's lines touch do not return enough receipts to cover expenses, neglecting, moreover, points which could be a good source of revenue—(Belen, Brazil, brings to the Western Brazilian Company $600 a day, and the French company has there a cable which it has allowed to be interrupted since 1901)—heads of bureaus in the Avenue de l'Opéra busied themselves about petty details of the affair, and every year saw the enterprise decline.

"In the political troubles which agitate the greater part of the countries where they had installed their service these heads of bureaus saw only the temporary increase in the number of telegrams, and, as on the other hand the service of the company had caused the discontent of the governments of all the countries where they were established, these heads of bureaus came little by little to see in revolutions only opportunities of fishing in troubled water. That is what happened in the Matos revolution in 1902-1903."

It will be remembered that the government of Venezuela is punishing the company for alleged participation in political intrigues and revolutions.

The Advance of the Rural Telephone.

It is safe to say that no other agency has influenced country life in America to the extent that the telephone has in the past five or six years. During this period many thousands of instruments have been placed in service by both the Bell and the independent companies, and it would be impossible to estimate the amount of time and money which the farmers of this country have been saved by the rural telephone systems, from the fence post lines to the manually-operated exchanges of the more populous communities. It is a mistake to suppose, however, that the field has been so well covered that little remains to be done to bring home to the farmer the incomparable advantages of the telephone as a labor-saving device. A vast number of rural homesteads are still without telephone service, and although the time is far distant when the cost of telephone service will bring it within the means of every farmer, it is certain that many tillers of the soil are to-day losing money through the lack of telephones in their homes. The influence of the trolley has been very great in its reduction of rural isolation, but in the natural course of events every farm cannot border a cross-country street railway or interurban line, and even short journeys consume valuable time.

On most American farms there are only about 200 good working days per year, and the loss of a single day in the busy season may readily damage a crop to the extent of $20 or more. In case farm machinery breaks down or stock falls ill the lost time involved in a trip to the nearest town for spare parts or a veterinarian is a serious matter when the cornfield is weedy or the wheatfield ripe. Arrangements for additional labor, market quotations, news of the world, social conversations, calls for help in case of illness, fire or accident, orders of provisions and supplies—these and many other uses render the telephone simply invaluable on the modern farm. It will pay for itself many times over in the course of a year on any farm which is worked for profit. Even the ancient birthplace of John Greenleaf Whittier in Haverhill, Mass., is equipped with a telephone for convenient use in preparing for parties of visitors. The contrast the telephone offers to the antique fireplace, furniture and fittings of this isolated farmhouse is a significant mark of the scientific progress of the last century.

Prof. Darwin on Radium.

A special cable dispatch from the Cape of Good Hope reports as follows the opening of the British Association meeting there on August 15: "At their first session to-night Prof. George Howard Darwin, of Cambridge, the president of the association, delivered an address in which he recounted some recent experiments with radium which supports a theory of transmutation of elements. The results, he declared, seemed in absolute contradiction to all that was known until recently about the elements in the make-up of the universe.

"Within the last few years, he said, electrical researches had shown that the atom was not indivisible, and a flood of light had been thrown thereby on the ultimate constitution of matter. By various convergent lines of experiment it had been proved that the simplest of all atoms—that of hydrogen—consisted of about 800 seperate parts, while the number of parts in the atom of the denser metals must be counted by tens of thousands. These separate parts of the atom had been called corpuscles or electrons, and might be described as particles of negative electricity." He then said: "Although the conception of the decay of an element and its spontaneous transmutation into another element would have seemed absolutely repugnant to the chemist until recently, yet analogy with other moving systems seems to suggest that the elements are not eternal. Thomson conceived that an atom might be constructed after a model he had devised—an electrical miniature planetary system which was a triumph of mathematical power—that he thought might be made to run for a million years, but it would not be eternal. Such a conclusion is an absolute contradiction to all that was known of the elements until recently, for no symptoms of decay were perceived, and the elements existing in the solar system must already have lasted for millions of years. Nevertheless, there is good reason to believe that in radium, and in other elements possessing very complex atoms, a break up and spontaneous rearrangement which constitutes a transmutation of elements is actually observed."

It was impossible to say how science would solve the difficulty, he concluded, but future discovery in this field must prove deeply interesting.

Electricity in the Mining of Marble.

The application of machinery to the mining of marble is quite modern, American and electrical. In Vermont alone it is estimated that more than $5,000,000 is invested in quarry machinery and other equipment, a large portion of which is electrical. The latest adaptation of power and machinery to the marble industry is the result of changing conditions. The Lynn (Mass.) *Item* gives some very interesting details on the subject. When such extensive marble deposits as those at Rutland, Vt., were first opened, the range of work was kept within a narrow field, and a single steam plant would often serve to operate derricks, drills and channeling machines. Steam was conducted through pipes to the different machines, and air compressors were driven by the same power at the various places where pneumatic tools were employed. So long as the quarries were of moderate size, the hand and steam derricks, drills and locomotive cranes were sufficient to answer all purposes. But the business rapidly assumed such proportions as to make a change of power distribution necessary, and some of these quarries have already reached such dimensions that steam power distribution has grown unwieldy and costly, and naturally electricity was looked to as a means of lessening the cost. The great quarries are steadily displacing the old-fashioned methods with electric motors. Owing to the tremendous size and weight of some of the blocks of marble that are now cut and dressed for shipment, such as for obelisks, mausoleums, statuary groups and so on, the derricks and cranes are the most important machines, and modern powerful electric gantry cranes have been installed.

At Proctor there is a five-motor, electric traveling gantry crane which displaced ten of the old steam power derricks. This crane operated by one man saves as much in labor as it does in efficiency. This particular gantry travels 800 ft., but the distance can be increased indefinitely as the quarry extends. Its maximum capacity is 50 tons, and the blocks can be raised nearly 40 ft. if necessary. The crane is used chiefly for loading cars, the trains passing directly under the crane, and as the bridge upon which the crane travels is 160 ft. in length, it has a wide field of operation. Portable locomotive cranes are further making the boom derrick unprofitable; they can travel from one part of the quarry to another, and load blocks directly from the beds to the cars.

It has only been within the last year or two that electric channeling machines were used, but they have given so much satisfaction that their use is steadily increasing. The new type of electric machine cuts on either side of it a channel from four to 10 ft. deep, and less than two inches wide, whereas the steam type of channeling machine cut but one channel at a time. A single electric motor mounted on the new machine and traveling with it operates the cutting implements and also drives the traction gear of the machine. In addition, electrically operated drills, chisels, sand saws, buffers, etc., are also used in the New England quarries, and in fact nearly every practical means of reducing hand work and manual labor is being employed.

Duncan Meter Patents.

The Patent Office budget of August 1 contained 40 patents issued to Mr. Thomas Duncan, of Lafayette, Ind., relating to various types of commercial electrical measuring devices. It will be recalled that about three years ago (April 29, 1902) 57 patents were on the same day issued to Mr. Duncan, mostly on alternating-current meters. The recent patents relate principally to meters for special service, as for use with storage batteries, in connection with prepayment and discount systems, etc. The patents carry consecutive numbers from 796,030 to 796,061.

Three patents, Nos. 796,033-035, are for monetary meters; that is, they indicate upon their dial, the equivalent of the energy consumed in dollars and cents, so as to provide a very easy method of showing to the customer the amount of energy that he has consumed. These patents also show an additional dial which indicates the electrical energy in kilowatt-hours, so that the customer can have readings of the energy in kilowatt-hours, and the equivalent thereof in dollars and cents.

Two patents, Nos. 796,036-037, relate to meters to be used in conjunction with motor service, and by which it is possible to make the users of motors pay a little extra for the abnormal current which they use when starting motors. These inventions are based upon the principle that it is but proper that the users of energy as applied to electric motors, should be required to pay more for the current used in starting the motors, on account of its being such a tax upon the generating capacity of the plant. These two inventions also show an arrangement whereby a predetermined discount can be allowed by the mere setting of a little switch lever on a contact which corresponds to the per cent discount that is to be allowed. This is for the purpose of eliminating the necessity of the bookkeeper having to figure out the bill at the end of the month, with the discount already referred to—the meters doing it automatically.

Two patents, Nos. 796,038-039, are on discount meters, and provide means whereby a predetermined discount may be allowed, the meter taking care of itself, while provision is also made for giving a sliding discount, depending upon the load. For example, if a contract is made to allow a customer a 10 per cent discount from the regular rate, the discount lever is set on the contact marked 10 per cent; then, by means of an electromagnetic arrangement, a further discount will be allowed, depending upon the load that is being used. If the motor is operating at one time on 25 per cent of its capacity, the meter will automatically allow for, say 5 per cent; for operating on one-half load, 10 per cent; and for operating on full load, 15 per cent, or any predetermined percentage that has been decided upon. The object of these meters is to provide an instrument in which a single reading on the dial at the end of the month may be taken, which, when mutiplied by the standard rate will represent the actual amount of the bill, the meter having taken care of all the various discounts for the different loads automatically during its operation.

Patent No. 796,040 shows an ingenious arrangement in an electric meter whereby a dial that reads both in watt-hours and in dollars and cents may be placed at any convenient point on the outside of the building—such as the back porch—so that the monthly readings of the meter can be taken by the meter man without his having to enter the house. This eliminates the difficulty of the meter man having to go to a house a number of times, if perchance, he does not find the occupants in. It also prevents having to let the reading of a meter lapse for two or three months through the meter man failing to find anyone in the house when he went there for the purpose of taking the reading. This invention also contains provisions whereby a plurality of dials may be used; that is, a second one may be placed in the library or any other place within the house for the occupants to read, instead of having to examine the one on the outside.

Three patents, Nos. 796,041-042 and 796,066, show multi-rate meters, and have for their object the securing of a sliding rate, depending upon the load at the plant; that is, as the load in the evening approaches the highest point, or the peak, these meters automatically increase the rate with the increase in the output of the plant. They are also so organized that they will operate during a certain portion of the day at normal or regular rate, and at other portions of the day will give a discount, whereby the more energy consumed, the cheaper will be the rate. For example, these meters will, from 4 o'clock in the afternoon until midnight, automatically increase the rate by any predetermined amount as the load at the central station increases, and from midnight until 7 o'clock the following morning, they will reduce the rate in a sliding manner as the energy passing through them is increased—the object being to secure as much business as possible between midnight and the following morning when the majority of the customers have no lights in use. From 6 to 7 o'clock in the morning until 4 or 5 in the afternoon, the rate is normal, or that which is ordinarily charged, and without any sliding rates one way or the other.

Twelve patents, Nos. 796,043-044 and 796,049-060 represent many methods of measuring the energy delivered to storage batteries, and also means for measuring the amount of energy that is given out by said batteries in return. Dials are provided to show the amount of energy used in charging, and the amount given out in discharging, and further provisions are provided to indicate when such batteries are fully charged and when empty. In some of these inventions an electromagnetic drag is supplied to the retarding disk, which is made to vary its strength with the change in the e.m.f. of the cells, so that the index will always show correctly when the batteries are ready to be recharged again. The meters of these inventions are particularly applicable to electric vehicle work, enabling the operators of such vehicles to tell readily when to recharge their batteries, and also when they have been sufficiently charged; in addition to this, the meters can also be used by lighting plants for the purpose of ascertaining the exact amount of energy supplied for the purpose of charging the cells during the month. The dials which show the input and output also show the efficiency of the battery, and thus are a good check or means for indicating when batteries are in bad condition. One of the principal aims has been to have the instruments in a compact form, so that one can be supplied to each electric vehicle, and at the end of the month the central station superintendent can send his meter man around to read the meter just as he would a meter installed in a residence. A number of methods are shown whereby the inefficiency of the cells is taken care of, and as per the following example:

If a battery of cells has an efficiency of 70 per cent, then the 30 per cent must be taken care of in the operation of the meter, so that the indicator will show that the battery is ready to be charged again when only 70 per cent of the energy delivered to it has been taken out or expended. One way of doing this is to subject the detarding disk to an electromagnet, the terminals of which are connected in shunt to a portion or all of the battery cells. As the cells become exhausted their e.m.f. becomes less, and consequently, the amount of current that traverses the electromagnet will also become less, the electromagnet thus becoming gradually weaker as the pressure of the cells is gradually lowered; as the pressure at the batteries is gradually reduced, the drag will be correspondingly reduced, so that the meter will have a chance to operate quicker as the pressure falls off. In this way it is very easy to have the meter indicate exactly the exhausted condition of the battery when any predetermined percentage of the energy supplied to it in charging has been taken out. To take care of large amounts of current that may be drawn from the battery, a differential electromagnetic drag system is described, which also tends to reduce still further the drag when heavy amounts of current are required. This is desirable, since the efficiency or output of a battery is reduced when its current discharges beyond a normal point. In addition to employing an electromagnetic means in conjunction with the retarding mechanism of the meters, still other methods are shown for automatically compensating for the loss in the batteries, as by varying the resistance in the armature circuit; this is accomplished by a solenoid in series in the main circuit, and as the current or output of the batteries is increased, the plunger of the solenoid cuts out resistances from the armature circuit so as to permit the armature to speed up as the load is increased.

Three patents, Nos. 796,046-048, represent what may be termed sliding discount meters. In the sale of electrical energy it is common to give a customer a certain rate per kilowatt-hour, providing that he uses a certain amount, but such arrangements have had to be taken care of by the bookkeeper when making out the bill at the end of the month. This represents a great deal of work in the office if a number of customers are using current, each of them, perhaps, enjoying a different discount or rate. To simplify the matter of taking care of such accounts, and at the same time to have the computations done automatically in the meter, these three inventions have been developed. These meters are provided with neat switching mechanisms, which permit the giving of a sliding discount as the amount consumed is increased, as illustrated by the following example:

Suppose a central station makes a contract with a customer, as follows: "We will charge you a rate of 10c. per kilowatt-hour on all energy which you use up to and including 25 kilowatt-hours, and after you have used this amount we will allow you a discount of 10 per cent on the next 25 kilowatt-hours, another discount of 5 per cent on an additional 25 kilowatt-hours, and so on." The arrangement for accomplishing this can take care of 10 sliding discounts, and the mechanism of the meters are also so organized that the relative amounts of energy that is to be discounted can be taken care of. The result is that the meters take care of the plurality of rates and discounts automatically; at the end of the month the meter is simply read in the ordinary manner, and then the product of the reading by the usual or standard rate will represent the amount of the bill for the month, with all the different rates taken care of.

Patent No. 796,062 is for a prepayment meter, which is so constructed that a number of coins can be deposited at one time and full credit given for same. It also has a ringing alarm to operate at any predetermined time before the switching mechanism in the meter is operated; in other words, it can be so set that it will ring an alarm bell 15 or 30 minutes before the lights will become extinguished, or before the last coin has dropped into the cash receiver. This does away with the annoying drawback of having the lights extinguished by prepayment meters without any warning.

Two patents, Nos. 796,063-064, are on automatic storage-battery charging devices designed for the purpose of installing in garages to charge the batteries of automobiles. It is only necessary to connect the terminal plugs of the vehicle battery to the switchboard, which is part of the charging device, and after this the operation is entirely automatic; when the battery is properly charged the switches will be opened, and the battery disconnected from the charging circuit. One of these inventions takes advantage of the pressure of the cells to regulate the time when the charging is to be stopped. A solenoid is provided with a moving pointer which passes over a graduated volt scale, which scale is provided with an adjustable contact placed at a point on the volt scale which will represent the pressure of the cells when charged; as soon as the e.m.f. of the cells becomes high enough, the solenoid core or pointer will touch the scale contact, and thereby open the charging circuit automatically. These inventions also have application in private garages, enabling the owner of the vehicle to simply connect his battery with the charging apparatus; then go off and leave it for the night, the operation of charging being entirely automatic.

Patent No. 796,065 is likewise for a meter employed in the charging of automobile batteries, and indicates when such battery is full, also when empty or ready to be recharged. Provision is also made to take care of the leakage of the cells when the battery is out of commission. It frequently happens that after the battery is fully charged, the owner of the vehicle may not have occasion to use it for a month or so; as he has not used it since it was charged, he would naturally assume that it was all right, while, as a matter of fact, it may have become pretty well exhausted in the interim, and if put in use, as would be done under ordinary circumstances, the plates would probably be damaged. This meter provides means whereby an indicator will show whether or not the battery is exhausted, and irrespective of whether or not it has become exhausted through long standing or constant use.

Patent No. 796,068 is for a meter in which provision is made to save the armature from the destructive effects of lightning. In the operation of direct-current commutator meters, the lightning destroys quite a number of armatures annually. This invention is devised for the specific purpose of preventing the lightning from entering the armature.

Patent No. 796,069 is also for a direct-current commutator meter, and in which the principal novelty is that of adjustable brushes and polyphedral formation, and has for its object to enable the meter man at central stations to apply a new brush surface to the commutator whenever necessity demands it. The brush tips of meters have heretofore only one contact surface, so to speak, and when this became rough or worn, it either has to be removed from the meter and filed down to a smooth surface, or a new brush substituted; with the polyphedral arrangement a new surface can be brought into contact with the commutator by simply turning the brush around. Some of the other inventions are for indicating ammeters and voltmeters.

The Passenger Traffic Problem in London.

The full report of the Royal Commission on London Traffic is a bulky document, but no larger than might be expected, in view of the magnitude of the questions with which it deals. Its issuance was noted briefly in these columns. We now give below the Commission's own "conclusions," as summarized by it at the end of the report:

It is imperatively necessary, in the interests of public health and public convenience, and for the prompt transaction of business, as well as to render decent housing possible, that the means of locomotion and transport in London and its adjacent districts, should be improved; they are seriously defective, and the demands and needs of the public are annually increasing.

The main obstacle to such improvement is the narrowness of the streets, which were not laid out in accordance with any general plan. The arterial roads leading out of London largely suffer from the same defects. A comprehensive plan for the improvement of streets and main roads should be prepared and carried out continuously, as financial considerations will allow. We have suggested some improvements; many more might be suggested, but the difficulty is one of money, and progress must be gradual.

Increased modern means of locomotion and transport are much needed, both to facilitate movement within the central area, and to facilitate access to and from and within the suburbs for those who work in London and live outside. Electric tramways and railways are necessary for both these purposes; tramways mostly for the former and railways mostly for the latter, with intercommunication between the two.

The tramways system of London is disconnected and insufficient; it should be largely extended, and the portions of the tramway system that are now isolated should be linked together, through communication being provided from east to west and from north to south.

We believe that much could be done in tramway development without having recourse, at any rate in the first instance, to great and costly street improvements, but, as such improvements are unavoidable, in any case, the preference should be given to those which will facilitate the extension of the tramway system.

The absolute "veto" over the construction of tramways, passed by local and street authorities, should be abolished throughout the area of "Greater London," but with a preferential right to county councils and the Corporation of the City of London, to construct tramways within their districts, if they are prepared to do so.

Tramways should run through from side to side of London, so far as possible, and termini, in the streets and central districts, should be avoided.

In regard to railways, their further development must be governed by the features of the existing and authorized systems, which should be extended and improved; we have suggested various extensions and improvements.

It is important that all possible facilities should be afforded to suburban passengers, arriving at the terminal stations, to reach their destinations throughout the central area by railway, either by means of through trains, or by interchange within the stations to which the suburban trains may run.

In the more crowded parts of London, where property is expensive, railways must be placed underground. Railways in shallow subways are preferable to "tube" railways, where the cost is not prohibitive, or where other considerations do not render them impracticable. We desire to draw special attention to the importance of urban railways, traversing London from side to side ,on routes where there is a heavy traffic, having four lines of way, in order to provide a separate service for fast and for stopping trains.

Owing to the high capital cost of "tube" railways, constructed under present conditions, there is a difficulty in providing a sufficient number of such railways to distribute population over the outlying districts, but we are advised that it is possible to construct a cheaper type of deep-level railway adapted for suburban traffic, with fewer and less expensive stations, and rising to the surface when the open country is reached.

If private enterprise will not construct the necessary railways, the local authorities might be authorized to give assistance in view of the fact that re-housing within the central area involves a heavy loss to the rates, and that it may be cheaper, and will be better in other respects, to help in making healthier residences in the suburbs accessible. Assistance might be afforded, either by remission of rates, or by direct contribution, according to the precedent of the Light Railways Act, 1896, and the recommendations of the Joint Committee of 1901 on London Underground Railways.

In cases where railways exist, but additional train services are required to open up new districts for building, and railway companies decline, and cannot, under the existing law be compelled, to put on additional trains, local authorities might be empowered, if the necessity is urgent, to guarantee, for a limited period, such net receipts per train-mile for the proposed trains as may be reasonable.

In cases where a new railway is proposed to be made, which would have the effect of opening out a district for building purposes, we think that a railway company might be authorized to purchase, under proper safeguards, land, likely to be increased in value by the construction of the railway, by means of voluntary agreement with the owner of such land.

A traffic board should be appointed with jurisdiction over "Greater London," constituted, authorized and required to discharge the duties therein set forth.

CURRENT NEWS AND NOTES.

EARTHQUAKE CONFERENCE.—The International Earthquake Conference met at Berlin, Germany, on August 15. Dr. Theodor Lewald, who was the German Commissioner General to the St. Louis Exposition, was elected chairman. Ambassador Tower received instructions by cable to represent the United States.

MORE ATLANTIC CABLE.—The British cable steamer *Colonia* left England on August 5 for Canso, whence after laying a 200-knot cable across the Gulf of St. Lawrence, she was to start homeward across the Atlantic, laying a new main cable. Of this she carried no less than 8,700 tons. The submarine cable industry seems to be thriving in spite of all the activity in the wireless field.

MUNICIPAL TELEPHONES FOR CHICAGO.—City Electrician Carroll, of Chicago, is proposing to install a municipal system of telephones and is securing bids on some 1,400 instruments, for which cables will be run in the Illinois Tunnel subway. This will apparently involve cutting adrift from the general system of the Chicago Telephone Company, which has hitherto had the maintenance of the municipal telephone service.

INTERNATIONAL SCIENTIFIC EDUCATION.—A dispatch from Berlin August 15 says: "While the liberal press warmly welcomes the proposed interchange of professors between German and American universities, Nationalist newspapers are inclined to sneer at the suggestion. They profess to be doubtful if German science will gain any advantage. American scientific methods, they say, are too embryonic. America possesses hardly a scientist who is able to tell Germany anything valuable; nevertheless, German science is so rich it can afford to be bounteous. They point out, however, that care is necessary lest American influence impregnate German life."

PRESIDENT STAYS ON TOP.—It had been stated in the newspapers that this week President Roosevelt would take a dive at Oyster Bay, Long Island, in the new submarine *Plunger*. This is now denied. The President will stay on top and witness the experiments.

CHICAGO TROLLEYS.—A canvas of the aldermen of Chicago City Council reveals the fact that a large majority is opposed to the institution of condemnation proceedings against the street railway company. This ties Mayor Dunne's hands in his municipal ownership campaign.

BRITISH ASSOCIATION IN AFRICA.—No fewer than 385 members of the British Association for the Advancement of Science have started from England for the meeting in South Africa, and of these 276 will go up country to the Transvaal Colony, Kimberley, etc. There are some Americans in the party. The programme is a most interesting and attractive one.

WIRELESS IN U. S. NAVY.—A special dispatch from Washington of August 11 says: "According to a report received at the Navy Department, ships of the North Atlantic fleet have communicated with one another by wireless telegraph at a distance of about 262 miles. This is announced to be the greatest distance at which wireless messages have been sent from ship to ship in the navy."

EDISON'S BIRTHPLACE.—A dispatch from Norwalk, Ohio, states that Mr. Thomas A. Edison has made an offer to the present owner for the purchase of the house, in Milan, Ohio, in which he was born. Mrs. Mary Ristine, of Chicago, a niece of Mr. Edison, is the owner of the place, and the amount offered by Mr. Edison for the property is stated to be much more than its intrinsic value.

A POLE LINE COMEDY.—A special dispatch from Cincinnati, Ohio, says: "To prevent the Bell Telephone Company from erecting poles along the roads of their locality, farmers of Green Township gathered their children and placed one in each hole that had been dug. Over half the school children in the neighborhood were in the earth up to their chins when the telephone people abandoned their work."

X-RAY LEPROSY TREATMENT.—It is stated that American surgeons connected with the Board of Health at Manila, P. I., are treating leprosy very successfully with Röntgen rays. Of twenty-five cases, six are reported as actually cured, while several patients, portions of whose bodies were gone, have recovered, on account of the check of the disease, no trace of germs being discoverable in the blood.

WORK AT PORTSMOUTH.—Last week we gave an account of the telegraphic preparations at Portsmouth, N. H., for the Russo-Japanese peace conference. All the facilities thus described have been freely used. The telegraph operators are among the busiest people at Portsmouth. On the average 12,000 words a day have been cabled to Europe and Japan. The Russian messages to St. Petersburg have gone over the French lines, as they did not wish them to pass through England. The Japanese dispatches to Tokio have been sent via San Francisco. There has been a large amount of traffic for American and European newspapers.

ELECTRIC COOKING STOVE.—In a patent issued August 8 to Prof. Elihu Thomson a form of stove is described which may be designated as an electric heat accumulator. The stove is heavily jacketed externally with a layer of some good heat-insulating substance, such as asbestos, fire-clay or mineral wool of any desired thickness, and provided with a lid of the same character. Within the jacket is placed a mass of refractory material, and embedded therein is a granular resistance material. It is stated that silicon is particularly desirable as a resistance material, because it has a high specific resistance, a high fusing point, and a suitable temperature coefficient, and, furthermore it is not oxidized at high temperatures. The construction of the stove is such that the whole interior may be maintained red hot for a considerable time by a moderate expenditure of power. It is intended that the current will be turned on in the morning and that the stove will be run the greater part of the day without involving great cost and will be ready at any time for the work of cooking.

AN "ELECTRIC FLUID" CRAZE.—A dispatch from Peoria, Ill., of August 12 says: "The inquest to-day on the body of Edward Drouin, formerly a wealthy Philadelphian, who was found dead in his hallway, disclosed that the interior of their Fisher Street home is filled with furniture of the strangest character, and that the walls are covered with fac-simile reproductions of the 'coat-of-arms' adopted by Drouin and his wife. For some time he had posed as 'King of the World' and his wife as 'Empress of the Universe.' With an energy almost inconceivable, Mrs. Drouin spent hours of each day writing letters to prominent people warning them of attempts upon their lives and asserting that a band of people was threatening the extermination of the populace by turning on the 'electric fluid.'"

THE POLITICS OF IT.—The New York *Times* gives the following summary of the political situation in regard to the New York State Lighting Commission: "The Public Utilities Commission, composed of Frederic E. Gunnison, of Kings; John C. Davies, of Oneida, and Lucien L. Shedden, of Clinton, all Republicans appointed by Governor Higgins, will soon be called on by the Republican State organization, it is said, to justify its existence from an organization point of view by coming to this city and investigating a few supposedly Democratic schemes. The commission organized only last week by electing Mr. Gunnison chairman. It was decided that desk room must be found in Albany, New York and Buffalo. When quarters are found here, the Republican district leaders, from the Battery to the Bronx, will expect a prompt examination of Charles F. Murphy and others with reference to the construction of the Astoria gas plant."

WIRELESS TELEGRAPH RECEIVER.—An extremely simple form of coherer is disclosed in a patent granted August 8 to Prof. E. Branly, of Paris, France, who in 1891 gave to the world the principle of the first or filings coherer. The coherer comprises essentially three rods of polished steel having blunt points resting upon a plate of polished steel. The blunt points of the metal rods are oxidized. The contact of the oxidized with the polished surface possesses the property of preventing the passage of current under normal conditions, but of immediately becoming conductive under the influence of the waves from an electric spark, and of instantly resuming its resistance under the action of a very slight shock. The decohering shock is produced by a tapper which is operated by an electromagnet, the current for which is obtained from a local battery whose circuit is controlled by a relay which is responsive to the current in the coherer circuit. The closing of the circuit of the local battery serves in the ordinary way to throw into action a recording instrument which causes the unrolling of a paper band and the impression thereon on the long and short signs representing dots and dashes of the Morse alphabet.

SENDING A WAR DISPATCH.—In discussing the work of the Associated Press, Mr. Melville E. Stone in the August *Century* describes the ordeals of the war correspondent at the front, and says: "When the battle has been fought, and the correspondent, at great hazard, has written his story, his troubles have only fairly begun. He must 'pass the censor.' This may be easy or it may be most difficult. Much depends upon the character and intelligence of the censor. It is only fair to say that we have found the Russians very reasonable. They have shown far more wisdom than did the American censors during the Spanish war. Next, the messages must be transmitted. The correspondent must be 'first at the wire' or his work may all come to naught. Here, again, he must exercise tact; otherwise a petty telegraph official, who is often a very monarch in his field, may spoil everything. And all along the long line—for the telegram is retransmitted half a dozen times before it reaches San Francisco or New York—the cable officials must be friendly and painstaking and intelligent, or the news will fail to reach its destination promptly and in the form in which it was sent. Delays in transmission are inevitable, and it speaks volumes for the efficiency of modern telegraphy that they are so infrequent. Russian operators, Danish operators, Japanese operators, French operators—all handle and transmit these messages, often in bad chirography, in a language which they do not understand, and they seldom make a serious mistake."

SUBWAY FOR PITTSBURG.—A syndicate, headed by M. A. Verner and Mayor William B. Hays, has applied for charters for a subway system for Pittsburg. The sum of $10,000,000 will be involved in the deal, and work will be started as soon as the charters are granted.

ILLINOIS INDEPENDENT TELEPHONE.—At Peoria, Ill., on August 8, the Illinois Independent Telephone Association elected officers as follows: President, E. R. Conklin, Aurora; vice-president, Manford Savage, Champaign; secretary, C. B. Cheadle, Joliet; treasurer, C. S. Hankin, Decatur. It was decided the State should be divided into three large districts for better co-operation and service.

OHIO ELECTRICAL CONTRACTORS.—The Electrical Contractors' Association, of Ohio, held its annual meeting in Toledo, on August 9, in the rooms of the Builders' Exchange, and elected the following officers: President, Charles S. Hall, Dayton; vice-president, Emil Grah, Toledo; secretary, A. Oppenheimer, Cleveland; treasurer, J. C. McMasters, Columbus. There were about 30 present. The meeting was called to order by President Hanson, of the local branch. W. H. Morton, of Utica, N. Y., national secretary, and Past-President McCreary, of the national organization, were present The delegates had dinner at the St. Clair Hotel, after which they took a trolley ride around the city and enjoyed supper at the Toledo Yacht Club, spending the evening at the Casino.

FLOATING POOLROOMS, with wireless service, have had a lively time off Chicago, but the end is not yet. There are more torments in store for the race track gamblers whose last hope of evading the law is precariously reposed in Commodore "Bud" White's wireless flagship, the *City of Traverse*. The plan is to erect a wireless telegraph mast and station on the roof of the Chicago City Hall at city expense. It is said a continuous operation of the sending apparatus during the afternoon while the races are being run would prevent the De Forest station from getting into intelligible communication with the steamer. When Commodore "Bud" White is waiting the returns on the first race his guests will receive this from Assistant Chief Schuettler: "The eyes of the Lord are in every place beholding the evil and the good." When the odds are posted on the second race the bettors will be warned: "Woe to him that ganeth an evil gain."

"THIRD-RAIL EYE."—All kinds of funny new diseases are credited to electricity. The latest is recorded as follows: "For some time motormen on the Union Railway in the Bronx have been reporting trouble with their eyes. Every day a few of the men would report ill. Their eyes were in such a state that it was impossible for them to attend to their duties. There were several investigations, but the mystery remained unsolved until Traffic Superintendent William Hansen decided to investigate for himself. After one trip over the line Mr. Hansen also suffered just as the motorman had. An examination by an oculist showed that there were sixty minute pieces of steel in his eyes. It is believed that these particles are thrown from the third rail when the power shoes of the Third Avenue Elevated cars overhead rub over them. The showers of powdered steel strike the motormen in the face. As the men have no trouble in the winter time, when they are behind the glass partitions, it is proposed to supply them with automobile glasses to guard against the danger."

SAFETY ON ENGLISH RAILWAYS.—The general report to the London Board of Trade on railway accidents in 1904, issued on July 17, states that the danger of railway traveling has been reduced to such a point that in 1904 the chances against a passenger being killed in a train accident in the course of a given journey were more than 200,000,000 to 1. The risks incurred by railway servants, especially those concerned with the movement of traffic, are of course much greater. In their case there is an element of danger which cannot be eliminated, though its effect may be minimized by the adoption of suitable appliances and safeguards. The increasing use of such appliances is having an appreciable effect, but it is claimed that the carelessness engendered by familiarity with dangerous conditions appears to be responsible for so many accidents that it is unreasonable to expect any marked reduction in the total number of accidents to railroad servants. These figures show that it is much safer to travel in England than in America, and should induce the greater adoption in this country of safety signals, etc.

Electrical Engineers of the Times—XXIII.

MAX LOEWENTHAL.

Max Loewenthal was born at Oldenburg, Germany, on February 22, 1874, his father being a merchant in that old military town, where he received his elementary education and attended the Gymnasium (college) for three years. When thirteen years of age his family, on account of business reverses, emigrated to the United States. During the first six months he attended public school, and stood second in a class numbering 55 pupils, although he was not versed in the English language—all questions having to be asked him on a slate, to be translated by him before replying.

In the fall of that year, 1887, he entered the Hebrew Technical Institute, New York, and in 1890 was graduated from that institution, in the electrical course, with honors. He was then but 16 years of age, and his essay on the phonograph, delivered on the occasion of his graduation, was reprinted in several magazines. After graduation he became laboratory assistant to Mr. George A. Hamilton, chief electrician of the Western Electric Company, and, in 1891, he accepted a similar position with the Schuyler Electric Company, Middletown, Conn., under Mr. E. R. Knowles. Feeling the need of higher education, he prepared himself evenings for the entrance examinations to some university, and saved sufficient funds by practicing economy and teaching drawing at the Young Men's Christian Association, to enable him to leave his position in the beginning of 1893, and pass all the entrance examinations at Columbia University in the spring of that year. There he earned a scholarship during the first year at college, which enabled him to go through his course without the payment of any tuition fee.

He was graduated from Columbia with the degree of Electrical Engineer in 1897. During the remainder of that year he wrote a number of text-books for a correspondence school, and, in 1898, joined the editorial staff of *The Electrical Engineer*, remaining in that position until the consolidation of that journal with *The Electrical World*.

MAX LOEWENTHAL.

He then was interested in train lighting for some time and equipped the first tug in the harbor with an electrical equipment for lighting operated from the propeller shaft. He next associated himself with the late Max Osterberg, in consulting electrical work, and, in 1901, was one of the organizers of the Prometheus Electric Company, manufacturers of electric heating apparatus, of which company he is now secretary and electrical engineer. He has developed and received patents on a large variety of electric heating and cooking appliances, and was awarded a personal medal at the St. Louis Exposition for his contribution to the electrical heating industry. He also prepared the electric heating chapter for "Foster's Electrical Hand Book."

Mr. Loewenthal has been, for a number of years, instructor in mechanical drawing in various evening schools, also one of the lecturers for the New York Board of Education, on technical subjects, and has been a frequent contributor to electrical and scientific magazines. He is an associate member of the A. I. E. E., vice-president of the New York Electrical Society, a member of the Pi Lambda Phi Fraternity and the New York Press Club, as well as of a number of educational and charitable organizations.

An Italian 40,000-Volt Transmission Plant.

By Franz Koester.

AMONG the interesting high-tension hydro-electric plants of Europe is that located at Gromo, on the Serio, a mountain stream in the northern part of Italy. This plant, officially opened July 11, 1904, was designed and built by the Brown, Boveri Co., of Baden, Switzerland, for the operation of the spinning mills of Messrs. Crespi & Co. and various other industrial plants at Nembro, a small town some 20 miles distant. Up to the present time the hydraulic power has been utilized only at the former town, but it is intended at a later date to utilize the power also at a higher point, finally using a total of 4,000 hp, double that at present generated.

The power plant has been located only a short distance from the town at the foot of the mountain down which the penstock leads, the lower part of the latter being led under ground right up to the building. Three Escher-Wyss water turbines are at present installed, direct-connected to three 4,000-volt, three-phase alternators designed for a continuous capacity of 1,000 hp with a power factor of .80. The frequency is 50 cycles at 500 r.p.m. The efficiency of these generators at full load is something better than 93 per cent and at half load 90 per cent. Fig. 1 gives a general view of the generating room, showing the three main generating sets in a row and one of the two 25-kw, 115-volt exciters which are also driven by water turbines. The third generator is held in reserve and will operate in case of emergency only.

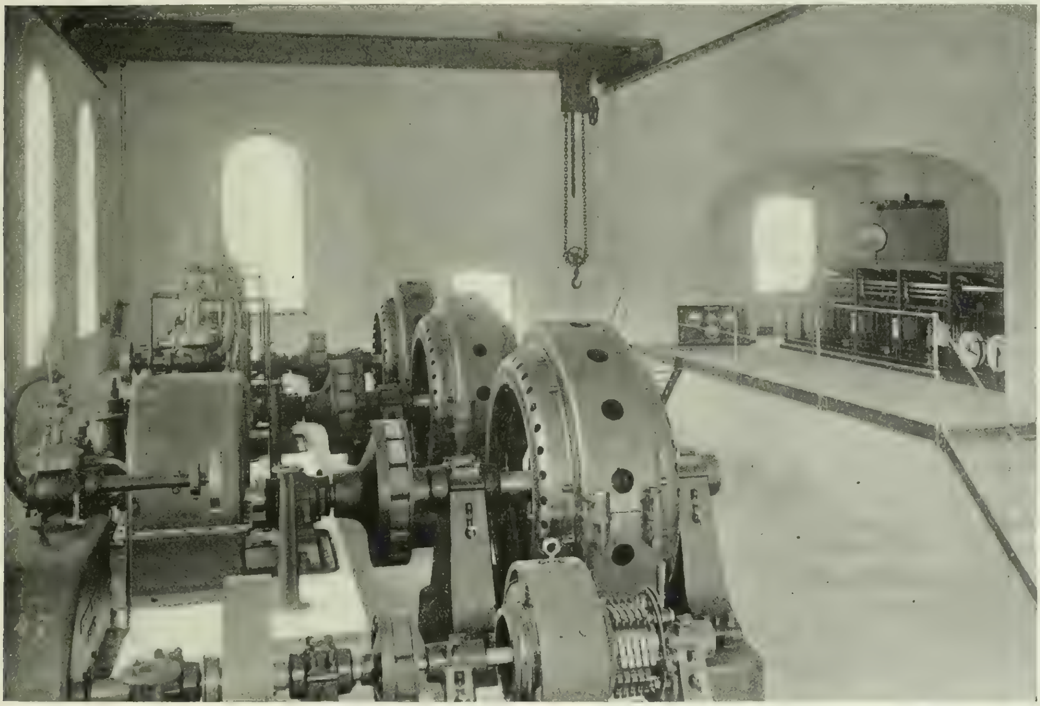


Fig. 1.—Generating Room.

Each generator feeds directly to the primary of an 850-kw. step-up transformer, the secondary circuit containing the switches and necessary apparatus for parallel operation. Thus the turbine, generator and transformer constitute practically one unit, which method is distinctly modern. The elimination of bus-bars between the generators and transformers practically cuts the number of measuring instruments, etc., in half. The current and tension transformers for ammeters, voltmeters and overload relays of the automatic switches are connected to the low-tension side, thus considerably reducing the first cost of the installation.

The transformers are of the Brown, Boveri oil-insulated, water-cooled type, requiring on the average about 18 liters of water per minute at a temperature of approximately 18° C. The primary and secondary sections are wound in the shape of concentric cylinders and are separated one from the other by strong insulating partitions, and as a still further safeguard against breakdown, the secondaries are wound on the sandwich principle, each subdivision having a terminal potential difference of 300 volts. These transformers were subjected to a flash test of 67,000 volts.

All the switching apparatus for this plant is located in a special building adjoining the generating room. This switch house, as it might be called, consists of a basement and three stories, each of which has a floor space of 32 by 23 ft. The basement is divided into two compartments; the first, situated 4 ft. below the generating room floor level, contains the regulating resistances and the framework for the 4,000-volt apparatus, while the second is located above the generating room floor and contains the transformers. A wide trench is provided under the generating room floor through which the exciter and primary (4,000-volt) leads pass. The first story is also divided into two compartments. The first, shown at the right in Fig. 1, gives access to the generator room and forms a gallery from which the complete installation may be viewed, and contains the main operating board with switch hand wheels and measuring instruments (see Fig. 2). The secondary automatic switches and the three current transformers for the line feeders are installed in the second compartment. The third story is reserved for the lightning arresters and line feeders.

A separate frame is provided for each generator and carries three high-tension, tube-type, single-pole fuses with blow-out horn, one potential transformer and two current transformers. This framework is made completely of iron with the sides covered with perforated metal sheeting and removable front shields which allow inspection or replacement of fuses.

As previously stated, the leads pass directly to the primaries of the transformers, entering the transformer room through glass tubes cemented into the dividing wall. The high-tension automatic switches are located directly below the high-tension bus-bars. A front view of these switches is given in Fig. 3. These are of multiple-break, single-pole type, but operated simultaneously. On the left is shown one of the line switches while the other two belong to the hydro-electric transformer units. Each switch is mounted in a separate fire-proof compartment with 5-in. dividing walls. The oil reservoirs are arranged so that they may be easily lowered for inspection, etc.

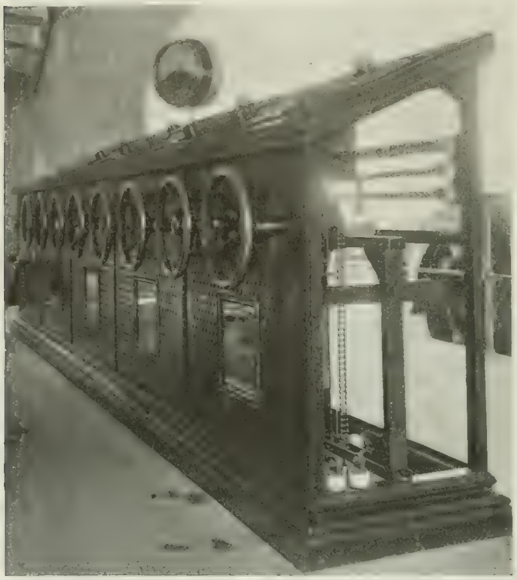


FIG. 2.—SWITCHBOARD.

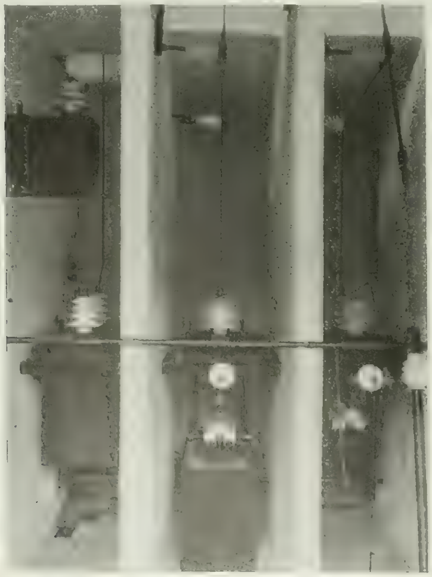


FIG. 3.—FRONT VIEW OF AUTOMATIC HIGH TENSION SWITCHES.

As shown in Fig. 2 the generator board is built in the form of a desk inclined toward the generator room and placed in the gallery in such a position that the attendant may stand at the board and at the same time overlook he entire plant equipment. The operating board is equipped with only low-tension apparatus and consists of three generator panels, one feeder panel and one exciter panel. Each generator panel contains two hand wheels, one for the high-tension oil switches and one for the low-tension regulating rheostats. The latter are so arranged that they may be connected together and the generators simultaneously regulated when running in parallel. Each panel also has an overload relay, those for the units being two-pole and that for the line three-pole. The push button for the automatic release of the high-tension switches and the phase lamps and tumbler switches for the same are mounted on the table. It is interesting to note that no marble or slate was used in the construction of the board. The lightning arresters, as previously stated, located in the third story, are of the well-known Wurts type and are insulated from the earth by several porcelain insulators.

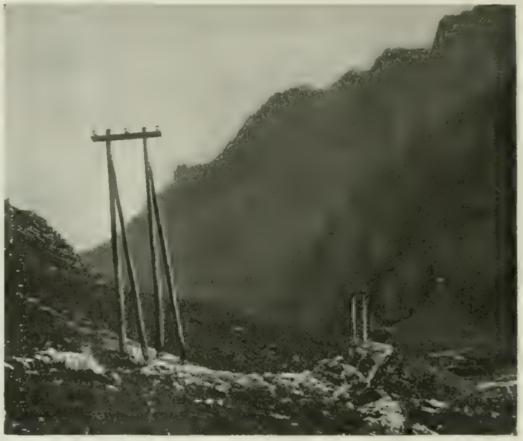


FIG. 4.—ANGLE AT THE "DEL COSTONE" BRIDGE.

The lines leave the building through heavy glass tubes inserted in the window panes and held in position by means of copper sleeves soldered to the leads. The line is approximately 20 miles long and follows more or less the River Serio through the Seriana Valley. It consists of three high-conductivity bare copper wires 6.5 mm. in diameter mounted on delta insulators and is designed to transmit 4,000 hp with a drop of 5 per cent. The insulators are of special design and besides having all the ordinary advantages of the delta type were subjected to especially severe tests. With the atmospheric humidity at 62 per cent it required 89,000 volts to jump a spark to the iron support, and in an artificial rain corresponding to a precipitation of 1½ in. per minute, 54,000 volts. The insulators were finally subjected to a flash test of 80,000 volts. They are mounted

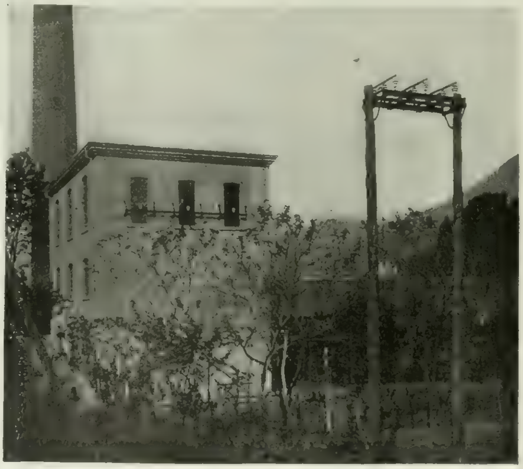


FIG. 5.—SAFETY SWITCH AT NEMBRO SUB-STATION.

on wooden poles and cross arms, the standard height being 25 ft. The lower insulators are placed 23½ ft. above the ground except at crossings, where this is increased to 29 ft., the poles here being 30½ ft. above the ground. Where long spans and sharp curves occur two poles have been erected and the insulators mounted on cross arms 3 ft. apart (center to center). The longest span is 400 ft. and the sharpest angle that at the Del Costone Bridge, which is 145° (see Fig. 4).

The line enters the transformer sub-station at Nembro through a three-pole emergency switch (see Fig. 5), mounted on a pole close to the station, thus making it possible to isolate entirely the sub-station. This switch is so arranged that when it is opened the line entering the sub-station is short-circuited and grounded, thus making it impossible for any foreign body to complete accidentally the circuit and energize the sub-station apparatus. After passing this switch the line enters the sub-station in exactly the same manner as it leaves the generating station. As will be seen from the double-pole construction illustrated in Fig. 5, the line is well protected by lightning arresters of the horn type.

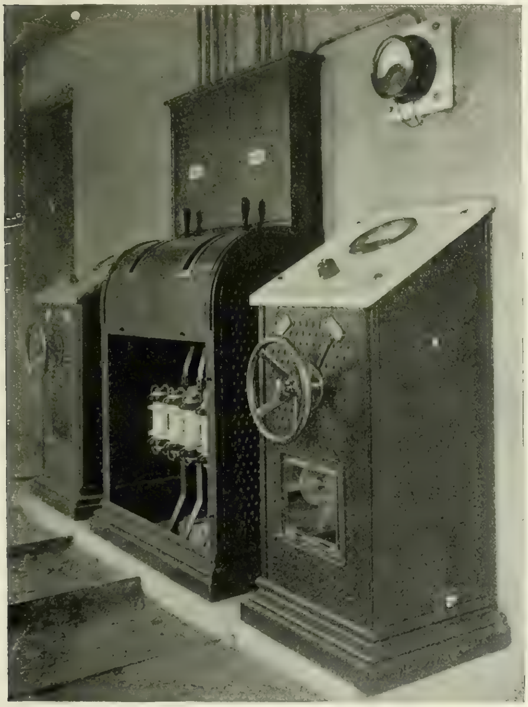


FIG. 6.—SWITCHBOARD FOR PRIMARY AND SECONDARY TRANSFORMER SIDE AND FOR 500-VOLT FEEDERS.

The sub-station is a two-story building, both floors being divided into two compartments. The second floor contains the lightning arresters and leading-in arrangements in one section and the high-tension bus-bars in the other. The apparatus at Gromo is so regulated that the potential at these buses shall be 38,000 volts. From these bus-bars the current passes through the high-tension oil switch, which are of exactly the same type as in the Gromo plant, to the primaries of the transformers located in the rear room of the ground floor. In the front room of the basement there are at present two desk type panels of the same design as those installed at Gromo except that there is only one hand wheel for the main switches and the two-pole overload relay (see Fig. 6). In this room is also located the distributing panel for the 500-volt secondary system, carrying two 500-volt switches and the necessary fuses. The framework of this distributing panel is entirely of iron and self-contained, all the current-carrying parts being protected by sheet iron. The low-tension feeders pass through the upper part of the building and thence out to the motors, etc.

Inter-Relation of Ballast and Glower in the Nernst Lamp.

By Lewis A. Terven.

THE problems presented by the glower and the ballast are very difficult taken singly, but when a problem of one is complicated by inter-connection with a problem of the other, the case becomes very complicated. It has been often said that the more complicated in theory an apparatus is, the simpler it operates in practice. While this is of itself untrue, at the same time the saying carries some truth. It is well known that the induction motor is an apparatus capable of a great deal more abuse than the direct-current motor, although direct-current apparatus is much simpler in design. Such is the case with the Nernst lamp. That it is a complicated lamp is freely granted, but that these complications interfere with the operation of the lamp is not admitted. The understanding of the physical occurrences of minor importance in the filament of the ordinary incandescent lamp offers just as many difficulties as do the parts of the Nernst lamp, but these small things have never been thoroughly investigated for the simple reason that there was no practical use in doing so.

Because the Nernst lamp glower is an unstable device it is necessary to use a steadying resistance in series with it and this resistance has been called the ballast. As is commonly known, the ballast used consists of a fine iron wire, sealed into a bulb containing hydrogen. The hydrogen not only prevents the iron from oxidizing, but on the other hand it materially affects the molecular arrangement of the iron resistance, so that the curve between current and volts is found to be much steeper in a hydrogen atmosphere than it is under other conditions.

Fig. 2 shows the normal ballast curve. It will be seen that the rise in resistance of the iron wire is quite rapid just above the point upon the curve where the lamp is normally operated. The ballast curve is usually plotted on the basis of percentage. This is the only fair way to show a ballast curve, but the current scale is extended in the curve shown, which makes the ballast curve appear flatter than it really is. The ballast is a very interesting piece of apparatus from quite a number of standpoints. The shape of the curve may be changed and one may get a different characteristic from the lamp by working at different points upon the curve. The selection of the proper quality of the iron to be used for wire is of very great importance.

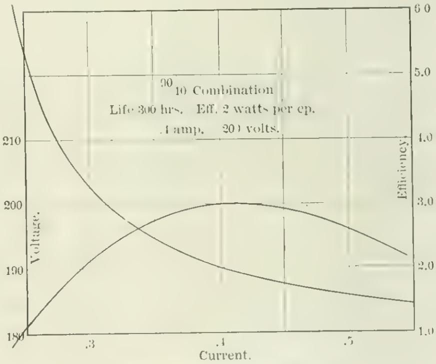


FIG. 1.—CURVE ON AVERAGE GLOWER.

The beauty of the ballast is its sensitiveness. The reverse of sensitiveness is known as sluggishness; that is, failure of the ballast to immediately respond to changes in the line voltage. This is due to the specific heat of adjacent materials, as well as to interheating of parts and other things

The glower curve is shown in Fig. 1. This curve was taken at 300 hours and is much steeper than the usual glower curve. In other figures, such as Fig. 4, glower curves are shown where the glower had been run only an hour. It can easily be seen by inspection that the glower changes its characteristic remarkably with age.

A very peculiar point is to be noted here. While the glower surface emission deteriorates about 13 per cent cent during its life, the point upon the glower characteristic at which one operates at constant efficiency does not shift, or at least if it does shift, moves over toward a more stable position. This can be seen by an inspection of Fig. 3. The curve shows a very rapid rise in stability during the first 100 hours, after which the curve is flat. By stability is meant the ratio of the abscissa of the peak of the curve to the abscissa corresponding to the point of 2 watts per candle-power on the glower curve between current and voltage. Of course, it must be borne in mind that the glower may be operated beyond the peak of the curve, in which case the stability must be reckoned as a negative quantity.

In a previous paragraph the need of a ballast has been referred to. The necessity can be easily seen by reference to any of the later curve sheets of the paper. In Fig. 2, which shows two lamp curves taken from an aged glower, one of the curves is taken in connection with a normal ballast, while the other one is taken in connection with a straight resistance, which consumes 20 volts at .4 ampere. Lamp curve No. 1 shows how a rise in voltage is easily taken care of by the ballast, while curve No. 2 shows a very unstable lamp, and a rise of 5 per cent in voltage would mean the destruction of the glower. If a simple resistance is to be used as a ballast, the percentage of ballast would have to be increased from 10 to 30, in order to take care of the variation in line voltage, and even this 30 per cent resistance does not accomplish the same result as the 10 per cent iron ballast. One advantage of the ballast, which has no temperature co-efficient, is due to the fact that the lamp is non-sluggish and the glower never gets an excess current, except that corresponding to an over-voltage circuit. The question of ballast sluggishness is a very broad one and is much too extended to be taken up in this paper.

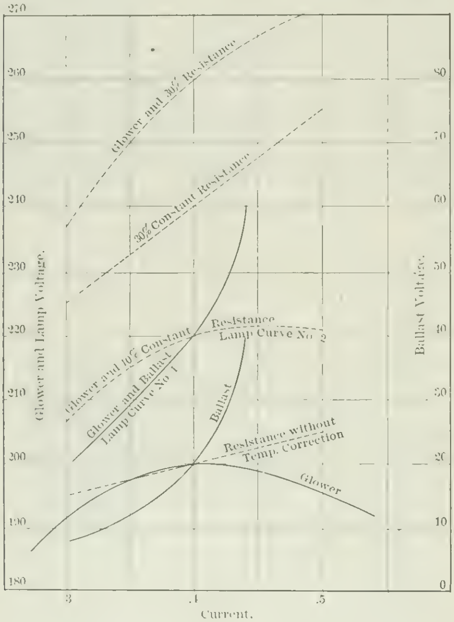


FIG. 2.—NORMAL BALLAST CURVE.

The best way to learn how the ballast and the glower combine to make the lamp is to study curves illustrating different cases. Theoretically one has an innumerable variety of circumstances. For instance, the glower may be normal or it may be squirted for too low or too high an efficiency. The ballast with which these three glowers are combined may be a normal, an under-voltage or an over-voltage ballast. Taken in this way, nine curves would result, but all of these are not necessary. In Fig. 4 the normal ballast curve is combined with the normal glower curve to produce the normal lamp characteristic. The lamp curve so shown is very stable, and the lamp will withstand a 10 per cent excess of voltage for continuous service.

The lamp will stand a temporary over-voltage of 20 per cent without injury. On the same sheet (Fig. 4) a lamp curve is shown corresponding to a glower which is 5 volts lower sorted voltage than it should be. This corresponds to a method formerly used for so-called glower correction. During the early stages of the Nernst lamp development, and in fact up to 1903, glowers commonly had quite a rise in voltage during life. This amounted to from 3 to 4 volts per 100 hours on constant current. When such a glower is run in the lamp, during the first 100 hours it does increase in voltage by 3 volts, but afterward, because of running at a higher current, caused by a rise in glower voltage, the rate of rise in voltage of the glower is very small, because the rise in voltage of the glower is a direct factor of the specific consumption at which the glower is operated.

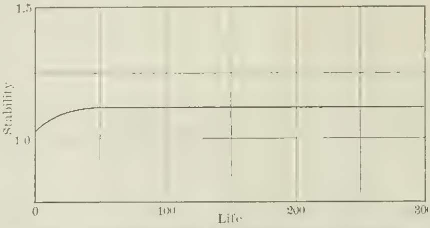


FIG. 3.—CURVE SHOWING STABILITY OF GLOWERS.

In order to partially overcome this feature, glowers after being sorted had a certain glower correction applied to them. This amounted usually to 4 or 5 volts and was supposed to correspond to the rise in voltage of the glower during the first 300 hours, i. e., a 195-volt glower would be rated as a 200 and at the end of 300 hours the voltage of the glower would really be 200 volts, which would put the lamp on its normal basis. It is seen by reference to the curve that this expedient threw the ballast into the position of an over-voltage and the over-voltage which the lamp could stand was decreased thereby. At the same time the glower ran at a larger current than normal and necessarily gave more light than it was intended to give and the efficiency was accordingly much higher than normal. Under such circumstances the decrease in candle-power of the lamp was very rapid. The custom of adding glower corrections was done away with in the early part of 1904, due to an arrangement being made to correct the glower mixture so as to get a material giving a very small rise in voltage with life.

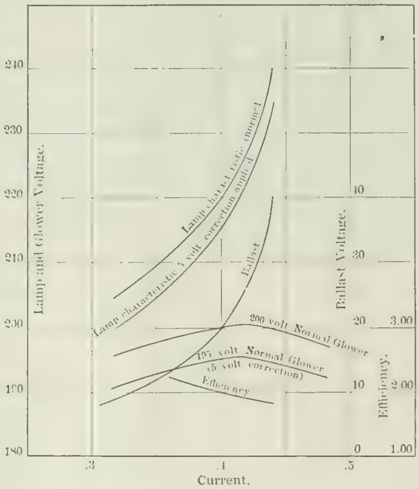


FIG. 4.—EFFECT OF GLOWER CORRECTION ON NORMAL GLOWER.

Fig. 5 shows a normal glower when combined with a ballast running high in current. By referring to the efficiency curve it can be easily seen how the glower must do over duty when running with a ballast which takes an excess current, while the glower in the lamp with a small current ballast does not operate at a specific power consumption sufficiently low for a satisfactory efficiency.

A very peculiar thing may happen in case of a circuit with bad regulation, and a concrete example occurs to me which explains what I mean. Some single-glower lamps were installed upon a circuit which had a very bad regulation, rising from 104 to 117 volts, and staying at the latter figure throughout the latter part of the night. In the morning when the light was really needed at its best the voltage was down to about 108. Now, ordinarily, had we installed 112-volt glowers, 108 volts would have given a fairly good light, but it must be remembered that these glowers had been operated during the night on an over-voltage, and after quite a deal of service upon over-voltage necessarily rose to meet the maximum demand; that is, the glower tried to approximate the necessary voltage to take 0.4 amp. on 117 volts. Now, when burned on 108 volts one can readily see how small the current taken will be. Such a case is not against the glower, but really shows how it accommodates itself, just as the human eye adjusts itself for the maximum light within vision.

The effect of missing the die is shown in Fig. 6. One glower has a specific consumption of 2.15 at 0.4 amp., while the other has a consumption of 1.85 at 0.4 amp. When compounded with a normal ballast the glower which resulted from the large die does not get its full amount of current necessary to bring it to 2 watts per candle power, as can be seen from its efficiency curve, while the glower with the small die gets more current than it should and runs at an over-consumption and strains the ballast. In Fig. 7 the worst conditions possible have been shown. Here ballast curves have been plotted where the current is too high and too low. Glower curves have been plotted where the consumption of the glower is too high and too low. By combining the ballast which runs low with the glower which runs at an under-consumption the worst conditions are obtained for light emission. This may be seen by reference to curve No. 1. Lamp curve No. 2, which is made from the ballast curve with high amperage and the glower curve with too high consumption, is seen to be more unstable. This is because the glower runs at such a consumption as to bring it over the bend of the curve. Such a lamp will give a great deal of light, but will strain the glower. In the previous example the glower will receive no injury, but the ballast will be strained.

For easy reference there is compiled a table of strains. A strain is always referred to the normal lamp, which consists of a normal glower in series with a normal ballast. When either the glower or the ballast in a lamp is abnormal it is presumed that the parts suffer as the standard product would under conditions which produce a similar strain. For instance, if a ballast which runs 0.39 amp. at 20 volts is put into a lamp and the lamp current is found to be 0.395, the ballast is in a condition of strain, because its normal is 0.39 amp. instead of 0.4 amp., as in the case of the regular product.

The check of any strain when referred to a similar strain upon the normal lamp is that the condition of the glower or ballast considered shall be physically the same; thus glowers are compared on the basis of equal efficiency (specific consumption) and ballasts on the basis of temperature of the iron resistance wire.

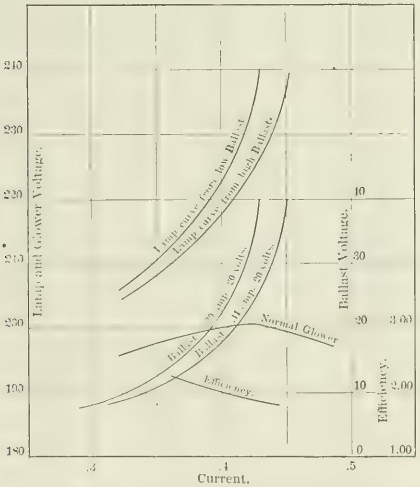


FIG. 5.—EFFECT OF HIGH AND LOW CORRECTING BALLAST.

Numerical examples will illustrate the methods described. Take the case of the lower consumption glower and low ballast shown in Fig. 7. A lamp composed of these parts would take 0.397 amp. at 220 volts. The normal for the glower is 0.43 amp; that is, at this amperage the glower runs at 2 watts per candle power. Hence the glower is running at a current 0.033 amp. less than its normal. When compared to the normal lamp we find that a current of 0.368 of an ampere is required to produce similar conditions, so far as the glower is concerned, when

$$\frac{.397}{.43} = \frac{x}{.400}, \text{ or } x = .368 \text{ amp.}$$

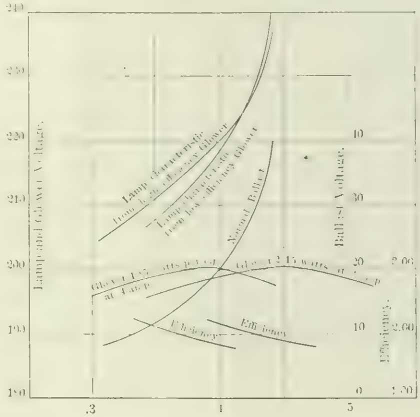


FIG. 6.—EFFECT OF COMBINING WITH A NORMAL BALLAST A GLOWER WHICH HAS MISSED THE DIE.

Referring this amperage (0.368) to the standard curve of Fig. 4, it is found that 212.8 volts is the lamp voltage which will produce 0.368 amp. in a normal 220-volt lamp.

For the ballast we have the current as above at 220 volts upon the abnormal lamp, equal to 0.397 amp. Now, the ballast normal is 0.39 amp., and equating as above:

$$\frac{.397}{.39} = \frac{x}{.4}, \text{ or } x = .407 \text{ amp.}$$

In other words, a current of 0.407 amp. flowing through a normal ballast produces a strain upon it which is equivalent to the strain produced upon a 0.39-amp. ballast when 0.397 amp. flows through it. Comparing this value with those found from the curves of Fig. 4, it is seen that 221.9 volts upon a normal lamp will produce 0.407 amp.

The table of strains shows several things that could not be well obtained by a glance at the curves. Above all, it shows the great care that must be exercised in the manufacture of the glower and ballast, that they will not vary in their relations to each other.

TABLE OF STRAINS.

	Equivalent circuit voltage on glower.	Equivalent circuit voltage on ballast
Five volts correction on normal glower	224.8	221.8
Low ballast with normal glower.	217.5	220.4
High ballast with normal glower.	222.5	219.6
Low consumption glower and normal ballast.	214.2	221.0
High consumption glower and normal ballast . .	232.0	219.0
Low consumption glower and low ballast	212.8	221.9
High consumption glower and high ballast. . .	240.0 plus probably 245.	220.0

The fact has been mentioned before that the glower characteristic can be materially changed by altering the proportions of chemicals used in manufacture. One certain mixture is adhered to because it is found that this mixture gives the best all round working results, but the standard mixture is not quite so stable as a glower mixture differing only by a small percentage in its components. The curve may also be slightly changed by altering the physical characteristics of the chemicals used, without varying the proportions. It is an important matter to get as steep a characteristic as possible and one which does not reach the knee of the curve between volts and current until a very good efficiency has been attained. However, it does not seem possible to do much better than is now being done.

When a glower is first run a great deal more light is emitted from its surface in proportion to the temperature at which it is operated than happens afterward in its life. This is explained by the fact that the glower surface initially has a selective radiation; that is, the radiation is concentrated in the visible spectrum. It is not certain that the glower has a selective radiation. The phenomenon is possibly caused by the fact that the glower has a certain porosity when new, but with age it attains a crystalline structure. The quality of the light does vary with the surface. When the glower is new the light is of a whiter hue. As the glower obeys the common law for black bodies heated to incandescence, although it is a white body, the hue of the light depends upon a function of the absolute temperature of the glower. The quality of the light may also be shifted toward the blue end of the spectrum by absorbing rays that fall within the red and orange part of the spectrum. The light falling upon a surface after being transmitted through a thin cobalt glass wall will appear very white, even though the glower may be operating at a specific power consumption as high as 2½ watts per candle power.

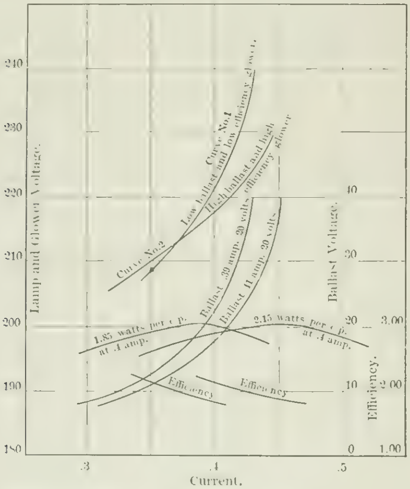


FIG. 7.—EFFECT OF OOMBINING A GLOWER WHICH HAS MISSED THE DIE, WITH HIGH AND LOW CORRECTING BALLASTS.

Because daylight differs so much owing to different amounts of diffusion which it has undergone, it would be difficult to give a table showing how near the Nernst glower approaches daylight for different efficiencies. If a glower is exposed to the sun on a bright day and it is attempted to make the light of the glower falling on a white screen equal in value to the light falling direct from the sun, it will be found that the glower must be operated at as low a consumption as 1.2 watts per candle power. Under such circumstances a glower will not live very long. On the other hand, if one wishes to duplicate diffused daylight in a hall it can be easily done with glowers running at 2 watts per candle power, but it must be remembered that if shades are put upon the glowers the tendency is to throw the spectrum down toward the red end. The diffused light in ordinary residences is duplicated almost exactly by the light received from Nernst lamps using opalescent balls absorbing about 16 per cent of the light passing through them. Heavier balls usually give a yellowish effect to the light. Sand-ballasted and etched balls do not play so much havoc with the color value of the light.

In what precedes is given a study of the ballast and the glower under circumstances where a sufficient time has elapsed after starting the lamp that the operation of the lamp will have attained its final value. Everything is much more complicated during the time the lamp is starting and up to thirty minutes after the switch is turned.

The Electrical Equipment of Manaos Harbor, Amazon River.

By Charles J. Seibert.

FOR some two years past the Manaos Harbor, Limited, has had in constant service, at the port of Manaos, on the Amazon River, 1,000 miles above Para, a system for handling cargo, which has proved to be very successful, and therefore a short description of the same may be of interest.

The contract between the Federal Government of Brazil and the company known as the "Manaos Harbor, Limited," calls for the latter party to execute the following works: "To grade the bank of the river from the extreme points of the city, construct warehouses, inclines, permanent works and floats for steamers of all sizes to go alongside at all times of the year; also the discharging and loading of all merchandise and warehousing of same from both large and small steamers."

In order to carry out the terms of this contract it was found necessary to provide floating landing stages at some distance from the shore line, as the annual rise and fall of the Amazon River is in the neighborhood of 40 ft., with a very flat grade to the shore. In order to establish a means of transferring cargo between these floating stages and the warehouses a specially constructed sectional steel pontoon was designed, shipped in small parts from England and the parts assembled in Manaos. This steel pontoon measures approximately 300 ft. by 60 ft. and carries the "head" towers of three two-ton Lidgerwood cableways, the "tail" or shore towers being erected in bays between the warehouses on the river bank. Each of these cableways is capable of transferring 70 tons of cargo one way between floating stages and warehouse, and this rate is easily maintained with native operators.

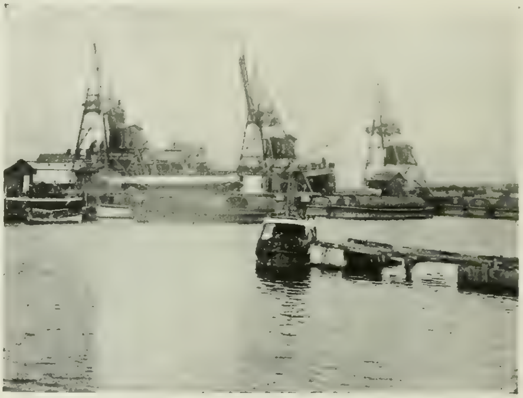


FIG. 1.—HEAD TOWERS OF CABLEWAYS.

These cableways are of the double-track cable type and have a span of 550 ft.; the shore end of the track cables are not made fast, but, passing over sheave wheels at the apex of the towers, are fastened to vertical counter weights of 10 tons sliding in guides on the far side of the tower. Thus the strain on the track cables can never be greater than the initial strain due to the counter weights. Both the endless and hoisting lines operating the to and fro motion of the carriage and the hoisting fall, are operated by means of a special double-drum winch direct geared to a 75-hp, 250-volt, series-wound, direct-current motor, located in the base of the "head" tower on the float. The controller for the motor and levers for operating friction clutches and brakes for endless and fall line drums are placed in an elevated shelter on the tower in such a manner that the operator may have an unobstructed view.

As regards the practical operation of this system, it may be of interest to state that these cableways were put in operation in June, 1903, and have been in continual daily operation since without a single accident, and this it should be noted with ordinary labor such as may be secured among the native longshoremen or steamboat sailors. It may also be noted that a large amount of work is done at night, in many cases a single operator working eighteen hours per day. Besides an operator for each cableway (who receives 9 milreis or about $2.70 for ten hours' work and double pay for overtime), an attendant is employed to oil the winches, cable sheaves, etc., and exercise a general supervision over the machinery while it is in operation. (This attendant receives ten milreis per day.)

It has also been brought to light during the two years' operation of this system that parts of the system need to be replaced as follows: Endless and hoisting ropes and button lines have had a life of about nine months, as have also the wheels of the overhead carriage. The removable rims of the endless drums are subject to wear and have a life of twelve to fifteen months, and controller contacts require renewal about once in the same time. This constitutes the sum total of the repairs so far found necessary.

In addition to the above apparatus there are installed on the platform or wharf in front of the warehouses, three two-ton steel stiffleg derricks. These derricks are each operated by a three-drum Lidgerwood hoist driven by a 25-hp, 250-volt, direct-current, series-wound motor. These derricks are operated by the same class of labor as the cableways and are in constant service during the period of high water, when river steamers and lighters may reach the platform close to the warehouses. They have been in operation the same length of time as the cableways, and except for the renewal of hoisting ropes, have required absolutely no repairs.

The company up to the time of the present writing has constructed eight warehouses, all of which are supplied with double rows of incandescent lights. All exterior lighting is performed by 220-volt enclosed arcs, and about 40 of these are operated nightly. An adequate water supply is furnished from a steel tank holding 180 tons of water and supported at an elevation of 50 ft. above the ground by a steel tower. Water is supplied to this tank by means of two triplex double-acting Deane pumps driven by electric motors, one pump having a capacity of 90 gallons per minute and the other 320 gallons per minute. Both of these pumps are suspended on elevator cars, the cars running in hoist ways built up from the bed of the river. This is necessary on account of the rise and fall of the river. A single pipe system is used, the pump being connected in a by-pass to the main pipe; valves are placed in the main pipe at fixed heights and tees are provided above and below these valves for making connections to the suction and discharge of the pump.

The power house of the company consists of a steel and brick building 60 ft. square with a brick partition dividing the interior into two equal rooms. One room contains at present the boiler equipment, which consists of two boilers of the locomotive type, each boiler having 1,000 sq. ft. of heating surface and 25 sq. ft. of grate surface. The boilers are 21 ft. long with shells 63 in. in diameter. They are constructed throughout of $\frac{3}{8}$-in. steel of 60,000 pounds tensile strength, and the longitudinal steams are butt joints, double-strapped and riveted. Each boiler has a separate iron stack 30 in. in diameter by 60 ft. high. There is a separate injector for each boiler and a Worthington duplex feed pump is installed.

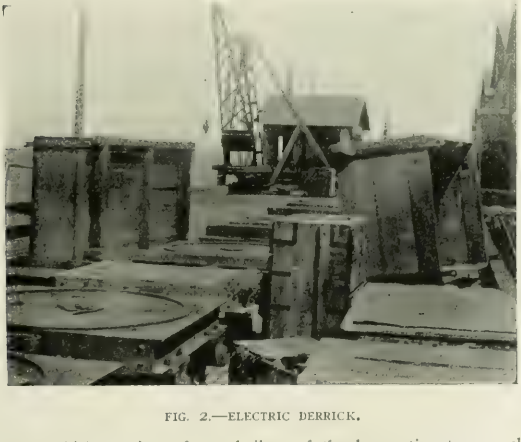


FIG. 2.—ELECTRIC DERRICK.

The engine room contains two 18 by 36 Allis-Chalmers 1890 model Corliss engines, one right-hand and the other left-hand. These engines operate non-condensing at a pressure of 90 pounds and run at 92 r.p.m. They have cast-iron fly-wheels 17 ft. in diameter and 26 in. face made in two pieces. These engines each drive by means of a belt a 150-kw, 250-volt Westinghouse direct current generator. In addition to these two units there is also installed a 12 by 10 Harrisburg standard engine direct-connected to a $37\frac{1}{2}$-kw, 250 volt, direct current Westinghouse engine-type generator. This set is primarily used for operating the lighting load, but is also operated during the day at times when the load is such that a Corliss engine is not required. The engine room also contains two Locke dumper regulators, one for each boiler and the switchboard, which consists of six panels, three generator panels and three feeder panels.

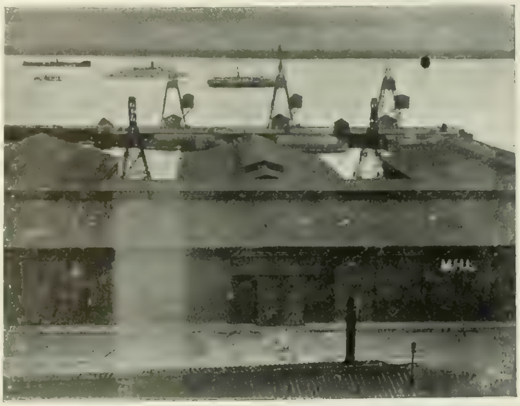


FIG. 3.—VIEW SHOWING THREE ELECTRIC CABLEWAYS.

A novel feature in line construction may be noted in the feeder that runs from the power house to the cableway float. There are only two spans, one of 350 ft. and one of 550 ft. The feeder is of stranded aluminum, 650,000 c.m. in section, with triple-braid insulation. A half-inch steel cable is securely anchored to the foundation of the power house, passes over a heavy wooden A-frame and then to No. 1 shore tower of the cableways; from there it passes out over the river to the "head" tower of No. 2 cableway and is there securely anchored. This steel cable forms a support for the aluminum feeders, the positive and negative lines of which are suspended therefrom, one under the other, by means of iron links and moulded mica bell insulators. In addition to the above equipment the company has in operation a number of steam locomotive cranes and several steam-operated inclined planes, but the fact has been demonstrated clearly that the electrically-driven machines far surpass the steam ones at every point, and the writer understands that when the entire works are completed the steam machinery will be entirely displaced.

Aluminothermic Process.

According to A. Colani, in the *Comptes Rendus*, binary compounds of aluminum may be obtained by igniting a mixture of aluminum powder and a metalloid such as sulphur or phosphorus. He has carried this process further and has obtained binary compounds of other metals by reducing a metallic oxide with aluminum in the presence of a metalloid. In a magnesia-lined crucible he places a well-stirred and thoroughly dried mixture of the oxide and the aluminum powder in theoretical proportions, with the metalloid in excess if it is volatile. It is then ignited with a magnesium cartridge. The reaction is often violent. The metalloid may be replaced by its oxide, and reduced by the aluminum together with the metallic oxide. This is especially convenient in the case of arsenic or antimony, if the heat disengaged by the action of aluminum upon the metallic oxide is insufficient to melt the mass. In the case of silicon and boron, the preliminary preparation of these elements becomes unnecessary. Also, it is possible to add mixtures like $3CuO + 2Al$ or $3SnO_2 + 4Al$, and thus to attain temperatures which rival the electric furnace. The difficulty encountered is that of removing the metallic aluminum which remains uncombined. The author gives a number of examples, such as arsenides and phosphides of iron and uranium, and silicides and borides of copper and iron.

Regulation of Gas and Electric Rates in Massachusetts.—I.

By Alton D. Adams, LL.B.

MILLIONS of dollars have been taken from the earning capacity of gas and electric plants in Massachusetts by rates fixed in decisions of its Gas and Electric Light Commissioners during the past twenty years. This rate making has been done under a statute which provides that, upon complaint in writing of the mayor of a city or the selectmen of a town in which a gas or electric plant is located, or of twenty consumers supplied by such a plant, as to either the quality or price of the service, the Commissioners may order such reduction in price of gas or electricity, or improvement in the quality, as "they deem just and proper." Any court having jurisdiction in equity may, on application of the Commissioners, enforce their lawful orders. Under this delegation of authority by the Legislature, the only limit to the power of the Commissioners in fixing rates is the constitutional provision that property shall not be taken without due process of law. As to what rates are warranted by sound public policy, above those which courts will hold to be confiscatory, the Commissioners have a free hand.

In their decisions the Massachusetts Commissioners have enforced a law or policy as to rates that is quite distinct from what a court might make in deciding whether rates were confiscatory. New York has recently created a gas and electric commission with rate-making power, other states may be expected to follow this example at an early day, and the precedents set by the Massachusetts Commissioners tend to show what may be expected in other jurisdictions. The law or policy of the Massachusetts Commissioners is found in their decisions on gas and electric rates, in connection with the facts of each particular case. In the opinions announcing their decisions the Commissioners state only a few of the important facts bearing on each case, such as the ratio of net earnings to the capital employed, and the costs and prices of gas or electric service by the company concerned, or by others similarly situated. These facts are, however, before the Commissioners in the sworn annual reports of all the gas and electric companies of the state, and a knowledge of the facts is essential to an understanding of the principles involved in the decisions to which they relate.

The following collection of cases includes a few of the most important involving the question of gas rates, and all those on electric rates that have come before the Massachusetts Commissioners. Each case, as stated, is intended to contain the more important facts bearing on its determination, the decision of the Commissioners and the reasons given therefor, and any expressions of general policy that the Commissioners may have made. Statements of the law or policy of the Commissioners are here cited frequently in their own wards. Annual reports of gas and electric companies are made, in Massachusetts, for years ending June 30, and the financial data stated in each case are usually taken from the latest reports before the Commissioners at the time they made their decision. For the purpose of comparing costs and prices, companies under similar circumstances as to output and other factors have been selected, as far as possible. In each case the aim has been to select, for comparison with the company directly concerned, those whose costs or prices of output were as low as any that could be found, under approximately similar circumstances, as this is one of the ways in which the policy of the Commissioners is to be brought out. The rule followed in the statement of the cases has been to avoid all expressions of opinion save those of the Commissioners, and to add nothing in the way of discussion. Each case stands, therefore, on its groundwork of facts just as the Commissioners left it.

The earlier cases before the Commissioners related mostly to the price of gas, but in later years an increasing number of decisions have involved rates for electric service. A study of the opinions of the Commissioners, and of the facts to which they relate, shows that they have followed the same policy in fixing both gas and electric rates

The total cost of gas, or of electric service to any company, as named in the cases, includes every expense incurred in the conduct of its business except depreciation, and thus covers such items as management, legal fees, insurance and taxes Neither interest nor dividend charges are covered by the sums given for cost or expense. Depreciation is not included in the costs named, except in so far as the charges made by the companies for repairs and renewals may offset shrinkage in plant, because no regular amounts or percentages are allowed for it in the reports, and the irregular charges that do appear under this head are inconclusive. Cases are arranged according to the years of decision.

1. Rate regulation by the commission began with a petition from Worcester, early in 1887. This petition was signed by 105 consumers and asked for lower gas rates and better service. At that time the Worcester Gas Light Company had a capital stock of $500,000, and no bonds or notes outstanding. Since its organization, in 1851, it had paid a 10 per cent. dividend in nearly every year, and for the year ending June 30, 1887, the dividend rate of the company was 9.5 per cent., amounting to $47,500. During that year the company sold 80,453,700 cu. ft. of mixed coal and water gas at the gross rate of 2.25, the net rate of 1.80, and the actual average rate of $1.82 per 1,000 cu. ft. The $47,500 paid in dividends for the year amounted to 59.04 cents per 1,000 ft. of gas sold, or to 32.4 per cent of the average price received for gas. Per 1,000 ft. of gas sold during the year ending June 30, 1887, the capital of the Worcester company was $6.21, and the sales of gas per capita amounted to 950 cu. ft., on the basis of the population of that city, in 1890, which was 84,655. In the same census year the Massachusetts cities nearest to Worcester in population were Lowell with 77,696, and Fall River with 74,398. Using these figures, the sales of gas at Lowell were 2,201 ft., and at Fall River 700 ft. per inhabitant, during the fiscal year ending at the middle of 1887. In the same year the stock and bonds of the Lowell company amounted to $2.92 and of the two companies in Fall River to $4.27 and $7.13, respectively, per 1,000 cu. ft. of gas sold. Though Worcester was the second city of the state in population, it was fourth in the volume of gas sold, and there were eight cities, in 1887, that had lower rates These cities and the net rate per 1,000 ft. of gas in each to ordinary consumer's were, Boston $1.40, Cambridge $1.75, Charlestown $1.75, Fall River $1.75, Lawrence $1.60, Lowell $1.20, New Bedford $1.50 and Taunton $1.65. Gas at Worcester average 17.93 cp., according to the official tests, but consumers claimed that there were great variations in candle power from day to day For all the coal and water gas plants of the state the average was 17.74 cp.

With these facts before them in the books and reports of the gas companies, if not in the evidence at the hearings, the commission reduced the net price of gas in Worcester to $1.50 per 1,000 cu. ft. In the course of its opinion on the case the commission said, in part:

"A reduction in price should be made, because the capital of the company is excessive for the output of gas and the value of its plant. It should be stated, however, that every dollar of stock has been paid in cash. The company has not improved its field for business to the extent that it might have done. . . . Worcester ought to consume two or three times the amount of gas that is now sold, and under a different policy would undoubtedly do so, and this increase in consumption would easily insure lower prices The company has a valuable franchise and is under obligations to make every reasonable effort to supply the citizens with all the gas required, and at a price consistent with a fair interest on the investment."

The net rate of $1.50 per 1,000 was put into effect by the company July 1, 1887, as directed by the commission. If this rate had been applied to the sales of gas during the twelve months ending on June 30, it would have reduced the amount applicable to dividends by 30 cents per 1,000 cu. ft. of gas, or by 50.8 per cent. of the sum paid as dividends in that year. This would have reduced the sum paid as dividends to 4.826 per cent of the capital stock. No account is taken in these figures of the increase of sales that would have resulted from the lower rate. During the year ending June 30, 1888, the sales of gas by the Worcester company increased 14 per cent. over those of the previous year. The income from gas and residuals exceeded the operating expenses by $44,470.77, and $30,000 were paid in dividends, which were 6 per cent. of the stock, and 32.71 cents per 1,000 cu. ft. of gas sold.

2. The South Boston Gas Light Company was one of the group of four Boston companies against each of which the mayor of that city, and gas consumers, brought petitions for a reduction in rates, during the year ending June 30, 1893 In their decision the commissioners fixed the net rate for gas sold by the South Boston company, on and after July 1, 1893, at $1.30 per 1,000 ft. Gas sup-

ply was carried on in South Boston. On June 30, 1892, the capital stock of the company was $440,000, and there was outstanding against it $25,000 in notes. During this year the company had an income from sales of gas and residual products of $133,699.69, its entire expense of operation was $82,079.34, and the excess of earnings was thus $51,620.35. From this last sum, interest to the amount of $1,461.10 was paid during the year, and the remaining $50,159.25, which might have been applied to dividends, represented 11.4 per cent. of the capital stock. Only 4 per cent. on the capital was actually paid in dividends, however, and this amounted to 23.61 cents per 1,000 ft. of gas sold. The gas sales had a volume of 74,531,793 cu. ft. during the year, and the capital and notes represented $6.24 per 1,000 cu. ft. of this volume. In price, South Boston gas was $1.70 gross, $1.50 net, and $1.52 average, per 1,000 cu. ft. during the year. After the sum received for residual products was deducted from the operating expenses, the total net cost of gas to the company was 82.8 cents per 1,000 cu. ft. sold in the year under consideration. This total was made up of a net cost of 53.61 cents in the holder, and 29.19 cents for distribution per 1,000 cu. ft. sold. If the rate of $1.30 per 1,000 had been in force on the sales of the year ending June 30, 1892, the net income of the South Boston company would have been reduced by about $14,906, or to $35,253, which represents 8 per cent. on the capital stock. The South Boston company in this year sold 2.4 million cu. ft. of gas per mile of main, and the average candle power of its gas tested at 17.8. During the same time the company in Haverhill sold a total of 52.8 million cu. ft., which amounted to 2.2 million cu. ft. per mile of main, and the average candle-power of this gas was 20.79. At Haverhill, the net price of gas was $1.40 per 1,000 cu. ft in this year. The Bay State Gas Company, which was controlled in common with the South Boston and other Boston gas companies by a foreign corporation, sold 883.2 million cu. ft. of gas during the year under consideration, and this gas cost the company 33.77 cents net in the holder. If the Bay State company had sold gas to the South Boston company at 43.77 cents per 1,000 cu. ft., the latter company could have sold at less than $1.30 per 1,000, and paid a 10 per cent. dividend.

In explanation of their decisions in the kindred Boston, South Boston, Roxbury, and Dorchester cases, the commissioners wrote only one opinion, in which it was pointed out that the companies were distinct persons in law, and must be so treated. The existing plants at Dorchester and Roxbury were not large enough to meet the demands in those territories, and could not supply the quality of gas that was being distributed. The prices fixed for the Roxbury, Dorchester and South Boston companies were said to be based on the assumption that these companies would continue to buy a part or all of their gas from the Bay State Company. Prices charged by the Bay State Company to the other gas companies were said to have been in excess of what was essential to a fair profit, and to have imposed an unjustifiable burden upon consumers. In the rates fixed for the companies that distributed gas, it was the intention to allow the Bay State Company to earn only a fair return on the actual investment in its business. It was stated that a fair and uniform price for gas throughout the city of Boston could only be had when it should be supplied by a single corporation in law and fact. The large profits of the Bay State Company had been derived mainly from the old central part of Boston, where nearly five times as much gas was distributed per mile of main as in the suburbs, and there the greatest reduction in price must be made. Even if the Roxburg, Dorchester and South Boston companies bought their gas at a fair price, they could not sell it at as low a rate as the Boston company.

As to the obligations of public service companies the commissioners said: "The Board has always taken the position that companies which have received from the public as a free gift extensive and valuable privileges by the exercise of which alone their profits became possible, are bound to return to the public the most efficient service at the lowest prices consistent with a fair profit, and for this purpose to avail themselves of all reasonable facilities and expedients known to the business in which they are engaged. If by reason of superior skill in management, or by the existence of a common control in companies supplying contiguous territories, special economies become available, while the corporation which secures these results is entitled to a liberal reward, the public should also receive, as a matter of sound business policy, some share in the benefits thus made possible."

New Telephone Patents.

EXCHANGE SYSTEM.

The circuit of an exchange system is shown in Fig. 1, which is remarkable for the simplicity of its cord circuit. It will (from reference to Fig. 1) be seen that the signal apparatus of this has been reduced to a remarkable minimum. The practicability of this simple cord circuit depends solely upon the cut-off relay and its novel location in the circuit. It will be seen that not only does the cut-off relay clear the line of the line signal apparatus, but in addition it controls the shunt of the supervisory lamp through its auxiliary contact. At first sight it looks as though the line lamp would follow the hook switch, but it must be remembered that the cut-off relay only releases when the receiver at the station is on the hook, the condition for a non-actuated line relay. Mr. F. R. McBerty, of Chicago, is the inventor of this system.

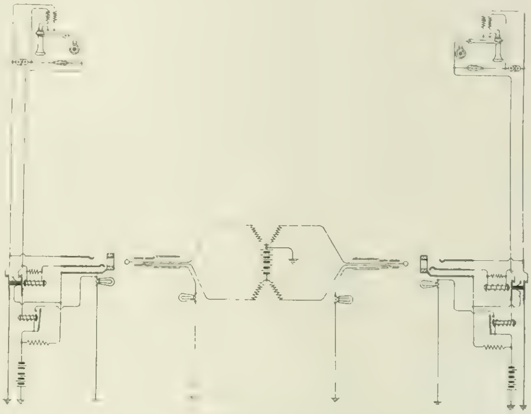


FIG. 1.—M'BERTY EXCHANGE SYSTEM.

SELECTIVE CALL SIGNAL.

With some systems of operating it becomes necessary for a receiving or distributing operator to forward a call to any one of a number of connecting operators, and it becomes a problem to efficiently notify the proper operator of the particular line upon which she is desired. Calling circuits and auxiliary trunks have heretofore been largely used. Mr. F. R. McBerty has obtained a patent for a selective lamp call by which the distributing operator may readily

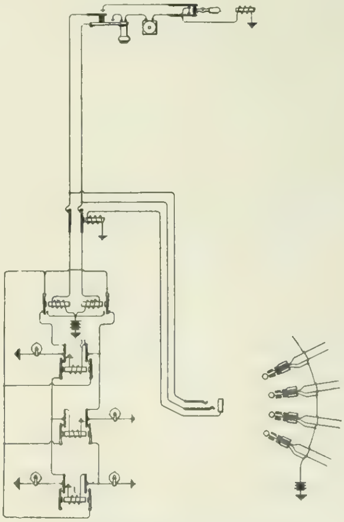


FIG. 2.—M'BERTY SELECTIVE CALL SIGNAL.

signal the desired operator, the signal being directly associated with the line demanding attention. Fig. 2 shows the circuit. If the distributing operator throws her key up once to the right she causes the lighting of the upper left-hand lamp of the calling group. A stroke up, followed quickly by one down, lights the upper right-hand lamp alone. Similarly a quick double stroke followed by an up-stroke lights the third lamp and, two doubles, the fourth lamp. The answering of any operator restores all relays 'to normal by cutting off the battery supply.

SERVICE METER.

Mr. C. E. Scribner has patented a so-called automatic service meter or call register. This is associated with the circuit of a subscriber's line so that the act of calling begins the count while the act of response by the operator completes it. It has been found that this general type, namely, the automatic, is not very practicable. This patent of Mr. Scribner, as well as the two preceding, have been assigned to the Western Electric Co.

TELEPHONE TELLTALE.

A rather novel use of the telephone is that of telltale for an annunciator system, described in a patent issued to S. B. Bankson, of San Francisco. The telephone is wired in the battery line and the vibrating of a distant bell is noted by the noise. The ringer knows the bell sounds by this means.

PHOTOPHONE.

Although the photophone was invented many years ago, it has never been brought to practical service. From time to time improvements have been made, but it has been possible to transmit speech over but a short distance, even with all known appliances used. Mr. B. Saenger, of Berlin, Germany, states that this is due to the fact that it has been impossible with the parabolic mirror used to sufficiently concentrate the beam of light, and he has patented a selenium cell photophone wherein, by means of lenses and a diaphragm, he concentrates his whole beam of light upon the receiving cell.

SWITCHBOARD CIRCUITS.

This week brings forth three patents for switchboard circuits. Mr. E. R. Corwin, of Chicago, the patentee of one of these, has gone upon the principle that with the common-battery system, with lamp supervisories, it is unnecessary for the operator to listen in. He therefore arranges his cord circuit so that one or both of the supervisory relays must be de-energized for the operator to listen in. This condition arises only when one or both stations has the receiver hung up.

E. E. Reis, of New York City, the inventor of the second system, has developed his system with one supervisory lamp responsive to both hooks and he has combined this with an automatic switching device contained within the sub-station receiver. This is so designed that it is, so to speak, impossible to leave the receiver off the hook.

H. G. Webster's improvements relate to the two-wire common-battery system, and he has devised a large number of various alternative circuits, all accomplishing a surer operation of the signals than has existed in many systems. Fig. 3 shows two of his cord circuits and one line circuit. The feature of these circuits is the cut-off relay, which is so constructed that the energizing winding included in the line circuit before answer is cut out of circuit by the answering operator, a shunt-circuit being substituted. Mr. Webster has assigned his patent to M. G. Kellogg, of Chicago.

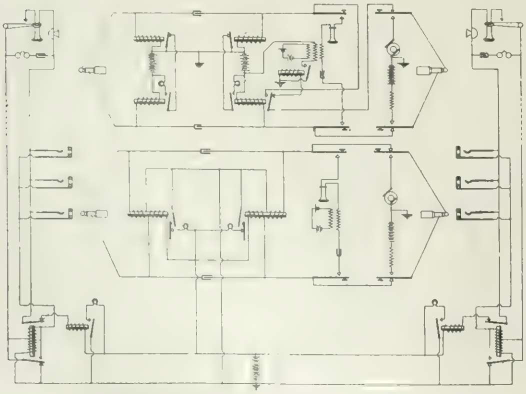


FIG. 3.—WEBSTER SWITCHBOARD CIRCUITS.

CUT-OUT.

A porcelain base cut-out for telephones, the invention of J. A. Tornquist, of Clinton, Iowa, is shown in Fig. 4. The apparatus comprises mica-mounted fuses, a knife switch, a plug switch, a saw-tooth protector and a carbon plate protector. All are evident from the cut, but the last, the blocks of which are shown in plan at the right-hand end. One block rests under each of the two outside clamping plates and the third, the ground block, with ends exposed to those of the line blocks just mentioned, is beneath the middle plate.

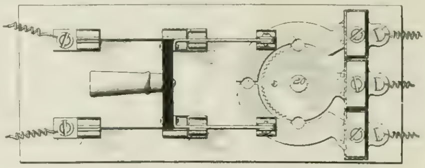


FIG. 4.—TORNQUIST CUT-OUT.

SELECTING SYSTEM.

A. D. Neal, of South Boston, Mass., has patented a system for selecting any one or more of a number of circuits branching from a main circuit at a distant point. Control is effected by a combination of polarized and non-polarized relays. With three main lines three polarized relays, one associated with each, and three ordinary relays, one associated with each main, and using current reversals and currents of two strengths, sixty-four branch circuits may be brought under control.

LETTERS TO THE EDITORS.

Self-Excited Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to the paper presented by Mr. William Stanley at the Asheville meeting of the American Institute of Electrical Engineers, and of which you published an abstract in your issue of June 24, page 1183, I wish to observe that the author is perfectly correct in the statement that the armature reaction is nullified in non-synchronous alternators. But he does not state that this is true only in case a machine is operating at unity power factor. An article which clearly demonstrates this fact and which treats of the same method of auto-excitation of alternators was contributed by me in 1901 to the *Elektrotechnische Zeitschrift,* December 12, page 1022.

When the machine is under an inductive load a component of the armature reaction enters into play. A power factor slightly less than unity, such as is common in many lighting plants, produces a fall in e.m.f., and if the alternator is self-excited it drops the load.

Another disadvantage resides in the fact that non-synchronous alternators cost more than synchronous machines, since for equal losses the weight of field copper is four times greater in the former than in the latter. (See *Elektrotechnische Zeitschrift,* December 17, 1903, page 1037.) To neutralize the armature reaction, it is preferable to employ compound-wound alternators, and preferably compound, self-exciting, synchronous alternators, as is done in many European installations. These machines cost in some cases less than ordinary alternators excited by direct current.

Brussels, Belgium. A. Heyland.

Single-Phase vs. Polyphase Traction.

To the Editors of Electrical World and Engineer:

Sirs:—In an article in the *Electric Journal,* abstracted in your issue of July 8, Mr. C. F. Scott, after reviewing statements made by various engineers during the last few years, reaches the following conclusions:

1. That the use of single-phase, alternating current is essential for heavy and long-distance railway service.

2. That a single-phase motor and a single-phase system fulfilling the ideal requirements have been developed; and,

3. That engineers all over the world are substantially agreed that one form of motor, namely the series-compensated, single-phase motor, is the motor best adapted to meet the demands in heavy railway traction.

Mr. Scott does not put this forward as his own personal view in the matter, but rather as, what he calls "a legitimate conclusion from the statements" made by the engineers named. But, granted even that Mr. Scott is justified in drawing the above conclusions from the selected statements given in his article—which is not readily apparent—with what right can he claim that engineers all over the world are substantially agreed upon the points he makes?

I am voicing the opinion of a great many engineers, both here and in Europe, who hold that exactly the reverse is true, namely:

1. That single-phase alternating current is not at all essential for heavy and long-distance railway service.

2. That no single-phase motor and single-phase system has yet been developed which fulfills the ideal requirements; and,

3. That there are several forms of alternating-current motor better adapted to meet the demands of heavy traction than the series-compensated, single-phase motor.

It is only necessary to look at actual facts to see that our view has at least the same chance of being correct, as has that of Mr. Scott. Let us consider Mr. Scott's conclusions in their order:

1. The principal desideratum in heavy and long-distance railway work is a comparatively high pressure in the contact line. But this can be obtained in various ways other than by the use of single-phase alternating current. Perhaps in eliminating the three-phase system entirely, Mr. Scott laid great stress on the difficulties connected with the second overhead conductor of that system. If he does he certainly overestimates those difficulties. At all events, the only heavy and long-distance railroads thus far electrified are being successfully operated by the use of three-phase alternating currents, and not a single road deserving the adjective "heavy" is using single-phase currents. The latter are, therefore, certainly not essential for this purpose.

2. It would, of course, be necessary to know exactly what Mr. Scott means by ideal requirements, in order to answer him accurately. But the fact remains that the very best single-phase motor yet produced has a considerably lower efficiency than any other type of railway motor; its starting torque is poorer, its weight much greater for the same output, and it is restricted to a very low pressure at the terminals—certainly none of these points speaks in its favor. Add to this the fact that it has not yet been produced in large sizes, so that a number of motors distributed in two or more locomotives are necessary to get any really important output, it seems obvious that the ideal has not yet been reached.

3. Had Mr. Scott restricted himself to claiming superiority for "long-distance" service and interpreted this as meaning long interurban lines operating single cars over both city streets and the open country, his case would have been a little stronger. But he distinctly says "heavy and long-distance" service and repeats the "heavy," so that he certainly must have in view steam railroad conditions. And for these there is at least one motor better suited than the single-phase compensated series motor. Those who have followed the discussions of this subject at the general meeting of the American Institute of Electrical Engineers in 1902 and at the recent Asheville meeting of the same body, will understand why I believe the three-phase motor to be distinctly superior for this class of service, nor am I the only one who is of this opinion. The reasons for our belief were there stated in detail, the principal factors being greater efficiency and lower cost, combined with certain technical features which will often be of very decided advantage.

Now, to put the matter in contention on a basis promising some definite result, allow me to make the following suggestion:

If Mr. Scott will make his own choice among the railroads fairly representative of the average American line with really heavy traffic, and if he will work out a project for this road based on the use of single-phase alternating currents and submit the results in an article in the Electrical World and Engineer or in a paper before the American Institute of Electrical Engineers in sufficient detail to show exactly what he is offering, I will then work out a project for the same road based on the use of three-phase alternating currents and submit my data in the same way, leaving it to the technical world in general to draw its own conclusions on this subject.

New York City. C. L. de Muralt.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Single-Phase Motor.—A description of a new motor of Lundell from an English patent specification. It combines "the principles which govern the operation of a series-wound motor and those which govern the rotation of a partly short-circuited armature which is caused to rotate by the secondary or the induced currents in the short-circuited coils." In Fig. 1 *L L′* is a single-phase supply. *M* is the laminated field magnet with the two poles, *P P′*, and field windings, *F F′*. *A* is a Gramme armature and *C* the commutator. *B B′* are brushes insulated from each other and wide enough to connect a number of commutator bars and coils. The position of these brushes is regulated by the rocker arm, *D*, which is connected by the rod *E* to the plunger, P^3, in the solenoid coils, C^1C^2. The switch, *O*, short-circuits one or the other of these coils and when opened puts both coils in circuit. (The coils C^1C^2 are preferably operated not from $L L^1$, but from a direct-current supply.) By means of the switch, *O*, the motor may be quickly reversed from a distance. *R* is a starting rheostat. The direction of the current is indicated by arrows which are shown in full if they pertain to the primary circuit and dotted if they pertain to the induced currents; the polarities, *S N*, are likewise indicated. The combined polarities of the primary and secondary currents will be located on the line *Y Y′*, and indicated by the letters *S* and *N* within small circles. "This is exactly where the polarities should be located in order to produce the best torque effects and the best efficiency. . . . By this invention it is proposed to reduce the secondary or the induced current in any one coil to a normal amount by short-circuiting such a number of coils that the combined ampere-turns from the short-circuited portions of the armature will nearly equal the ampere-turns on the other portions of the armature which are due to the primary currents. It will be seen that the induced and the primary currents in the armature winding are in the same direction at the leaving edges of the contact blocks, *B* and *B′* (at line *X X* in Fig. 1). If these currents are nearly equal it follows that there will be no sparking as the commutator segments leave the brushes because of the fact that there will be no reversal or change in the current in the armature windings at these particular points.—Lond. *Elec.*, July 14.

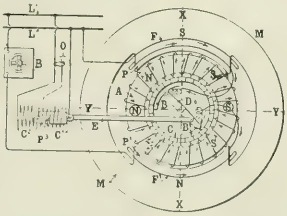


FIG. 1.—SINGLE-PHASE MOTOR.

Direct-Current Motors.—Dubois.—The first part of an article on various applications of direct-current motors, with special reference to starting and braking. The author first discusses the starting of a direct-current motor under load and shows how to calculate the different steps of the starting rheostat, a numerical example being given. The author then deals with the starting of centrifugal pumps and ventilators, in which at the start the energy is consumed to supply the losses due to friction and agitation of the liquid only; later on the energy consumption increases as the third power of the speed. Calculations are given for a shunt motor.—*L'Industrie Elec.*, July 25.

Lights and Lighting.

Electric Arc.—Dyke.—An account of experiments on the flux of light from the electric arc with varying power supply. The author determined a series of curves for both continuous and alternating-current arcs, showing the relation between the mean spherical candle-power and the watts taken up in the arc. This relation follows a straight-line law. This straight line, however, does not pass through the origin, but for zero candle-power there is still an outstanding amount of power amounting to some 200 to 400 watts. The amount of this power increases in general with the arc length, and is probably due to the energy dissipated as heat by radiation, and as chemical energy in evaporation of the carbon at the crater. For lengths of arc greater than ⅛ in., the ratio of the efficiencies of the continuous and alternating arcs is about 3 to 2. If the arc be made shorter than ⅛ in. the consumption line for the alternating-current arc gradually approaches the line for the continuous-current arc until for an arc length of 3/32 in. they are practically coincident. The arc is quite stable at this point, and even in the alternating-current case may be supplied at more than 600 watts without causing hissing. Any further decrease in the arc length will result in the alternating-current consumption line rising above the continuous-current line, although the alternating-current arc now begins to hiss badly. —*Phil. Mag.*, August.

Mercury Vapor Lamp.—Mareschal.—A description of the Heraeus mercury-vapor lamp, made from fused quartz for photographic purposes. The quartz permits the passage of the ultra-violet rays, which are extremely active for photographic work. The lamp is shown in Fig. 2, *V* being the tube of fused quartz, connected at both ends to reservoirs *A* and *R*, filled with mercury. *A* is provided with a cooling device, while *R* is surrounded by a heating platinum wire. When the circuit is closed by means of the button, *B*, the platinum wire is connected to the circuit and gets heated. This has the effect that the mercury in *R* expands and gradually fills the quartz tube, *V*, until it reaches the mercury in *A*. Now the automatic commutator, *C*, disconnects the heating wire around *R* from the circuit, the mercury contracts again and the arc is started.—*La Nature*, July 15.

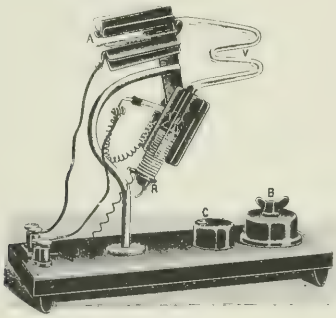


FIG. 2.—MERCURY VAPOR LAMP.

Singing Arc.—Blondel.—A full discussion of the properties of the singing arc with reproduction of very different wave forms obtained with different dimensions of the arc.—*L'Eclairage Elec.*, July 15 and 22.

Power.

Power Plant Design.—Koester.—The first part of a serial on modern power plant design and economics, with special reference to the differences in American and European practice. In the present installment the author discusses the general features of the design of large power plants. In continental Europe power plant designing is a vocation of itself, while this is not the case in this country. He thinks that this has to do with the fact that in a modern plant in continental Europe a steam consumption of only 9 to 10 pounds per indicated horse-power is obtained, while in England and America a consumption of 13 to 15 pounds is considered good practice. The modern tendency is now toward very large single stations, and also toward very large generating sets. The most favorable arrangement of the location of the engine room and boiler room has been found to be side by side, thus allowing in most cases the shortest steam pipe runs. With the adoption of the steam turbine as the prime-mover making a compact layout, the turbine room is much smaller than the boiler room, provided the much-used horizontal water-tube boilers are installed. It is probable that the compactness of the turbine will create a revolution in the design of the boiler house, introducing into more general use the vertical type of boiler. Some notes are given on steel construction of power plants. The article is profusely illustrated.—*Eng. Mag.*, August.

Electric Power for Canals.—Kronstein.—The Austrian Department of Commerce arranged last year an international competition for equipping a hoisting plant in connection with the Danube-Oder Canal, the difference of level being 36 meters. The electric equipment is one of the projects which received the prize. It is described and illustrated in detail.—*Zeit. f. Elek.* (Vienna), July 30.

Hydro-Electric Power Station.—Galloway.—A profusely-illustrated description of the hydro-electric power station of the California Gas & Electric Corporation, at De Sabla, Cal. The station contained formerly two 2,000-kw generators, while recently a third generator of 5,000 kw capacity has been installed which is run by a single water wheel operating under a static head of water of 1,528 ft. All are 60-cycle, three-phase, 2,300-volt machines. The transmission line is of aluminum.—*Eng. News*, August 10.

Furnace Charging.—An illustrated description of electrically-operated machines for charging open-hearth furnaces.—Lond. *Elec.*, July 14.

Steam Turbines versus Steam Engines.—Two articles discussing their relative advantages. The first article is in favor of the steam engine, the second in favor of the steam turbine.—*L'Industrie Elec.*, June 10, July 25.

Traction.

Street and Elevated Railway Statistics in the United States.—The annual statistical table on street and elevated railway mileage, cars and capitalization in the United States and Canada. Figures are also given for our insular possessions and Cuba. For the United States alone the total number of roads was 993. The electric railways had a track mileage of 29,548, the cable, steam and horse railways one of 639; total, 30,187 miles. The capital stock in 1904 was $1,761,571,812 (an increase of $68,181,514 against 1903); the funded debt, $1,455,520,159 (increase $66,055,810); the capital liabilities, $3,217,091,971 (increase $134,839,324, or 4.4 per cent.).—*St. R'y Jour.*, August 5.

Electrolysis Due to Tramway Return Currents.—An account of experiments made in Germany, especially in Strassburg and Dresden. The work consisted mostly in potential measurements. No practical conclusions are drawn.—*Eng. Record*, August 5.

Freight Automobile.—A detailed illustrated description of the "couple gear electric truck."—*Iron Age*, August 10.

Wires, Wiring and Conduits.

Temporary Wiring.—An illustrated description of a method of temporary wiring, especially designed to avoid fire risk and the liability of electric shock. Special tinned copper wire with rubber insulation is enclosed in a flexible steel tube, which is fire-proof and water-proof. Suitable lengths are made up, and a mechanical coupling is fixed on each end so that any desired length of run can be effected, and fittings connected wherever necessary. One advantage is that the tubing forms a continuously-connected metallic conductor, so that accidental shock is impossible. The coupling is shown in Fig. 3. The case is of brass, turned out of the solid rod and divided into two parts connected by a screwed and milled ring. The insulating material is ebonite and the plugs are of brass. "Each female plug is provided with a small tapered pin which enters a split hole in the male plug, thus spreading out the latter when it is home, and pressing it against the sides of the interior of the female plug. This insures an increased area of contact and conse-

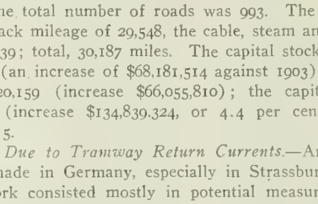


FIG. 3.—TEMPORARY WIRING.

quently an enhanced carrying capacity. One-half of the coupling is provided with a sleeve, held in position by the projecting head of a spring pin, and this sleeve serves to cover an additional pair of plug holes in the brass case. When the sleeve is raised a plug can be inserted and a connection taken off at right angles.—Lond. *Elec.*, July 14.

ELECTROPHYSICS AND MAGNETISM.

Radium.—Rutherford.—An account of an experimental investigation on the charge carried by the alpha and beta rays of radium. The total number of alpha particles expelled per second from one gram of radium at its minimum activity is 6.2×10^{10}. The total number of alpha particles expelled from radium in radioactive equilibrium is four times this figure and equals 2.5×10^{11}. The alpha particles are positively charged at the moment of their expulsion. The total number of beta particles expelled from one gram of radium per second is 7.3×10^{10}. From these figures the author calculates some physical constants of importance in radioactivity. The average life of radium is 1,850 years. The heating effect of radium and of its various products is due to the bombardment of the alpha particles expelled from them. The emission of energy in the form of kinetic energy of the alpha particles is 126 gram-calories per gram per hour. With respect to the number of ions produced, the alpha particle has a somewhat larger sphere of action than the electron, and is able to ionize about two molecules for the electron's one.—*Phil. Mag.*, August.

Recombination of Ions in Gases.—Richardson.—A paper in which the author attempts to explain the variation of the rate of recombination of ions formed in gases with the pressure of the gas. The hypothesis that recombination takes place only after the kinetic energy of the ions has been reduced by collision with neutral molecules, when the ions are very near each other, affords a satisfactory explanation of the variation of the rate of recombination with the gas pressure. The results indicate that practically every ion which makes a collision with four molecules becomes fixed; that most of those which make only three, and about one-sixth of those which make only two, collisions, recombine. The terms with fewer collisions become more important at lower pressures. The quantity obtained by dividing the coefficient of recombination by the sum of the velocities of the two kinds of ions, when expressed as a function of the pressure, depends, in the cases of different gases, on a single parameter, which is the mean free path of an ion in the gas in question at some definite pressure. An ion in carbon dioxide at high pressures probably contains the same number of gas molecules as an ion in air.—*Phil. Mag.*, August.

Magnetic Effect of Electric Displacement.—Whitehead.—An account of an experiment which was devised to prove directly the magnetic effect of electric displacements, the arrangement being shown in Fig. 4. If a portion of dielectric be subjected to an alternating electric intensity, alternating displacement currents will be set up in the dielectric. If now the dielectric be properly surrounded by a magnetic circuit, alternating magnetic induction will be set up therein, and if this circuit be wound with a number of turns of wire, an alternating e.m.f. will be induced therein, and this e.m.f. may set up a current. The value of the current may be calculated and measured. As constructed the dielectric was a cylinder, *A*, of paraffin. The e.m.f. was applied to electrodes *B* consisting of circular brass plates on the end faces of the cylinder. Concentric with the cylinder and surrounding it was the laminated magnetic circuit, *C*, consisting of soft iron discs; the iron ring thus formed was wound with what may be called the secondary winding, in circuit with which the measuring instrument, *G*, was connected. The observed effect was of the same order of magnitude as that calculated. —*Phys. Rev.*, August.

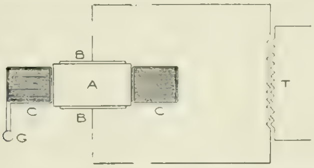


FIG. 4.—MAGNETIC EFFECT OF ELECTRIC DISPLACEMENT.

Magneto-Optics.—Wood.—An abstract of a British Physical Society paper, in which he discussed the magneto-optics of sodium vapor for light traveling along the lines of force.—Lond. *Elec.*, July 14.

Electrical Vibrations.—Nicholson.—A mathematical paper on electrical vibrations between confocal elliptic cylinders, with special reference to short waves.—*Phil. Mag.*, August.

ELECTROCHEMISTRY AND BATTERIES.

Industrial Resistance Furnaces.—FitzGerald.—An illustrated article discussing the furnaces of Gin, Colby & Kjellin. The author gives the calculation of the Gin furnace and describes some recent improvements in its design. In the same issue there is a very full account of a report by Engelhardt, who studied the Kjellin furnace in actual operation last year in Sweden. In his conclusions he states that in comparison with the crucible steel furnace, the Kjellin furnace produces a steel equal in quality to crucible steel, and is able to furnish it at a lower cost. He also thinks that the electric induction furnaces can compete successfully with the open hearth furnace for making structural steel as long as the kilowatt-hour does not cost more than 0.5 cent.—*Electrochem. and Met. Ind.*, August.

Raw Materials for Electrochemical Industries of Niagara.—Green.—An article giving the sources of supply of the chief materials used in the electrochemical industries of Niagara Falls. The most convenient sources and the cost of the following materials are discussed in detail: Salt for making caustic and chlorine in the Acker and Castner processes; coke, for the graphite, carborundum, siloxicon and carbide industries; pure glass sand, used for graphite, siloxicon and carbon; anthracite for making graphite; and lime for bleaching powder and calcium carbide.—*Electrochem. and Met. Ind.*, August.

Chemical and Electrical Energy.—Haber.—A paper discussing the development of the fundamental formulas of chemical and electrical energy. As the first stage of the development he considers the view according to which the electrical energy generated in a cell is exactly equal to the energy of reaction. This view leads to Thomson's rule, but was later modified by Helmholtz, who showed that at the right hand of Thomson's rule a second term must be added corresponding to the tendency of the cell to heat or cool during discharge. This second term is proportional to the temperature coefficient of the e.m.f. Van't Hoff has then given another formula for the e.m.f. as function of the temperature and of the concentrations of the ions formed and consumed respectively during the reaction. The numerous investigations which were undertaken to conform by experiments the formulas of Helmholtz and van't Hoff are considered the second stage in the development, while the third stage relates to some questions arising from a comparison of these two formulæ. The author shows that it is possible to calculate the equilibrium constant of the reaction from the reaction heat, the temperature and the difference of the specific heats of the substances formed and decomposed during the reaction. The paper is chiefly mathematical.—*Electrochem. and Met. Ind.*, August.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring of Low Resistances.—Wild.—A description of a method of comparing two low resistances, the arrangement of which is shown in Fig. 5, where *C* is a battery of two or three storage cells, *R* a resistance for regulating the current, *H* the higher and *L* the lower of the two low resistances to be compared, *B* a Wheatstone bridge, *S* a two-way, double-pole switch, and *G* a sensitive moving-coil galvanometer, with mirror and scale. The actual resistance of the galvanometer is first measured at the temperature at which it is to be used. *S* is then switched over to the right and *R* regulated so that a convenient deflection may be obtained on the galvanometer scale. *S* is then switched over to the left, and then *B* is regulated till the same deflection is obtained as at first. If an accuracy of 1 in 500 is sufficient the test is finished. For greater accuracies, the procedure is as follows: The torsion head the galvanometer is turned

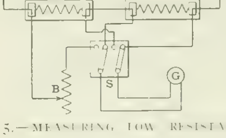
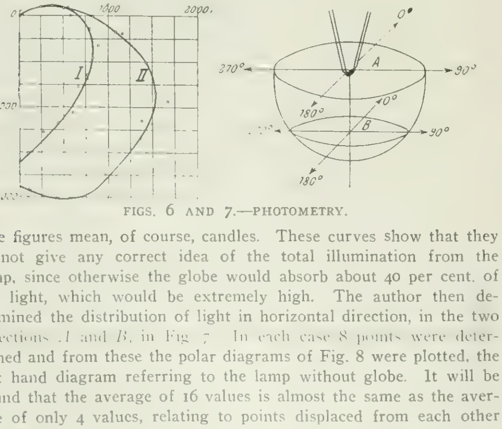


FIG. 5.—MEASURING LOW RESISTANCES.

until the mirror looks out at an angle of about 90 degrees from the direction of the scale. The current should now be increased till the spot of light comes on to about the center of the scale. On switching over *S* it will now be perceived that there is a slight difference in the deflection obtained. *B* should be again adjusted till this difference of deflection disappears. The test is now finished. If the scale is about 8 ft. from the galvanometer, the difference of deflection corresponding to an error of 1 in 10,000 between *H* and *L* will be 0.015 in. The ratio of *H* to *L* equals that of *G* plus *B* to *G*. With a galvanometer having a resistance of 300 ohms and a bridge box going up to 30,000 ohms, two low resistances may be compared, having a ratio of 100 to 1. If the galvanometer is shunted, it is quite possible to compare resistances with a ratio of as much as 1,000 to 1. The advantages claimed for this method are the comparatively small current required to be passed through the resistances under test, the high degree of accuracy obtainable and the ease with which the comparisons can be made.—Lond. *Elec.*, July 14.

Testing the Magnetic Properties of Sheet Iron.—The following rules have been adopted by the German Association of Electrical Engineers: The total loss in iron is determined by means of a wattmeter in samples of at least 10 kg., taken from at least four sheets. The total loss is given for *B* maximum 10,000 and 50 periods per second, in watts per kilogram at a certain temperature. This fixture referring to sinusoidal voltage curves is called the loss figure ("Verlustziffer".. A standard thicknesses of sheet iron 0.3 and 0.5 mm. are considered. No variation of thickness by more than 10 per cent. is permitted. For the test a magnetic circuit is used which contains only iron of the quality to be tested. The specific gravity of iron is assumed to be 7.77. The "ageing coefficient" is the change in per cent. of the loss figure after 600 hours of heating to 100° C. The apparatus of Epstein, Moellinger and Richter are considered to be suitable for the tests.—*Elek. Zeit.*, July 27.

Photometry of Non-Symmetric Sources of Light.—BLOCH.—The photometry of non-symmetric sources of light is generally considered to be complicated. It is possible to get with a single measurement the total illumination with the aid of either the lumenmeter of Blondell or the sphere photometer of Ulbricht. But these instruments are not yet in general use, since they are either too complicated or their simplified designs have not yet proven reliable in practical use. The present author shows that even sources of light with a great lack of symmetry can be tested in the ordinary way with only a few additional measurements. He describes a test of an a c lamp with inclined carbons (Fig. 7) of 10 and 7 mm. diameter. The thicker carbon lagged in burning off behind the thinner one, so that the distribution of light was very unsymmetric. He first determined the distribution of light from the arc with and without a globe in a vertical plane perpendicular to the plane through the carbons. Curve *I* in Fig. 6 was taken with globe, *II* without globe.



FIGS. 6 AND 7.—PHOTOMETRY.

The figures mean, of course, candles. These curves show that they cannot give any correct idea of the total illumination from the lamp, since otherwise the globe would absorb about 40 per cent. of the light, which would be extremely high. The author then determined the distribution of light in horizontal direction, in the two directions *A* and *B*, in Fig. 7. In each case 8 points were determined and from these the polar diagrams of Fig. 8 were plotted, the left hand diagram referring to the lamp without globe. It will be found that the average of 16 values is almost the same as the average of only 4 values, relating to points displaced from each other by 90.

	Without globe		With globe	
	Curve A	Curve B	Curve A	Curve B
L_1 average of 16 values	640	1260	520	1030
L_1 average of 4 values.	660	1300	525	1040
L_0	900	1860	530	1050
$k = \frac{L \text{ average}}{L_0}$	0.71	0.68	0.98	0.98

From the averages of *L* and from the values of L_0 taken from the curves Fig. 8 in the direction of O^0 (the same as Fig. 6) the reduction factor $\frac{L \text{ average}}{L_0}$ is calculated, which refers to *A* and *B* respectively. It will now be seen that this reduction factor is almost the same for *A* and *B*, so that its mean value may be assumed to be correct for the whole vertical plane in the direction O^0. This factor is 0.695 for the lamp without globe and 0.98 for the lamp with globe. If we determined by the usual methods the mean hemispherical intensities from the curves of Fig. 6, we have to multiply these values with the above reduction factors, to get the correct values for the whole lamp. We thus get without globe 0.695 × 1,620 = 1,130 candles. And with globe 0.98 × 980 = 960 candles mean hemispherical intensity. This gives an absorption of 15 per cent., which agrees with other tests.—*Elek. Zeit.*, July 13.

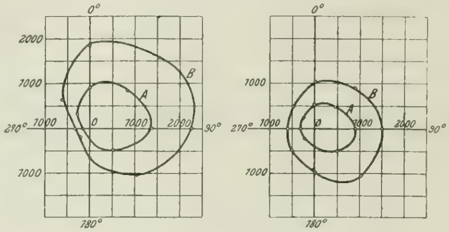


FIG. 8.—PHOTOMETRY.

Thermo-Electric Measurements of Temperature.—PALMER.—An account of measurements in which he used a couple of iron and "advance" wire. This is the trade name of a wire, which contains approximately 55 per cent. copper, 44.4 per cent. nickel and 0.6 per cent. iron. This results show that temperatures in the interval from 0 to 200° C. can be determined within one twenty-fifth of one per cent., with the iron-advanced thermo-element when the residual thermo-electric effects are suitably eliminated.—*Phys. Rev.*, August.

Comparison of Electric Fields.—OWEN.—An abstract of a (Brit.) Physical Society paper describing experiments in which an "electric needle" is used to measure electric fields in a manner similar to that in which a magnetic field is measured by an oscillating magnetic needle. The needles are cylindrical in form, of aluminum or brass, suspended by quartz fibres. The couple on the needle when disturbed from the direction of the field is proportional to the square of the field strength. For small displacements the needle vibrates isochronously, the frequency being proportional to the electric force. It may be used in alternating as well as in steady fields, and may be applied to illustrate many of the laws of electro-statics.—Lond. *Elec.*, July 14.

Motor Meter.—A fully illustrated description of direct-current motor meters made by Mix and Genest, and admitted by the Reichsanstalt for calibration. The meter consists essentially of a motor free from iron, while the magnetic brake is rigidly connected with its axle. A shunt current produced by the supply voltage passes through the armature, while the supply current passes through the stationary field coils. The speed of the meter armature is proportional to the electric power consumed within the meter if the friction resistances are negligible. The construction is described and illustrated in detail. *Elek. Zeit.*, June 29.

Differential Ballistic Galvanometer.—RAYMOND.—A detailed description of various methods of using the differential ballistic galvanometer for determining self-inductances, mutual inductances and capacity. Some of these are zero methods, while others require the measurement of ballistic deflections of the needle of the galvanomter.—*Phys. Rev.*, August.

Oscillograph.—HORNAUER.—A description of the construction of the oscillograph of Siemens & Halske Co. Various curves taken with this instrument are reproduced.—*Zeit f. Elek.* (Vienna), July 16, 23.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Coherer in Telephony.—STEADLE.—An account of experiments made with coherers of special dimensions to protect the ear against acoustic effects of atmospheric discharges during the transmission of telephonic messages.—*Elek. Zeit.*, July 20.

Wireless Telegraphy.—An illustrated description of the wireless telegraph plant at Heysham Harbor, the Lodge-Muirhead system being used. A steamer in service to the Isle of Man is fitted with similar apparatus. The system is tuned to a wave length of 500 yards. The novel feature is that no earth connection is employed. The lower capacity surface of the antenna is insulated, consisting of a network of wires in the form of a square and covering an area of 6,400 sq. ft. Porcelain insulators are employed to support it at a height of 3 ft. from the ground. The upper aerial is of similar construction and is held in position by four masts.—Lond. *Elec.*, August 4.

BOOK REVIEW.

Die Wechselstromtechnik. By E. Arnold and J. L. La Cour. Berlin: Julius Springer.

The second volume of this series covers 370 pages and has 335 figures printed in the text and three plates.

In this volume the subject of transformers is handled from an engineering standpoint not from the historic, and everything out of date is avoided. The knowledge of calculus and symbolic method is presupposed. The chapters cover the following subjects: Chap. I is introductory and covers e.m.f. and winding ratios; Chap. II the curve form of the magnetizing current and the calculation of its watt and wattless components; Chap. III takes up the equations and constants of a single-phase transformer and the relations between self-induction, mutual induction and leakage; Chap. IV gives very complete graphical illustrations of vector and phase relations of pressures and currents under non-inductive as well as inductive load, and also single-phase transformer connections for three-wire circuits. Transformer losses, selection of proper magnetic circuit, the influence of frequency and most favorable distribution of losses are treated in Chap. V; Chap. VI gives the polyphase transformer built in one structure, two-phase and three-phase transformers, the monocyclic system and the single-phase-polyphase system of distribution by Ferraris-Arno; Chap. VII is devoted to choke coils, auto-transformers and the like. Chapter VIII describes the influence of e.m.f. wave form on regulation and core losses. In Chap. IX we find mechanical details of transformers of American and European construction, with reference to the cores, while insulation and windings are discussed and excellently illustrated in Chapter X. XI takes up the determination of heat radiating surfaces of transformers with or without special means for cooling. Examples of transformers of well-known makes are given in Chapter XII, with data of mechanical dimensions of cores, windings, output, voltage, efficiency, etc. In Chapter XIII the calculation of lighting and power transformers is given, while XIV contains the complete determinations and data sheets. XV relates to transformer tests and of investigation of iron, insulation, etc. XVI takes up circuit connections and connections of transformer windings for special circuits and purposes. XVII deals with transformers for measuring boosting and regulating, and Chapter XVIII refers to the polyphase system of distribution. Several tables are added containing the most essential data of designs of well-known makes. The book is very carefully prepared and is of the same high standard as other books of these well-known authors. It is especially suited for designers and instructors.

The third volume of "Die Wechselstromtechnik," by the same authors is devoted to windings for alternators and alternating-current motors. This vast subject is covered in 360 pages and is illustrated by 426 figures. This subject is carried out on somewhat similar lines as the work by the same authors for direct-current armature windings.

The production of an alternating current by means of various field pole dispositions and relations to the armature conductors forms the introductory part. By means of diagrams many different typically alternator armature windings are shown, followed by well-known direct-current types of armature windings. Following the "unaltered" direct-current windings the author shows types produced by the "cut" direct-current types of windings for the production of polyphase currents. Then he presents an interesting treatment on "altered direct-current types of windings" which permits of a greater variety of armature windings and conductor numbers for alternators, and space is also given to multiple-connected windings for collecting large alternating currents. A chapter is devoted to special windings for non-synchrorous machines.

Insulation is well taken care of and many data furnished which will prove helpful to students, teachers and engineers who are not actively engaged in the manufacture of apparatus. Many detailed constructions of forms of windings are excellently illustrated. Leaving the practical side of dynamo building, the authors take up the determination of the field flux and its distribution. It is well known that the e.m.f. curve of the armature is dependent upon the flux distribution in the air-gap, the pole shoe form and windings and this subject is very carefully prepared and well worked out, also the influence of harmonics and the width of the armature slots upon the field flux variations. The rotating magnetic field is analyzed and illustrated by many simple diagrams, while the alternating-current field is considered as a resultant of two fields rotating in opposite direction with the same angular velocity, a method first mentioned by Prof. Ferraris. In Chapter XI the authors determine the field curve, a curve which represents the air-gap flux density as a function of the armature circumference. It is used for determining the armature e.m.f. curve. At the end of the book they give an exact method for its determination, which although highly interesting will hardly be used by designers because the much simpler method described above answers, it is believed, all practical purposes.

On page 32 the authors refer to the Heyland motor, and one would expect in a book on motor and generator windings to find a proper account of this now well-known design, but in this respect the otherwise excellent volume is lacking.

The fourth volume of the series is entitled "Die synchronen Wechselstrommaschinen," by E. Arnold and J. L. La Cour. It is a work covering 840 pages, with 314 figures printed in the text, and 13 plates. In their introductory remarks the authors state that for the purpose of obtaining reliable results it has been frequently necessary to use an amount of mathematics which may prove to be beyond that at the command of the practical engineer, and he is not expected to look upon this book as a textbook, but rather as a reference book to which he would turn to consult those branches in which he is particularly interested. As the mathematical requirements made on the engineer increase yearly, the progressive one becomes a good student and it is the duty of the technical schools to see that the graduates have a good mathematical foundation so students will not have much trouble in mastering the subject. They call special attention to certain parts of the book treating on the design and predetermination of alternating-current generators and refer to the change of potential at the generator terminals due to load variations and further to the heating under load. The closer these quantities can be predetermined the better is the designer enabled to use economically the material without passing the limits mentioned in the specification. For the purpose of determining the voltage variation, the knowledge of the armature reaction and that of the reactance of the armature winding is essential. The armature reaction is very minutely described and determined by graphical and analytical methods. It is resolved into the cross magnetizing action of the watt current and the demagnetizing action of the wattless current and can be determined accurately from the no-load characteristic. For the determination of the reactance some formulæ are given which are sufficiently accurate for practical purposes. The authors use the title "synchronous alternating-current machines" in a broader meaning than is customary; they designate by this name all types of dynamos, motors or rotaries whose field excitation is produced by direct current. The design of machines is investigated and calculated in all their details and illustrated by examples. Considerable space is devoted to the hunting action and parallel working of alternators, further self-exciting machines and methods of compounding such as developed by Hutin and Leblanc, Heyland and Boucherot are discussed and analyzed.

The rotary transformer forms the last part of this excellent work. It is analyzed in all its phases of construction, operation and tests in twelve chapters. Twelve plates give sectional views of representative alternators, while plate 13 shows magnetization curves per centimeter length of magnetic circuit for different values of B for various irons.

This work shows throughout the care and painstaking characteristic of these authors, not only in the treatment of the subject, but also in the neatness of its publication. This as well as the earlier volumes will be a valuable addition to any engineer's or scientific library. As a reference book it will be a standard, but its value may still be enhanced by furnishing besides the permanent key of reference letters a detached one for obvious reasons.

Recent Improvements in Switchboard Details.

By E. P. Edwards.

Recent years have shown a rapid and wonderful advancement in the science of electricity. This forward movement has been so marked and so universal in its nature that no one of its ramifications stands out in bold relief as an example of radical improvement. Present practice constitutes a series of revolutions when compared with the methods and achievements of from five to ten years ago. One of the most absorbing problems that presents itself to the engineer to-day, is the development of suitable apparatus and appliances for properly controlling and measuring the electrical forces at his command.

Switchboard engineering is a branch of electricity which has made great strides in recent years. A few years ago the switchboard was given grudging consideration, but it is no exaggeration to state that, at the present time the design of a switchboard in all its details receives as careful attention as the apparatus which it is to control, and the specifications under which it is built are as rigid as those governing the construction of this apparatus.

While the necessity will always exist for special switchboards and switchboard devices, the last few years have shown a marked tendency toward standardization. This is a natural condition, and its benefits are manifest. Uniformity, better workmanship and better deliveries are insured. Prices are reduced as a necessary consequence of the concentration of energy and the saving effected through decreased charge for development, drafting and engineering.

The illustrations used in this article will give a fair, if somewhat meagre, idea of the mechanical perfection that has been reached in switchboard construction as carried on by one of the prominent manufacturers of this country. Because of space limitation it is impossible to cover in detail all of the devices shown, but sufficient importance attaches to the subject of automatic protection to warrant special attention.

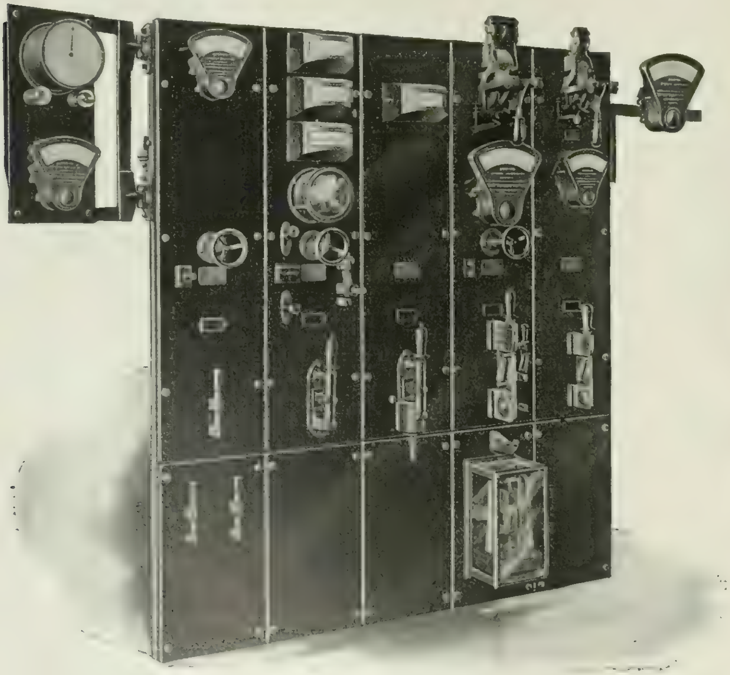


FIG. 1.—COMBINATION DIRECT AND ALTERNATING-CURRENT RAILWAY SWITCHBOARD.

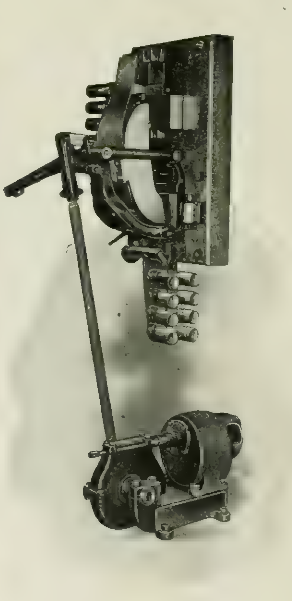


FIG. 2.—MOTOR-OPERATED BREAKER, 11,000 AMP.

Safety is the watchword of the station operator of to-day and the automatic circuit-breaker is his main reliance. Ammeters, wattmeters, voltmeters, power factor indicators, automatic regulators, synchronism indicators and other measuring and regulating devices are essential, but the automatic switch or circuit-breaker is pre-eminently THE essential. Upon its reliable operation and ability repeatedly and successfully to perform its functions under the most severe conditions, often depends the safety of thousands of dollars worth of apparatus, and its use affords the best insurance against those interruptions in service that might entail great pecuniary loss to the operator.

Broadly speaking, automatic protective devices may be divided into two classes, those for use on direct-current systems, and those for use on alternating-current systems. The air-break circuit-breaker is typical of the former class, the oil switch of the latter.

The purpose of this article is to deal briefly with the carbon-break circuit-breaker. The automatic circuit-breaker, as it stands to-day, embodies the results obtained from years of experience and constant experiment.

The prime object of a circuit-breaker was automatically to protect a system against the evil effects of short-circuits and overloads; now automatic protection can be secured for almost every service condition arising. Circuit-breakers can be made to operate from a distance, by means of motors, solenoids or float mechanisms, tripping automatically on overload, underload, low voltage, high voltage, reversal of current, or phase reversal. The overload circuit-breaker is of dominant importance.

A general survey of the essentials in circuit-breaker construction reveals the following characteristics:

1. The breaker must be capable of opening the circuit under the most severe conditions of short circuit, as upon its reliability in this respect depends the safety of all of the apparatus which it is designed to protect.

2. It should be mechanically simple and compact; it should be durable, and the use of springs and delicate parts that will not withstand continued rough usage should be avoided.

3. All parts should be readily accessible and capable of easy renewal.

4. Perfect contact surface should be secured, and moderate temperature rises under normal load conditions should be insisted upon. This temperature rise should not exceed that guaranteed for the apparatus with which the breaker is to be used. Commercially, this is all that can be reasonably expected. Effectiveness as a protective device is so much more essential than efficiency expressed in terms

of energy lost, that the latter consideration is of subordinate importance.

5. The circuit-breaker should be easy to close, so that it may be mounted above the other appliances on the switchboard, removing them from the danger zone of the flaring arc that is a necessary evil of air-break device.

6. Knife-blade construction should be avoided, the contact secured being inferior to that obtained by using the laminated brush, and any "bugging" of the clips or blades produces a tendency to stick, which may result fatally to the apparatus of the system.

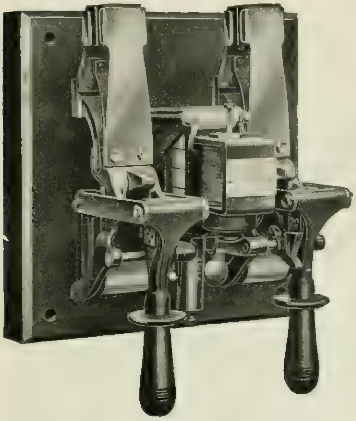


FIG. 3.—CIRCUIT-BREAKER WITH LOW-VOLTAGE RELEASE, 500-AMP., 250- VOLTS.

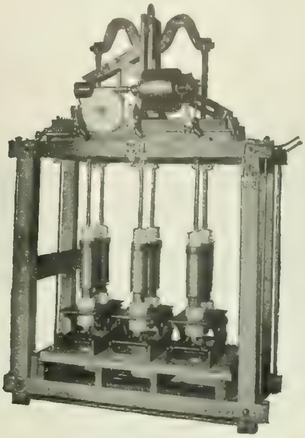


FIG. 4.—MOTOR-OPERATED OIL SWITCH, 13,000 VOLTS.

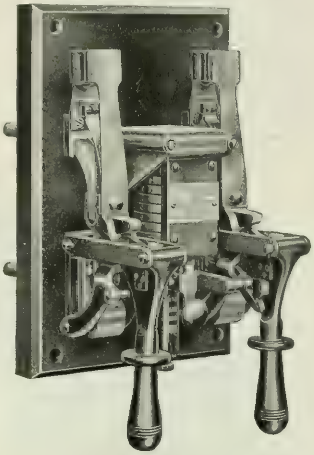


FIG. 5.—OVERLOAD CIRCUIT-BREAKER, 300-AMP., 250-VOLTS.

7. The main contact brush should be adequately protected by carbon and copper auxiliary contacts through which the current is shunted by the opening of the main contacts and on which the final break should occur.

These contacts are of vital importance to the life of the circuit-breaker. This is especially true of the carbon secondary contacts, no matter how roughly the breaker is handled. A broken carbon which should be so constructed that they cannot possibly be broken, will often result in the total destruction of the circuit-breaker, with a suspension of service as a consequence.

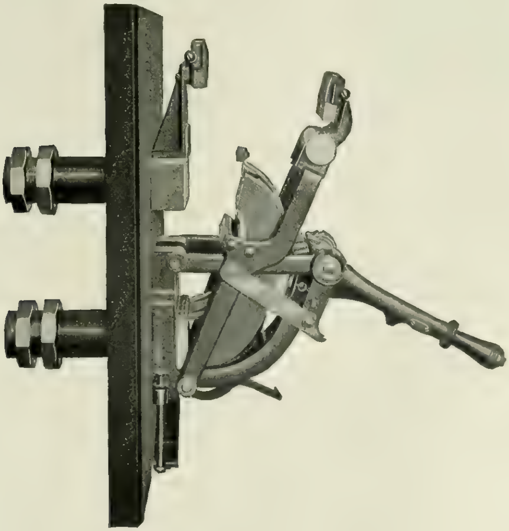


FIG. 6.—OVERLOAD CIRCUIT-BREAKER, 6,000-AMP., 650-VOLT.

A high standard of excellence has been arrived at in the manufacture of circuit-breakers, and the accompanying cuts will give some idea of the great progress that has been made in recent years.

An important installation has just been made by the Edison Illuminating Company of New York. This consists of nineteen 3,000-ampere, thirty-two 6,000-ampere and four 11,000-ampere, 250-volt circuit-breakers; four of the 6,000-ampere, and the 11,000-ampere breakers, are motor operated, remote controlled, the others being hand operated.

Fig. 2 shows one of the 11,0000-amp., motor-operated breakers, which is the largest ever built. The breakers illustrated in this article represent the designs of the General Electric Company.

◆

Pressed Steel Buckets.

The Link-Belt Engineering Company, of Philadelphia, is using pressed steel in the manufacture of elevator buckets. The new buckets, made in one piece free from seams and rough surfaces, are from 20 to 40 per cent. lighter than malleable iron buckets of corresponding sizes. The accompanying illustration shows the uniformity of gauge and the symmetrical design. The superiority of the new pressed steel buckets over cast buckets is obvious. Compact and light, they obviate the destructive wear on chain and sprocket wheels and prolong the life of the elevator, a factor of importance to the users of this class of machinery. Where cement, sand, grain, coal, gravel and materials of a like nature are to be handled, the use of these buckets should prove advantageous. Users of japanned or galvanized buckets recognize the superior qualities of pressed steel in the service demanded by the conditions that exact special surfaces in conveying buckets.

PRESSED STEEL BUCKET.

"Commercial" Induction Motors.

The Commercial Electric Company, Indianapolis, Ind., is placing on the market a line of induction motors, in the design of which the services were retained of Mr. H. M. Hobart, of London, the well-known authority on induction motor design. The details of this motor are illustrated in Fig. 1 and the complete motor is shown in Fig. 2.

It is well known that in order to produce a high power factor in induction motors it is essential that there shall be a limited clearance between the rotor and stator. In the present motor the design of the stator frame and stator head is such that an equal division of this clearance is always secured and maintained, it being an impossibility to assemble the machine in such a manner as to give the rotor an unequal air-gap on opposite sides. In order to reduce the wear of the rotor shaft to a minimum, very large bearing surfaces have been provided. The bearings are also so designed that if the operator should flood them with oil no damage to the machine could possibly occur. The bearing linings are duplicate and interchangeable; thus, it is claimed, making the replacement of the bearing a much more simple and less expensive matter than is involved in the accurate re-adjustment of "adjustable" bearings. The shaft is accurately ground to gauge, the bearings are polished and the rotors are mounted on the shaft by means of hydraulic pressure. Ventilating apertures are provided across the faces of the stator and rotor cores, thereby causing a free circulation of air and insuring cool operation.

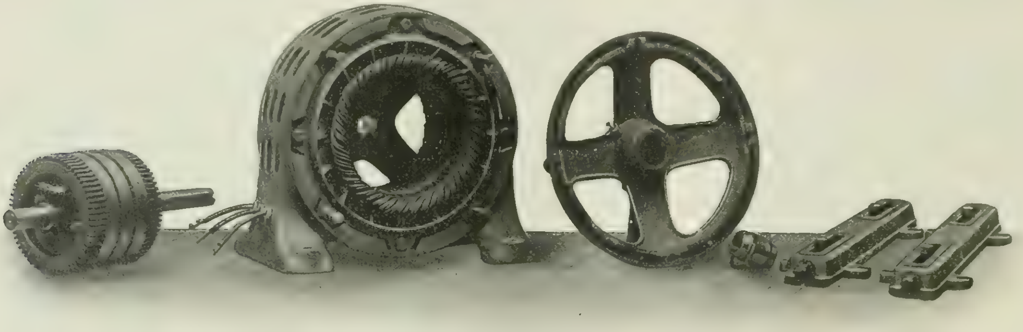


Fig. 1.—Details of Motor.

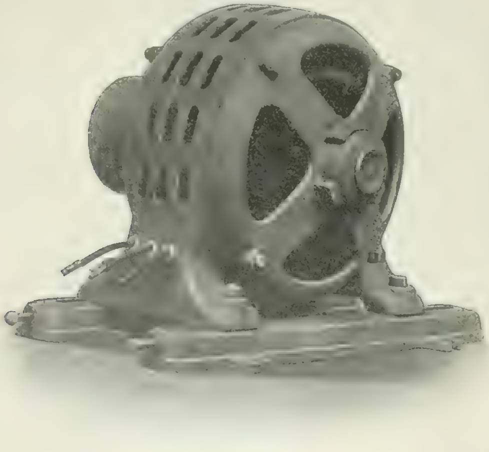


Fig. 2.—Motor.

The motors are manufactured in all standard ratings from 5 hp to 200 hp. A line of small single-phase, self-starting induction motors is also made in ratings from 1 hp to 5 hp. The machines are made for all standard voltages for both two and three-phase circuits and for frequencies of from 25 to 60 cycles.

The Subways in Chicago.

In connection with the proposal of the city of Chicago to install and operate its own telephone service, the right of the municipality to the free use of the subways of the Illinois Tunnel Company was asserted last week by city officials and a notice was served on the company that city employees may at any time begin to place wires in the conduits for the service of the telegraph, telephone, electric light and signal service of the city.

The move looking to a reservation of the alleged rights of the city was made by Comptroller Lawrence McGann in a letter sent by him to City Electrician Carroll. Another letter was also sent to the chief of police calling attention to the alleged right of city employees to free access to the tunnels and asking that a proper inspection be made to secure the safety of persons working in the conduits.

The letter to the city electrician was followed by a reply in which it was declared that the lowering or destruction of the traction tunnels would be the first occasion on which the city would need the Illinois company tunnels for wires.

City Electrician Carroll says: "We shall want to place approximately four cables two inches in diameter from the north side of the river via Wells Street to Washington Street, Washington Street to La Salle Street and La Salle Street to the City Hall. Also about the same number of cables from Van Buren and Clinton streets, via Van Buren to Fifth Avenue, Fifth Avenue to Washington, Washington to La Salle, and La Salle Street to the City Hall. These cables can be attached to the roof of the tunnel, in the same manner as the Illinois Telegraph & Telephone Company's cables are attached at the present time. We should be afforded the same facilities for getting in and out of the tunnel as are afforded to the telephone company, and our men should have the use of a car wherever they have tracks for their own use in placing and whenever necessary for repairs on these cables. In addition, we will probably want to use the tunnels for other telegraph, telephone and electric lighting service wherever they have tunnels. The number and size of cables required being from one cable one inch in diameter to four cables two inches in diameter."

Electrical Sales in the Far East.

The activity in electrical lines in the Far East is indicated by recent orders received by the General Electric Company through its foreign department, for electrical apparatus for use in eastern countries. Mitsui & Co., Tokio, Japan, have purchased one three-phase, revolving-field, 200-kw, 60-cycle, 2,300-volt generator and one 110-volt, 7-kw, direct-current marine generating set with switchboard. Another order for the Kosaka Copper Mines, Japan, consists of one motor-generator comprising a 100-hp, 3,120-volt induction motor, direct-connected to a 75-kw, 550-volt, direct-current generator. In addition to the above for Japan, a recent order includes 28 miles of single-conductor, lead-covered wires of various sizes, and 22 miles of stranded lead-covered cables of various sizes.

Australian orders include six General Electric 58 double-motor railway equipments for the Perth Electric tramways, and one 10-kw, one 16-kw and one 25-kw storage battery booster set for the New Zealand Electric Construction Company.

The Siam Electricity Company, Bangkok, Siam, has purchased a 500-kw, 550-volt, direct-current, two-stage Curtis steam turbine alternator, several direct-current pump motors and a switchboard.

South African orders include two 500-kw, three-phase, 2,300-volt Curtis steam turbine alternator sets and one 450-hp, 2,080-volt, two-speed induction motor for Robinson Deep Mine, one 1,000-kw, 3,300-volt, three-phase Curtis turbo-alternator set and sixteen 200-volt induction motors aggregating 115 hp for the Consolidated Gold Fields of South Africa, Limited.

In addition to the above for the Far East, Brazilian orders come from South America as follows: Five two-motor General Electric 58 equipments with controllers and electric brake for Jardin Botanico, Rio de Janeiro; eleven 440-volt induction motors aggregating 220 hp; forty type H transformers aggregating 400 kw, with switchboard equipment for Mococa, Brazil. The Rio de Janeiro Tramway, Light & Power Company, Brazil, has purchased a 200-kw, 50-cycle testing transformer with 150,000 as maximum, stepping up from 216 volts primary, and there have been ordered for Manaos, Brazil, two 150-hp, 550-volt, direct-current motors and one 400-kw, 575-volt, direct-current generator for direct connection to a Harrisburg engine.

◆

A New Type of Revolving-Field Alternator.

The accompanying illustrations show an alternator, the construction of the field magnets of which departs materially from that of the older type of revolving-field machine. Referring to Fig. 1, it will be noted that the field coils (of which there are only two, regardless of the number of poles) are wound concentric with the shaft in the line of mechanical motion, and therefore the mechanical placing of the coils is facilitated. The air-gap between polar faces and armature iron may be as short as mechanical clearance may require, and not excessive as in older types. The decrease of the air-gap allows a corresponding decrease in the exciting current, while the peculiar construction of the field cores allows the use of a heavier current density in the field winding without a corresponding increase in temperature.

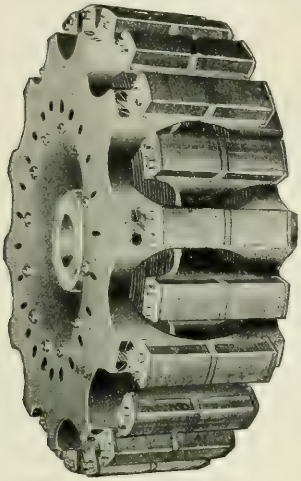


FIG. 1.—NEW REVOLVING FIELD.

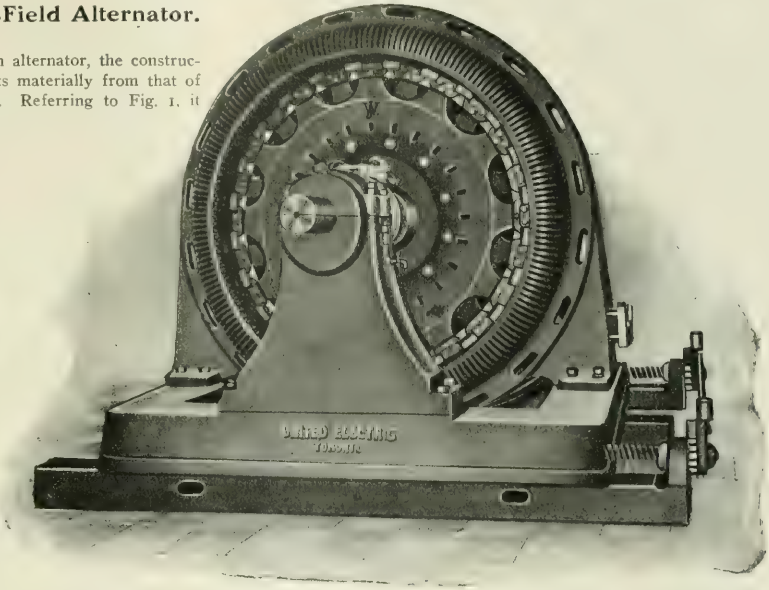


FIG. 2.—END VIEW OF ALTERNATOR.

By using this same construction, but with the addition of a short-circuited bar winding on the field cores for self-starting, these machines may be used as motors. The generators or motors are interchangeable; that is, the machine may be used as a commercial synchronous motor or generator at pleasure under the most favorable conditions.

Fig. 2 gives an end view of the completed machine, and shows also the short-circuited winding. When the machine is to be operated as a motor, it can be thrown directly on the line as an induction motor. When the rotor is up to speed the field can be excited and the machine will thereafter operate as a synchronous motor. This auxiliary winding is of use also where two or more generators run by separate engines are to be operated in parallel on account of the fact that it assists in keeping the machines in exact synchronism. It is stated that when used as a generator the regulation is practically the equivalent of what is found in static transformers.

These machines are manufactured by the United Electric Company, of Toronto, Canada, according to the designs of the inventor, Mr. W. A. Johnson, of that place.

◆

Exhaust Steam for Station Auxiliaries.

An abstract was published recently in these pages from the National Electric Light Association "Question Box" of the answers as to central station exhaust, etc. Mr. R. H. Ramsey, of the Harrison Safety Boiler Works, Philadelphia, writes us as follows on the subject:

"We are very much interested in the article entitled 'Feed Water, Heaters and Pumps' in your issue of July 22. We quote from this article as follows: 'To the query "Is it good practice to turn exhaust from station auxiliaries into an open type feed-water heater?" the twelve replies would indicate that an open type heater accumulates the oil, thus making poor water to feed to the boilers, and, therefore, if the practice is followed an oil separator should be used.' As a matter of fact, if a Cochrane feed-water heater is used there is no danger from oil, for every Cochrane heater is equipped with a Cochrane oil separator.

"Cochrane oil separators are now protecting more than 4,000,000 horse power of boilers from oil. They are mechanical appliances, and, therefore, if they ever give good separation under normal conditions (they have done it thousands of times), they will repeat the results wherever the conditions are repeated. Do you not think that this matter is of sufficient importance to your readers from an engineering standpoint to point out editorially the facts as they exist? The only advantage claimed for the closed heater, according to the synopsis given in the article quoted, is that it keeps the oil out of the boilers, while, on the other hand, a number of important advantages for the open heater are stated (though these advantages do not represent nearly all that the open heater possesses). Eliminating the commercial side of the question, would it not be of interest to your readers for you to tell them that they can obtain all of these important advantages without having to fear oil, if they will install the right kind of an open heater?

"Again we quote from this article as follows: 'In regard to the method of driving auxiliaries, a correspondent states that "in a non-condensing plant a motor-driven pump is doubtless the most economical form that can be employed. .. .' In turbine plants steam-driven auxiliaries will be more economical up to a point where all of the exhaust steam can be condensed in heating the feed water.' In a non-condensing plant less than 10 per cent of the heat in the steam is utilized in the engine, the remaining 90 per cent or more being wasted unless the exhaust steam is utilized. In the plant in which everything is run condensing, less than 15 per cent of the heat in the steam is utilized in the engine, and the remaining 85 per cent or more must be dissipated by the condensing water and wasted in order to obtain the 15 per cent efficiency. But in a plant in which steam-driven, non-condensing auxiliaries are used and the exhaust steam is utilized in a Cochrane open heater, these auxiliaries ordinarily will have an efficiency of practically 100 per cent, for all of the heat in the steam not utilized in doing work (and the quantity of heat utilized is the same as in the case of the motor-driven auxiliaries) will be conserved and turned back into the boilers. This proposition is true of a condensing plant, whether turbines or reciprocating engines are employed. Since no motor-driven or condensing auxiliary can give an efficiency of anything like 100 per cent, does not the independent steam-driven, non-condensing auxiliary, when used with an open heater, represent far better engineering practice than motor-driven auxiliaries?

"Aside from the question of economy of operation, there is also the important question of first cost, insurance and depreciation, and here the non-condensing auxiliaries and an open heater easily have the advantage.

"If this doctrine is true (and it can be demonstrated both theoretically and in actual practice), do you not think that technical editors should insistently preach it to the owners, designers and operators of condensing plants?"

More Exhibits at the Portland Exposition.

Last week a number of electrical exhibits at the Portland Exposition were described in these columns. A few further notes are now given as to other exhibitors:

The Holtzer Cabot Electric Co., of Brookline, Mass., exhibits in the Agricultural Building a 500-volt, direct-current motor in operation, belted to a coffee-cleaning and roasting plant, giving a practical demonstration of the application of its motors for commercial purposes. The company also displays a watchman's clock or time detector, suspended on the north wall of its booth, having several test stations connected to and surrounding it to demonstrate its practicability. Here are also shown a long distance telephone, both 4 and 5-bar telephone generators, and the Ness automatic house telephone and single station telephones. In conjunction with this exhibit, the Patterson Electric Co. of Meriden, Conn., displays one of its electric clocks essentially consisting of a master clock working in conjunction with a secondary clock and operating a set of Westminster chimes, hung over the entrance to the boot, and striking the quarters and hours. There is also exhibited in this connection a keyboard electrically connected to 13 bells or chimes arranged in symphony so as to permit the playing of ordinary airs thereon.

The John A. Roebling Sons' Co. of Trenton, N. J., has an exhibit space of some 300 sq. ft. in area, in which it gives a complete demonstration of the many and varied adaptabilities of its wire rope and cables. In the center of the display space is shown a glass cabinet containing on a revolving pyramidal form, neatly and systematically arranged, a variety of wire and wire rope for nearly every purpose, comprising telephone, power transmission lines, etc. Prominently displayed, apart from the pyramid and directly back of one of the glass sides of the cabinet, is a small spool wound with wire 1-1000 of an inch in diameter and drawn from a steel bar 4 in. square, making a truly unique adjunct to the exhibit, as well as demonstrating the capabilities of the company's factory to manufacture wire of any requisite size for practically any purpose. The other side of the pyramid, already mentioned, are samples of heavier grades of wire rope and cables. The display to the left contains two sections of cables, in actual use for years and built for the Brooklyn and Williamsburg bridges, the diameters of which are 15½ and 18½ in. respectively, while a third section of cable, considerably larger, is also shown of 21¾ in. diameter, being a sample of cable now under construction for the new Manhattan bridge, New York. The other section is devoted to various types and [illegible] of transmission sheaves, arranged on display boards, as well as numerous tools, fittings and appurtenances in general use, in the manufacture and laying of cables. Among these may be mentioned hooks, clips, alligator and drop forged wrenches, etc., etc., and below them are shown samples of the fittings in application. Three large photographs are suspended above the display, the center one showing the factories of the company at Trenton, N. J., while on either side are the Brooklyn and Williamsburg bridges, respectively. The exhibit is attractively decorated and illuminated with numerous incandescent lights and electric display signs, and is in charge of one of the company's Western representatives.

The B. R. Electric & Telephone Company, of Kansas City, have erected a booth in the Machinery, Electricity and Transportation Building, in which they exhibit a comprehensive and varied display of telephone machinery and apparatus. Immediately opposite, and facing one of the main aisles of the building, are two telephone switchboards of 100 and 50 lines capacity, respectively, so arranged as to display the complete mechanism; also near by is a Warner "pole changer" on a stand opposite which is a dry cell battery of extraordinarily large dimensions. The battery is 27 in. in height, weighs 125 lbs. with a capacity of 1-15 volts and 92 amperes and naturally attracts a good deal of attention, proving to be quite a unique feature of the display. The interior of the booth contains a collection of telephone apparatus. A showcase containing linemen's test sets, and portions of central energy equipment, etc., occupies one side of the display space, while Moon terminals and terminal heads, as well as Stombaugh anchors of different types and sizes are seen on the opposite side of the aisle. The display of central energy telephones, mining telephones, rural switchboards, plug boards, the latter adapted for small country exchanges, is very complete in every particular; two small display boards showing respectively the evolution of the telephone generator and ringer movement from the raw material necessary for its construction to the finished article; rural telephones, linemen's tools neatly arranged in consecutive order, go to make up an exhibit both interesting and instructive.

The Hobart Electric Manufacturing Company, of Troy, O., have an exhibit in conjunction with the Storer Manufacturing Company, of Freeport, Ill., in the Building of Machinery, Electricity and Transportation. The display comprises a 115-volt, 27-kw, direct-current generator in operation, used to illuminate the display signs of the exhibit, and belted to a Stover 10-hp gasoline engine, which also operates a centrifugal pump, pumping 63,000 gals. per hour into and out of a series of wooden tanks placed near the side entrance to the display, illustrating the capabilities of the pump.

By those interested in transportation and transportation machinery generally the exhibit of the Baldwin Locomotive Works, Philadelphia, Pa., in the Machinery, Electricity and Transportation Building will probably be found to be one of the most distinctive and attractive displays of that nature in the hall. Suggestively facing the steam locomotives is a Baldwin-Westinghouse 70-hp electric locomotive and weighing 20,000 lbs., designed for industrial plants and contractors' use and fitted with 250-volt, direct-current Westinghouse motors. This machine is small, compact and withal, powerful. In another section of the exhibit is displayed the Baldwin Company's interurban railway truck identical with those at present used by the Twin City Rapid Transit Company, of Minnesota. The truck is made entirely of wrought iron and steel and is put together with the same care and workmanship that distinguishes their locomotives. The company manufacture several sizes of railway trucks ranging from 5,300 lbs., weight suitable for street railway service, to 12,500 lbs. for interurban service.

The exhibit of the Standard Paint Company, of New York City, in the Manufacturers' Building was a typical display of its Ruberoid roofing material, insulated tape, Ruberoid flooring preservative paints, etc. A very practical demonstration of the roofing material as used commercially is shown by two models, representing a saw mill and a lumber or shingle dry kiln respectively, each being very ingeniously put together architecturally, and roofed with two-ply Ruberoid. The models are placed on each side of the booth, the center being utilized to display Flexite preservative paints arranged in a pyramidal form toward the front of the exhibit, the space to the rear being occupied by S. P. C. and P. & B. insulated tape, building papers and roofing material in packages or rolls of commercial sizes. The whole display is tastefully decorated and reflects credit on the designer, the models particularly attracting the visitor's attention

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Satisfactory net results are reported for the week's business, the uniformly favorable reports of late having been affected by some adverse factors of a temporary nature. Numerous strikes have occurred, exerting the customary pernicious influence over business, and the epidemic of yellow fever is restricting Southern trade. On the other hand, the hot weather has facilitated retail trade, crop prospects have greatly improved, and out-of-town buyers are numerous in all the leading markets. Preparations for winter and spring distribution of merchandise are no longer handicapped by uncertainty regarding agriculture, for harvest operations are progressing rapidly under better than average conditions, and there is little anxiety regarding the future. Manufacturing plants are increasingly active, textile mills still occupying the strongest position, while shoe shops are not making concessions to get business. Iron furnaces and steel mills make progress, but less rapidly. Iron is rather quieter in demand, the reflection probably of the late advance restricting sales. Output in July was reduced and stocks unsold increased slightly. Finished products are in active request and the mills are pushed to meet orders. Structural material and rails are in good request for this season of the year. Plates are selling better on the Atlantic coast. Steel billets are in active request and very firm. Bituminous coal is rather quiet and easy in price. Lumber mills and dealers are having an exceptionally busy season. Railway earnings in July were 7.4 per cent greater than in the same month last year, and foreign commerce at the port of New York for the week showed an increase of $3,917,439 in imports, while exports decreased $1,969,227. The copper market advanced during the week, electrolytic being in good demand. Dealers demanded 15¾ for delivery during the next eight weeks. Lake is quoted at 15⅝, and casting stock at 15¼. *Bradstreet's* reports 166 business failures during the week ending Aug. 10, as compared with 178 the week previous and 167 in the corresponding week last year.

GROWTH OF EXPORTS.—Exports of manufactures from the United States in the fiscal year 1905 were not only the largest on record, but are in excess of the combined ?xports of all articles in the centennial year, 1876, and nearly $140,000,000 more than the total imports and exports of the country at the close of the Civil War. Statistics just compiled by the Bureau of Statistics of the Department of Commerce and Labor show that the exports of manufactures in the year just ended amounted to $543,620,297, as against $452,415,921 in the preceding year, $433,851,756 in 1900 and $183,595,743 in 1895. The growth in exports of manufactures far exceeds the growth of population or the growth in commerce as a whole. This is apparent from an examination of the following table showing the population, commerce and exports of manufactures of the United States in 1800, 1875 and 1905, and the percentage of increase in each since 1800 and 1875, the beginning of the greatest era in American development:

Year.	Population.	Commerce (imports and exports of mechandise).	Exports of domestic manufactures.
1800	5,308,483	$162,224,548	$2,493,755
1876	45,137,000	1,001,125,861	100,492,055
1905	83,145,000	2,636,074,349	543,620,297
Per cent of increase:			
1800-1876	750	517	3,930
1876-1905	84	63	441

An examination of the statistics of exports of domestic manufactures, especially in recent years, by articles and countries of destination, shows that about thirty manufactured articles were exported during 1905 with value in excess of $1,000,000 each, and that of these articles all except seven showed an increase as compared with exports of 1904.

ELECTRICITY IN MEXICO.—Recent sales through the foreign department of the General Electric Company indicate that electricity is well established in every day use in Mexico. The Pueblo Compania de Luz y Potencia has purchased two 220-volt induction motors, 50 and 35 horse-power, and four transformers of various capacities, for use on 2,300 volt transmission lines stepping down to 220 volts for distribution. The city of Tepic will use two revolving field three-phase 350 kw 6,600 volt generators and two 22 kw 25 volt exciters, together with generator and substation switchboards and small transformers aggregating 650 kw. The Mexican Light & Power Company has ordered one feeder panel and one mercury arc rectifier panel for its El Oro substation. The Guanajuato Power & Electric Company has purchased a horizontal revolving field three-phase 3,000 kw 2,300 volt alternator for direct connection to water wheel, and four water cooled 60-cycle, 1,080 kw transformers stepping up to 60,000 volts for line transmission, and four 60-cycle water cooled 970 kw transformers stepping down to 15,700 volts, from the line potential supplied by the first four transformers. In the same city the Guanajuato Reduction & Mining Company has ordered eight induction motors of various sizes aggregating 375 horse-power for use on 440 volt circuits.

A CHEERFUL OUTLOOK.—Interests identified with the Standard Oil Co. in one way or another are extremely bullish, says the *Wall Street Journal*, on general business conditions. Through its many agencies the Standard Oil Co. is in touch with business developments throughout the country at all times. The reports it has received over the last few weeks are such as to warrant the optimistic stand taken by John D. Rockefeller and his associates. A person in close touch with the Standard Oil Co. said: "Business prosperity is in evidence everywhere . It is of a genuine character, and if half the people of the United States turned pessimistic, a continuation of the prosperous business conditions that now prevail could not be checked. If any person fails to make money this and next year he cannot say the country has not done its duty. We will have no money scare this year. Rates may get a little high at times, but the average quotations for call and time money will be reasonable."

THE PELTON WATER WHEEL COMPANY reports new orders, as follows: From the Homestake Mining Company, Lead, South Dakota, an 800-hp Pelton wheel direct-connected to an electric generator. The Homestake mines comprise probably the largest and most permanent low grade deposits in the United States and their operations are of great magnitude. From the Nevada Power Mining & Milling Company, an order for an additional Pelton of 3,000 hp maximum capacity, direct-connected to an electric generator and operating under a head of 990 ft. This company is now installing two Pelton wheels for direct connection to 750-kw generators and proposes to transmit power to Tonopah and Goldfield, Nev. Through Mitsui & Co., San Francisco, an order was received for a 500-hp wheel for use in an electric light station in Japan.

RAILWAY ELECTRIC POWER CO.—The Ganz system has been taken up for this country by the Railway Electric Power Co., as already noted in these pages. The company has just issued a handsome pamphlet, descriptive of its three-phase Ganz apparatus and methods, particularly as applied to the Valtellina road, of which a full account we gave lately. The company hopes to benefit by the general awakening of interest among the large steam railroads in electric traction. The headquarters of the company are at 114 Liberty Street, New York, and the officers are Stephen Peabody, president; Leopold Wallach, vice-president; Gustave Leve, second vice-president; John E. Borne, treasurer; D. W. Kincaid, assistant treasurer, and Henry L. Sprague, secretary.

LONDON COUNTY COUNCIL CONTRACT.—Five tenders were submitted to the London County Council for the reconstruction, electrically, of the tramways from North Street, Wandsworth, to Westminster Bridge, via York Road, Battersea Road, etc. The bid of J. G. White & Co. has been accepted at £163,874, or about £1,600 less than the engineer's estimate. The successful bidders are allowed to sublet part of the work to the Lorain Steel Company.

BROOKLYN FIRE ALARMS UNDERGROUND.—Bids will be received until August 21 by Thos. W. Churchill, deputy and acting fire commissioner, New York City, for furnishing material and placing conduits for the fire department, telegraph and alarm system underground in the Borough of Brooklyn, and for alterations and additions to the fire alarm telegraph system in the Borough of Richmond.

THE STROMBERG-CARLSON TELEPHONE MAUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Kansas City, Mo.; Decatur, Ala.; Boise, Idaho; Creighton, Neb.; Unadilla, N. Y.; Maquoketa, Ohio; Granite Falls, Minn.; Charity, Mo.; Greenville, Ohio, and Crystal, N. D.

ELECTRICITY ON LACKAWANNA.—The recent destruction by fire of the Delaware, Lackawanna & Western Railroad depot at Hoboken, may hasten the adoption of electric traction on part of that system. The plans for the new depot include a large power equipment, but this would hardly take care of all the traction requirements if electricity were to be adopted on a large scale.

ELECTRICITY ON THE CENTRAL.—The New York Central & Hudson River Railroad has placed orders with the General Electric Company for the complete electrical equipment for the cars to be used in its suburban service. These cars are in general similar to those now in use on the Interborough Railway in New York City. One hundred and twenty-five complete car equipments have been ordered. The Sprague-General Electric multiple-unit train control system will be used and each car will be equipped with two General Electric 69 200-hp motors. The equipment is so designed that trains consisting of ten motor cars may be operated, although, of course, the motor cars may be operated singly or in groups of less than ten if desired. It is expected that cars of this type will eventually take care of all the suburban service on the electric zone of the New York Central. The order for electric locomotives has recently been increased to thirty-five. These are also made by the General Electric Company and are exact duplicates of the one which has been running for some months on the experimental tracks of the New York Central and which has been fully described in these columns. The locomotives will haul the through trains between Croton, 35 miles from New York, White Plains, on the Harlem division, 25 miles out, and the New York Central station, and eventually no steam power will be used in hauling trains out of the New York Central station. The suburban cars are of steel, and the total order of 175, it is reported, has been placed with the American Car & Foundry Company.

BIDS WANTED.—Sealed bids will be received by John Holton, chairman electric light committee, Stoughton, Wis., until Aug. 26, for the following electrical apparatus and power equipment. The work will be let as follows: Power house; one 150-hp water tube boiler, one 150-hp steam turbine and generator, one 100-kw generator and two exciters, two switchboards, arc light transformers, 50 arc lamps, one water wheel governor for two 100-hp wheels, one condenser, feed-water heater and pump. An old arc machine and switchboard will be for sale. Plans and specifications may be seen at 1636 Monadnock Blk., Chicago, and blank proposals obtained at 31 Vroman Bldg., Madison, Wis.

Financial Intelligence.

THE WEEK IN WALL STREET.—The sentiment in stock trading was decidedly bullish owing to the more satisfactory reports and the more favorable outlook as to the peace negotiations at Portsmouth. Railroad and industrial stocks generally showed advancing tendencies, but the features, as recently, have been extreme advances and new high-price records in various gilt-edged dividend-paying railroads. Easy money market conditions are also an influence, there being little apprehension of high interest rates during the crop-moving period. Continued favorable news about steel-trade conditions and prospects resulted in keeping up the quotations for the United States Steel stocks and the 5 per cent bonds of that corporation. The greatest gain in electric stocks was in General Electric, which closed with a net advance of 6 points, the last quotation being 184. Westinghouse made a net gain of 2½ points, closing at 170½. Both the Allis-Chalmers issues are down, the common closing at 17, which is a loss of 1¼ points, and preferred at 59, a net loss of 3 points. Western Union made a gain of ¼-point, closing at 93¾. Electric Storage Battery receded 1½ points, the closing figure being 82. The tractions are little changed, Metropolitan closing at 127¾, an increase of ⅛, while Brooklyn Rapid Transit remains unchanged at 69½. Interborough Rapid Transit was ¼-point lower at the close of the week, the last quotation being 219. The curb market, while showing general gains, exhibited no special features. Transactions were somewhat larger than those of the previous week. Following are the closing quotations of Aug. 15:

NEW YORK

	Aug. 8	Aug. 15		Aug. 8	Aug. 15
Allis-Chalmers Co	18¾	17	Electric Vehicle pfd........	25	24
Allis-Chalmers Co. pf'd	60⅛	59	General Electric............	179⅛	183⅛
American Tel. & Cable.	90	80	Hudson River Tel...	..	..
American Tel. & Tel.....	138	143	Interborough Rap. Tran...	218	218
American Dist. Tel	29	30	Metropolitan St. Ry..	127⅝	129¼
Brooklyn Rapid Transit	69⅝	70⅛	N. Y & N. J. Tel...	..	..
Commercial Cable			Marconi Tel............	..	..
Electric Boat	22	32	Western Union Tel.........	93⅝	93¾
Electric Boat pfd	67	75	Westinghouse com.... ..	166	170
Electric Lead Reduction			Westinghouse pfd....... ..	.	..
Electric Vehicle	19	19			

BOSTON

	Aug. 8	Aug. 15		Aug. 8	Aug. 15
American Tel. & Tel	138½	143½	Western Tel. & Tel. pfd ..	99	*99
Cumberland Telephone .	117	117	Mexican Telephone.	1¼	1
Edison Elec. Illum.	245	253	New England Telephone...	136⅛	135
General Electric . ..	179	185	Mass. Elec. Ry	17½	18
Western Tel. & Tel.	*18½	*18	Mass. Elec. Ry. pfd	60	61

PHILADELPHIA

	Aug. 8	Aug. 15		Aug. 8	Aug. 15
American Railways.. . .	52½	53	Phila. Traction...	..	..
Elec. Storage Battery....	82	81	Phila. Electric	8¾	8⅞
Elec. Storage Battery pfd.		.	Phila. Rapid Trans .	29⅛	28¾
Elec. Co. of America.. . .	11⅝	11¼			

CHICAGO

	Aug. 8	Aug. 15		Aug. 8	Aug. 15
Central Union Tel...........	..	..	National Carbon pfd.......	115	115
Chicago Edison			Metropolitan Elev. com	24	24
Chicago City Ry	*196	*196	Union Traction .		..
Chicago Tel. Co. .			Union Traction, pfd		..
National Carbon.	60½	63			

* Asked.

MANHATTAN-INTERBOROUGH.—The report of the Manhattan Elevated Railway for the twelve months ending June 30, 1905, reflects in part the effect of the Interborough Subway on the earnings of the elevated. It shows for the year a surplus of $8,328,257, as compared with $8,683,136 in 1904, a decrease of $356,479. This is before the charges or dividends are subtracted, and represents the total earnings of the system after deducting running expenses. The report of the entire system shows that the Subway lines earned in three months ending June only $1,349,871, or at the rate of $449,960 in gross. This indicates that during that time the public traveled on the Subway at the rate of about 9,999,000 per month, or over 300,000 per day. Since some other small earnings are included in this total gross, the number of passengers during the last quarter was probably below 250,000 daily. The net surplus of all lines, both Subway and Elevated, during the quarter was some $56,000 less than the surplus of the Elevated lines alone during the same quarter of 1904. This report is very interesting, in view of the fact that the Subway strike was a factor, and because this year is the first in which the Elevated has had the competition of the Subway. It appears that in a normal year the earnings of the Manhattan division of the Interborough Company will be cut. The dividends of 7 per cent on Manhattan are guaranteed by Interborough, and any decrease in the net revenues of the Manhattan Company involves only a corresponding increase in the Subway earnings.

U. S. HEATING CONTROL.—At a meeting of the board of directors of the United States Light & Heating Company this week control of that concern passed into the hands of the New York Air Brake Company. Charles A. Starbuck, president of the latter, is the new president of the United States Light & Heating Company, and Edwin Hawley is the new vice-president. John G. Gilbert retires as president. Recently the capitalization of the United States Light & Heating Company was increased from $3,000,000 to $6,000,000. It was incorporated in New Jersey a little more than three years ago, and its object is to furnish light, heat and power for railroad cars by the Moskowitz system; the power is obtained from the car axle. The New York Air Brake Company is fifteen years old and has $10,000,000 capital stock. Dividends at the rate of 8 per cent a year have been paid since 1899. An important asset of the United States Light & Heating Company is its control of the Moskowitz patent. The taking over of control by the Starbuck Company is thought to be a result of the latter's desire to control this patent. The new directors of the United States Light & Heating Company are W. F. Crandell, Clifford Chaffee and C. G. Smith. A. Sanford Adler and Charles S. Furst were re-elected to the board.

ADVANCE IN OTIS ELEVATOR.—The recent advance of about twelve points in the common stock of the Otis Elevator Company was brought about, says the *Wall Street Journal*, by the purchase of less than a thousand shares of stock, indicating a limited floating supply. There have been no unusual developments in connection with the company to account for the advance. Its business in consequence of the revival in the building industry has been benefited, and the financial results so far this year are a little ahead of last year's. This is expected, however, as in the preceding year the building industry in certain parts of the country was rather poor. The common stock has received 2 per cent yearly for the past three years. The last report showed that the company was in good financial condition, the working capital on December 31, 1904, amounting to $3,746,453. The gold notes now outstanding amount to only $400,000, of which $200,000 matures in 1907 and $200,000 in 1908. It is likely that the redemption of these notes will be anticipated, as was done with the amounts falling due in 1905 and 1906.

WESTCHESTER, N. Y. ROAD.—The contract for the grading of the bed for the Westchester Railroad, in the Bronx, a distance of a little less than five miles, has been let to James P. McDonald, contractor, of 42 Broadway, and the work of building the rapid transit electric road will be pushed. The contract calls for the expenditure of something over $1,000,000 in grading alone. Solid embankments and cuts, with concrete arches or steel bridges to carry the road over streets and roads will be the type of construction. It is expected that the construction of the roadbed ready for the laying of track, and exclusive of bridges, will cost in the neighborhood of $3,000,000. Concrete retaining walls will be used on the sides of cuts and fills.

SUSQUEHANNA POWER PLANT.—For the power plant to be built on the Susquehanna River near York, Pa., Harvey Fisk & Sons, of 62 Cedar Street, are managers of the syndicate which is underwriting the $10,000,000 of bonds. William Barclay Parsons, the Interborough Rapid Transit Company's chief engineer, is the chairman of the engineering board under the supervision of which the big plant will be constructed. There will be a large dam across the Susquehanna about twelve miles from York, and its cost will be $2,500,000—one-quarter of the cost of the entire plant. It is expected that the dam will be finished in two or three years. Dr. Cary T. Hutchinson is the chief engineer in charge of construction.

REPORT OF THE CANADIAN GENERAL ELECTRIC.—President W. R. Brock, in his report on the affairs of the Canadian General Electric Company for the year ended December 31, and discussing the present outlook, says: "The profits for the year were $582,519, out of which four quarterly dividends at the rate of 10 per cent per annum upon the common stock, two half-yearly dividends at the rate of 6 per cent per annum upon the preferred stock, and bank interest amounting in the aggregate to $392,763 have been paid. Of the balance the sum of $113,612 has been written off for depreciation, $75,000 transferred to reserve and $1,143 added to the credit of profit and loss account, which now stands at $81,913. The reserve fund is now $1,239,770, plus $100,000 at credit of contingent account, and $81,913 balance at credit of profit and loss, making the total surplus $1,421,683. At the last annual meeting reference was made to the very decided growth in the company's business, in both the electric and foundry departments, and it was intimated that owing to the fact that some especially large contracts were secured during that year, notably in connection with Niagara Power development, there might be some falling off in the volume of business during 1904. The directors are now pleased to say that instead of falling off the business of the company materially increased, and we carry over to 1905 uncompleted contracts amounting to $1,885,000 in the electrical department and $845,000 in the foundry department, or $2,730,000 in all. In addition to these totals, which deal with the past year's business, we can state that the business of the first two months of the current year is the largest in the history of the company for any similar period. From January 1 to March 5 contracts to the amount of $1,007,000 have been closed by the electrical department and $381,000 by the foundry department. These amounts added to the total unfinished business carried forward from 1904 make a gross total of $4,118,000, or over 35 per cent more than the capital of the company. In view of the fact that the company has no bonded indebtedness, its credit has enabled us to borrow money for the purchase of raw materials required for contracts, etc., at a less rate of interest than would be paid in dividends on new capital. Owing to the great and continued growth of the business, however, the working capital required must necessarily increase, and your directors will recommend at a meeting of shareholders to be called for the purpose that application be made for supplementary letters patent increasing the capital stock of the company, and that of such increase new shares to the par value of $900,000, being at the rate of one new share to three old shares of the common stock, be offered, subject to the discretion of the directors to the shareholders at a premium price to be considered later."

POWER FOR NEW YORK CENTRAL.—It is announced by Mr. Joseph G. Robin, who has been identified with the development of the Niagara, Lockport & Ontario Power Company, that the control of the company as well as of the Iroquois Construction Company, which is allied with the power company, had passed to a syndicate headed by H. H. Westinghouse, brother of George Westinghouse, and John J. Albright, of Buffalo. Mr. Robin stated that the New York Central Railroad interests have a share in this syndicate and that in effect the transactions represented the passing of the Ontario Power Company under New York Central control. The Central, which has been making extensive contracts for electrical power at various points along its lines, recently contracted with the Ontario Company for electrical power to be delivered for some distance east from Buffalo. As a result of the change in the control of the Niagara, Lockport & Ontario Power Company, H. H. Westinghouse has been elected a director of that company in place of C. M. Wicker. Gen. Francis V. Greene succeeds to the presidency of the Iroquois Construction Company, and S. M. Clement, president of the Marine National Bank of Buffalo, takes Mr. Robin's place on the board of syndicate managers for the underwriting of the company's securities. It is stated that hereafter interests identified with this bank will attend to the financing of the company. The executive offices, it is announced, will be moved from New York to Buffalo. In a statement in regard to the change of control issued by Mr. Robin reference is made to the contest over the company's franchises that was carried on before the State Legislature. In regard to the struggle of the company for an extension of its original rights, Mr. Robin says in his statement: "Although it was little understood at the time, it now transpires that all the vital legislation wanted by the Lockport Company was actually secured by it."

THE NATIONAL BATTERY COMPANY.—The annual meeting of the stockholders of the National Battery Company was held August 4 at the general offices of the company in Buffalo. The present board of directors was continued unchanged, and the following officers of the company were elected: Mr. John R. H. Richmond, who was formerly treasurer, was elected president. Mr. James McNaughtan, formerly vice-president, was continued in the same office. Mr. Ralph Kimberly, formerly secretary, was appointed to fill the offices of both secretary and treasurer. Mr. Richmond and several associates have taken a large block of the increased capital stock, which will be used in the extension of the business. Mr. R. L. Coleman, formerly president of the company, was elected chairman of the board of directors, and still retains his large interest in the company. Mr. James McNaughtan, under whose management the company has been brought to its present position of strength and activity, was reappointed general manager. The results accomplished during the past year have encouraged the stockholders of the company beyond their expectations. Extensive plans for further development have been made; the field of activity will be broadened, and it is confidently expected that the results for the coming year will more than justify the company in a continuation of the progressive policy that has been inaugurated.

GENERAL ELECTRIC OUTLOOK.—Discussing General Electric affairs, the *Wall Street Journal* says: "If there is no falling off in the demand for electric apparatus the earnings of the General Electric Company for the current fiscal year are expected to show a substantial increase over the preceding year when they were $6,719,000. While the output of the company is large, it is claimed that the margin of profit is smaller than in preceding years. It is estimated that the company is now employing nearly 22,000 men, the largest number in the history of the corporation. In 1901 the company employed 12,000 men; in 1902, 15,000 men; in 1903, 18,000 men; in 1904, 17,000 men, and in 1905, 18,000 men. It would appear that the profits of the company have not been proportionate to the increased output. The earnings of the General Electric Company, in 1902, for example, were $8,555,000; 1903, $10,232,000; in 1904, $7,789,000, and in 1905, $6,710,000. An interest of the company says that it is too early to estimate earnings for the current year, although it is safe to venture a guess that they will be larger than in the preceding fiscal year. According to the last annual report the General Electric Company was well fortified from the standpoint of cash reporting $6,530,000, as compared with $3,289,000 in the preceding year, $3,289,000 in 1903 and $4,058,000 in 1902."

AMERICAN PNEUMATIC SERVICE.—The American Pneumatic Service Co. has acquired the entire bond issue of the New York Mail & Newspaper Transportation Co. The company holds an unrestricted franchise for the streets of New York in perpetuity, also the contract for carrying the United States mail in that city by pneumatic tube at an annual compensation of $415,000. The acquisition of these bonds is considered the key to the New York tube situation, and gives to the American Pneumatic Service Co. the government business for all the large cities of the country excepting Philadelphia, which has only a small, incomplete system of about one mile in length. Messrs. Howard Gould and A. H. Calef, vice-president of the Missouri Pacific R. R., are to enter the directory of the American Pneumatic Service Co. President Dillaway, of the American Co., has been elected president of the New York Company, and Messrs. John Shepard and Oakes Ames have become associated with Messrs. Gould and Calef in the New York Tube Company.

DIVIDENDS.—The Columbus (Ohio) Railway has declared the regular quarterly dividend of 1¼ per cent on the common stock, payable Sept. 1. The board of directors of the American Railways Company has declared a regular quarterly dividend of 1½ per cent (75 cents per share), payable Sept. 15. The directors of the Scranton Railway Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable Sept. 1.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports increasing earnings, a statement given out this month showing gross earnings for May of $50,865; operating expenses, $29,264; net, $21,600. For five months the gross was $259,570; operating expenses, $158,815; net, $100,755. The net increase for May as compared with the corresponding month last year was $5,246, and for the five months the gain was $23,060.

UNION SWITCH & SIGNAL.—Advices from Pittsburg say that the advance in Union Switch & Signal is based upon a rumor that an increase in the capital stock is likely in the near future and that it will carry valuable subscription rights to stockholders. Union Switch & Signal common stock, paying 8 per cent on par $50 a share is quoted at $87, while Westinghouse Electric paying 10 per cent on $50 is selling around 84 a share.

ELECTRIC LIGHT GAINS.—Two of the Stone & Webster lighting systems show good gains for June. The Minneapolis General Electric Company showed a net profit for the month of $15,002, or an increase of $3,385 over June, 1904, and the Lowell (Mass.) Electric Light Corporation, $2,686, a gain of $1,189.

ELECTRIC LIGHT EARNINGS.—The Seattle Electric Company reports $208,608 gross for May and $75,834 net. The gross for 12 months was $2,378,040, the net $745,192, and the surplus $443,776, an increase of $51,863 over 1904.

CALIFORNIA GAS & ELECTRIC, San Francisco, shows gross earnings for June of $433,718 as compared with $321,264 last year, a gain of $112,454 for the month. There was a net surplus of $64,256.

General News of the Week

The Telephone.

SEWARD, ALASKA.—Seward, Alaska, has been connected with the outer world by telegraphic communication. With the connection of the Seward and Valdez cable, the Government now has about 2,300 miles of cable in Alaskan waters.

FOWLER, CAL.—Citizens of Fowler have incorporated an independent telephone company and will erect a telephone exchange system. The capital stock is $7,500.

POMONA, CAL.—Because the Sunset Telephone Company has failed to show cause why it should not buy a franchise for its business done in this city the City Council has passed a resolution declaring the poles and apparatus of the company a nuisance and ordered them removed within 30 days. The company must now procure a franchise under the Broughton law or fight the city in the courts.

BOISE, IDAHO.—The Pacific and Idaho Northern Telegraph & Telephone Company has filed articles of incorporation at Boise. Capital $100,000. Incorporators are E. C. Van Riper and Joseph M. Dever, of New York, and Edgar M. Heigho, Lewis Hall and Frank Gribbon, of Weiser, Idaho.

CHICAGO, ILL.—The Chicago Telephone Company's gain in July was 1,346. The total now in use is 131,754.

LEMONT, ILL.—The Interstate Telephone Company is installing its exchange here and has already put in a number of telephones.

CAIRO, ILL.—The Bell Telephone Company is contemplating establishing service in Mounds, Tamma, Sandusky, Hodges, Park, Cache, Olive Branch and Thebes.

CHICAGO, ILL.—According to a director of the Chicago Telephone Company there will be no necessity of a new issue of stock this year. The matter was discussed recently, and it was found that the company has enough money to carry on all extension work now contemplated. Earnings are increasing steadily, and a certain percentage of these is being used for renewals and extensions.

CHICAGO, ILL.—The Chicago Telephone Company reports on new instruments for July show there were 1,346 installed during the month, of which 1,012 were in the city and 334 in the country. The total now reported in service is 131,754, a gain of 13,861 since January. During 1904 the total gain for the year was 16,706, and if the present ratio is maintained for the rest of 1905 officials expect the increase to reach a total of over 20,000.

LAFAYETTE, IND.—A telephone line is being built at Junction City for local business men.

FORT WAYNE, IND.—John A. Dungan, assistant general manager of the Fort Wayne Independent Telephone Company, has resigned to accept the superintendency of the Sioux City (Ia.) telephone system.

WASHINGTON, IND.—The Daviess County Home Telephone Company has authorized and issued $100,000 preferred stock. This company has been very prosperous and is now extending its field and putting in new and modern equipment.

MARKLE, IND.—The Markle Telephone Company has increased its rates from $1 and $1.50 to $1.50 and $2. It is claimed that the increase has nothing to do with the sale of the United to the Bell, but resulted from local conditions.

WEST TERRE HAUTE, IND.—The West Terre Haute Telephone Company has filed articles of incorporation with the Secretary of State. Burton Cassiday, D. S. Gonnell and H. H. Knipe are the directors. The capital stock is $10,000.

FRANKTON, IND.—The Central Union Telephone Company is establishing a telephone system in this city, to cost $10,000. In order to build up a business and successfully compete with the home company the Central Union proposes to reduce the rate to 50 cents a month.

HUNTINGTON, IND.—The Central Union Telephone Company, which recently came into possession of the United Telephone Company's property in Huntington and adjoining counties, has announced that $20,000 will be spent in overhauling the system. A large amount of cable will be strung and much of the work will be placed under ground. Four new rural lines will be built and exchanges in the Southwestern part of the county will be connected with the Huntington system.

FORT WAYNE, IND.—George W. Beers gave out a statement a few days ago to the effect that the independents contemplated cutting off the United from all connections and gave as a reason therefor that the manager was discriminating against the independent toll service. This statement brought out a rejoinder from Manager Sale, who said: "Independent companies will not be permitted to sever their relations with the United Telephone Company in retaliation for the United signing a sublicense contract with the Bell, and the minute one of them tries to cut its wires it will be met with an injunction." Mr. Sale said: "If the United States Company of Ohio has severed its connection with us, as stated by Mr. Beers, we have received no notice of it. We are still carrying on business with them, that is certain. We have time contracts with the independent companies, and those contracts are valid and will be enforced," said he. "The statement of Mr. Beers that the business the United has been handling over the independent companies has been rapidly decreasing since our connection with the Bell is not correct. On the contrary during the month of June we turned over to them more business than in any previous month, and it is our interest to turn our toll-line business to the independents, as it is more profitable than giving it to the Bell. There is no danger of our plant being isolated by other independent companies taking it from us as it would hurt them more than us. Other companies over the State will soon be operating without the consent of the Bell, and two companies already sustain that relation, although their officers deny it. Nothing more has been done by the independents toward invading the territory of the United than the connecting up of a small line through Marion to a small town near by, and this is insignificant. Most of this talk of invasion and cutting of connections come from promoters and contractors." Mr. Beers says: "There will be some interesting developments in the situation very soon. I do not wish to be drawn into a controversy with the paid agents of the Bell. The United Telephone Company, from what Mr. Sale says, is fully alive to the consequences of being cut off from the independents, which have 165,000 telephones to 33,000 of Bell telephones in the State."

LOGAN, IA.—A mutual telephone company will be organized at Logan, as a result of the old company's refusal to reduce rates.

GLENWOOD, IA.—The Mills County Telephone Company has started to run a new line from Malvern to Henderson. The company is figuring on a number of other lines.

WAVERLY, IA.—A deed has been filed from trustees of the U. S. Telephone Company conveying all the property owned by that company to the Corn Belt Telephone Company. The latter is the name of the new corporation which now owns and operates what was formerly known as the Cedar Valley Telephone Company. The consideration named in the deed was $55,000. The company owns and operates telephone lines in 13 counties.

COUNCIL BLUFFS, IA.—On each bank of the Missouri River, two miles south of Council Bluffs, the Independent Telephone Company of this city will erect towers of steel 125 feet high for the purpose of stretching cables across the stream to connect Council Bluffs with South Omaha. Omaha, which has no independent exchange, will be left out, while Lincoln, Sioux City and Des Moines, its trade rivals, will get the benefit of the interstate connection. The towers will be of sufficient height to be used as wireless telegraph stations, and there is some likelihood that they will ultimately be made to serve that purpose.

NESTORIA, MICH.—The Michigan Bell Telephone Company will build a toll line to Nestoria.

MARQUETTE, MICH.—A merger by which the Michigan State Telephone Company will absorb the Marquette County Telephone Company, a local concern, is pending and is expected to be successfully concluded.

GRAND RAPIDS, MICH.—The capital stock of the Citizens' Telephone Company will be increased from $2,000,000 to $3,000,000 for the purpose of erecting new exchanges and improving the old ones. The present board of directors was re-elected.

GRAND RAPIDS, MICH.—Grand Rapids and Detroit capitalists are interested in a new independent telephone company. The new company will be known as the Standard Telephone Company and will have lines and stations in St. Joseph, Grand Rapids, South Haven and Benton Harbor. The consolidation of the Twin City Telephone Company with the Michigan line was effected a year ago.

MARQUETTE, MICH.—Should a deal, now in progress, be concluded, the telephone business in Marquette County will again be monopolized by one concern, as was the case before the Marquette County Telephone Company was organized by home capitalists ten years ago. The Michigan State Company is negotiating for the stock of the county system, and there is reason to believe the deal will be successful. The local concern has been paying annual dividends of 10 per cent. on a capitalization of $60,000.

ST. PAUL, MINN.—The Twin City Telephone Company has been granted a number of privileges for the construction of overhead lines.

DEERWOOD, MINN.—The Deerwood Baylake Telephone Company has been formed with a capital of $3,000, by A. N. Gray and David Archibald.

SACRED HEART, MINN.—The Farmers' Consolidated Telephone Company has been formed with a capital of $50,000, by Hans Berger and N. J. Holly.

ST. PAUL, MINN.—The Villard Telephone Company, with a capital of $10,000, has filed articles of incorporation. The incorporators are C. F. Angell, E. L. Scovelle, B. A. Angell, L. F. McGray, W. R. Burter, A. E. Clark and J. W. Burter.

HATTIESBURG, MISS.—The City Council has granted a franchise to J. A. and S. A. Jones and George D. Winter, of Chicago, to build an underground telephone system, at a cost of $125,000.

BRAXTON, MISS.—The Braxton Telephone Company has been organized. Capital, $25,000. It is incorporated by J. H. Gibson and L. D. Spell.

ST. LOUIS, MO.—The recently formed Kinloch-Bloomington Telephone Company, which is a combination of the lines of the old Home Telephone Company and the long-distance lines, controlled by the Kinloch Company of St. Louis, has filed a trust deed to secure the issue of $500,000. The deed is made to the American Trust and Savings Bank, of Chicago.

BOSEMAN, MONT.—The Rocky Mountain Bell Telephone Company will erect an exchange building here.

TRENTON, N. J.—The Rio Janeiro Telephone Company has been incorporated with a capital stock of $1,500,000. The incorporators are Charles H. Sisson, Isaac S. Gilbert, Frank H. Richmond and Henry A. Robinson.

STEWARTSVILLE, N. J.—The Stewartsville Telephone Company has been formed by Benjamin F. Strader, Stewart A. Shillinger, Michael F. Dowling, John C. Boyer, William Y. Bush and others, all of Stewartsville. The capital stock is $10,000.

NEW YORK, N. Y.—The Ontario & Steuben Telephone Company has been organized, by J. E. Lynn and W. H. Hisel. Capital $40,000.

TROY, N. Y.—The Commercial Union Telephone Company of this city has secured a controlling interest in The Co-operant Telephone Company, of

Whitehall, and added these lines to its system, which now covers the entire eastern section of the State, as well as territory in adjoining States. The Whitehall Company has a capital stock of $50,000 and operates over 1,200 telephones in the territory from Whitehall northward to Ticonderoga and eastward to Fair Haven, Hydeville, Castleton and Poultney.

MICHIGAN CITY, N. D.—The Michigan City Telephone Company has been formed with a capital of $5,000, by Edward Litton, Larimore, N. D., and J. H. Lerrett.

COLUMBUS, OHIO.—The Yorkshire Telephone Company has been incorporated by C. D. Grove and E. A. Fisher. The capital is $10,000.

MILLERSBURG, OHIO.—The Millersburg, Wooster & Orrville Telephone Company will erect a three-story building on Mad Anthony Street in this place.

HAMILTON, OHIO.—The Cincinnati Bell Telephone Company has completed plans of a new 2-story telephone exchange for Hamilton at an estimated cost of over $40,000.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has installed a new $3,000 switchboard. The new board has 900 numbers on it divided into 12 blocks of 80 numbers to the block. It accommodates six operators, each operator working 169 numbers.

LORAIN, OHIO.—Negotiations have been opened by the Bell Telephone Company, with a view to buying out the Black River Telephone Company which now enjoys a monopoly of the Lorain business.

CLEVELAND, OHIO.—Under the profit-sharing arrangement existing between the Cuyahoga Telephone Company and its employes, a distribution of funds has just taken place amounting to 7 per cent. of salaries for the six months ending June 30, a gain of ½ of 1 per cent. over the distribution six months ago and 1 per cent over that of a year ago.

DAYTON, OHIO.—In order to be able to accommodate the enormous increase in business, extensive improvements are contemplated by the management of the Central Union Telephone Company. If the plans now being considered are carried out, the added facilities will necessitate the expenditure of about $300,000. One of the most important parts of the improvements will be the extension of the conduit system, and the elimination of telephone poles wherever possible. The overhead cable service will be extended.

WILKESBARRE, PA.—Plans are being prepared for the erection of the new building for the Pennsylvania Telephone Company.

DOYLESTOWN, PA.—Residents of Nockamixon have organized the Nockamixon Telephone Company, with an exchange at Revere. The officers are: President, William O. Ealor, Kintnersville; secretary, Thomas L. Henry, Kintnersville; treasurer, T. M. Moyer, Ferndale.

RIMERSBURG, PA.—The Rimersburg Bell Telephone Company has been incorporated. Capital $5,000.

NASHVILLE, TENN.—E. T. Mitchell and C. A. Thatcher, of Chicago, are applicants for a telephone franchise in Nashville, Tenn.

LAREDO, TEX.—The Southwestern Telegraph & Telephone Company will install an entirely new outfit in Laredo as soon as it can be manufactured.

TIMPSON, TEX..—The Timpson Telephone Company has been formed with a capital of $10,000 by J. B. Bussey and Frank Bussey.

MONTELL, TEX.—The Citizens' Telephone Company has been formed with a capital of $1,000, by A. S. Baylor and T. S. Sutherland.

HUMBLE, TEX.—The Humble Telephone Company has been formed with a capital of $2,000. Incorporated by W. Campbell and W. M. Abbey.

AUSTIN, TEX.—The Commercial Telephone Company of Texas has been sold at public auction for $110,000, having been bought in by a committee representing the bondholders, most of whom are located in Kentucky, Ohio and Indiana. The sale was the result of a suit brought by the stockholders to secure interest on $400,000 worth of bonds, which was defaulted. It is announced that the company under the new organization will proceed at once to enlarge and newly equip the company's property so as to cover Texas, Louisiana, Arkansas and the Indian Territory.

LYNCH'S, VA.—Lynch's Telephone Company, of Lynch's, Campbell County, has been organized with a maximum capital of $5,000, minimum $500. W. S. Frazier is secretary and treasurer.

TACOMA, WASH.—The new long-distance telephone line, of the Sunset Telephone Company, between Tacoma and Spokane, has been completed, and opened to the public. There are but three stations on the line—Tacoma, Seattle and Spokane. It is built over the mountains and is shorter by 100 miles than any other telephone or telegraph line between the cities. Heretofore all messages sent to Spokane from either Tacoma or Seattle had to be sent by way of Portland, but the completion of the new line gives direct connection.

CHARLESTOWN, W. VA.—The Jefferson County Telephone Company has its line up from Charlestown to Harpers Ferry, and the work is now being actively pushed. The lines of the company will connect Charlestown, Harpers Ferry and Hagerstown, Shepherdstown and Martinsburg. The central is now being installed in Harpers Ferry. There are 269 stockholders in the company, all citizens of Jefferson County, among them being banks, bank presidents and directors, real estate agents, insurance agents, doctors, lawyers, merchants and farmers. The company is so planned that each stockholder on taking $25 of the preferred stock is entitled to a residence telephone at $10.50, or a business telephone at $16.50. The company is also offering to farmers the opportunity of building their own lines into the towns, and on such farmers' lines, farmers will be able to have first-class telephone service at $6 a year.

BLAIR, WIS.—The Preston Farmers' Telephone Company has been formed by H. C. Shepard, A. P. Peterson and Guy Shepard. The capital stock is $5,200.

Electric Light and Power.

[illegible]—The City Council has defeated the resolution to call an [illegible] issuing bonds for a municipal electric light plant.

ANAHEIM, CAL.—C. A. Copeland, of Los Angeles, has submitted to Council a report on improving and enlarging the water works and electric light plant. He estimates the cost at $40,000.

STAFFORD SPRINGS, CONN.—Judge Reed has extended the time four months for the [illegible] electric light company to continue to do business under the [illegible].

DERBY JUNCTION, CONN.—The New Haven road is to establish a power-house at this point to work all switches, lights, etc., by electricity.

LAKELAND, FLA.—The Council has under consideration the question of increasing the capacity of the electric light plant. W. B. Clay is superintendent.

ST. AUGUSTINE, FLA.—Thos. R. Osmond and associates have applied for a franchise for the St. Johns Light & Power Company, which proposes to manufacture gas, electricity or other illuminants for light and power and to construct and operate electric railways.

LAGRANGE, GA.—Ludwig & Co., of Atlanta, have secured the contract to construct the municipal electric light plant for Lagrange.

MONROE, GA.—The Electric Supply Company, of Savannah, has secured the contract to construct the municipal electric light plant for about $20,000.

WINDER, GA.—It is proposed to install at the city electric light plant a 30-kw. alternating-current generator, switchboard, etc. D. W. Robertson is superintendent.

FRANKFORT, IND.—It is proposed to add a 120-kw., alternating-current generator to the city electric light plant. J. T. Small is superintendent.

VALPARAISO, IND.—The Valparaiso (Ind.) Light & Fuel Company sold its gas and electric light plant to Charles H. Geist, of Chicago, for $60,000.

WORTHINGTON, IND.—The Indiana Water & Light Company contemplates installing a new arc light system; the adoption of meters and the extension of lines.

NORTH VERNON, IND.—It is proposed to install at the city electric light plant before the fall, an additional 150-kw. unit and boiler. A. B. Berkshire is superintendent.

JASONVILLE, IND.—The Jasonville Electric Light Company will receive bids for the construction of an electric light plant. The incorporation of this company was noted last week.

NOBLESVILLE, IND.—The S. M. Smith Company, owner of the electric light plant, proposes to change from the open arc to enclosed direct-current, 6.6 ampere lamps and rebuild the pole lines. O. N. Eiler is manager.

MUNCIE, IND.—Among the improvements contemplated by this city is the rewiring of the city electric lighting system and the purchase of 100-ft. stacks. Harry L. McCullough is superintendent.

COLUMBUS, IND.—The Columbus Street Railway & Light Company contemplates constructing a power house, making extensions to the street railway and electric light systems and the addition of a heating plant. R. F. Gottschalk is president.

OTTAWA, ILL.—The Ottawa Power Company has been incorporated with a capital of $5,000. Jas. A. Sheldon is one of the incorporators.

ALPHA, ILL.—The Tri-County Light & Power Company expects to extentd its lines to North Henderson and Viola. W. I. Taze is manager.

CLAYTON, ILL.—It is proposed to purchase at once a 60-kw. alternator for the municipal electric light plant. I. M. Brown is superintendent.

BLOOMINGTON, ILL.—The Peoples Gas Electric & Heating Company will probably rebuild its plant in the course of a year. J. N. Moncrieff is superintendent.

CHICAGO, ILL.—Shepley, Rutan & Coolidge are preparing plans for the enlargement of the Hyde Park plant of the Commonwealth Electric Co. The estimated cost of the work is $150,000.

DENISON, IA.—The Denison Electric Light & Power Company contemplates installing a 50 or 60-kw. unit and a boiler.

FORT DODGE, IA.—The Illinois Central is contemplating the installation of an independent electric lighting plant at this city.

BEDFORD, IA.—The Bedford Light, Heat & Power Company proposes to install two new 60-cycle alternating-current generators, one of 40-kw. and the other 100-kw. capacity. M. L. Burt is president.

MADRID, IA.—The Madrid Electric Light & Power Company wants estimates on installing storage batteries of sufficient capacity to carry lights after 12 o'clock and also carry a day current. W. Zenar is chief engineer.

ALBIA, IA.—The Albia Electric Light & Power Company has just started a day circuit, and is in the market for small direct-current motors of ½ to 25 horse-power, 110 and 220 volts. A. R. Jackson is the purchasing agent.

KEOKUK, IA.—The Keokuk & Hamilton Water Power Company proposes to develop electric power at the foot of Des Moines Rapids and transmit it to cities in the States of Iowa, Illinois and Missouri. It is proposed to develop a minimum of 60,000 horse-power. The estimated cost of proposed work is $6,000,000. John N. Irwin, of Keokuk, is president; R. R. Wallace, of Hamilton, Ill., is secretary, and Lyman E. Cooley, of Chicago, Ill., is consulting engineer.

HAYS CITY, KAN.—The Hays City Electric Light & Power Company proposes to install a 65-kw., 1,100-volt alternator.

GARDEN CITY, KAN.—The Garden City Electric Company will soon add to its equipment a 75-kw. dynamo and a 100-hp. Corliss engine.

LINCOLN, KAN.—A committee has been appointed, including A. Marshall, J. Albert Smith and others, to investigate and report on the question of constructing water works and an electric light plant.

PIKEVILLE, KY.—The Pikeville Electric Light Company will install a 100-kw., 250-volt, direct-connected generator.

MIDDLESBOROUGH, KY.—The Middlesborough Electric Light, Heat & Power Company may move its plant to the water works; if not, it is proposed to install a dynamo at the present station and a motor at the water works station. The company would like information about cost of iron poles and underground conduits. Address W. M. Todd, manager.

HOLYOKE, MASS.—About $9,500 will be spent on improvements for the municipal electric light plant.

GLOUCESTER, MASS.—The Gloucester Electric Company proposes to add to its equipment a 500-kw. Curtis steam turbine.

PLYMOUTH, MASS.—At the annual meeting of the Plymouth Electric Light Company the following officers were elected: James N. McCoy, president; Frank C. Calley, treasurer; George H. Adams, clerk; James N. McCoy, Fred P. Weeks, Warren G. Chase, George H. Adams and Frank C. Calley, directors.

LEWISTON, ME.—The Alfred Light & Power Company, which is controlled by the Atlantic Shore line, has taken over the Linscott and Ester water privileges, which were purchased by Bodwell Brothers some time ago. In developing these privileges they will make one privilege at the Ester dam and that will give them a water power capable of developing 800 horse-power.

LONACONING, MD.—The Lonaconing Electric Light & Power Company expects to install a 90-kw. dynamo. Wm. Atkinson is manager and purchasing agent.

ADRIAN, MICH.—The Citizens' Light & Power Company contemplates installing a 500-hp. turbine and boiler outfit.

MASON, MICH.—A new boiler, engine, alternating-current dynamo, switchboard, etc., are needed for the municipal electric light plant. R. E. Darling is superintendent.

HASTINGS, MICH.—The Hastings (Mich.) Gas Company has sold its plant to the Thornapple Electric Company which will hereafter be known as Thornapple Gas & Electric Company.

HOUGHTON, MICH.—The Houghton County Electric Light Company has elected the following directors: Henry G. Bradlee, James R. Dee, Waldo E. Forbes, Henry R. Hayes, William L. Putnam, Russell Robb, Charles A. Stone, Edwin S. Webster and Charles D. Wyman.

BIG RAPIDS, MICH.—The Michigan Heater Company, which is rebuilding the burnt portion of its plant for the Hanchett Sewage Works, is also figuring on generating electric power to supply its own needs, the needs of the Hanchett Sewage Works and also to give the city a day current.

CASS CITY, MICH.—Surveys are now being made for the construction of a dam for the municipal electric light plant, about 4 miles southwest of Cass City, on Cass River. If the report is satisfactory the water power plant will be built next spring, for which a new equipment of dynamos, motors and pumps will be needed. Wm. N. Strube is superintendent and chief engineer.

PONTIAC, MICH.—The Pontiac Savings Bank and the Citizens' Savings Bank, of Holly, have taken possession of the Holly Milling Company at Holly. This also includes the Holly Electric Light & Power Company. C. H. S. Poole, president and majority stockholder of the company, it is said, is indebted to the banks in the sum of $15,000.

GRAND RAPIDS, MICH.—The Cascade Electric Company, which has acquired flowage rights on the Thornapple River, is seeking a franchise in the city to furnish commercial lighting and power. The proposed franchise prohibits the company from charging more than 15 cents per kw-hour for lighting and 4 cents per hp-hour for power, and forbids the company disposing of the franchise to a competitor. The management of the enterprise is vested in Frederick C. Miller, and associated with him are Ernest A. Stowe, Stephen Sears, Robert W. Irwin, A. Hompe, C. C. Follmer, Henry Idema, Walter C. Winchester and Guy W. Rouse, all Grand Rapids men.

ANN ARBOR, MICH.—The Washtenaw Light & Power Company, of this city is to be united with the light and power system of Detroit, and within a few months a feed wire will be run from the Geddes plant to the county line to connect with a feed wire from Delray. The companies concerned are all controlled by the North America syndicate, which is preparing to develop extensively the power of the Huron River.

MUSKEGON, MICH.—The Shaw Electric Crane Company is planning to drive all of the machinery of its great shops at Muskegon Heights by electric current, to be furnished by the Grand Rapids-Muskegon Water Power Electric Company. The machinery is now driven electrically from the Shaw Compan's own plant. A new 400-hp. rotary converter will be put in by the Shaw Company.

STARBUCK, MINN.—Mr. A. H. Dreyer, superintendent of the village lighting system, reports the addition of a new 30-kw dynamo and a 50-hp engine.

MARSHALL, MINN.—It is proposed during the coming year to renew the entire equipment of the municipal electric light plant. E. Simmons is superintendent.

HOUSTON, MISS.—Bids will be received until Sept. 1 by J. M. Griffin for $13,500 water and light bonds.

SARDIS, MISS.—The Panola Electric Light & Power Company expects to put in a series arc light circuit for street lighting about Jan. 1 next.

GLOSTER, MISS.—This city has in contemplation the installing of duplicate dynamos and engine at the city electric light plant. Howard E. Pigford is manager.

COLUMBIA, MO.—It was voted to issue $[illegible] water and electric light bonds. John S. Bicknell is City Clk.

JOPLIN, MO.—The Spring River Power Company proposes to construct a new power plant. The Arnold Company, of Chicago, Ill., is the engineer.

BUTTE, MONT.—Saml. T. Hauser, of Helena, former Governor of Montana, is interested in the construction of a second dam across the Missouri River. It is proposed to transmit the power to Anaconda.

YORK, NEB.—The York (Neb.) Electric Light & Power Company, and the York Gas Company have effected a consolidation and will be known as the York Electric Light, Gas and Power Company. C. A. Haas of Omaha has been elected president and J. A. Peffer manager.

MILFORD, N. H.—Murphy Brothers are soon to put in electric power at their granite works.

WOODSTOWN, N. J.—The Woodstown Ice & Cold Storage Company, which lights this town, proposes to install a larger dynamo and engine. C. F. Moore is manager.

ATLANTIC HIGHLANDS, N. J.—At the municipal electric light plant, it is expected to change over to alternating enclosed arcs and the alternating system to 2,000 primary and 60 cycles. A new dynamo and engine will also be installed. F. E. Price is superintendent.

RATON, N. M.—The Raton Electric Light & Power Company will install a new boiler, engine and a 150-kw alternating-current dynamo.

ROSWELL, N. M.—The Roswell Electric Light Company has in contemplation the purchase of an entire new equipment for its power house. J. H. Cook is superintendent.

LOWVILLE, N. Y.—The Wetmore Electric Company proposes to install a 500-kw. alternator and a pair of water wheels. L. Wetmore is manager.

PENN YAN, N. Y.—The Yates Electric Light & Power Company proposes to rebuild and install two 400-hp. Victor turbines of the horizontal type, direct connected to two 150-kw. generators.

LOCKPORT, N. Y.—The citizens of Lockport are considering a proposition just made by the Albright, Green and Hayes interests of Buffalo, representing the Ontario Power Company, to furnish to the residents of Lockport electric power at $16 per horse-power. They purpose to furnish power in blocks of 100 horse-power at the transmission station on the Ernest farm. The offer is receiving favorable consideration from the business interests of the city.

FAYETTEVILLE, N. C.—Electric light bonds amounting to $30,000 have been sold.

ROCKINGHAM, N. C.—It is proposed to install a new dynamo at the municipal electric light plant.

RALEIGH, N. C.—The Raleigh Electric Company proposes to construct two miles of railway and extend the lighting system. W. J. Andrews is president and manager.

MORGANTON, N. C.—W. A. Mauney, of Kings Mountain, and J. M. Torrence, of Morganton, will organize a company to construct an electric light plant and erect a cotton factory.

STRASBURG, OHIO.—Contracts are being let by the Strasburg Electric Company for doubling the capacity of the plant.

MOUNT VERNON, OHIO.—Mr. Carl Hoster and Samuel Blumenthal, of the Hoster Brewing Company, intend to install a large electric plant.

ADA, OHIO.—The Ada Water, Heat & Light Company will require about 10 miles of construction material for its extension to Algiers. B. S. Young is secretary and manager.

TOLEDO, OHIO.—Frank I. Consaul, chief engineer of the Board of Public Service, estimates the cost of constructing a municipal electric light plant at $470,400.

CAREY, OHIO.—At the village electric light plant it is proposed to add a 75-kw. alternating-current generator and a separate engine for the arc lighting. Harry C. Fink is manager.

OBERLIN, OHIO.—The Oberlin Gas & Electric Light Company, of Oberlin, has been incorporated with a capital of $10,000, by W. B. Whiting, C. F. Brooks, A. J. Sperry and others.

WEATHERLY, PA.—The Town Council has decided to construct a new electric light plant.

COLUMBIA, PA.—The Lancaster County Electric Light & Power Company has decided to construct a power station at Columbia.

HYNDMAN, PA.—The Hyndman Electric Light, Heat & Power Company expects to install a larger engine in the near future. N. A. Blair is president.

HUGHESVILLE, PA.—The Citizens' Electric Light & Power Company is preparing plans for a power plant. John B. Fox is secretary.

KUTZTOWN, PA.—This borough has decided to issue bonds to the amount of about $8,000 for the construction of an electric light plant.

SOMERSET, PA.—The Somerset Electric Light, Heat & Power Company will add a 300-kw. alternator and a 600-hp. engine. J. M. Bricker is manager.

SHAMOKIN, PA.—The Shamokin Light, Heat & Power Company expects to replace its present machinery with 600-kw., 60-cycle, 2,200-volt, 2-phase generators.

TREMONT, PA.—The Tremont and Pine Grove Electric Light & Power Company proposes to extend its system to Pine Grove, a distance of 6 miles, and to Donaldson, 1 mile. Geo. Bernd is superintendent.

WILLIAMSPORT, PA.—The Lycoming Electric Company has decided to lay conduits for underground wires in connection with the building of its proposed new power plant on Hepburn St. Ernest H. Davis is manager.

READING, PA.—The Reading Illuminating Light Company has been incorporated with a capital of $100,000. The directors are. Gustav Ulbricht, of Brooklyn, N. Y.; Ralph W. Gifford, of New York, N. Y., and Dan'l J. Driscoll, of Reading.

BARNET, VT.—The Pioneer Electric Company will install new water wheels this fall. A. S. Hunt is manager.

The Electric Railway.

ATLANTA, GA.—A charter has been granted to a company proposing to build an electric railway from Atlanta to Macon, to be known as the Atlanta-Macon Interurban Railway Company, with a capital stock of $100,000. T. B. Felder, Atlanta; C. C. Canfield, Chicago; and others are the stockholders.

FREEPORT, ILL.—The power plant of the Freeport Railway, Light & Power Company was seriously damaged by fire a few days ago. The loss is estimated at $50,000, and is covered by insurance.

KANKAKEE, ILL.—The Kankakee Street Railway and Electric Park have been sold to a syndicate consisting of R. A. McCracken and E. D. Risser, of Paxton, and C. O. Patton, of Chicago. The price was $100,000.

EDWARDSVILE, ILL.—The Carlinville, Alton & St. Louis Railway Company, of Jerseyville, has been incorporated. The capital stock is $2,000. The incorporators are Andrew W. Cross, Jos. M. Page, Joseph W. Becker, and John C. McGrath, of Jerseyville; Aaron O. Auten, of Chicago; Robert Curdie and June M. Rhoades, of Alton.

COLUMBUS, IND.—The plan to build an electric railway from Columbus to Hope, Hartsville and Greensburg has been revived and is now well under way.

EVANSVILLE, IND.—Evansville and Rockport, Ind., capitalists have held a meeting here to discuss the building of an electric line from either Marengo or English, Ind., to White Sulphur Springs.

NEW CASTLE, IND.—The New Castle-Indianapolis Construction Company has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The object of the company is to build the Indianapolis, New Castle & Toledo Traction Line.

ROCKPORT, IND.—S. O. Graham and associates are promoting an electric railway from a point on the Southern Railroad to White Sulphur Springs. The line will be twelve miles long and afford service to a territory destitute of transportation except by hack line.

RICHMOND, IND.—Six sub-stations are being installed on the line of the Indianapolis & Eastern Traction Company. The new stations are to be located at Cumberland, New Castle, Charlottsville, Lewisville and Cambridge City, the one at the latter place being portable.

DES MOINES, IA.—The State Board of Health of Iowa is considering the practicability of asking the Legislature to pass laws requiring steam and electric lines to disinfect passenger cars at their terminals.

PARIS, KY.—The Nicholas County fiscal court has granted the Paris-Carlisle-Maysville Interurban line the right of way through the county.

BANGOR, ME.—The property and franchises of the Penobscot Central Railroad Company, which has been operating an electric railway from Bangor to Kenduskeag, Corinth and Charleston, will be taken over by the Bangor & Northern Company, which has been organized in Bangor. The officers of the new company are: President, John R. Graham; vice-president, Charles F. Woodward; treasurer, F. D. Oliver; clerk, E. C. Ryder.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company will build a line from here to Waynesboro and Pen Mar, in Franklin County, a distance of 10 miles. The company also proposes to build an electric railway from Boonsboro to Sharpsburg, through the Antietam battlefield, a distance of six miles.

WORCESTER, MASS.—Something unique in street railway excursions in New England is the proposition of the Boston & Worcester Street Railway to take a party from Worcester to Salisbury Beach on a two-days' excursion.

GRAND RAPIDS, MICH.—The Consolidated Railway & Light Company, of Philadelphia, is negotiating for the lease of the municipal electric light plant. Their offer is not considered favorably by the city officials.

MORRISTOWN, N. J.—The Morris County Traction Company has made a mortgage to the Trust Company of America, of New York, to secure $3,000,000 5 per cent 30-year bonds, redeemable at 110. The company has now in operation 7½ miles of road from Wharton to Rockaway. It proposes to build about 60 miles of additional road through Springfield, Union and Milburn.

OGDENSBURG, N. Y.—President Hawkins of the Ogdensburg Street Railway Company has submitted to the directors a plan to connect this city with Gouverneur by trolley. An extension to Waddington and to Morristown, up the St. Lawrence River, is also planned.

PENN YAN, N. Y.—An application will soon be made for a certificate for the construction of an electric railway on the west side of Keuka Lake, to run from Hammondsport to Gibson's Landing and thence to Branchport, there to connect with the Penn Yan, Keuka Park & Branchport Electric Railroad.

CALGARY, N. W. T.—The Calgary Street Railway Company has asked for permission to proceed with the construction of an electric street railway.

LORAIN, OHIO.—The City Council has granted a franchise to the Lorain Street Railway Company for the extension of its line to the river.

PHILADELPHIA, PA.—The Germantown & Chestnut Hill Belt Line has asked Councils for permission to lay tracks which will cover nearly the whole of Germantown and Chestnut Hill.

KNOXVILLE, TENN.—The Knoxville Traction Company and the Knoxville Electric Light & Power Company will be merged into one concern under the name of the Knoxville Railway & Light Company. The capital stock will be $2,000,000.

SALT LAKE CITY, UTAH.—After Judge George G. Armstrong had issued and dissolved an order restraining Councilman Rulon S. Wells, W. J. Tuddenham and A. E. Barnes from voting for the ordinance cosolidating and extending the franchises of the Utah Light & Railway Company, the Salt Lake City Council passed the ordinance, 8 to 7.

New Industrial Companies.

THE HAWKS ELECTRIC COMPANY has been incorporated at Goshen, Ind., with a capital of $36,500, by F. E. Hawks, O. C. Cover, and others.

DODD & STRUTHERS have incorporated at Des Moines, Ia., with a capital of $750,000 to continue the business of making copper cable, lightning rods, etc., established eight years ago.

THE ELECTRIC WATER PUMPING AND FILTER COMPANY, of Kerhonkson, N. Y., has been incorporated with a capital of $600,000. Directors: Arthur J. Baldwin, East Orange, N. J.; C. S. Batt, Tarrytown; Edward T. Magoffin, New York.

THE UNIVERSAL ELECTRIC STORAGE BATTERY COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $500,000; the capital stock in Illinois is $125,000.

THE BATTERY SUPPLIES COMPANY, of Newark, N. J., has been incorporated with a capital of $100,000. Incorporators: James W. Gladstone, Eben G. Dodge and Elisha E. Hudson.

THE SMITH STORAGE BATTERY COMPANY has been incorporated at Zoar, O., capital $30,000, by John Bimeler, Peter Bimeler, Lewis Zimmerman, Malcolm O. Smith, Edwin C. Knapp.

THE AMERICAN CORRESPONDENCE SCHOOL OF ELECTRO-THERAPEUTICS has been incorporated at Chicago by A. D. Gash, James H. Hooper and Page V. Lyon. The capital is $2,500.

THE CLARK ELECTRIC & MANUFACTURING COMPANY, of New York, has been incorporated to conduct business as electricians and mechanical engineers; capital, $100,000. Directors: G. W. Ryburg, T. J. Conry, and C. P. Nevin, of New York.

Legal.

BALTIMORE FRANCHISES.—Mr. Alexander Brown, the well-known banker, who was recently unsuccessful in his efforts to restrain the Maryland Telephone Company from engaging in the electric lighting and power business in Baltimore, has instituted suit to prevent the electric lighting and power franchises of that company from being turned over to the Baltimore Electric Power Company without proper compensation. The suit is against the Baltimore Electric Power Company, the Maryland Telephone & Telegraph Company, Mr. George R. Webb, former president of the Maryland Telephone Company and promoter of the Baltimore Electric Power Company; Mr. H. W. Webb, president of the Maryland Telephone Company, and Mr. David E. Evans, vice-president of the Maryland Telephone Company and president of the Baltimore Electric Power Company.

CURIOUS LIGHTING LITIGATION.—At Springfield, Ill., injunction proceedings are pending in the Sangamon Circuit court as a result of the lighting controversy which has been in progress for several weeks. Judge James A. Creighton was aroused from his slumbers a few mornings ago to issue an injunction against the Springfield Light, Heat & Power Company, restraining it from changing the machines used at the municipal plant, and also from severing extensions to poles in various parts of the city. The cause is set for hearing Sept. 1. Attorney James H. Graham, representing the city of Springfield, prepared the bill, which is directed against Emil J. Schmidt, general manager of the company, and his agents or representatives. The bill recites the agreement entered into between the city and the Springfield Light, Heat & Power Company, and charges the company with preparing to change lamps and extensions. It is also claimed that the dynamos at the company's plant at Tenth and Reynolds streets are being rewound, and that the old open arc lamps, which were taken down about three years ago, were to be placed in position, instead of the enclosed arcs which now are in use. The old lamps were taken down by the company without the consent of the city and have since been in storage. There are 394 lamps which the company claims are the property of the city. Since the lamps were changed, a number of extensions have been made and new lamps have been placed in position. The injunction proceedings recites that to allow the company to carry out the plans recently agreed upon, a portion of the city would be left in darkness.

Obituary.

MRS. E. FLEISCHMANN ASCHHEIM. Mrs. Elizabeth Fleishchmann-Aschheim the wife of I. J. Aschheim, grand secretary of the Independent Order B'nai B'rith, San Francisco, Cal., died August 3, after suffering for months from injuries sustained in the pursuit of her profession as a radiographer. For years Mrs. Aschheim had been operating with the X-ray, and had acquired fame as one of the best experts in that line. She became indispensable to the Army physicians during the Philippine war, when wounded and crippled soldiers landed on the transports, and she located the bullets and splinters and exposed them to the eyes of the surgeons. Her work attracted the attention of the Surgeon-General of the Army, who rated her work very highly. But so intent was she in the performance of her own work that she became careless of her own health, and thus she sacrificed her arm in the pursuit of that fame. The arm was amputated last January. She never fully recovered her health,: though she endured all suffering with heroic fortitude. Death came as relief. Mention of the noteworthy work of Mrs. Aschheim has frequently been made in the ELECTRICAL WORLD AND ENGINEER. Her most recent work was in perfecting a heavy plate-glass screen for use in radiographic demonstrations, but her invention was conceived too late, as the x-ray had already burned her arm badly and fatally.

Personal.

W. B. HALE

MR WILLIAM B. HALE, who has just assumed the duties of general manager of the Mexican Telephone & Telegraph Company, is one of the well-known electrical engineers of Chicago, having been president of the Chicago Electrical Association at the time of its union with the Western Society of Engineers, to become the Electrical Section, and having been since honored again by being elected chairman of the Electrical Section in recognition of his services. Mr. Hale is 37 years of age, and received his education at the University of Toronto and at the School of Practical Science in the same city, in which latter he took the course in electrical engineering. For a short time after graduation he was employed as assistant in the Meteorological Observatory at Toronto, and went to Chicago in 1889 to take a position with the Sperry Electric Mining Machine Company. In 1890, he entered the employment of the Western Electric Company and was soon promoted to various positions at the laboratory, and a little later was given complete charge of the company's laboratories and testing room. Many of the methods of testing employed in the plant have been devised by him. He has had large experience, both in the testing and installation of underground cables and has superintended their installation in many cities. Mr. Hale has been for many years a fluent speaker of Spanish, which, of course, will be indispensable to him in his new position. The company of which he has just become general manager is the Bell telephone organization of Mexico, having exchanges in all the principal cities of the republic. The electrical men of Chicago regret very much to lose such a member from their ranks, but unite in congratulations to Mr. Hale on the greater opportunities offered by his new position.

MR. J. G. WHITE, of J. G. White & Company, sailed for Europe Aug. 15 on the "Koenig Wilhelm II."

MR. JOSEPH A. HERBERT has been appointed manager of the Citizens' Telephone Company, Terre Haute, Ind., to succeed Mr. C. R. Duffin, resigned.

Dr. J. E. IVES has resigned from the De Forest Wireless Telegraph Company to accept the position of assistant professor of physics in the University of Cincinnati O.

MR. C. W. KOINER has been made manager of the National Lighting & Improvement Company, of St. Louis, which owns and operates various lighting, traction and other properties.

MR. H. R. KING was recently elected local secretary of the A. I. E. E., Chicago. Mr. King is now head of the engineering work of the Western Electric Company in Chicago, formerly in charge of H. H. Wait, resigned.

MR. H. F. CAMERON, of the Atlanta office of the Westinghouse Electric & Manufacturing Company, has been appointed to take charge of the New Orleans office of that company, with headquarters at 1110 Hibernia Bank building.

MR. HENRY NOEL POTTER, of Cooper Hewitt mercury arc and Nernst lamp fame, has been made a doctor of science by Amherst College in recognition of his valuable contributions to engineering and science. He has himself taken out nearly threescore patents.

MR. RALPH B. COLEMAN, formerly electrical engineer of the Case Threshing Machine Company, Racine, Wis., is now connected with the Western Electrical Company, of Omaha, Neb., as superintendent of the construction department, handling the sales of Northern Electrical Manufacturing Company's generators in that district.

MR. J. A. VAUGHAN, who for some time past has been sales manager of the Manhattan Electrical Supply Company, New York, has resigned to take charge of the Southern Electric Company, Baltimore, Md. Mr. Vaughan's extensive acquaintance and experience in the electrical field will insure his success in this southern trade.

MR. W. J. WARDER, JR., has been promoted from the engineering department of the Western Electric Company, of Chicago, to a much more important position in the engineering department of the New York office of that company. Mr. Warder was at one time secretary of the Chicago Electrical Association and is well known among Chicago electrical men.

MR. A. O. BENECKE announces that he has severed his connection with the Weston Electrical Instrument Company, with which he has been associated for the past 15 years as chief engineer, and that he has opened an office at 763 Broad Street, Newark, N. J., as an expert on electrical measurements, measuring instruments, testing outfits, standardizing laboratories for power plants and manufacturers, instruction of station attendants, etc., as to testing and repair of instruments.

DR. F. A. C. PERRINE, 49 Wall Street, New York, has decided to go extensively into isolated plant work, covering the general engineering and operating problems of electric lighting, power development and operation, thus affording to the small company or corporation the advantages of a well-equipped engineering office at a very moderate fee. Dr. Perrine is directly assisted in this work by Mr. Edwin H. Seaman, who will attend to the [illegible] details thereof.

PROF. DR. W. WYSSLING, of Zurich, Switzerland, will arrive at New York, Aug. 21, on a visit during which he will make a study of some of the latest developments here in electrical engineering. Dr. Wyssling is professor of [illegible] in the Polytechnicum of Zurich; director of the Sihl Electrical Generating plant, secretary of the Swiss Institute of Electrical Engineers and Secretary and member of the Government commission for the study of the electrification of the Swiss railways.

MR. F. B. H. PAYNE, formerly Expert Manager of the Westinghouse Electric & Manufacturing Company, has been elected vice-president and chief engineer of the Iroquois Construction Company, which is building the power plant of the Niagara, Lockport & Ontario Power Company, and of which General Francis V. Green is president.

MR. J. S. ANTHONY.—Mr. James Stowell Anthony, of the General Electric Company, was married to Miss Alys P. Scott, daughter of Mr. and Mrs. Alfred Bowne Scott on August 15. The wedding took place at Geneva, Switzerland, the ceremony being performed by the Rev. Percy Gordon, assisted by the Rev. Mr. Belden. Mr. and Mrs. Anthony will return to this country early in the fall and will reside in New York, where Mr. Anthony has charge of the affairs of the District. He has been for many years past connected with the electrical industry, and was assistant director of the U. S. department of machinery and electricity at the Paris Exposition of 1900.

MR. B. A. MAPLEDORAM the new general manager of the Northern Texas Traction Co., Fort Worth, Tex., has had a long connection with trolley work. From 1884 to 1896 he was with the Lorain Steel interests, and began to have charge of electric railway construction. He has built roads in Philadelphia, New York, Washington, Harrisburg, Lancaster and Chester, Pa. In 1899-1902 he built and operated the Suburban Rapid Transit of Pittsburg, and then built and organized the Mississippi Valley Traction Co.'s operating department. In 1905 he reconstructed the Memphis (Tenn.) system.

DR. LEE DE FOREST.—Lee DeForest, inventor of the DeForest system of wireless telegraphy, is at the Pensacola Navy Yard inspecting the plant there. He went to ascertain the trouble with the local system and why uninterrupted communication could not be maintained between Pensacola and Key West. The wireless station there was completed several months ago, but has never been operated successfully, especially with Key West, though messages have been exchanged with battleships far out at sea and with Gulf ports. It is expected that another mast, about 200 feet in height, will replace one of the present ones, and it is believed that this will remedy the difficulties now encountered.

MR. A. S. RICHEY, chief engineer of the Union Traction Company, Anderson, Ind., has been appointed assistant professor of railroad engineering at the Worcester Polytechnic Institute, Worcester, Mass. Mr. Richey got a degree in electrical engineering at Purdue University in 1894. After having been associated with the Citizens' Street Railway Company, at Muncie, Ind., and the Marion (Ind.) Street Railway, he became, in September, 1899, chief electrician of the Union Traction Company of Indiana. He became electrical engineer of the Indiana Union Traction Company when it absorbed the other company in 1903 and remained as such until July 1, 1905, when he became chief engineer of the company's system of 400 miles of track. Mr. Richey was born in Muncie, Ind., April 10, 1874.

MR. W. W. WHEATLY, president and general manager of the Federal District Railway, and managing director of the Mexican Traction Company, of Mexico City, Mex., was given a banquet by Sir Charles Euan-Smith, the chairman of the board of directors of the company, at the Chapultepec restaurant, Mexico City, on Monday, Aug. 7. There were present as guests some 47 persons, among whom were many leading government officials, representatives of the diplomatic corps and leading business men and bankers. Especially prominent among those present were the son of President Diaz and the President's Military Chief of Staff. Sir Charles complimented Mr. Wheatly highly on his efficient management of the street railway lines. Mr. Wheatly expects to be in New York during October to remain several weeks, during which time he will contract for considerable sub-station machinery.

MR. WALTER E. HARRINGTON has resigned as vice-president and general manager of the New York-Philadelphia Company to become associated with the J. G. White Company of New York as operating manager. In this capacity he will supervise all of the railway, electric lighting, gas and other properties operated by the company. Mr. Harrington is a graduate of the University of Pennsylvania, and since 1887 has been principally engaged in electric railway work. He has been electrical engineer for the Pennsylvania Railroad Company in charge of the electric railway at Atlantic City, N. J., general superintendent of the Wheeling Traction Company and the Citizens' Railway Company, of Wheeling, W. Va., supervising electric railway engineer for the General Electric Company in the Northern Pennsylvania coal regions, and for some years general manager and vice-president of the Camden & Suburban Railway Company, Camden, N. J. After the latter was absorbed by the Public Service Corporation, he was placed in charge of all the properties of the latter south of Trenton, N. J. Mr. Harrington has also acted as consulting engineer for a number of railway systems, supervising the change from horse to electric power.

MR. CHARLES S. BRADLEY has taken into partnership his two sons and opened an office at 41 Park Row for the practice of consulting engineering. Mr. Bradley's work in the electrical field is so well known that it is needless to refer to it in detail. As an inventor of single-phase and polyphase apparatus, of the process now used for the production of aluminum and of the rotary furnace for the production of calcium carbide, he has been a leader in the electrical field for the past twenty years and his name will always occupy a conspicuous place in the history of the art. His elder son, Mr. Alonzo B. Bradley, was graduated from Columbia University in 1903 with the degree of electrical engineer. Since then he has been with the General Electric Company in its Schenectady shops, and has taken part in establishing one of the electro-chemical processes at Niagara Falls. The younger son, Mr. Walter E. F. Bradley, was graduated from Columbia University the present year as an electrical engineer. While at the university he was manager of the University boat crew, president of the University Electrical Engineering Society and president of the Senior Class of the School of Mines. The firm will design and supervise the construction of isolated lighting and power plants, central station, railway and gas engine plants and electro-chemical plants, as well as report on inventions and undertake the perfection of electrical, mechanical and chemical devices and processes.

MR. J. C. PATRICK has been appointed superintendent of the new plant of the Marquette County (Mich.) Gas, Light & Traction Company.

MR. GEO. HORNUNG, of Cincinnati, O., has been engaged to design an entire new electric light plant for Reading, O., to take the place of the present old plant. New boilers, engines, generators, street lamps and line work will be required.

MR. T. N. McCARTER.—Mr. Thomas N. McCarter, president of the Public Service Corporation, of New Jersey, has had plans drawn for a mansion to cost $100,000, to be erected on his estate on the Rumson Road, at Seabright, N. J. The house will have forty rooms, with a telephone in each.

MR. S. INSULL.—A special dispatch from Chicago of August 9, says: "A report from London that Samuel Insull of this city, president of the Chicago Edison Company, would make his permanent home in the British metropolis, was denied emphatically in a cablegram from Mr. Insull to-day, to William A. Fox, secretary and treasurer of the Edison company. The report from London also said Mr. Insull had had private assurance that the enabling act now before parliament would pass. This gives authority for the building of an immense plant to generate and distribute electric power throughout the metropolitan district of London."

MR. G. L. GROVER vice-president and general manager of the Eastern Wisconsin Railway & Light Company, operating the local street railway in Fond du Lac, Wis., the Fond du Lac interurban line and the Fond du Lac electric and gas plant, has handed in his resignation, to take effect Oct. 1. He has been identified with the Fond du Lac company for nine years, going to that city in 1896 from Milwaukee, where he was superintendent of the Milwaukee & Wauwatosa Electric Company. In 1903, when the Eastern Wisconsin Railway & Light Company was organized, he was elected general manager. Mr. Grover was president of the Northwestern Electrical Association in 1904, and is a thorough electric light man, an "Edison man," in fact, having been connected with the old Edison Electric Mfg. Company at "Sixty-five," away back in 1885-6, when he did considerable construction work. Mr. Grover, who is a Jersey man by birth, has been visiting in Newark this month.

MR. HALBERT P. GILLETTE, M. Am. Soc. C. E., M. Am. Inst. M. E., formerly associate editor of *Engineering News*, and Mr. Geo. H. Gibson, A. M. Am. Inst. E. E., J. M. Am. Soc. M. E., formerly manger of publicity for the International Steam Pump Co., manager of the advertising department of the B. F. Sturtevant Co., and editor of the Westinghouse Companies' Publishing Department, have formed a partnership as "advertising engineers," under the name of Geo. H. Gibson Company, with offices in the Park Row Building, New York City. They undertake to conduct a firm's advertising in the same manner as would a department in the firm's own offices, and are not advertising agents in the usual sense of the term, as they receive no commissions, rendering only service and leaving the actual purchasing of space and printed matter in the client's hands. In an interesting circular announcing its new departure, the firm says: "Products of scientific manufacture require promotion even more than do commercial articles of general consumption. The engineer or manufacturer who has spent years of work and thought upon the perfection of a new product or machine accepts as axiomatic that, because there is a need for it, there will be a demand. He forgets that before his possible customers will give up their accustomed and familiar methods to adopt the new, they must to some degree pass over the same mental course that he has traversed, and, unless educational measures are adopted, this is apt to be a matter of many years. To introduce his improvements in steam engine valve gears, Corliss was forced practically to giving his machines away. The Parsons steam turbine was an engineering success for twelve years before it became a commercial success in this country. On the other hand, the turbine centrifugal pump, by modern advertising methods, has been made commercially successful in a period of two years, the sales of the third year being four times those of the first, while a prominent cordage manufacturer has increased the sales of his transmission rope twenty times over within a few years by means of advertising."

Trade Publications.

"A B C" DISC FANS. A very attractive little pamphlet has just been issued by the American Blower Company, Detroit, Mich., in which are given illustrations of "A B C" disc fans of various sizes for a variety of uses. Accompanying each illustration are a few words of descriptive matter. Some of the fans are driven by electric motors. A price list and telegraphic code are also given.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., has recently issued a supplement of its No. 5 catalogue, listing its Type A switches up to 1,200 amperes. Especial attention is given to aligning the blades and jaws. After being perfectly adjusted, the blades are ground into the jaws with fine emery, to insure the smoothest contact surfaces. This adjusting is so accurate that these switches, it is stated, will continuously carry, without heating, a considerable overload.

News of the Trade.

TOLEDO STORAGE BATTERY COMPANY.—Mr. L. B. Humiston has, it is said, purchased a controlling interest in the Toledo Storage Battery Company. At the annual meeting of the stockholders the following named officers were elected: President, C. E. B. Lamson; vice-president, C. A. Byers; secretary, treasurer and general manager, L. B. Hamilton. The company intends to make some improvements to its plant in Toledo.

EQUIPMENT FOR APARTMENT HOUSE.—A 12-story apartment house is to be built on Amsterdam Avenue from 72nd to 73rd Streets, New York, which will have a complete steam, electric and refrigerating plant. The Central Realty Company, of 900 Seventh Avenue, is the owner; Messrs. Mulliken & Moeller, architects, and Percival Robert Moses, E. E., 320 Fifth Avenue, has been retained as consulting engineer. There will be practically two separate plants, consisting of two boilers of 125 horse-power capacity in each building. The engines will be three simple automatic high-speed horizontal type. Two will be 11 in. x 10 in., and one 10 in. x 10 in. They will operate at about 300 r.p.m. The generators will be direct-current, 115-volt, compound-wound multipolar, two of 40 and one of 30 kilowatts capacity. There will also be an extensive storage battery and refrigerating system.

HYDRAULIC JACKS. Unless a hydraulic jack is absolutely reliable, its use had best be avoided. Just at the critical moment, when everything depends on a jack "standing up," a poorly made device is liable to give way, with consequences best left to the imagination; they are not pleasant, even to imagine. In the Watson-Stillman hydraulic jacks, it is claimed that every element of uncertainty is eliminated. The cylinders and rams, for which, in some makes, so-called seamless tubing is thought good enough, are in the Watson-Stillman jacks forged from solid steel billets and bored like the cylinder of a high-class steam engine. Valves, glands, pistons, etc., are made and finished with equal care, packings and other parts subject to wear are easily accessible and replaceable, the result being a hydraulic jack thoroughly dependable and constantly ready for service. The manufacturer, Watson-Stillman Company, 46 Dey Street, New York, makes a line of about 300 styles of hydraulic jacks.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUGUST 8, 1905.
[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

796,435. SECONDARY BATTERY; Jacobus Langelaan, Oberschoneweide, near Berlin, Germany. App. filed Feb. 27, 1905.

796,437. DOOR SECURING MEANS; Libermond A. Leon, Montreal, Can. App. filed Aug. 4, 1904. A construction of a door latch in which an electro-magnet is effective to release a hammer which falls by gravity and permits opening the door. The hammer is re-set by a connection from the door knob. Additional means permit the door to be opened by a key.

796,441. TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed Feb. 4, 1901.

796,464. CAR BRAKE; Charles J. Specht and Charles R. Krueger, New York, N. Y. App. filed June 24, 1904. The usual pivoted brake shoe has a pair of electromagnets embedded in its face with sectional windings thereon which can be successively cut into or out of circuit so as to vary the braking action.

796,467. ELECTRIC ARC LAMP; Bernard A. Stowe, Cleveland, O. App. filed Dec. 5, 1902. A construction of arc lamp having a central tube or "back-bone" with a U-shaped spring plate embracing the same and regulator magnets suspended from the free ends of said spring plate. The lamp is arranged so that coils for constant current, constant potential, or alternating potential, can be substituted for one another in the device.

796,474. MOTOR CONTROL SYSTEM AND SWITCH THEREFOR; Leonard A. Tirrill, Lynn, Mass. App. filed Apr. 15, 1903. A device for stopping a motor after a pre-determined amount of work has been done. An auxiliary motor in series with the armature circuit winds up a cord which throws the main switch after a pre-determined movement.

796,483. FEED REGULATING DEVICE FOR ELECTRIC MOTORS; Seward W. Williams, Lapeer, Mich. App. filed June 1, 1903. In order to prevent a controller being manipulated to cut out the starting resistance too suddenly, the controller arm carries a ratchet and pawl arrangement which allows the starting resistance to be cut out only by a step by step movement. The controller can be returned by a single movement. An emergency connection is made to the reverse switch by which the latter can be moved three points at once under certain circumstances.

796,501. CONDUCTOR RAIL HOLDER FOR ELECTRIC RAILWAYS; George L. Courtney, New York, N. Y. App. filed Feb. 14, 1905. A third-rail support comprising a massive block of cement which has an iron base plate embedded in it by which it is secured to the ties. The cement block has a petticoat flange formed thereon to secure more efficient insulation.

796,512. EXTENSION CIRCUIT CLOSER; Jacob R. Hershey, Keokuk, Ia. App. filed Dec. 7, 1901. An alarm circuit is closed by the vibration of the usual hammer of a telephone bell, which vibrates against a trip lever and releases a spring blade which closes the local alarm circuit.

796,517. BATTERY HOLDER FOR AUTOMOBILES; Frank Jackson, Denver, Col. App. filed Sept. 27, 1904. A casing having four rectangular pockets with spring clips at the bottom to embrace the usual zinc casing of a dry battery, and additional spring clips at the top of each pocket to embrace the carbon elements.

796,533. ELECTRIC BATH ROBE; Edwin B. Rayner, Piqua, O. App. filed Oct. 2, 1902. The bathrobe is lined with small heat-coils which not only serve to warm the wearer of the robe, but also constitute electrodes for electric treatment.

796,550. LIGHTNING PROTECTOR FOR BUILDINGS; John P. A. Anderson, Madrid, Ia. App. filed Sept. 20, 1904. In order to avoid expensive lightning conductors, the patentee makes use of the usual gutters and metallic fittings of a frame house. A special cap is placed upon the chimney.

796,555. APPARATUS FOR DISTRIBUTING ALTERNATING CURRENTS; Arthur F. Berry, Ealing, England. App. filed Nov. 6, 1903. When the current falls below a predetermined amount, a magnet is sufficiently de-energized to cut in a supplemental transformer, so as to bring its primary and secondary coils into series with the primary and secondary windings of the main transformer. When the current exceeds a certain amount, the supplemental transformer is short-circuited so that the main transformer is alone in action.

796,559. ELECTRIC SIGN; Charles T. Bradshaw, Philadelphia, Pa. App. filed Mar. 17, 1902. A display apparatus in which a circular box has illuminated letters on its front face and rotates on a diametrical axis at high speed, so that the illuminated letters appear to be floating in space.

796,562. TELEPHONE CALL MECHANISM; Tracy R. Campbell, Aberdeen, S. D. App. filed Jan. 14, 1905.

796,568. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Oct. 27, 1902.

796,595. TELEGRAPHIC TRANSMITTER; Alexander Muirhead, Shortlands, England. App. filed Apr. 27, 1899. A relay for cable telegraph systems in which a transmitter is operated by the line current and sends local currents of varying intensity corresponding to the line current through a vibrating relay coil. The relay coil makes a succession of dots of positive or negative character according to the polarity and duration of the line current.

796,596. ELECTRIC TELEGRAPHY; Alexander Muirhead, Shortlands, England. App. filed Oct. 14, 1901. Relates to modifications of the above in which a vibrating relay coil is connected in a specially arranged circuit, including a condenser. By virtue of the arrangement the received wave is retransformed into its original characteristic of a pulsating current.

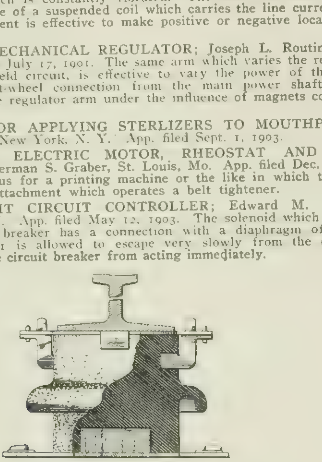
796,597. TELEGRAPHIC RECEIVER. Alexander Muirhead, Shortlands, England. App. filed Dec. 13, 1901. Line current is led through a wire under tension which is constantly vibrated. The wire also has a lateral movement by virtue of a suspended coil which carries the line current, and this lateral movement is effective to make positive or negative local circuit contacts.

796,606. ELECTROMECHANICAL REGULATOR; Joseph L. Routin, Lyon, France. App. filed July 17, 1901. The same arm which varies the resistance in the generator-field circuit, is effective to vary the power of the prime mover. A ratchet-wheel connection from the main power shaft is employed to move the regulator arm under the influence of magnets controlled by the potential.

796,607. DEVICE FOR APPLYING STERLIZERS TO MOUTHPIECES; Orrin H. Savage, New York, N. Y. App. filed Sept. 1, 1903.

796,637. COMBINED ELECTRIC MOTOR, RHEOSTAT AND BELT TIGHTENER. Herman S. Graber, St. Louis, Mo. App. filed Dec. 8, 1904. A driving apparatus for a printing machine or the like in which the rheostat arm has an attachment which operates a belt tightener.

796,646. TIME-LIMIT CIRCUIT CONTROLLER; Edward M. Hewlett, Schenectady, N. Y. App. filed May 12, 1903. The solenoid which actuates the usual circuit breaker has a connection with a diaphragm of an air chamber. The air is allowed to escape very slowly from the chamber, which prevents the circuit breaker from acting immediately.



796,501.—Conductor-Rail Holder for Electric Railways.

796,684. ELECTRIC HEATER; Elihu Thomson, Swampscott, Mass. App. filed Jan. 13, 1905. (See Current News and Notes.)

796,687. CIRCUIT CONTROLLER. Howard B. Wilson, Schenectady, N. Y. App. filed Apr. 18, 1903. The final break of a motor controller is made by contacts in an oil bath which are actuated by a tappet. An additional feature is the heating of the oil bath under excessive current to raise a piston and break the circuit.

796,697. TROLLEY CATCHER; Seth J. Buckland, Springfield, Mass. App. filed Jan. 30, 1905. The returning spring is held normally ineffective by a laterally moving spring pressed bolt. Under excessive speed of the trolley reel certain arms fly outward and release the bolt, which permits the returning spring to act.

796,701. ELECTRIC CLOCK; Ragnar Carlstedt, Jersey City, N. J. App. filed Sept. 1, 1904. The special feature relates to the operating magnet which is concealed in vertical columns which support the clock mechanism. An armature oscillates between the columns and winds up the main spring.

796,702. POLE PIECE; Alexander Churchward, New York, N. Y. App. filed Oct. 25, 1902. The pole pieces are arranged with lateral triangular holes which are designed to render the intensity of the field uniform across the pole piece whether or not the generator is under over-load conditions.

796,728. RAILWAY SIGNALING DEVICE; Joseph Irwin, St. Louis, Mo. App. filed Sept. 13, 1902. In order to show when a locomotive is entering a block section a local circuit on a train is provided, which includes different sets of wheels on the train sufficiently spaced apart so as to lap over the insulated joint and temporarily open the local circuit to give an alarm.

796,740. ELECTRIC CAR LIGHTING; James F. McElroy, Albany, N. Y. App. filed Oct. 6, [illegible]. A dynamo which is direct connected to the wheels of a car, has a mechanical attachment by which it is only connected to the storage batteries when its speed is sufficiently high, and has a mechanical pole changer to adjust the dynamo to the direction of movement of the car.

796,753. MACHINE FOR TREATING ORES; John R. Parks, Spokane, Wash. App. filed Aug. [illegible], 1903.

796,754. PROCESS OF TREATING ORES; John R. Parks, Spokane, Wash. App. filed Aug. [illegible], 1903.

796,757. ELECTRIC INCANDESCENT LAMP; William J. Phelps, Detroit, Mich. App. filed Apr. [illegible], [illegible]. Relates to that type of lamp in which the main filament can be extinguished, but a small one candle-power filament left glowing. In this patent the lamp is adapted to a Thomson-Houston socket.

796,760. LIGHTNING CONDUCTOR; Frank E. Price and William H. McCullough, River Forst, Ill. App. filed Mar. 6, 1905. A construction of lightning conducor having a cluster of points made of copper, the body of which is plated with gold, while the points are plated with platinum.

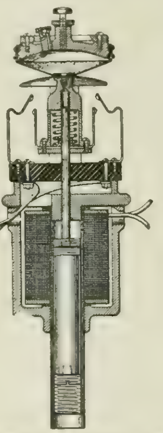
796,797. CLAMP FOR ATTACHING GROUND WIRES; George R. Blackburn, Cleveland, O. App. filed Oct. 21, 1904. A fixture for bell hanger's use adapted to provide a ready means of grounding wires on gas pipes, etc. An iron strap has a screw for tightening it upon the pipe.

796,8[illegible]. RECEIVER FOR USE IN WIRELESS TELEGRAPHY; Edouard Branly, Paris, France. App. filed Sept. 4, 1902. (See Current News and Notes.)

796,817. TROLLEY APPLIANCE; Frank P. Criner, Fort Wayne, Ind. App. filed Dec. 19, 1904. In order to prevent the trolley wheel from so great a tendency to jump the wire, its harp is supported by parallel rods which always hold it in a vertical relation.

796,821. SWITCHBOARD FOR METER TESTS; Russell A. Dangler, New York, N. Y. App. filed Dec. 9, 1904. A portable meter testing set having terminal connections with clips which can be inserted into openings in the meter to make the necessary contacts therein.

796,851. RUHMKORFF COIL; John McIntyre, Jersey City, N. J. App. filed Dec. 3, 1904. A contact for induction coils which does not change its angular relation when adjusted. The contact rod is square and slides into its various positions of adjustment.



796,646.—Time Limit Circuit Controller.

796,853. COMBINED FIXTURE SUPPORT AND CANOPY; William H. Nichols, Bennington, Vt. App. filed Jan. 9, 1904. A canopy particularly designed for supporting electric chandeliers in which the interior faces of the canopy have a pair of porcelain blocks upon which the necessary connections are made.

796,867. SYNCHRONIZING SYSTEM; Paul Ribbe, Halensee, near Berlin, Germany. App. filed Dec. 16, 1904.

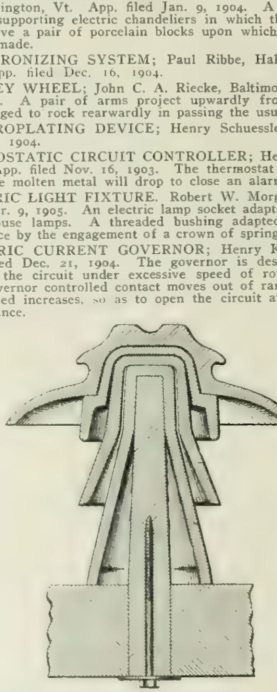
796,869. TROLLEY WHEEL; John C. A. Riecke, Baltimore, Md. App. filed Jan. 14, 1905. A pair of arms project upwardly from the trolley harp and are arranged to rock rearwardly in passing the usual supporting wires.

796,872. ELECTROPLATING DEVICE; Henry Schuessler, Peru, Ill. App. filed Sept. 17, 1904.

796,904. THERMOSTATIC CIRCUIT CONTROLLER; Henry A. Fiske, Newton, Mass. App. filed Nov. 16, 1903. The thermostat plug has a chamber into which the molten metal will drop to close an alarm circuit.

796,922. ELECTRIC LIGHT FIXTURE. Robert W. Morgan, Yonkers, N. Y. App. filed Mar. 9, 1905. An electric lamp socket adapted for either Edison or Westinghouse lamps. A threaded bushing adapted for Edison lamps is held in place by the engagement of a crown of spring clips.

796,935. ELECTRIC CURRENT GOVERNOR; Henry K. Sandell, Chicago, Ill. App. filed Dec. 21, 1904. The governor is designed to cut in resistance into the circuit under excessive speed of rotation, and for this purpose a governor controlled contact moves out of range of a fixed brush when the speed increases, so as to open the circuit at this point and cut in the resistance.



796,977. Insulator Pin.

796,944. HEATER; Harry S. Stewart and Margaret A. Wilcox, Chicago, Ill. App. filed Dec. 19, 1903. A feed water heater in which heating coils are enclosed within the feed-water chamber.

796,972. RAIL BOND; Edward B. Hunter, French Village, Ill. App. filed Dec. 15, 1903. A rail bond in which the bushings having the connecting bond are expanded into the rail by conical wedges with nuts upon their small ends.

796,977. INSULATOR PIN; Fred M. Locke, Victor, N. Y. App. filed Sept. 25, 1902. In order to promote the strength and insulation of the high potential insulator, the usual petticoats are carried by a conical sleeve upon the central pin which abuts against the woodwork.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, AUGUST 26, 1905. No. 9.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE	1139 Monadnock Block
PHILADELPHIA OFFICE	929 Chestnut Street
CLEVELAND OFFICE	402 Cuyahoga Building
EUROPEAN OFFICE	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving old as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **471,000.**

NEW YORK, SATURDAY, AUGUST 26, 1905.

CONTENTS.

Editorial 333
Applause by Wireless 336
Private Convention at Hartford, Conn 336
Underground Conduit for Long-Distance Telephone 336
Porcelain Electrical Supplies 336
Defining the Ether 336
Transformers for the New York Central 337
Statistics of American Railroads 337
Telegraphy and Telephony in Great Britain 337
The Exhaustion of the World's Supply of Iron and Copper 338
The Old-Time Telegraphers' Convention 339
The Electrical Industries of Germany 339
Extensive Trolley System Around the Great Lakes 339
Current News and Notes 340
Electrical Engineers of the Times. XXIV. Henry A. Lardner 342
Hydro-Electric Developments of the Ontario Power Company. I 343
The Boston Edison Fights Municipal Ownership 345
Reactance E.M.F. and the Design of Commutating Machines. By Prof. C. A. Adams 346
Regulation of Gas and Electric Rates in Massachusetts. II. By A. D. Adams 348
Convention of the Ohio Electric Light Association 350
Letter to the Editor:
The Patent Law Situation. By Ludwig Gutmann 354
Digest of Current Electrical Literature 355
Reviews of New Books 358
New Westinghouse Electric Locomotive 359
Ohio Lighting Convention Exhibits 360
New Harmonic Ringer for Party Lines 361
The Universal Direct-Connection Panel 362
Electric Flatirons 362
Industrial and Commercial News 363
General News of the Week 366

OHIO ELECTRIC LIGHT CONVENTION.

Elsewhere we print a report of the annual convention of the Ohio Electric Light Association, one of the oldest and best of our State electric light organizations, which was held last week at Put-in-Bay, Ohio. While the discussions were not as long as at some of the other State conventions, a formidable array of papers was presented, several of which have more than an ephemeral value. The meetings of the Ohio association for a number of years appear to have been a favorite place for representatives of manufacturing companies to present literature relating to new devices. It is perhaps a matter worthy of consideration how far an association of this kind can wisely allow its programmes to be largely taken up by this type of papers. In saying this we do not reflect on the quality of such papers, for they usually contain much information of practical commercial and engineering value, and their preparation for presentation to an association of this kind often leads to the getting together in convenient form of a lot of useful information on commercial devices which might not otherwise be readily obtainable. Nevertheless, such information might as easily take the form of a manufacturer's bulletin, and there is much truth in the remark of a delegate at the present convention, to the effect that information about new apparatus is easy for any central station man to obtain from the manufacturer direct without presentation at an electric light convention, while information on the practical details of the management of a central station cannot be exchanged with as much facility as at conventions, and consequently papers on such subjects are what the central station man most needs. The history of electric light associations seems to bear out this idea, as it is notable that the most successful associations are those which have confined themselves mainly to discussions by members of papers written by members, with an occasional contribution from the supply man's contingent by way of variety. The moment an association begins to get away from this idea and comes to depend too much on manufacturing and supply companies for papers, the real interest begins to wane. Fortunately, the programme of the Ohio association usually contains numerous papers written by members in addition to those originating in manufacturing companies.

It is interesting to observe the various kinds of competition over which the central station men in various States are worrying at different times. Just now a great surplus of cheap natural gas in Ohio is putting up about as stiff a proposition for electric light companies to meet as any companies in the country have ever had to encounter. Natural gas competition struck Indiana some years ago, but is there now on the wane. In Iowa a few years ago the consumer's private gasoline plant and the individual gasoline "arc" were sources of alarm. It is gratifying that electric lighting has survived all these threatened forms of competition, and the outlook has never appeared brighter than at present. While the situation in Ohio is momentarily somewhat unpleasant for the central station men of that State and their minds are evidently much engaged in devising methods to meet the competition, we are confident that electric lighting will continue to hold more than its own just as it has in the case of all previous similar competitions. In spite of the apparent cheapness of natural gas, the expenses occasioned by its smoke and dirt and its inconvenience as compared with electric light, are strongly against it, and these are powerful weapons in the hands of the electric light men. The question of rates to meet cheap gas competition and yet give a proper return on investment, naturally received considerable attention at the convention, but it was quite evident that on this subject the average central station man yet requires much education to broaden his views sufficiently to enable him to cope fully with the situation which the modern rate question presents. It seems, however, that the first step toward a rational system of rates is the adoption of a system of bookkeeping that will enable every item entering into cost to be segregated. Until this is done the central station man should proceed with caution in adopting any of the complicated systems of rates, even though successfully used elsewhere, for he cannot proceed safely until he has submitted a system to an analysis involving consideration of all local cost and other factors.

A State association like that of Ohio could in this particular be of immense service by devising a system of cost keeping and having printed for issue to members complete sets of forms and books for putting it into execution. It is true that such a system would probably not be equally suitable for every central station in the association, but however much it might fall short in a specific case, it would be enormously better than none at all. Moreover, its use would impart the fundamentals of modern central station accounting, and changes suggested by special conditions could then safely be introduced later. In a most interesting preliminary report to the association, Messrs. Bechtel, Miller and Perkins, submitted a draft of a system of cost accounting which might well be put in final shape and placed at the disposition of members in the practical manner above suggested. We fear that unless some action is taken along these lines very few central stations will of their own initiative take up a system involving the complication—in appearance, at least—inseparable from rational cost accounting. In that submitted, for example, there are 14 heads under construction accounts, and 39 heads under general generating and distribution costs. With, however, the privilege of appealing in cases of doubt to a committee of the association appointed to advise members in the matter, and with opportunity to consult with other central stations taking up the system, all but the inevitable weakling would in due time and greatly to their advantage, master this important adjunct to profitable central station working.

Legibility of Electric Signs.

In the tremendous growth of the electric sign business which has taken place in nearly all the large cities of the United States the past few years, it is but natural that sufficient attention has not been given to what may be designated as the engineering side. In other words, there has been too much of a tendency to stick a lot of incandescent lamps into a sign without regard to how they are placed or whether the sign is or is not legible at a reasonable distance away. The essential object of any electric sign is to make certain letters or designs stand out so that they can be read. If a sign fails to do this it has no excuse for being as far as its owner is concerned. There are hundreds of electric signs to be seen on our streets today which are equipped with enough lamps to make the sign easily legible a block or more away, but which can hardly be read at a distance of 150 ft. The cause of the illegibility is usually a blurring together of the lights, and how to avoid this defect is a question of sign design that can be handled in a number of different ways. It is certainly time that some attention were given to this matter, for the waste of money in illegible signs is at present altogether too great. If the reader is unconvinced, let him walk down the streets of any of our large cities some evening and count the number of large electric signs that cannot be read over a half or a quarter of a block.

Modern Electric Lighting.

It would take a regiment of Yankees to guess the future of electric lighting from the present tendencies of lighting practice. The only really safe prediction is that there will be a steady increase in the business, since the gravest objection now urged against the electric light is that one cannot light his pipe at it—at least since the disappearance of the open arc from current practice. But as to the form of lighting that we will have five or ten years hence, the wise prophet is silent, and squares accounts by looking wise and ruminative. Five years ago he gave welcome to the passing of the open arc, and cheerfully staked his reputation upon the incandescent lamp, but now he is badly tangled again. For the flaming arc is on the rampage in out-of-the-way stations, the mercury arc sheds its intense greenery-yallery effulgence on unexpected street corners, and the Nernst lamp glows indoors and out at unexpected points. Then the tantalum lamp and the osmium lamp and the zirconium lamp are coming into sight, with the vacuum tube lamp shimmering behind them. It is enough to make any conscientious seer shudder. And the station manager who makes no professions as a prophet, but merely keeps his ear to the ground, is not a little disconcerted at the uncertain messages that he receives.

Some little certainty, however, can be made out from existing conditions. It is unquestioned that the new illuminants have an additional advantage in efficiency that cannot be put aside for any merely sentimental considerations, nor kept in the background by any commercial maneuvering. In the long run the consumer will find a way of obtaining the advantages of increased efficiency whether the station manager welcomes the change or not. And in the long run, too, it will pay the latter to adopt the more efficient forms of illuminant since the ultimate result of cheap light is a greatly increased demand. But the central station man is keenly interested in one thing for which the consumer, save in cases where he furnishes his own renewals of incandescent lamps, cares not a straw, to wit: the cost of up-keep. The enclosed arc lamp was from the standpoint of energy consumption a step backward, yet its introduction cut the labor cost, in this country, so much that the old open arc is now almost as hard to find as an overshot water wheel. Now, however, comes the flaming arc with so prodigious a saving in energy as to make it necessary to strike a new balance sheet. And the Nernst lamp, undoubtedly of better efficiency than the alternating-current enclosed arc, is also pushing ahead, and is held back mainly by doubts as to its real maintenance cost. From figures recently reported this cost, while subject to great variations, seems to average a good bit less than that entailed by arc lamps of equal aggregate illuminating power.

As to the new incandescents, the actual economy in energy of the tantalum lamp seems to be settled beyond question, and its life under ordinarily good conditions leaves little to be desired. Oddly enough, the only questions raised about its life are those relating to its use on alternating circuits, and these questions have not yet been shown to be anything more than hypothetical. As to the osmium lamp, too, the efficiency question admits of no dispute, and the reports from the zirconium lamp are of a similar tenor. It certainly warms the cockles of the consumer's heart to see, as we did the other day, a tantalum and a carbon lamp burning side by side, the former giving obviously the more light, and yet skimming the meter disc at just two-thirds the rate put up by the latter. And the last word does not seem by any means to have been said on carbon, either, by the sign of the improved lamps just announced. The mercury arc and the vacuum tube, too, are in the game, with somewhat less certain prospects, but surely with a gain in efficiency. We really would like to know as a matter of fact to what extent electric lights other than enclosed arcs and common incandescents are in commercial use throughout the country. We have a notion that the statistics of the heterodox illuminants would figure up rather surprisingly, The large plants, always rather conservative, are slow in taking up with these newcomers, but the smaller plants here and there and everywhere are beginning to move, some in one direction and some in another. They have not yet been stampeded, as they were by the exploitation of the enclosed arc, but they are perhaps getting ready for a rush. Certain it is that the standard incandescent and the "standard" enclosed arc are to-day up against a very real even if somewhat scattered competition. The new lights are now past the stage that can fairly be called experimental in any proper sense of that much abused word. They are out for business on the good old plan of every one for himself and Devil take the hindmost. May they have a merry chase and let the best light win!

THE TESTING OF ALTERNATORS UNDER FULL-LOAD CONDITIONS.

The Hopkinson method of testing electrical machinery by the circulation of power between a pair of units in such a way that only the wasted power has to be supplied to the system from an external source, has had a number of useful applications. Not only direct-current machines, but also alternating-current generators, motors and transformers are conveniently tested in this way. While, however, there is no difficulty in circulating power between two large transformers even if they are in different parts of the same building, there is often much difficulty in circulating power between two large alternators, owing to the inconvenience of bringing them into mechanical connection. It seldom happens, moreover, that two similar large alternators are available for testing at the same time, and consequently the method of circulating power between two units is not readily applied to large alternators. This has rendered it necessary to break a single large alternator up, electrically, into a pair of divisional units, and to circulate power between these units. At the present time large alternators are almost invariably tested in this manner at the factory, where the armatures are operated on short circuit.

In carrying out the plan, however, various difficulties present themselves in detail, and various methods of connection are in vogue. The Mordey method consists essentially in subdividing the armature into two unequal opposed parts and exciting the fields up to the point at which the residual preponderance of armature coils causes the full-load current to circulate through the whole. The plan involves the existence of unbalanced stresses in the armature; but in certain types of alternator this gives rise to no difficulty. In other types, however, the unbalanced stresses on the shaft of the rotor are found to produce serious vibrations and distortional strains. An alternative plan, suggested by Behrend, is to subdivide the fields into two halves, and excite one half stronger than the other, over the short-circuited armature. In this method the center of the field circuit is grounded in the case of a revolving-field machine. It usually requires only a relatively small difference in excitation between the field halves and greatly reduces the mechanical stresses exerted upon the armatures. In an article recently published in *The Electrician*, Prof. Stanley P. Smith gives some observations made with this and other methods of circulating power in a particular 2-kilovolt, 30-kilowatt, single-phase machine.

In this relatively small machine it was found that the difference in excitation between the two half fields of the Behrend test was so great that one of the half fields was practically without excitation. The stresses upon the rotor shaft were thus nearly as great as though the two half fields had been fully excited in opposite directions. The vibration of the rotor shaft was, therefore, so great that the full-load current could not be circulated through the armature. The impedance of the armature is not stated, but it seems possible that it was sufficiently large in reactance to require much greater differential excitation in the field halves than is required in the ordinary large sizes of alternator. In order to avoid this large vibration a number of different methods of connecting the field coils in opposition were experimented upon. In some tests the field was divided into two groups; in others into three; in yet others into four, and in one case into six, the total number of field coils being twelve. The groups were, moreover, connected up in different ways with regard to symmetry, and also with regard to strength of excitation. In general the results recorded show that in cases where the electromagnetic stresses were balanced, so that the resultant electromagnetic forces acting on the rotor at rest being zero, the power and armature current could be circulated without difficulty up to overload capacities. When, on the contrary, the electromagnetic stresses upon the armature at rest remained unbalanced, as for instance with eight consecutive field coils in one group opposed to the four consecutive coils in the other, the mechanical result was dangerous when the machine was driven at speed. In a few cases, however, the mechanical disturbance at speed was large even when the stresses on the armature at rest appear to have been balanced. In these instances it would seem that the vibration must have been due to unbalanced thrusts set up by armature reaction; i. e., by armature-current magnetization at speed. It would be interesting to ascertain whether the interruption of the armature circuit in these instances would convert the vibratory running into smooth running.

The deductions made in the article, from the observations, point to symmetrical distribution of the generator and motor thrusts upon the rotor shaft at rest, in order to secure smooth running. These deductions are, however, only made upon the observations with this small generator, and it is quite possible that with large alternators the result to be obtained would be markedly different. A great question in all such cases of unusual field and armature connections, not answered in the article but postponed for future consideration, is whether the hysteretic losses in the rotor and stator are substantially the same as in the normal mode of operation. Manifestly, the value of the test would be greatly impaired, or even altogether destroyed, if the circulation of full-load current in the armature could only be secured at the expense of large variation from the normal distribution of hysteresis losses. This is a matter which can only be settled by thorough experimental investigation. It cannot be taken for granted. So troublesome is it in many cases to find the best arrangement of circulating power in an alternator that the method is often abandoned and hysteretic waste is substituted for joulean waste—that is, iron losses for copper losses. This is done by measuring the hysteretic loss on open armature circuit for a large range of voltages and field excitations. The field is then left over-excited at such a strength that the hysteretic loss in the machine is equal to the normal full-load hysteretic loss plus the computed full-load copper loss. It is true that all the wasted energy is thus expended in the iron, instead of being expended partly in the iron and partly in the copper; but in the course of a few hours the equalization of temperature is fairly complete and the gradients of temperature in a large alternator armature are sensibly the same in either case. Another advantage of this test is that the field connections remain normal, while the over-excitation, while it naturally raises the temperature of the field to some extent, yet tends in the direction of safety, that is, to make the machine hotter than it would be in practical operation under full load.

Applause by "Wireless."

A novel application of the wireless telegraph transmitter was made the other night during one of the weekly band concerts given at the Pensacola Navy Yard. The large wireless transmitter station is located near the band stand, and at the finish of a selection by the Navy Band, the De Forest operators, who had been testing their wireless plant, by way of expressing their enthusiastic applause, opened wide the great spark gap as well as the doors to the sound proof "spark muffler," and then depressing the Morse key sent out a succession of long, loud dashes, the deafening sound of which could be heard for blocks around. The spark is one of "low frequency," and its rattle, following upon the last notes of the music, sounded not unlike the outburst of thunderous applause from a vast multitude of clapping hands, only sevenfold louder than any ever heard before. The startled bandmaster, recognizing the novelty of this sort of applause, and impressed with the electrical enthusiasm of this new "claque," responded with the only encore of the evening, to the great amusement of the wireless men and his audience in general.

But the most striking part of the whole proceeding came to light shortly afterwards, when the DeForest operator at the station at New Orleans reported that precisely at that time he heard the succession of long, loud dashes, breaking up into the irregular clatter simulating the clapping of hands. So it proves that the bandmaster of the Navy Yard Band of Pensacola has been honored by the most thunderous applause ever yet given in the history of music. Applause heard 180 miles! Unfortunately the New Orleans operator was unable to hear the music prompting this etheric enthusiasm.

◆

Private Convention at Hartford, Conn.

According to advices from Hartford, Conn., representatives of thirty gas and electric companies, from cities in various sections of New England, and as far West as Kansas City, were in that city on August 16, attending the annual meeting of the United Gas & Electric Co. The visitors represent companies which are affiliated under the United Gas & Electric Co.

The members of the party were nearly all superintendents of their companies. They were cordially received by General Manager R. E. Slade, of the Hartford City Gas Light Company. After a thorough inspection of the company's works, they went to New Haven to inspect the new plant of the New Haven Gas Light Company, and returned to Hartford for their first business session at the gas works this morning. During the meeting the subject of high pressure lines was taken up. A committee will report on the subject of "Ammonia." After lunch the session was resumed, and at 5 P. M. the party visited the new and partially completed plant of the Hartford Electric Light Company at Dutch Point. On Wednesday the report of the committee on electric signs was read. Topics relating to advertising were also taken up and discussed. The subject of gas engines was also taken up. The visitors then left for Albany and on the following day they were guests of the General Electric Company, a private car conveying them to the works at Schenectady.

◆

Underground Conduit for Long Distance Telephone.

Details of construction of a projected underground conduit for telephone service between New York and New Haven have been announced from the New Haven office of the Southern New England Telephone Company. It is a joint undertaking entailing a large expenditure of money and is being financed by the Southern New England and the American Telegraph & Telephone Company. All surveys and draughtings have been completed and contractors are now bidding on the work.

The present conduit extends from New York to Portchester and the work from there will be begun in the early fall. It will be of great use in the toll line service, for which it is expressly designed. In building this conduit a trench four feet deep is made with a cement flooring or foundation. Upon this the ducts are placed. The number varies from six to eight in the country sections of the line, but as cities are approached the number greatly increases. A layer of planking preserved by creosote protects the tiles from damage by promiscuous digging along the line.

The cables themselves are not fastened inside the tile piping, but may be drawn out and replaced in case of necessity by a system of manholes which will be built every thousand feet

◆

Porcelain Electrical Supplies.

Statistics of the clay-working industries in the United States, which have been compiled by Jefferson Middleton, show that, of the total pottery produced in 1904, 5.69 per cent., representing a value of $1,432,943, was used for porcelain electrical supplies. In the year 1903 there were 31 producers of such supplies, while in 1904 the producers had increased in number to 33. It is interesting to observe that the greatest centers of the pottery industry are found at Trenton, N. J., and at East Liverpool, O. At the former place during the year 1904 the porcelain electrical supplies produced had a total value of $276,714, and at the latter place the corresponding value was $371,802, or the total value for the two places was $648,516, which represents more than 45 per cent. of the whole supply of the United States for last year. Probably there were some porcelain supplies of an electrical character not specifically reported as such.

◆

Defining the Ether.

Mr. W. A. Shenstone, F.R.S., in a recent magazine article says: Of all the theories of the ether, that propounded by Professor Osborne Reynolds is perhaps the most startling. It inverts all our previous ideas on the subject. According to this, the youngest theory of the ether, we must look upon the ether as the one really substantial thing in the universe, its density being ten thousand times greater than that of water; while matter, which seems so substantial, consists, so to speak, in an absence of mass, and has the character of a mere wave in the ether. On this newest view "we are all waves," as the author of the theory, bursting into poetry, exclaimed at the close of the eighth section of his Rede lecture. This astonishing proposition, which has cost its author no less than twenty years of labor, asks us to imagine that the universe, except those minor portions which constitute matter, is built up, like a bag of sand, of grains of definite shape and in size so inconceivably small that their diameters are no greater than the seven hundred thousand millionth part of the wave-length of violet light, which in its turn amounts to only sixteen millionths of an inch, and so closely packed that, though not absolutely immovable, the four hundred thousand millionth of the seven hundred thousand millionth of one sixty thousandth part of an inch—i. e., the four hundred thousand millionth part of their own diameter—would represent approximately the mean free path through which these particles are free to move. Professor Reynolds tells us that the density of this medium, far from being almost indefinitely small, is nearly five hundred times as great as that of the densest matter known to us on earth, and its pressure more than three thousand times greater than that which any material yet tried has been known to sustain.

To get some idea of this conception of the ether, picture to yourself a billiard table carefully packed from one end to the other with line after line of billiard balls, each line so nicely fitted or geared into the next that the balls are packed almost as close to each other as is possible, yet not so very tightly as to prevent, absolutely, all motion among them. Imagine, again, that you have not one layer of balls, as on a billiard table, confined by the sides of the table, but layer upon layer piled one above the other and extending absolutely without limit in every direction. Remember that these balls or grains are so minute that, say, 11,200,000,000,000,000,000 of them laid side by side along a line would only occupy a single inch, and you will have a picture, so far as may be, of Professor Reynolds's conception of the universal medium, the ether.

Transformers for the New York Central.

The order for transformers to be used in the electrical operation of the New York Central & Hudson River Railroad at its New York terminal has been awarded to the General Electric Company. It covers all the transformers to be used in the eight sub-stations of the electric traction district. There will be fifty-four 375-kw and eighteen 550-kw transformers for operating rotary converters, and thirty-three 120-kw transformers for operating booster sets. All these transformers are of the air-blast type, and are built for 25-cycle circuits. This represents a total of 34,100 kw; or, approximately, 45,000 hp of transformer capacity. The sub-stations which will contain this apparatus are located at various points throughout the New York district, extending from the Grand Central Station to Croton-on-Hudson, on the Hudson River Division, a distance of thirty-four miles, and to North White Plains, on the Harlem Division, twenty-four miles. Three-phase, alternating current generated by Curtis turbines at 11,000 volts, will be transmitted from two power houses, one at Glenwood-on-Hudson, a suburb of Yonkers, and the other at the end of the Port Morris branch on Long Island Sound. At the sub-stations the alternating current will pass through these transformers and by means of rotary converters will be transmitted to the line at 600 volts direct current.

On account of the extraordinarily heavy service to which these transformers will be subjected, a brief description of the general design employed may be of interest. The transformer coils, both primary and secondary, are assembled vertically in groups side by side with intermediate air ducts. The groups are subdivided into several flat coils built up of flat conductors of rectangular cross-section, one turn per layer. A continuous non-combustible insulation consisting of mica strip separates each turn from the next, and the completed insulation on the coils can withstand potentials two or three times greater than the same thickness of the best insulating oil. Channels of insulation moulded into proper shapes maintain the requisite spacing and hold the coils firmly in place. The assembled structure is tightly bound together, thus preventing any possibility of vibration of the coils.

The insulation on the primary and secondary coils (which would readily withstand a much higher potential than that for which it is designed), the diaphragms between the primary and secondary coils, and the additional insulation due to the air ducts between the primary and secondary windings, insure a high factor of safety. The sheet-iron core is assembled around and through the coils, the core being supported directly on the cast-iron base. The numerous air ducts between the coils and through the core structure, in connection with motor-driven blowers, provide a circulation of air which maintains a low uniform temperature in all parts of the windings.

The order for the motor-driven blower sets for all of these transformers has also been awarded to the General Electric Company. These transformers are provided with one-third and two-thirds voltage taps on the low-tension side, to permit the starting of the rotary converters directly from the alternating-current end without the use of starting motor or starting compensator.

Statistics of American Railroads.

The annual report of the Inter-State Commerce Commission, giving the railroad statistics for the year 1904, shows that there were at the end of that year 207,073 miles of railroad in the United States operated by 2,104 corporations. The increase in single trackage for the year was 5,927 miles. On June 30, 1904, there were in the service of the railways 46,743 locomotives. The total number of cars of all classes, exclusive of those owned by private companies, was 1,798,561, 39,752 in passenger service and 1,692,184 in freight work. The number of persons on the payrolls of the railways in the United States was 1,296,121, or 611 per 100 miles of line. The wages paid for the year amounted to $817,598,810. The par value of the amount of railway capital outstanding on June 30, 1904, was $13,213,124,679. Of this capital $6,339,899,329 existed as stock, and the remaining part, $6,873,225,350, as funded debt.

Of the total capital stock outstanding $2,696,472,010 paid no dividends. The amount of dividends declared during the year was $221,941,049, equivalent to 6.09 per cent. on dividend-paying stock.

The number of passengers reported as carried by the railways in the year was 715,419,682. The passenger mileage was 21,923,213,536. The number of tons of freight carried was 1,309,899,165. The ton mileage was 174,522,089,577. The gross earnings were $1,975,174,091. Operating expenses were $1,338,896,253.

The total number of casualties to persons on the railways was 94,201, 10,046 killed and 84,155 injured. Of the persons killed 441 were passengers and the wounded 9,111, or one killed out of every 1,622,267 carried, and one injured out of every 78,523 carried.

Telegraphy and Telephony in Great Britain.

The fifty-first annual report of the British Postmaster-General has just been issued. It applies to the year ended March 31, 1905, and contains a variety of interesting data as to telegraphy and telephony in Great Britain. He says:

During the year 88,969,000 telegrams passed over the Post Office wires, as against 89,997,000 in 1903-4, a decrease of 1.14 per cent. The total value, however, has increased, being £2,755,485, as against £2,741,191 last year. The estimated value of the railway free telegrams is £55,800, against £59,100 in 1903-4; that of the Government free telegrams £22,800, against £23,200 in 1903-4. The decrease in the number of ordinary inland telegrams is, perhaps, due partly to trade depression; but, as it is coupled with an increase of 5.1 per cent. in the foreign telegrams, it may be attributed largely to the growth of the telephone system. The number of foreign telegrams is the highest on record. The average number of words per week in press telegrams during the year was 15,531,332, against 14,588,458 in 1903-4. The telegraph offices now open in the United Kingdom number 10,172 at post offices and 2,354 at railway stations and other public places. The system of providing direct communication between provincial towns has been pursued, as in previous years. The system of direct intercommunication between telegraph offices in London, of which the first portion was installed two years ago, continues to give good results; and it will be possible to connect a number of additional offices to the switch before the end of the present year. The underground line from London to the North has been extended by the provision of a cable containing 97 wires between Warrington and Carlisle, and the laying of 70 miles of pipes, which, together with the section laid in the previous year over the Beattock incline, complete the pipe line from Carlisle to Glasgow. It is proposed this year to provide wires over the latter section, and communication will then be possible between London and Glasgow by means of underground wires solely. A pipe is being laid to contain 137 wires between Hanwell and Slough, and during the present year it will be extended from Slough to Reading. The provision of a pipe and cable between London and Chatham is also being considered as a beginning of an underground route to the southeast coast, the point of departure of many of the submarine cables. Experiments with various high-speed automatic typewriting telegraphs are being continued, and some of the systems are very promising. British makers of electric plant are now devoting more of their attention than formerly to the manufacture of telephone apparatus; though it is not possible yet to dispense (or nearly dispense) with the services of foreign makers. Arrangements have been made for the establishment of a second direct wire between London and Cologne, and also for the establishment of direct telegraphic communication between London and St. Malo during the potato and fruit season. The question of further increasing the facilities for communication between London and Paris and certain other Continental towns is receiving attention. No new cables from the United Kingdom have been laid during the year, but it has now been arranged for a cable to be laid between the Shetland Islands and Iceland via the Faroe Islands by the Great Northern Telegraph Co. The strategical importance of wireless telegraphy, and the fact that some centralized control is necessary if the public are to secure the fullest advantage from this new means of communication, led to the passing of the Wireless Telegraph Act of last session (4 Edw. 7. c. 24), which renders it illegal for any person to install or work wireless telegraph apparatus in the United Kingdom, or on board British ships in territorial waters, except with the license of the Postmaster-General. In view of the progressive nature of the invention, and the possibility of unforeseen developments, the act was made operative for a period of two years only, to expire on July 31, 1906. The experience of the working of the act shows that it will be essential to the public interest that it should be renewed. Some difficulty has been experienced in dealing with the applications for commercial licenses, owing to the fact that, in the present state of electrical science, it is impossible for the stations of rival undertakings to work in the same neighborhood without danger of mutual interference. The International Conference on Wireless Telegraphy, which was to have been held in April last, has been postponed owing to the political situation. The number of telephone trunk-wire centers on March 31st last was 443, an increase of 47 in the year. The new trunk circuits provided during the year numbered 186, and the total number in use was 1,604, as compared with 1,418 in the preceding year. The total length of the trunk circuits in use was 56,400 miles, containing about 112,800 miles of wire. The capital expenditure on the purchase and development of the trunk wire system up to March 31st last was £2,537,288, including an expenditure during the year of £337,264. The total number of conversations over the trunk wires for the year was 15,401,822. This shows an increase of 1,933,847, at the rate of 14.8 per cent., over the corresponding number for the previous year, which was 13,467,975. The gross revenue derived from this service was £380,308, as compared with £325,525 in 1903-4. The increase was thus at the rate 16.8 per cent. The average value of each conversation was 5s. 9d. There are now four telephone circuits between London and Paris, one between London and Lille, and two between London and Brussels, the latter carrying an increasing amount of traffic. A still farther development of these services may be expected since the agreement with the National Telephone Co. has been approved by Parliament, as under that agreement the lines will become available for use by subscribers to the company's system. Experiments have recently been made in telephonic communication between London and Rome by way of Paris. It was found possible to exchange speech when the conditions were exceptionally favorable, but, in spite of the partial success of the experiment, a public service between the two capitals is not at present practicable. The total number of subscribers to the Post Office provincial telephone exchanges on March 31st was 6,854, and the number of telephones rented increased in the year from 6.874 to 8.644. According to returns recently furnished by the Corporations concerned, the number of telephones connected with the exchanges of the various municipal systems in Great Britain were as follows:—Brighton, 1,736; Glasgow, 11,623; Hull, 1,405; Portsmouth, 2,250; Swansea, 1,259. The number of telephones in connection with the Post Office London telephone system increased during the year from 15,032 to 24,351; and additional subscribers are being connected at an average rate of about 150 a week. A new exchange was opened at Hampstead during the year under review, and two others have been opened since March 31st. The accommodation at the central exchange is now almost exhausted, but a new exchange, to be called the City Exchange, with a maximum capacity of 18,000 lines, is expected to be ready for opening in a few months. The length of the underground pipes which had been laid in the London area on March 31st last was 1,251 miles, 105 miles having been laid during the year. Cables containing 102,216 miles of wire have been provided, including 35,572 miles rented by the National Telephone Co. pending the transfer of the company's system to the Post Office. The lines of the present subscribers and the junction lines between exchanges have absorbed 66,821 miles; and 50,823 miles of wire remain available for the future development of the London telephone system. The average cost of construction per mile of double wire has decreased since last year from £18 16s. 10d. to £16 18s. 0d., and the average cost of constructing an exchange circuit (including the installation of telephone instruments and of exchange apparatus, but excluding the provision of spare plant) has been £38 18s. 9d., as against £41 9s. 8d. in the previous year. Taking into account the whole system, including spare plant of all kinds, the capital expenditure per station (i. e., per telephone connected with an exchange) stands now at £94, as compared with £86 in 1902-3 and £73 in 1903-4. It is hoped that the expenditure per station will still further diminish as the very large amount of spare plant provided comes into use. An account of the receipts and expenditure relating to the London service for the year ended March 31, 1905, is printed in an appendix. It shows a balance of £93,208, a sum nearly sufficient to meet the charge for interest on capital and to provide for depreciation of plant. This balance is rapidly increasing as more of the plant comes into use and begins to earn revenue. Similar tables are also given (for the first time) in respect of the Post Office provincial exchange systems and the trunk-line system. A table is also added to show the financial position of the three systems taken as a whole. This shows a balance of £282,321, while the estimated amount required to provide for depreciation of plant and interest at 3 per cent. on the capital expenditure of £5,042,000 is £300,776. The amount of royalty received during the year from the National Telephone Co. was £192,562, and from other licenses £8,163. Two million five hundred and thirty-seven thousand five hundred and fifty telegrams and 48,900 express letters were sent by telephone for onward transmission, and efforts are being made to bring the advantages of these services more clearly under the notice of telephone subscribers.

◆

The Exhaustion of the World's Supply of Iron and Copper.

A recent issue of the *International Quarterly* contains an interesting article by Prof. N. S. Shaler, in which he discusses the importance to civilization of the metals, iron and copper, and deals with the possibility of the world's supply being exhausted. If any of the important metals, except iron and copper, were by some accident, to be transmuted, it would cause a temporary inconvenience, but the world would soon adjust itself to the loss. With copper, and in a greater degree with iron, however, it is far otherwise. Our whole civilization, indeed, may be said to be built on iron. Its cheapness forms a considerable element of its value to man. Iron is a very widely distributed element, and the amount of iron ores still available is very great, perhaps twenty times as great as has been won to use. Some of the best-known fields, however, are beginning to be exhausted, and it is evident that at the present rate of consumption of iron, the European source of supply are not likely to endure for a century. It may fairly be assumed that beyond the present century, the world as a whole will not have access to the metal at anything like the present cost in terms of labor. It is not to be supposed that the iron age will suddenly pass away. The cost of production will gradually increase as the lower grade ores and those remote from coal come into use. Later we shall have to resort to concentrating processes to separate the iron ore from the rock in which it is disseminated as grains. Finally, it may be some centuries hence, but surely, the world will be forced to an economy in the use of the metal such as was exercised 200 years ago. There exists a considerable leeway in the case of iron in the saving that will be made in scrap materials as soon as the price rises to, say, $50 per ton.

In the case of copper, the sources of supply are very much rarer than those of iron, and the total amount of the metal in the crust of the earth is probably not more than the thousandth part of that of iron. Its supply will doubtless be reduced to a point where its service to the arts will be seriously limited before there is a like reduction in the supply of iron. We can, however, look upon the approaching exhaustion of the sources of copper with less apprehension than in the case of iron, for the reason that, useful as the metal is in manifold ways, it is not indispensable, or even very necessary, in our arts except in the transmission of electric power, and, even in that, substitution is possible. In its qualities aluminum is admirably adapted to serve most of the needs now served by iron and copper. It is relatively very light, but for its weight is admirably strong, rigid, tough and elastic; it is a good conductor of electricity and it does not oxidize as readily as do iron and copper. The amount of aluminum lying almost at the surface of the earth's crust is enormous, probably many thousands of times as great as the amount of iron contained in the concentrated form of beds or veins. Every clay bank is a possible source of the metal. Aluminum is never found in the metallic state, but in the form of silicates. Before it can be put to the uses of man, its union with the silicon must be broken up, and the work of separating the elements is very costly. With any methods now conceivable we have to reckon that, while aluminum is likely in time to take the dominant place now held by iron, it will do so at a cost in terms of labor far higher than what men now pay for their capital metal. Nevertheless, the difference is not likely to be so great as to prevent aluminum from coming to the rescue of the mechanical foundations of our economic civilization.

The Old-Time Telegraphers' Convention.

The Old-Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps will hold their annual conventions in New York City separately and together next week, the exercises beginning on Tuesday and continuing until Friday inclusive. It is ten years since the two bodies last met in the metropolis, in which time a great many changes have been seen, not only in the personnel of these two organizations, but in the surrounding conditions that relate to telegraphic work. The Old-Time Telegraphers are fortunate in having at this juncture as president Mr. John C. Barclay, the efficient and energetic general manager of the Western Union Telegraph Company, and Mr. Francis W. Jones, chief electrician of the Postal Telegraph-Cable Company, as vice-president. The president of the Military Telegraphers is Col. W. B. Wilson, of Philadelphia. Behind these gentlemen stand a very able body of executive officers and a large number of working committees, of prominent men and their wives, the largest of which are those of reception and the ladies' general committee.

At the head of the reception committee is Mr. T. L. Cuyler, Jr. Mrs. F. W. Jones directs the work of the ladies' committee. The headquarters will be at the Waldorf-Astoria. On Tuesday, August 29, the business meetings will be held of both bodies in succession, with entertainment in the afternoon, and a theatre party in the evening. This is the only day in which any real work will be attempted, as the underlying object of both societies is not technical but the renewal and maintenance of friendships formed in the earlier days of the art. The Old-Time Telegraphers has become in a sense a self-perpetuating body, but it is needless to say that the ranks of the Military Telegraphers, constituted as it is of men who took part in the Civil War, are becoming thin, and that of the large body of operators who risked their lives at the front a bare handful is now left. The programme on Wednesday includes a trip to Coney Island, while on Thursday the banquet will take place at the Waldorf-Astoria, when Mr. Barclay expects that at least 500 to 700 will participate. Friday will be devoted to automobile rides and then the convention will disperse.

The Electrical Industries of Germany.

Mr. F. Oppenheimer, consul general from England to Germany, in the course of a report on the electrical industries of the German empire, says: "1904 has been called the year of resuscitation for the electrical industry in Germany. During the three preceding years the electrical industry had suffered very considerably because it had unduly extended its operations, as the result of which there was considerable overproduction and a very noticeable drop in prices. The electrical industry had, however, not been idle during the slump, but had endeavored to achieve practical successes through the perfection of its technical achievements and through intensified endeavors to apply profitable methods of production. As the result of this the turn of the tide last year found the industry well prepared, and its production reached the largest figures ever known.

"The perfecting of steam turbines during recent years assisted the extended use of electricity, as did also the more general manufacture of tools and tool machinery driven by electric power. In many instances public and municipal authorities and the larger electrical companies have endeavored to bring the advantages of electrical motors within the reach of the smallest industries by direct or indirect subsidies. Agriculture, too, is considerably extending its use of productions of the electrical industry in view of the prevailing scarcity of agricultural labor. Lastly, modern traffic in its various branches is availing itself of the advantages of electricity for technical improvements and by conversion of various other methods of locomotion to electricity.

"The electrical industry enjoys this advantage over other industries, that in spite of the existence of a few gigantic electrical concerns there will always be room for smaller factories manufacturing specialties, to which some of them owe a world-wide reputation. The special factories, of which there are approximately 225, occupy about 43,000 hands, representing 60 per cent of all hands employed in the German electro-technical industries. The total number employed in Germany today amounts to approximately 72,500, against 26,321 in 1895 and 54,417 in 1898. The working capital engaged in the electro-technical industry in Germany at the end of 1904 was estimated to amount to 600,000,000 m., of which 500,000,000 m. were represented by 35 limited liability companies, and the remaining 100,000,000 m. by all other firms.

"The financial result, in spite of the outward expansion, was not as satisfactory as might be expected. The reductions in the prices for finished articles, which were due to the years of the slump, have not yet been made good. Though an improving demand fosters higher prices, it was counterbalanced by a considerable increase in the number of producers. At the same time production has increased owing to improvements of manufacture, but this possibility of increased production has not resulted in any financial gain, because at the same time the most important raw materials of the electrical industry have risen considerably in price. Increased production and the increased price of raw materials have in other industries suggested syndication as a remedy. Any such syndication at present, however, still appears impossible in the electrical industry on account of the great variety of finished articles, though possibly the amalgamations which have taken place are preparing the way.

"The import of electrical machines amounted in the year 1900 to 4,350 met. centners, in 1903 to 10,094 met. centners, and has risen during the last year to 14,777 met. centners. The imports of accumulators, of wires insulated with india rubber, of low-current apparatus, of cables and electrode carbons, have always been inconsiderable, but the import of glow lamps has risen from 935 met. centners in 1901 to 1,336 met. centners in 1904, an increase which is due to French competition. The same cause has also increased the import of carbons, which in 1901 amounted to 452 met. centners and to 2,349 met. centners in 1904. The export of electrical machines amounted in 1900 to 129,178, in 1903 to 135,755 and in 1904 to 134,914 met. centners. The export of accumulators has risen from 16,079 met. centners in 1901 to 29,801 in 1904; of carbons from 12,429 met. centners in 1901 to 31,248; of electrode-carbons from 2,396 to 27,565 met. centners; of low-current apparatus from 4,283 to 6,367 met. centners. The export of cables amounted in 1904 to 209,634 met. centners and shows no actual improvement over the figures for 1900 (154,410 met. centners), as the former figure includes the export of submarine telegraph cables for the first time, and this in 1904 amounted to 58,950 met. centners. The world's market was particularly bad for wires insulated with india rubber, of which only 1,479 met. centners were consumed, against 7,000 met. centners in 1901. There is no doubt that, generally speaking, the difficulties in the sale abroad of the products of the German electro-technical industries are constantly increasing."

Extensive Trolley System Around the Great Lakes.

An important step has been taken with regard to unifying the control of the trolley systems that may be said to have Buffalo as a center. A new corporation, called the Tractional Company, has been formed to take over the entire stock of the International Traction Company, which owns the street railway lines of Buffalo. The total length of all the lines combined is about 375 miles. One share of the new company's stock will be exchanged for 100 shares of International Traction Company's common stock.

The capital stock of the Tractional Company amounts to $100,000, only $76,000 of which is to be issued immediately; the International Traction Company is capitalized at $15,000,000. Henry J. Pierce, president of the International Traction Company, is also president of the new corporation. The directors are Thomas De Witt Cuyler, G. L. Boissevain, Nelson Robinson, Grant B. Schley and Henry J. Pierce. Arthur Robinson is secretary and treasurer. The Tractional Company was incorporated under the laws of New Jersey.

Among the properties owned by the International Traction Company are the Buffalo Railway Company, the Buffalo, Tonawanda & Niagara Falls Electric Railroad, the Niagara Falls, Whirlpool & Northern Railway, and the Queenstown Heights Bridge Company. There are eleven other railroad companies in the list.

The banking firm of Kean, Van Cortlandt & Co., which has a very large interest in the new concern, controls the traction lines of Detroit and the traction lines and lighting companies of Toledo, and is the syndicate manager of the car builders' combination, which embraces nineteen of the largest car builders of the country.

The International Traction Company was formerly controlled by J. P. Morgan & Co., and was sold by them last March. It was announced at that time that certain Buffalo and Philadelphia capitalists had purchased the road, but the fact that Kean, Van Cortlandt & Co. is backing the new control has only developed with the formation of the Tractional Company

The possible extent of the activities of the group of capitalists which has organized the Tractional Company was outlined this week by one of the parties in interest. At the present time trolley lines are being built from Rochester to Buffalo and from Buffalo to Cleveland. Lines already are in operation from Cleveland to Toledo and from Toledo to Detroit. The New York Central is supposed to have an interest in the Rochester-Buffalo line, but the other lines are independent.

CURRENT NEWS AND NOTES.

TELEGRAPHY IN ALASKA.—The entire receipts of the Government telegraph and cable lines in Alaska will be used toward the extension of telegraphic communication in the north each year, according to an agreement reached between Gen. A. W. Greely, head of the U. S. Signal Service Corps, Congressman Humphrey and others.

WIRELESS IN MEXICO.—It is designed to establish wireless telegraphy in various parts of Mexico, using the Marconi system. Camilo Gonzalez, who is general manager of the Mexican Federal Telegraph Company, will have charge of the installation. The first system will probably be installed in the State of Chihuahua, while other stations will be erected in Jalisco, Tepic, Sonora, Sinaloa and Nuevo Leon.

TELEPHONING THE DOCTOR.—Walter Messersmith, Muncie, Ind., accidentally cut an artery a few days ago. A physician was telephoned, and, five minutes after receiving the message, was speeding to the Messersmith home in the fastest automobile obtainable. The young man is recovering. The family say the young man would have died from loss of blood had there not been a telephone in the house.

TROLLEY-STEAM COMPETITION.—The New York Central Railroad, with the permission of the State Railroad Commission, has decided to close its station at Crane's Village, a small place on the main line near Amsterdam. The passengers formerly using that station, at which six trains stopped daily, have been traveling on the trolley line passing through the village instead of on the railroad, and the steam patronage was literally wiped out.

TELEGRAPHERS' STRIKE OVER.—The strike of telegraphers on the Great Northern Railroad is at an end. The telegraphers who went out August 1 are asking reinstatement. President Perham, of the Telegraphers' Union, ordered a vote on the proposition to end the strike and return to work when he found he could not hold the men in line or force the railroad to terms; and the whole thing is now over, except for the unfortunates out of a job.

TRAIN TICKER SERVICE by means of wireless has been discussed and some years ago was attempted by the train telegraph static systems then on trial. There are other ways of accomplishing this and it is now reported that financial patrons of the Delaware, Lackawanna & Western Railroad will in future not have to await their journey's end to secure information in regard to the stock market. The railroad has arranged to supply passengers on its fast trains during market hours with the latest quotations from the New York Stock Exchange. The quotations will be distributed to the passengers on the arrival of each of the fast trains at Scranton on the trip either east or west.

SWISS ELECTRIC ROADS.—New electric roads are to be built in Switzerland as follows: Lugano to Paradiso, Lugano to Gerra, Lugano to Salvatore Railroad Station, Molino Nuovo to connect with St. Gotthard Railroad, Meyringen to Grindelwald, Oerlikon to Schwamendingen, Locarno to Valmara, Locarno to Camedo, Grindelwald to the Sea of Ice. Switzerland has a great electric scheme in view—the conversion of all its State railways to electric traction. They cover 1,520 miles of route, 242 being of double track, nearly all of which can be operated electrically. The Confederation makes money by its railways, the receipts last year being $23,680,000 and the expenses $15,600,000, and the government expects to make more (or to reduce fares) with electric traction. The Swiss lines are among the cheapest and best to travel on in Europe.

SUBMARINE-BELL SIGNALS.—The United States *Daily Consular and Trade Reports* for July 26 contained a statement from Consul-General Holloway, of Halifax, quoted in these columns, to the effect that the St. Lawrence River was not to have the benefit of submarine-bell signals, for which a contract has been made by the Dominion Government. This statement was made on the authority of a leading Canadian trade journal. Consul-General Holloway now reports that the Submarine Signal Company denies the accuracy of that statement, and declares that the bells, for which a contract has been made with the company by the Canadian Government, will be installed in due time, large shipments of material having already been made and the work being well under way. The company is required to equip with its apparatus 30 steamers. These need not necessarily be Canadian vessels.

THE CONFERENCE AND CABLES.—We noted recently the elaborate preparations made at Portsmouth, N. H., for handling the peace conference work. It is stated that the Postal and Western Union Telegraph Companies have been using 35 wires from the Wentworth Hotel and 50 operators, handling 50,000 words of press matter daily, exclusive of cables. The press cable rate to Tokio is 53 cents per word and to St. Petersburg 28 cents per word—14 letters or figures are counted as one word. The Russian cables go via French cables to Havre then to St, Petersburg direct; the Japanese cables via San Francisco, Honolulu, Guam and Manila. The rates charged for private cables are: St. Petersburg, 43 cents per word; Tokio, 133 cents per word. The envoys' cables exchanged with their respective governments often number 400 words. St. Petersburg time is seven hours ahead of Portsmouth; Tokio, 14 hours ahead. The Western Union has done the most press business, but the Postal Telegraph Company has had a lion's share of the cable business. Both the Russians and the Japanese have private wires to the Postal Telegraph Cable office on the ground floor of the hotel and summon an operator whenever they wish to send a message. Most of the dispatches are simply code words thrown into figures. A very liberal use has also been made of the long-distance telephone.

NURSING EXPORT TRADE.—United States Special Agent Hutchinson has been discussing export trade to Brazil in a series of very interesting letters. In one he says: "Much complaint is made as to the spasmodic character of American enterprise in the Brazilian market. A dull year in the domestic markets of the United States sends a flood of circulars and a horde of commercial travelers to South America in an attempt to get rid of surplus product. Usually these efforts are fairly successful, merchants here being induced by the excellence of the goods or by unusually low prices to enter into American connections. But the moment the home market shows improvement the American exporter grows indifferent and neglects or postpones attention to his South American orders. In short, Brazil is looked upon as a convenient dumping ground in times of need while the demands of more regular trade are neglected. This complaint I find is quite as universal as the one concerning careless packing. And in some cases the neglect takes the most exasperating forms. For instance, I was told a few days ago by one of the largest importers of goods from the United States, a man who fully recognizes the excellence of American manufactures and the possibilities of development of our trade, and who is anxious to do a larger business with us, that he has almost despaired of increasing his American purchases or dealing with any but a few of the largest and best-known American firms. He told me of numerous cases in which, after forming new American connections solicited by the Americans themselves, he had had his orders neglected, or his shipments delayed, for months or even abandoned entirely, with no more satisfactory excuse (to him) than that the factory was 'too busy' on other orders. Such connections he naturally abandons at once and for good."

NICARAGUAN DEVELOPMENT.—The Nicaraguan Finance & Improvement Company has secured a concession from the government permitting it to utilize the waterfalls of the Tipitapa River for hydro-electric development, and is also to build a railroad from Managna to Jinotega.

CABLE STEAMER ASHORE.—The cable steamer *Colonia* ran ashore last week on the Nova Scotian coast. A cable dispatch from Canso of August 19 says: "There was no change during this forenoon in the position of the British cable steamer *Colonia,* which grounded yesterday on the rocks near Fox Island, off this port. The steamer *Mackay-Bennett* stood by to-day ready to make an attempt to float the stranded vessel at high tide. The *Mackay-Bennett* is taking off the cable and apparatus to lighten the *Colonia.*" The cable steamer is engaged in laying the new Atlantic Commercial cable.

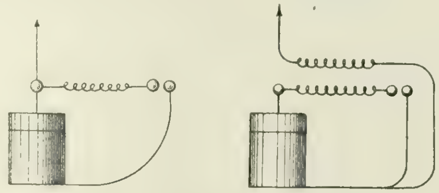
FIRE HAZARDS.—In its *Quarterly Bulletin,* recently issued, the National Fire Protection Association gives a report of the committee on special hazards and fire records. The bulletin contains three instructive articles dealing with shoe factories, paper mills and candle factories, respectively, which describe the various processes involved and point out the fire hazards in the different departments of the factories. Of the 71 pages of the bulletin, 12 are devoted to special hazard fire record and 25 to sprinkler fire record. The cause and result of each fire reported are treated in detail, and numerous illustrations are given of sprinkler fires.

WIRELESS DISTANT ACTION.—An item is copied by American newspapers from the London *Telegraph* as follows: "M. Branly, one of the foremost of French experimenters in wireless telegraphy, describes apparatus by which mechanical effects at a distance may be produced by etheric waves—such as starting a motor, lighting a lamp, or causing an explosion. It requires only suitable instruments at the distant station to bring about these effects, without any human assistance. The idea is not new, though the apparatus is. M. Orloff has shown in this country how a boat or torpedo may be steered by an electrician on shore." All this is very old in America. Mr. Tesla long ago exhibited a wireless automaton floating fort or gunboat, and at the New York Electrical Exhibition of 1898 miniature men-of-war were blown up in a tank by little floating mines discharged from the gallery by "wireless."

GREAT UNDERGROUND TERMINAL.—Plans for the Manhattan terminal of the Williamsburg Bridge have been drawn up by the New York Bridge Department. The Manhattan terminal will be entirely underground. It will be 600 ft. long and about 180 ft. wide, and will have altogether about 120,000 sq. ft. It will be about only one-third the size of the Manhattan terminal of the Brooklyn Bridge, but every inch will be adapted to transportation purposes. It will have a greater capacity for trolley lines, but probably only one-half that for elevated lines which the Brooklyn Bridge terminal has. The Williamsburg terminal will have eight loops for trolley lines. These will be entirely for the use of the Brooklyn Rapid Transit Company. The cars of the New York City Railway will require no terminal in Manhattan. There will be four subway tracks in the terminal. At least $1,000,000 will be spent on the work.

SPANISH ELECTRICAL WORK.—The municipality of La Rambla and the municipality of Calannas (province Huelva) plan the installation of electric lighting. Don José Lopez Planas in Oviedo has obtained a permit for constructing an electric tramway between Oviedo and Posada. The town of Orense is to get a telephone system. Talavera de la Reina (province Toledo) is also to have a telephone system. The town of Mazarron projects the construction of electric works for lighting. The ministerio de la gobernacion in Madrid has been empowered to spend $58,000 for [illegible] submarine cables. A trolley line will be built from Valencia to Moncada. A syndicate has applied for a concession to utilize the water power of the Henares and the Tajuna Rivers for [illegible] electric energy to supply light. Don Felipe Mora, Armunna (Guadalajara), is interested in the project. The Dirección General de Obras Públicas in Madrid has granted a concession to the [illegible] La Plata for utilizing the Bornoba River in Hiendelaencina in the province of Guadalajara for the development of electric energy to work the mines of that district. Don José Lopez Planas, of Oviedo, has a franchise for an electric road from that city to Posada.

SPACE TELEGRAPHY.—On August 15 two patents were issued to Ferdinand Braun relating to wireless telegraphy, the applications being filed February 6, 1899. The inventor proposes to use waves of great length in order to prevent the absorption of the waves by objects in the path of transmission, and states that such waves can be produced by the discharge of Leyden jars of the usual size in a circuit having moderate inductance. The transmitting wire may be connected conductively to the oscillation circuit or the connection may be made inductively, as indicated in the illustrations herewith.

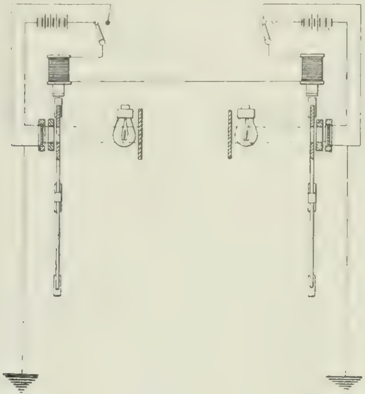


CONTROLLER FOR ALTERNATING-CURRENT MOTORS.—In the operation of controllers which are employed for varying the active lengths of the windings of transformers from which the motors are supplied with energy, either the motor circuits are broken at each step or portions of the main transformer windings are temporarily short-circuited, and arcs are produced when either of these changes takes place. Two patents granted August 15 to R. P. Jackson relate to means for reducing the arcing to such an extent that it does not seriously affect the operation of the controllers. The inventor employs an auxiliary inductance coil which is normally shunted across adjacent taps on the variable-potential transformer, and to the middle point of which is connected one terminal of the motor circuits. When the connections are made as here indicated, very little current flows in the local circuit of the coil, due to its high inductance for such current, but the requisite amount of current reaches the motor, because this latter current divides in such a way that the resultant magnetomotive force due thereto is zero and the inductance is nil. The inductance coil is transferred from one pair of taps to the next adjacent pair without being completely disconnected from all taps simultaneously. It is stated that comparatively little sparking occurs when this operation takes place, since one portion of the winding of the inductance coil is amply able to carry the motor current and the voltage of the circuit broken is comparatively low.

STEEL BY ELECTRICITY.—In a communication to the London *Times* Mr. F. W. Harbourd says: "While, on the one hand, the extravagant claims urged on behalf of electric smelting—that it will revolutionize the manufacture of structural steels as at present made by the Bessemer and open-hearth processes—may be dismissed as nonsense, the attempts on the other hand to prove that it cannot compete with the crucible process in the manufacture of tool steels, or the open-hearth furnace for many of the higher class steels intermediate between these and common structural steel, may equally be disregarded. The truth lies between these two extremes; and the manufacturer who realizes this and takes advantage of the great possibilities which the electric furnace offers to meet very many of the special steel requirements of to-day, and who does so with judgment and knowledge, will, without doubt, be in a most exceptional position, not only to meet foreign competition, but to more than hold his own against his British competitors. Since the Canadian Commission visited Europe last year, rather more than a year has elapsed. During this time very considerable quantities of electric steel have been made both in Sweden and in France, and have been used with [illegible] satisfactory results for all classes of tools and cutlery, and for [illegible] other purposes for which the highest class crucible steel [illegible] formerly employed, confirming in every way the conclusions of the Commission that 'steel equal in all respects to the best Sheffield crucible steel can be made.'"

CHICAGO SUBWAYS.—The committee of engineers appointed by the Commissioner of Public Works to examine the underground tunnels in Chicago, has made its report. The engineers failed to find any settlement due to the first main line tunnels which were built under air pressure. All the settlements found were traced to the work done without air pressure. There have been completed 173,510 ft., or practically thirty-three miles of tunnels, and the work is now proceeding at the rate of about 500 ft. a day.

SYNCHRONIZING SYSTEM.—Another of the many proposed uses for selenium is disclosed in a patent issued August 8 to Paul Ribbe, which relates to a system by means of which a disc at the receiving station may be caused to revolve exactly synchronously with one at the transmission station. Each disc is driven primarily by clockwork, and its speed is arranged so as to be approximately synchronous with that of the other disc. The novel features of the system reside in the means employed for obtaining exact synchronism. Each disc is provided with several radial slits through which light may pass from a lamp to a selenium cell when the disc is in certain positions. Upon the periphery of each disc are mounted soft-iron armatures corresponding in number to the number of slits. Opposite the periphery of each disc and in proximity to the armatures as the disc revolves is mounted an electromagnet whose coil is connected in series with a battery and the selenium cell of the other stations. When the discs are driven by the clockworks, they will revolve exactly synchronously on account of the fact that the electromagnet will receive an impulse of exciting current and hence will attract momentarily an armature on the periphery of the disc as each slit of the disc at the other station passes between the lamp and the selenium cell.



SMALL POWER BOATS.—The Washington correspondent of the *Iron Age* says: "The friendly offices of the Department of Commerce and Labor are being solicited by the American Association of Masters and Pilots of Steam Vessels to secure the passage in the coming Congress of a law that will place all launches and other power boats of less than 15 tons under the jurisdiction of the navigation laws, requiring those who operate them to pass examinations and take out licenses as pilots and engineers. The movement is a revival of a campaign that failed last winter and is strongly opposed by all builders of small gasoline and steam engines, electric motors, launches and pleasure boats, etc., and it is very freely intimated that the anxiety of the officials of the American Association of Masters and Pilots of Steam Vessels to secure this legislation is based less upon solicitude for the public welfare than upon the desire to impose such restrictions upon the operation of small pleasure craft as will create several thousand jobs for licensed pilots and engineers." Among those who opposed the bill in the last Congress was Mr. H. R. Sutchen, of the Electric Launch Company. He particularly opposed the application of the pending bill to the electric launch. Within the past dozen years, he said, large numbers of these small vessels had been built and were operated as easily and simply as rowboats. During the Chicago World's Fair over 1,000,000 passengers were carried without an accident of any kind. The boats were operated by young men, mostly college students, who had no [illegible] but who were perfectly competent to manage the boats.

Electrical Engineers of the Times.—XXIV.

HENRY A. LARDNER.

Mr. Henry Ackley Lardner was born in Wisconsin in 1871. After being graduated from the Milwaukee Academy, he entered the School of Electrical Engineering at the University of Wisconsin, from which he was graduated in 1893 with the degree of B. S. in electrical engineering. He then supplemented his college course with a year at the university, devoting his time to a study of electrical machine design and kindred subjects. In 1895 he received the degree of E. E. from the University of Wisconsin.

During 1895 Mr. Lardner was employed on railway construction work in Baltimore by J. G. White & Co., and during that time made a special study of rail bonding and track resistance. Following the work in Baltimore, he was instructor in electrical engineering in the engineering department of the Pennsylvania State College, State College, Pa. He spent his summer vacations in practical work, gaining experience in various branches of electrical engineering. Preferring active work to that of the educational field, he again joined the forces of J. G. White & Company in conduit construction at Buffalo. Later he became associated with the Cataract Power & Conduit Company, of Buffalo, and gained much valuable experience in the operation of high-tension cables, transformers, switchboards, etc., as well as transmission line construction and operation. This position he resigned in 1898 to become electrical superintendent for the Borough of Manhattan Electric Company, New York City. During the following year and a half Mr. Lardner was engaged in the reconstruction of this company's plant and underground distribution system, and when the company was bought out by the present New York Edison Company he was retained as engineer of tests on meters, machinery and instruments. While in this position he reorganized the meter department and other work under his charge. In January, 1900, he accepted the appointment as assistant electrical engineer of J. G. White & Co., and in June of that year he was made acting electrical engineer. In 1901 he was made chief electrical engineer, which position he now holds. In 1903 he was elected a director of J. G. White & Co., Inc.

H. A. LARDNER.

In his present capacity Mr. Lardner is in full charge of the electrical engineering department of J. G. White & Company and is responsible for the electrical design of a number of important plants and railway and lighting systems built by J. G. White & Company in this country and abroad. He has also made a large number of financial reports which have been submitted by the company to some of the largest banking interests in this country and Europe. These reports, covering steam and electric railroad properties, electric lighting companies, gas companies and hydraulic installations, have been the basis of a number of consolidations and underwritings.

Mr. Lardner has been an active member of the American Institute of Electrical Engineers and has served on several important committees. For three years he was a member of the editing committee and for the past four years a member of the board of examiners. He is also a member of the American Society of Mechanical Engineers. Since his residence in New York City Mr. Lardner has taken much interest in the New York Electrical Society and is a past vice-president of that organization.

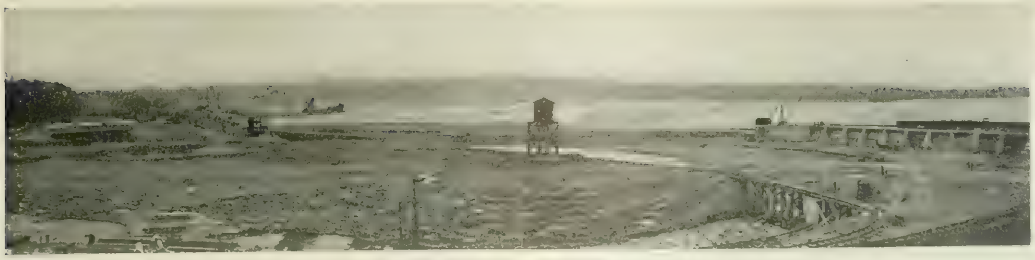


Fig. 1.—General View of Hydraulic Development of Ontario Power Company.

Hydro-Electric Developments of the Ontario Power Company.—I.

GENERAL PLAN.

THE Ontario Power Company was the first corporation to obtain rights from the Canadian Government to develop electric power from the Niagara River in Queen Victoria Park, but its operations along present lines date from the time when Messrs. P. N. Nunn and L. L. Nunn took up the work as chief engineers.

When these engineers came to the ground certain factors were already fixed. The existing government rights determined the location of the generating station and the use of a waterway through the park. The problems presented for solution involved the construction of an intake and headworks at some point on the Canadian bank of the river above the falls, the location of a generating station at a point best suited for the development of power and its distribution, a water connection between the intake and the generating station, a distributing and control station removed from the main power plant, and means for the delivery of the tail water.

The type of hydro-electric development that has become well known through its adoption in the pioneer development on the American side of the falls, includes a station located close to an intake and near the level of the upper river, a wheel pit beneath the station and deep enough to reach the tail water level, water wheels at the bottom and generators at the top of this pit connected by long vertical shafts, and a tunnel from the pit to the canyon below the falls to carry off the tail water. None of these features are included in the works of the Ontario Power Company. Instead of being located close to the intake above the falls, the generating station is more than a mile down stream in the gorge below. At this location the electric generators are brought down to the level of the water wheels below, and are direct-connected with short horizontal shafts, and the excavation of a wheel pit is avoided. The wheels being close to the lower river in the canyon and near its level, their draft tubes discharge the tail water without the aid of a tunnel. The intake works and the generating station more than a mile apart and differing by upward of 200 ft. in elevation, are connected by the largest steel pipe that has ever been used for conveying water.

The reasons for the adoption of this type of construction by the Ontario Power Company rest in part on the natural conditions under which the power development is made, on the franchise limitations, and on the fact that the development is almost entirely within the boundaries of the Queen Victoria Niagara Falls Park.

Niagara River has a drop of about 55 ft. in the upper rapids and approximately 158 ft. sheer drop at the falls themselves, making a total of 213 ft. It is desirable, therefore, in order to obtain a larger head and consequently a greater power with a given diversion of water from the Niagara River, that the intake works should be above the rapids that lead down to the falls. Another important reason for the location of the intake is found in the rapid formation in the turbulent water of much ice that would present serious difficulties in cold weather, if the intake were further down stream. In order to avoid the ice trouble the intake works of the Ontario Power Company were located above the upper line of rapids on the Canadian side. This location brought the forebay just outside the Dufferin Islands, a little group of islands which have been carved from the original bank by the strong river currents setting in their direction. A generating station might have been located close to these islands, but this would have involved a deep wheel pit with vertical wheels, shafts and generators, besides a tunnel nearly a mile long to carry off the tail water. There was, therefore, sought for the power station a location where the wheels and electric generators could be brought to the same level and where the draft tubes could discharge the tail water directly into the river.

The station thus located is at the base of the Canadian cliff (Fig. 2) nearly underneath that portion known as Table Rock, and rests on a narrow ledge between it and the lower river. With an intake works and generating station located more than a mile apart, it was necessary to connect them by a suitable waterway, and a closed conduit was adopted for this purpose. The shortest and most direct route for this conduit lay parallel to the river bank through Queen [illegible] Park, where an open canal would have been undesirable. [illegible] the other hand, could be laid beneath the park surface and [illegible] detracting from the æsthetic character of the surroundings.

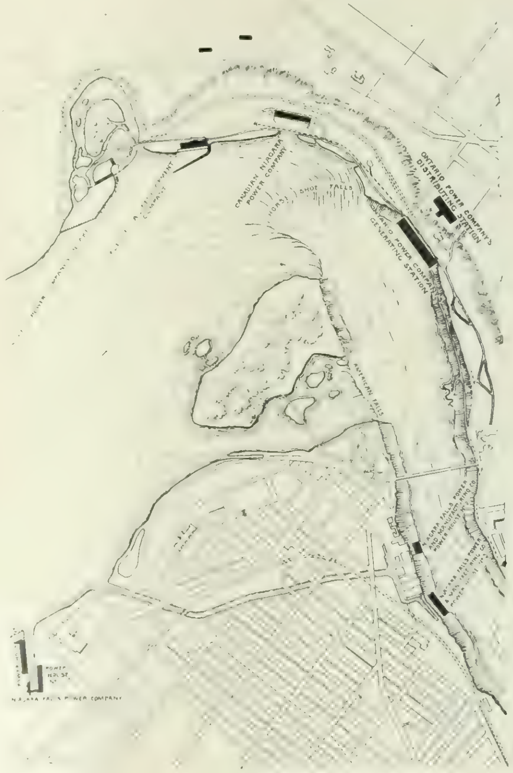

CANADIAN NIAGARA POWER COMPANY
HORSE SHOE FALLS
ONTARIO POWER COMPANY'S DISTRIBUTING STATION
ONTARIO POWER COMPANY GENERATING STATION
AMERICAN FALLS
NIAGARA FALLS POWER AND MANUFACTURING CO POWER HOUSE No 2
NIAGARA FALLS POWER & MANUFACTURING CO
POWER HOUSE
NIAGARA FALLS POWER COMPANY

FIG. 2.—MAP OF NIAGARA FALLS, SHOWING POWER DEVELOPMENTS.

INTAKE WORKS.

At the intake the general plan is to intercept an ample supply of water for the ultimate power to be developed at the station, to create [illegible] and comparatively quiet forebay, and to provide with especial care for the elimination of ice from the water before it reaches the conduits. It was necessary to erect a stone-filled crib dam before work on the forebay could be begun, as water covered the entire area. Twenty acres of river bed were laid bare at a point nearly opposite the Dufferin Islands. The area exposed consisted mainly of limestone ledge with a surface broken with peculiar pot holes and hummocks. Geologists have found much of interest in these formations.

The excavation necessary to give the water in the forebay its required depth was carried down in this limestone bed of the river, and the rock removed amounted to approximately 130,000 cubic yards, varying in thickness from about 3 ft. to 22 ft. Much of the excavated rock was crushed and then used in making concrete for the forebay walls and buildings, and the cores of the wells were filled in part with irregular stones from the same source, embedded in the concrete. Part of the excavated rock was used for the formation of new islands.

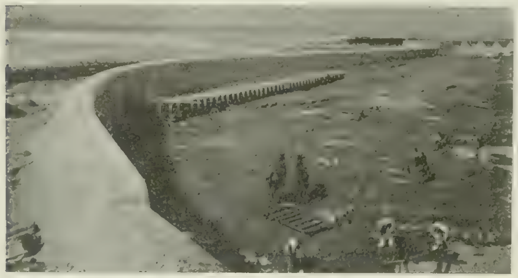


FIG. 3.—GENERAL VIEW OF RIVER WALL, OUTER FOREBAY.

Along the line of intake the low-water level of the river is 553 ft. above sea level, and this level is maintained by the forebay water down to the gate house where the present steel conduit begins. Outside of the forebay wall at the river side of the gate house, the river level is down to 540 ft. elevation, it having dropped some 13 ft. over the first cascades. Just above the line of intake piers, which extend from the bank out into the river before it reaches the first line of breakers, the depth of low water is 14 ft., and there is an increase in the forebay depth to 18 ft. at the screen house and 28 ft. at the gate house.

The intake is located at the large upstream end and the gate house at the smaller end. The length of the intake, which runs diagonally out and down stream from the river bank, is about 600 ft. The screen house crosses the forebay between its upper and lower curved portions and is 320 ft. in length. Between the screen house and the gate house the side walls of the forebay draw rapidly toward each other and are only 120 ft. apart at the latter. On the center line of the forebay from intake to screen house its length is about 880 ft., and between screen house and gate house the length is approximately 315 ft., besides a width of 30 ft. in the screen house. Between the intake and the screen house the forebay area is about 8 acres, and between screen house and gate house the area is about 2 acres.

When 2.500 cu. ft. of water per second are passing over the waste weir in this forebay, which is a waste discharge permitted when the forebay is at low water level of 553 ft., and when in addition a sufficient amount of water is being drawn from the head gates to operate a station having a capacity of 180.000 electrical hp, not more than one-half the water that reaches the intake from the outer river can enter. This large excess of intercepted water over full load requirements more than provides for an ample supply under any conditions of flow that are even remotely probable in the Niagara River. To operate the station with a full load, it is estimated that about 12,000 cu. ft. of water per second must be drawn from the forebay by the conduits, and this with the 2,500 cu. ft. per second discharged over the waste weir, brings the maximum demand for water at the intake up to about 14,500 cu. ft. per second.

When the river surface at the intake is above its low level of 553 ft., which is the case for large parts of each year, a quantity of water greater than the maximum just named may enter the forebay. For the discharge of this excess of water the entire river wall of the forebay between the outer end of the intake and the screen house, a length of about 700 ft., will act as a waste weir. Except for the length of 100 ft. of this wall next the screen house, its top elevation is 553 ft., or just that of "low water." Fifty feet of the wall next the screen house has an elevation of 549 ft., and the next 50 ft. upstream is at the level of 551 ft., so that this lower 100-ft. section of the wall acts as the permanent waste weir for the discharge of the 2,500 second-feet above mentioned.

Between the screen house and gate house the river wall, a view of which is given in Fig. 3, has an elevation of 560 ft., so that no water can escape over it, and the same is true of the entire landward wall of the forebay. Sluiceways in the core wall running through the made islands permit water from the outer and inner forebays to enter the channels about the Dufferin Islands, and this water escapes into the river at a point a little down stream from the head gates, passing over the conduits.

Perhaps the most notable feature of the forebay is the provision that has been made for the exclusion of ice at the intake, and for its discharge into the river should it enter. The intake constituting the outer protection, consists of a line of concrete piers set 20 ft. apart and connected along their tops and for some distance down their upstream faces by platforms, and by a curtain wall of concrete reinforced with embedded steel rods (see Fig. 4). Stop logs will be suspended freely on the river side of the curtain wall to act as an ice barrier, also to regulate the amount of water admitted. On top these piers and platform have an elevation of 560 ft., or 7 ft. above the low-water level of the river. From the top of this wall the concrete barrier drops down for a distance of 12 ft., or 5 ft. beneath the low-water line. At the upstream face of the piers they stand 18 ft. above the ledge of the river bed, which as excavated is at elevation 542, and there is, therefore, a distance of 6 ft. between the lower edge of the wall or barrier and the bed rock. All water entering the forebay must pass through these submerged openings at the intake.

The natural river currents in front of the intake will strike the ice barrier at an angle of about 30°. When water for the development of 180,000 hp is being drawn from the forebay the velocity of water entering the intake will probably be not more than 4.4 ft. per second. As not more than one-half of the water reaching the intake works will be drawn under this barrier, a strong cross current will result on the surface that will sweep the upstream face and tend to carry any ice that reaches the wall out into the rapids. Very little cake or floe ice can enter the forebay because, under the lowest water conditions, it must sink more than 5 ft. below the surface of the river in order to pass under the barriers.

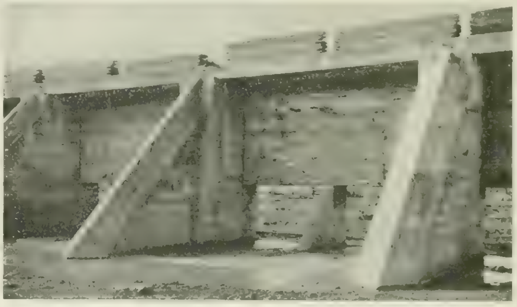
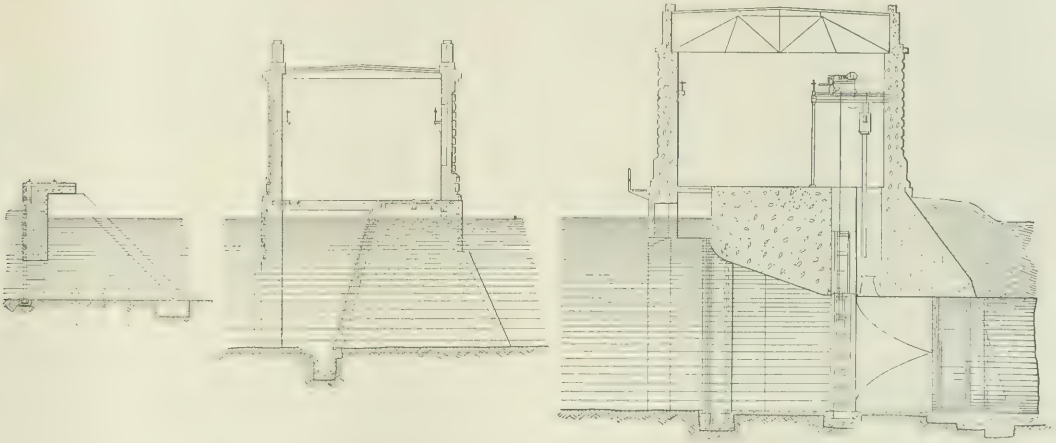


FIG. 4.—VIEW OF INTAKE PIERS AND CURTAIN FROM DOWNSTREAM SIDE.

With the maximum draft of water at the head gate for full-load requirements, the velocity of water just inside the intake will be about 2.9 ft. per second, along down the outer forebay the maximum of 4.7 ft. per second will be attained, and just before it reaches the screen house the minimum of 2 ft. per second.

Along the upstream side of the screen house, which is 320 ft. long, and spans the entire width of the forebay, a reinforced concrete wall or barrier extends vertically downward from elevation 558 to 549, or to a point 4 ft. beneath the low-water level of the forebay. This curtain wall stops the entry of surface ice to the screen house and, together with the waste weirs in the river wall of the forebay at the downstream end of the screen house, produces a surface current toward the weirs which sweeps floating ice into the river. After passing under the curtain wall the velocity continues at 2 ft. per second in front of the screens inside, and rises to 2.9 ft. per second while passing through the screens, and reaches a velocity of 2 ft.

per second beyond the screen house. On to the gate house from this last point the velocity gradually increases to 3.4 ft. per second at the upstream side of the gate house and to about 5 ft. per second at the beginning of the taper entrances to the main conduits that lead through the park to the cliff above the generating station. The taper section above mentioned is constructed of reinforced concrete and, after entering, the water gradually attains, under full-load conditions, a velocity of approximately 15 ft. per second, which velocity is maintained down to the distributor section of the conduit. The low velocity of 2 ft. per second inside of the screen house serves two important purposes, the first being that it allows the water to drop any sand or silt it may be carrying into a ditch or channel that extends entirely across the forebay just in front of the screens. This ditch in the rock floor of the forebay is 2 ft. wide by 4.5 ft. deep and connects with the river through an arched opening beneath the forebay wall. Not only sand and silt dropped by the water, but also stones swept along the forebay floor are carried out into the river through this opening in the wall. The second purpose served is that any ice still remaining in the water is given an excellent opportunity to rise to the surface inside the screen house, when it may be discharged through an ice run 5 ft. wide by 8½ ft. deep, with its sill approximately 3 ft. below the low-water level of the forebay.



Figs. 5, 6 and 7.—Sections Through Intake, Screen House and Headblock.

At the gate house the water encounters another curtain wall and a rack or screen. The wall is of concrete reinforced with steel and extends from the top of the foundation at elevation 560 down to elevation 552, or one foot below the low-water level. Beyond this curtain wall and in front of the entries to the main pipes is a second set of screens with a coarse mesh. In the forebay wall at the river end of the gate house there is an ice run 5 ft. wide by 4 ft. deep having its sill 3 ft. beneath the low-water level of the forebay. Into this run the curtain wall deflects any floating ice that may reach the gate house. Any ice that may pass under this last curtain and rise in front of screens may also be deflected into the ice run by a short cross channel connecting with it.

As may be seen from the foregoing description, any ice carried down the Niagara River must pass under three curtain walls that drop 5 ft., 4 ft. and 1 ft., respectively, below the low-water level, must escape three cross currents that sweep the faces of these curtain walls and tend to carry it into the river, must escape two ice runs with their minor currents, and must work its way through two screens in order to reach the head gates of the main pipes. The first screen or rack is within the screen house, runs its entire length of 320 ft., and extends from elevation 535 ft. at the forebay floor to elevation 558 ft., or 5 ft. above the low-water level. The spaces between the flat steel strips forming the racks are 2 in. across, while the strips are 3 by 5/16 in. set edge on to the current. Above the top of the screen the house has a height of 19 ft. 2 in. and a width of 25 ft. 4 in. In structure this house has reinforced concrete sides and roof, the exterior being faced with concrete slabs molded to simulate stone. The walls carry a traveling crane equipped with an electric hoist for lifting and changing the individual screens.

The gate house is also a concrete building with veneer of imitation stone. Both the screen house and the gate house, as well as the other buildings which the company is erecting within the park, although built of concrete, are of such architectural design and finish as to please the most fastidious in such matters. The gate house has a length of about 120 ft. over the entry of the three main conduits. The so-called headblock that forms at once the entry for these pipes, the framework for the head gates and the foundation for the gate house, is a monolith of concrete approximately 120 ft. long, 57 ft. wide at its base and 40 ft. wide at the top, rising 35 ft. above the limestone bed of the forebay. One pipe 18 ft. in diameter and two stubs for conduits each 20 ft. in diameter are imbedded in this headblock and the entry to all is guarded by a light screen with meshes 2 by 6 in. Instead of expanding the end of each pipe into an entry, the enlarged opening on the forebay side is formed in the concrete itself and gradually changes from an 18-ft. square to a circle of the diameter of the pipe. For each pipe the entrance on the forebay side of the headblock is approximately 38 ft. wide and 24 ft. high, and its cross-section shrinks to that of the pipe in a length of 34.5 ft. In front of each, to control the entry of water to the conduits, there is a steel gate of the Stoney type 20 ft. square, with its guides imbedded in the headblock (see Fig. 7). Each of these gates is counterbalanced, moves against roller guides, rests on a steel sill and lintel when down and is raised and lowered by means of an induction motor connected through gearing. The friction overcome in moving these gates, in spite of the fact that the head of water above the lower edge of the gate is at least 28 ft., is so small that a motor of only 5 hp is sufficient for the work of operation.

The Boston Edison Company Fights Municipal Ownership.

Telling work against the cause of municipal ownership is being accomplished by the Edison Electric Illuminating Company, of Boston, in its monthly publication, "Edison Light." This little magazine is regularly mailed to customers and other interested parties on the company's list, and in almost every issue extracts from the work of reliable writers and speakers in different parts of the country are reprinted in succinct form, showing clearly the fallacy of municipal ownership of public utilities employing large numbers of men. In a recent issue the company discussed every item of expense tabulated in the report of the Massachusetts Gas & Electric Light Commission and showed clearly how little if any saving in operating cost could be expected under the political management, which in this country at least is inseparable from municipal ownership. The recent visit of the Scotch expert, Mr. James Dalrymple, to Chicago, with his discouraging conclusions, is also mentioned, thus reaching a large part of the public who seldom would otherwise see the real truth of this *ignis-fatuus*.

Reactance E. M. F. and the Design of Commutating Machines.

By C. A. Adams.

At the Asheville Convention of the American Institute of Electrical Engineers, June, 1905, Mr. Senstius read a very interesting paper entitled "Limitations in Direct-Current Machine Design," in which he developed and applied a formula for the "reactance volts" of commutation, as defined by Hobart.

Working along similar lines, the writer last winter developed a formula for the same quantity, but expressed it in terms of the *design constants,* so that the latter may, at the outset of a design, be given such values as to yield a reactance e.m.f. within the desired limit. This formula makes possible a straightforward rational determination of the minimum safe number of commutator bars, and shows clearly the manner in which the several fundamental design constants affect the commutation.

The term *commutation belt* will be applied to the set of adjacent[1] conductors which are undergoing commutation at the same instant.

Designate by ϕ'_e the *flux* (maxwells) *per ampere-inch of embedded length of commutation belt;* i. e., the equivalent flux that would be linked with one inch of embedded length of the belt as a whole, when a current of one ampere flows through the belt, distributed uniformly throughout all of its conductors.

It is obvious that in general the number of conductors in the commutation belt varies with different positions of the armature, and that ϕ'_e also varies because of the change in relative location of the belt conductors and the consequent change in equivalent permeance of the leakage flux path. The *average* values of these quantities will be here considered, as well as the *average*[2] *value of the reactance e.m.f.*

It is hardly necessary to discuss here the method of calculating Φ'_c, as this subject has been thoroughly treated by Arnold,[3] Niethammer[4] and others; it is important, however, when making this calculation, to take note of the definition of ϕ'_e as given above.

Let k_b = the fraction of the pole-pitch angle subtended by the brush.

λ_p = the pole-pitch at the gap circumference (inches).

Δ = the peripheral current density, ampere conductors per inch of periphery.

I = the average current in a single armature conductor.

l_p = length of pole-arc (inches).

$k = \dfrac{l_p}{\lambda_p}$ = ratio of pole-arc to pole-pitch.

p = number of pairs of poles.

p' = number of pairs of paths in armature winding.

N' = conductors per coil.

l = length of core, in inches, excluding air ducts.

v = peripheral velocity of armature in feet per second.

B = mean gap density at pole-face (maxwells per sq. inch).

e'' = average volts per inch of active conductor, due to cutting of main flux; it is

$e'' = 12 k v B 10^{-8}$

e_b = average volts per bar of commutator.

E = terminal volts.

AVERAGE BREADTH OF COMMUTATION BELT

For a *multiple-circuit*[5] *winding* or for a *two-circuit*[5] *winding with two sets of brushes,* this is $k_b \lambda_p$; i. e., it corresponds to the width of brush, the insulation between commutator bars being neglected.

For a *two-circuit* winding with *2 p sets of brushes,* there are two short-circuit paths: the long path through the $2p$ conductor units which are in series between the two bars covered by one brush, the same as when only two sets of brushes are used; and the short path through two conductor units in series between two adjacent[6] brushes of the same polarity. The actual short-circuit phenomena include currents in both paths, the short-path currents predominating at the beginning and end of the commutation period. As the long path is considered in connection with the two-brush, two-circuit winding, the short path will be considered here. Then for a machine with *many poles,* the two bars which terminate a single coil enter under two adjacent[7] positive (or negative) brushes at almost the same instant, and leave at almost the same instant. Thus the breadth of commutation belt corresponds to the width of brush plus that of one bar. In a *four-pole* machine is corresponds to the width of brush plus that of one-half bar, in a *six-pole* machine to the width of a brush plus that of two-thirds of a bar, etc. In general the width of the short-path commutation belt, in this type of machine, may be expressed as follows:

$$\lambda_p \left(k_b + \frac{p-1}{p} \frac{e_b}{E} \right)$$

where E is the terminal e.m.f. of the machine.

The difference between this and that for the multiple-circuit armature increases with e_b and p.

Take an example: $k_b = 0.07$, $p = 12$, $e_b = 3$, and $E = 125$; the expression in the parenthesis is equal to 0.09, or nearly 30 per cent larger than k_b, which corresponds to the long path belt, or to machines in which the number of circuits and the number of sets of brushes are the same. Therefore, *with a given width of neutral field the brushes of this type of machine should be narrower* (k_b smaller) *than for the machine with equal numbers of circuits and brush sets.*

INDUCTANCE.

Consider first armatures (multiple-circuit or two-circuit) with as many brush-sets as circuits[8].

Embedded Length.

The average number of conductors in the commutation belt is:

$$\frac{\Delta \lambda_p k_b}{I}$$

and the average flux (maxwells) per embedded inch of belt for one ampere in each conductor of the belt is:

$$\phi_{eb} = \frac{\Delta \lambda_p k_b}{I} \phi'_e.$$

$$\frac{e_b}{e''} = \text{inches of active conductor in } \frac{p}{p'} \text{ coils} = \frac{e_b 10^8}{12 k v B}.$$

$$\therefore \frac{e_b}{e''} \frac{p'}{p} = \frac{e_b 10^8 p'}{12 k v B p} = \text{inches active conductor per coil,}$$

$$\text{and} \qquad N' = \frac{e_b 10^8 p'}{2 l \times 12 k v B p}.$$

Then the flux linkage per coil, for the embedded length, per ampere in each conductor of the whole belt, is:

$$2 l \phi_{eb} N' = \frac{\Delta k_b \lambda_p e_b 10^8 p'}{12 k v B I p} \phi'_e$$

and the inductance of the embedded length per coil, in henries, is:

$$L_e = \frac{\Delta k_b \lambda_p e_b p'}{12 k v B I p} \phi'_e. \qquad (1)$$

Free Length

The free length per active conductor is approximately $l_f = 1.35 \lambda_p$. The number of conductors in a commutation belt-bundle of end connections is only half that of the active belt; it is $\dfrac{\Delta k_b \lambda_p}{2 l}$, and the flux per inch of free belt per ampere in each conductor is $\phi_{fb} = \dfrac{\Delta k_b \lambda_p}{2 l} \phi'_f$, where ϕ'_f bears the same relation to the free belt as ϕ'_e to the embedded belt.

Then the *flux linkage* per coil, for the free length, per ampere in each conductor of the free belt, is $2 l_f N' \phi_{fb}$, and the inductance of the free length per coil, in henries, is:

$$L_f = 2 l_f N' \phi_{fb} 10^{-8} = \frac{.68 \lambda_p}{l} \phi'_f \frac{\Delta k_b \lambda_p e_b p'}{12 k v B I p} \qquad (2)$$

The *total inductance per coil* is thus:

$$L = L_e + L_f = \frac{\Delta k_b \lambda_p e_b p'}{12 k v B I p} \left(\phi'_e + \frac{.68 \lambda_p}{l} \phi'_f \right) \qquad (3)$$

But $\lambda_p = \dfrac{l_p}{k}$, where l_p = pole-arc, and $\dfrac{.68}{k}$ is, in the great majority of machines, very nearly unity; therefore,

$$L = \frac{\Delta\, k_b\, \lambda_b\, e_b\, p'}{12\, k\, v\, B\, I\, p}\left(\phi'_c + \frac{l_p}{l}\,\phi'_f\right) \tag{4}$$

In most direct-current machines the ratio $l_p \div l$ does not differ much from unity; (4) then becomes *approximately*:

$$L = \frac{\Delta\, k_b\, \lambda_p\, e_b\, p'}{12\, k\, v\, B\, I\, p}\,(\phi'_c + \phi'_f) \tag{5}$$

For a *multiple-circuit winding* $p = p'$, and there is only one coil in series between adjacent commutator bars; therefore, the inductance for this case is:

$$L_m = \frac{\Delta\, k_b\, \lambda_p\, e_b}{12\, k\, v\, B\, I}\left(\phi'_c + \frac{l_p}{l}\,\phi'_f\right) \tag{6}$$

For a *two-circuit* winding with two brush sets, there are $\frac{p}{p'}$ coils in series between bars, and the inductance is:

$$L_2 = \frac{\Delta\, k_b\, \lambda_p\, e_b}{12\, k\, v\, B\, I}\left(\phi'_c + \frac{l_p}{l}\,\phi'_f\right) \tag{6a}$$

These equations are not identical, since the amperes per conductor I, are different for the two machines.

FREQUENCY OF COMMUTATION.

For the two types above considered, the commutation frequency is:

$$n_c = \frac{6\, v}{k_b\, \lambda_p}. \tag{7}$$

REACTANCE VOLTS.

The *reactance per coil* is then $x = 2\,\pi\, n_c\, L$ and the reactance volts,

$$E_{\text{R}} = I\,x = 2\,\pi\, n_c\, L\, I = \frac{\pi\, \Delta\, e_b}{k\, B}\left(\phi'_c + \frac{l_p}{l}\,\phi'_f\right) \tag{8}$$

Thus the reactance e.m.f. of the *multiple-circuit* winding is the same as that of the two-circuit, two-brush winding.

$$\text{Let } \phi' = \left(\phi'_c + \frac{l_p}{l}\,\phi'_f\right)$$

and take $k = 0.7$, which is sufficiently accurate for the present purpose, then

$$E_{\text{R}} = 4.5\,\frac{\Delta\, \phi'}{B}\, e_b. \tag{9}$$

TWO-CIRCUIT WINDING WITH $2p$ BRUSH SETS.

For the *long path*, the reactance e.m.f. is given by equations (8) and (9). For the *short path*, the average width of commutation belt is, as shown above,

$$\lambda_p\left(k_b + \frac{p-1}{p}\,\frac{e_b}{E}\right) \tag{10}$$

The number of conductors in the belt and the inductance per coil will be increased nearly in the same ratio as the belt width. But it is easily seen that the period of commutation also increases in this same ratio, and the frequency in the reciprocal ratio. Thus the increase in the inductance is balanced by the corresponding decrease in the frequency, and the *reactance e.m.f.* for the *short path* is:

$$E_{\text{RS}} = \frac{\pi\, \Delta\, e_b\, p'}{k\, B\, p}\left(\phi'_c + \frac{l_p}{l}\,\phi'_f\right) \tag{11}$$

or

$$E_{\text{RS}} = 4.5\,\frac{\Delta\, e_b\, p'}{B\, p}\,\phi'. \tag{12}$$

If (12) could be used as the sole criterion in design, it is obvious that this type of machine would have a very considerable advantage over the other types, from the standpoint of commutation; but when the number of poles is large (just when the advantage would be greatest), the reactance e.m.f. is more closely represented by equation (9). An example will make this clear:

Consider a 12-pole machine, and assume a reactance e.m.f. of one volt per coil; then

	Long path.	Short path.
Reactance e.m.f.	0	1
Brush contacts in series..............	2	2
Coils in series........................	6	1
Approximate total resistance, in arbitrary units	3	2.2

Although this is a very rough analysis, it shows that much the larger part of the current will take the long path, and that the effective reactance e.m.f. will be somewhat less than that given by equation (9); how much less, it is difficult to determine with any degree of accuracy.

CONCLUSIONS AND DISCUSSION.

The *reactance e.m.f.* is, other things being equal, independent of the *voltage* and *capacity* of the machine, independent of the *peripheral velocity*, and independent of the *brush width*.

The *brush width* should be as great as is consistent with the width of the neutral field. An average value of k_b is 0.08; but a still better criterion is $k_{bm} = k_b \div (1 - k)$, since this is the ratio of the angle subtended by the brush to that subtended by the interpolar distance, or the neutral field. A conservative value for this ratio is 0.25. Other things being equal, a thick brush means a smaller value of ϕ'_c and ϕ'_f, owing to the increase in belt width.

The *reactance e.m.f.* is proportional to the average volts per bar, e_b, to the peripheral current density, Δ, and inversely proportional to the mean gap density, B.

A large value of Δ requires relatively deep slots and therefore a larger ϕ'_c, so that E_{R} increases more than in proportion to Δ.

Referring now to equation (9), the safe limit of E_{R} is determined by the resistance of the short-circuit path, which consists chiefly of the brush contact resistance (unless high-resistance commutator leads be employed).

Assuming E_{R} to be thus determined, we have

$$e_b = \frac{B\, E_{\text{R}}}{4.5\,\Delta\, \phi'}, \tag{13}$$

which determines the minimum number of commutator bars per pole. It is:

$$\frac{E}{e_b} = 4.5\,\frac{\Delta\, \phi'\, E}{B\, E_{\text{R}}}, \tag{14}$$

and the minimum brush pitch (the pole pitch at commutator surface), is:

$$\lambda_b = 4.5\,\frac{\Delta\, \phi'\, E}{B\, E_{\text{R}}}\, t_b. \tag{15}$$

where t_b is the minimum allowable thickness of bar at surface of commutator, including insulation.

But $\lambda_b = \frac{360\, v_c}{p \times R}$, where v_c = peripheral velocity of commutator (feet per second), and R is the speed in revolutions per minute. Therefore, the *maximum allowable* value of *pairs of poles × revolutions* is:

$$p \times R = \frac{80\, v_c\, B\, E_{\text{R}}}{\Delta\, \phi'\, t_b\, E}. \tag{16}$$

Since the peripheral velocity of the armature is limited mechanically, equation (15) practically places a lower limit on the pole pitch, thus the minimum safe pole pitch is:

$$\lambda_p = \lambda_b\,\frac{v}{v_c} = 4.5\,\frac{v}{v_c}\,\frac{\Delta\, \phi'\, E}{B\, E_{\text{R}}}\, t_b \tag{17}$$

If electromagnetic commutation be employed, the limit for E_{R} may be set somewhat higher, which will make the above safe maxima higher and the minima lower.

Numerous interesting conclusions may be drawn from the above equations, some of which are old friends. Some of the most general are as follows:

Assuming E_{R} and ϕ' to be fixed, the high-voltage machine should in general have:

1 A lower peripheral velocity of armature, v
2 A higher " " " commutator, v_c
3 A lower " current density, Δ
4 A higher gap density, B

5. A larger pole pitch, λ_p.
6. A smaller number of poles (constant r.p.m. assumed).
7. Thin commutator bars.

(*a*) 1 means a small diameter, *d*...

(*b*) 1 and 3 mean a larger projected area of armature, *dl*, although partly neutralized by 4.

(*a*) and (*b*) mean a greater length of core, *l*.

(*c*) 3 and 5 will more or less neutralize each other as far as the armature ampere-turns per pole are concerned. Assuming, on this basis, that the field ampere-turns per pole are approximately the same, the neutral field will be *flatter* and *broader* unless *k* be increased.

(*d*) Thus a thick brush may be used, although it is more conservative to retain the same brush thickness and to take advantage of the flatter field to offset the larger value of E_R, which it is sometimes difficult to avoid.

(*e*) The smaller current of the high-voltage machine means narrower (axially) brushes and a shorter commutator.

There are many and obvious reasons why all of the above differences should not appear in any one case; but the analysis shows the general tendency of direct-current design as affected by the Hobart criterion of commutation.

Many of the conclusions are not new, but the method is new and is readily susceptible of application to the quantitative solution of design problems. The method is essentially the same as that employed in the writer's recent paper on "Induction Motor Design."[10] This article is in fact a corollary to that paper and was developed at the same time.

◆

Regulation of Gas and Electric Rates in Massachusetts. II.

(*Concluded.*)

By Alton D. Adams, LL.B.

On the question of what a gas company should be allowed to earn, the commissioners said: "In addition to the cost of manufacture or a fair price for gas purchased and a fair cost for distribution, including management and tares, the Board believed it necessary and advisable to add a fair allowance for depreciation, and extensions or improvements. Extraordinary demands for extensions may properly be met by the issue of new capital, but the ordinary demands which a progressive management desires and is bound to meet may fairly be provided for out of income when the price of gas is not made so high as to be burdensome. This is the course which has been pursued by the best managed companies in this State for a long term of years—by those in which the prices are the lowest—and has probably contributed more than any other single factor to make these low prices a possibility. A study of the history of the business will show that the benefits arising from the increase of population and output are most surely secured to the consumer by an adherence to this policy. By this the capital charge is kept low, and the relation of capital to output is perhaps the most important single factor bearing upon the cost of gas to the consumer. It proves advantageous to the public by making a low price possible, and to the shareholder by adding security to his investment. An increased consumption demands added facilities for manufacture and distribution, and if the share capital remains the same, the amount per 1,000 cu. ft. which consumers must pay for fair and reasonable dividends rapidly decreases."

3 In 1892, certain consumers supplied by the East Boston Gas Light Company brought a petition before the Commissioners asking a reduction in price and an improvement in the quality of its gas. The candle power of this gas had been constantly above the standard fixed by statute, and at the public hearings on the petition the question of price was the main point of contention. No order as to the quality of gas was made by the commissioners in this case, but they fixed the price at $1.50 net per 1,000 cu. ft., from and after the first day of May, 1893, and the company adopted this price. Prior to the date just named, the regular net price of gas sold by the East Boston company was $0.25 higher per 1,000 cu. ft. On June 30, 1892, the capital stock of the East Boston company was $220,000, and it had no bonds or notes outstanding. During the year ending on that date, the latest year for which the reports of gas companies were before the commissioners when they fixed the price in East Boston, the East Boston company had a gross income of $77,369.07 from its gas business, and its entire operating expenses were $55,087.87. This left a net income of $22,281.20, and of this $22,000, or 10 per cent on the capital stock was paid out in dividends. Gas to the amount of 39,471,423 cu. ft. was sold in this year, at the gross price of $1.85, the net price of $1.75, and the average price of $1.76 per 1,000. On this volume of sales the capital of the company amounted to $4.06, and the dividends named to 55.73 cents per 1,000 cu. ft. of gas. Per mile of main the gas sold was 1.9 million cu. ft., and the cost of this gas to the company less the sum received for residuals was $1.16 per 1,000 cu. ft., at the meters of consumers. This total cost was made up of 72.84 cents net in the holder, and 43.72 cents from holder to burners. If the reduction of 25 cents per 1,000 cu. ft. in the net price of gas, made by the commissioners, had been in force on the sales of 39.471.423 cu. ft., in the year under consideration, the net earnings that might have been applied to dividends would have been reduced by about $9.867, or to 5.64 per cent of the capital stock. Prior to the year ending June 30, 1892, the East Boston company had accumulated a surplus, and had invested a part of it in securities that bore interest. From this source the company received interest to the amount of $2,934.55, during the year in question, and this interest was 1.33 per cent on its capital, so that with net earnings and interest a dividend of 6.97 per cent might have been paid, even under the rate subsequently fixed by the commissioners.

At Taunton the sales of gas were 38.3 million cu. ft., or about one million less than in East Boston during the year ending June 30, 1892, and the price charged by the Taunton company was $1.50 gross and $1.47 average, per 1,000 cu. ft. While the average candle power of gas in East Boston was 17.41, that in Taunton was 18.21, and both companies made coal gas only. The Taunton company sold 1.8 million cu. ft. per mile of main, or 0.1 million cu. ft. less than the South Boston company.

In this same year the Malden Gas Light Company sold a total of 36.3 million cu. ft., and had only 569,000 cu. ft. per mile of main, at a cost to itself of 95.65 cents per 1,000 cu. ft., the entire product being coal gas. This cost was made up of 55.70 cents, the net cost in the holder, and of 39.95 cents, the cost of distribution from holder to burner, per 1,000 cu. ft. sold. Gas sold by the Malden company had an average candle power of 17.24, or very nearly the same as that sold by the East Boston company. The net cost in the holder at East Boston was 72.84 cents per 1,000 cu. ft., or 17.14 cents higher than the like cost in Malden. This excess of cost in the holder for East Boston gas was mainly due to a charge of 26.09 cents for repairs and maintenance of the manufacturing plant there, while the corresponding charge on the Malden plant was 8.40 cents per 1,000 cu. ft. sold. For the distribution of gas by the East Boston company the entire cost including management and taxes was 43.72 cents from holder to burner, while the like cost in Malden was 39.95 cents per 1,000 cu. ft. sold. Between these two distribution costs the difference is 3.77 cents, and this was more than covered by the higher charges for management and for repairs and renewals by the East Boston company. In Malden the taxes of the gas company amounted to 13.09 cents per 1,000 cu. ft. sold, and the corresponding tax of the East Boston company was 13.78 cents. On both manufacture and distribution the entire cost of operation was 20.91 cents less to the Malden company than to the East Boston company per 1,000 cu. ft. sold by each. If the East Boston company had made and distributed gas at as low a cost as the Malden company, or say 96 cents per 1,000 cu. ft. during the year ending June 30, 1892, and if the rate of $1.50 per 1,000 cu. ft., subsequently fixed by the commissioners, had been in force on the sales of that year, the

---

[1] In the case of chord windings, the conductors in question are not immediately adjacent and the problem does not admit of any simple general statement. This class of windings will be excluded from the present treatment.

[2] This is on the whole quite as good a criterion as the maximum value, as calculated by Hobart, since in that calculation ϕ' is assumed to be constant, whereas it is generally a minimum when the number of conductors in the commutation belt is a maximum; moreover, during the period when the number of conductors in the commutation belt is a maximum, the brush-contact resistance of the short-circuit path is also a maximum. Both of these relations reduce the importance of the maximum as compared with the average reactance e.m.f.

[3] "Die Gleichstrommaschine," Vol. I, Chapter 18.

[4] "Berechnung und Konstruktion der Gleichstrommaschinen," Ferdinand Enke, Stuttgart, 1904.

[5] These may be either simplex or multiplex.

[6] See Hobart, "Electric Motors," page 48.

[7] Two poles apart.

[8] This applies equally well to *multiplex* windings, but if the winding be *m*-plex there will be *m* times as many circuits as brush sets.

[9] The brush contact resistance is not constant, but varies as the bar passes under the brush.

[10] A. I. E. E., June, 1905.

East Boston company would have derived a net income of $21,314 55 from its gas business. This net income would have paid a dividend of 9.68 per cent on the capital stock of the company, and it would have had the interest derived from its investment in securities besides. It had been the policy of the company throughout its history to lay aside a part of its annual profits, and at the time the commissioners fixed the rate just considered, the surplus thus accumulated was above $80,000, fully one-halt of which was invested in securities. The remainder of the surplus was invested in the plant and business of the company.

The commissioners said in their opinion on the case that the grounds for any considerable reduction in the price of gas charged by the East Boston company must rest in a measure upon what was a fair treatment of its surplus, and that the interests of the public demanded that a part of the surplus be invested in the plant. Though a reduction in price usually results in an increased output of gas, this is not always the case, but the surplus of the East Boston company was said to be a sort of insurance fund against possible loss from lower rates. With this idea, the commissioners fixed a lower price in East Boston than the figures for cost and output alone seemed to warrant. As to rights in the surplus that the East Boston company had invested in securities the commissioners said: "In this consideration it becomes an important and difficult question to determine the proper use to which these investments should be put, to discover what are the equitable interests of the stockholders and the public in them, and to determine how far and in what way the consumer may properly reap advantages for such accumulation. In view of all the relations existing between the parties in interest, the board is unable to agree that it should be treated as the exclusive property of either. If the affairs of the corporation were to be wound up by proceedings for dissolution, this sum would unquestionably belong and be distributed ratably to the shareholders. They have, to-day, an undoubted legal right to convert these securities into cash and to divide the proceeds in the same manner as they would distribute any other portion of their profits. Supch a course, however, would unquestionably be against the interests of the corporation and would probably prove fatal to its prosperity. . . . From the public the company has received, without any consideration, and at a time when it was probably not prepared to pay a consideration, a franchise which, although of doubtful value then, has proven since to be of the highest value to its owners. Very much of the company's profits has come from the natural growth of wealth and population in the territory which it supplies and to which its corporate management has directly contributed but a small share. This surplus must, we believe, be regarded as the combined result of a wise corporate management and the contributions on the part of the public. It would seem that the company is under obligation to so use a surplus of this character that substantial advantages may accrue from it to the public, and such a cause will bring added strength to the corporation itself."

4. Before the close of 1892 certain of its consumers petitioned the commissioners for a reduction in the rates charged by the Springfield Gas Light Company. After hearings on the petition the commissioners, on April 14, 1893, fixed the net price of gas supplied by the Springfield company on and after the first day of the following May at $1.40 per 1,000 cu. ft. This was a reduction of 35 cents per 1,000 cu. ft. in the net price of gas to ordinary consumers. Since 1848 the Springfield company had operated the only gas system in that city, and in 1879, it began to distribute steam for heating buildings. On June 30, 1892, the capital stock of the Springfield company was $500,000, and its notes payable were $45,000. Not all of this capital seems to have been invested in the gas business, for the company valued its steam plant and system at $72,741. During the year ending June 30 the company derived an income of $164,067.47 from the sale of gas and residual products, and its operating expenses were $104,049.67, so that the net income from the gas business was $60,017.80. No income from the steam heating business was reported for this year, and it is most probable that the distribution of steam had previously been abandoned. During at least a part of the time that the steam heating system was in operation, it had been necessary to support it with profits from the gas business. In the year under consideration, the company paid in interest $2,568.13, and this sum deducted from the net earnings left a profit of 11.48 per cent on the capital stock. Dividends of 8 per cent were paid. Gas sales for this year amounted to 84,935,720 cu. ft., at the regular net rate of $1.75, and the average rate of $1.69 per 1,000. This was all coal gas of 18.31 average candle-power, and 1,843,000 cu. ft. were sold per mile of main. Per 1,000 cu. ft. of gas sold, the capital and notes of the company amounted to $6.94, and the dividends paid for the year to 47.09 cents. This gas cost the company 98.10 cents net at the burners per 1,000 cu. ft. sold, made up of 67.17 cents net in the holder, and of 30.93 cents from holder to burner. If the net rate of $1.40 per thousand, as fixed by the commissioners for gas sold on and after May 1, 1893, had been received on sales during the year ending June 30, 1892, the business would have yielded an income of $35,588 above operating expenses. After deducting from this the sum of $2,568.13 paid as interest in that year, the remainder of the gas income would have amounted to 6.60 per cent on the capital stock.

In this same year the gas company in Haverhill sold 52.8 million cu. ft. of gas at the regular net rate of $1.40 per 1,000. One half was coal and the remainder was water gas, the average candle power of the mixture was 20.79, and the sales amounted to 2.2 million ft. per mile of main. The net cost of gas sold by the Haverhill company was 98.73 cents per 1,000 cu. ft., or 0.63 cent more than that sold by the Springfield company. In the holder at Haverhill the cost of gas was 68.40 cents net, and from holder to burner 30.33 cents per 1,000 cu. ft. sold, so that the holder cost was within two cents, and the distribution cost within one cent of that at Springfield.

The commissioners said in their opinion on the case that the most important facts to be considered in fixing a fair price for the gas, were the capitalization, the steam department, the present condition of the plant and recent profits. It was stated that in fixing the price of gas the principle that money invested in the steam heating plant should look to the steam business alone for profits was followed. From an examination of the gas plant it was evident that large sums must be expended for extraordinary repairs and extensions in the near future, if the business of the company increased at its normal rate. It appeared that the capital stock of the company had gradually been increased from less than $50,000 to $500,000, and that a very large percentage of this increase had been paid for directly or indirectly by the divided profits of the business, though the payments seemed to have been made in cash. "The policy seems to have been to maintain the capital on a level with the construction account by declaring dividends to the amount of its increase and issuing new stock for the same amount." Perhaps the most important feature of the case was these facts as to the increase of stock, in the opinion of the commissioners. All profits of the company ordinarily belong to the shareholders and may be divided among them, even when invested in the plant, but such a course is against the interests of the company and the spirit of existing legislation. and leads to a higher capital in proportion to output than sound policy can approve. Speaking further on this point, the commissioners said:

"It is important to consider, however, that every dollar of the new capital issued in this manner in this company was represented by money actually put into the development of the plant and that the entire capital is fairly entitled to dividends, although at a lower rate than might be permissible under a different policy." It was pointed out in the opinion that the reduction in rates made by the commission must result in a reduction of the dividends unless there was a substantial increase of business, if the efficiency of the plant was maintained. As to the possible reduction in dividends it was said: "It will be for the reason, as suggested in a former case, that the injudicious conversion of profits or supposed profits into stock imposes in the end a certain loss upon consumers or future holders."

On the subject of a fair price for gas, and the relation between this and the capital stock the commissioners said: "When gas reaches the consumer it is burdened with three obligations: First, its fair cost; second, a fair dividend on a reasonable amount of capital; and third, such excess as will give the company sufficient surplus to enable it to meet extraordinary accidents and conduct its business with the highest economy. The consumer is in duty bound to pay these charges. If he pays more and the company converts this excess into new capital, increasing it to a figure beyond the fair amount demanded by the business, the consumer is burdened with too high a price for the gas in the first instance and thereafter with a dividend charge upon his own contributions. A company which pursues this policy and to this extent fails to appreciate its obligations to its customers must sooner or later pay the penalty. The growth of the company's capital and its policy in reference thereto are recognized by this Board as facts which it is proper and necessary to consider in adjusting complaints by consumers."

Convention of the Ohio Electric Light Association.

The eleventh annual meeting of the Ohio Electric Light Association was held at Hotel Victory, Put-In Bay Island, August 16, 17 and 18. The place selected for the meeting is a delightful one for a summer convention. Being surrounded by so many miles of the waters of Lake Erie, it was cool and comfortable both in and out of the convention hall. There are plenty of opportunities for rest and recreation on the island, and many of the members were accompanied with ladies.

The convention was not without its entertainment features, and the ladies were especially well taken care of. Two afternoons the convention adjourned in time to go bathing. An informal dance was held Wednesday evening and also Thursday evening. Thursday evening an opportunity was given those members who wished it to go boat riding and later the Rejuvenated Sons of Jove held high carnival. Some handsome prizes in the way of electric heating devices were given by various friends of the association to ladies who won in the various bowling, tennis, croquet and card-playing contests.

Friday evening an illustrated lecture by W. D. A. Ryan, on "Illuminating Engineering" was a feature which attracted a large crowd. Mr. Ryan has given this lecture at several other conventions, but introduced a number of new features in this one, including the color effects of mercury-vapor lamps. After the lecture on Friday evening the banquet was held.

On Friday morning the following officers were elected for the ensuing year: President, Mr. F. E. Valentine, Piqua; vice-president, Mr. W. E. Russell, Massillon; secretary, Mr. D. L. Gaskill, Greenville. Advisory Committee—Mr. Samuel Scovil, Cleveland; Mr. J. H. Bendure, Lima; Mr. D. L. Gaskill, Greenville. Executive Committee—Mr. M. E. Turner, Cleveland; Mr. E. J. Bechtel, Toledo; Mr. M. C. Hull, Columbus; Mr. W. E. Miller, Mount Gilead; Mr. W. P. Engel, Defiance. Finance Committee—Mr. E. H. Beil, Youngstown; Mr. Fred. W. Bauer, Sandusky; Mr. W. E. Richards, Toledo. Publicity Committee—Mr. B. S. Young, Ada; Mr. J. H. Maxon, Gallipolis; Mr. C. C. Collins, Columbus.

The following new members of the association were elected: Active—Fremont Gas, Electric Light & Power Company, Fremont, Ohio, W. M. Adams, superintendent; Alliance Gas & Electric Company, Alliance, Ohio, D. W. Low, superintendent; The Ada Water, Heat, Light & Power Company, Ada, Ohio, B. S. Young, manager; Jamestown Electric Light Company, Jamestown, Ohio, S. A. Brown, superintendent; Columbus Public Service Company, W. H. Sharp, secretary. Associate—Library Bureau, T. E. Crawford, manager, Cleveland, Ohio; Allis-Chalmers Company, G. C. Colwell, district manager, Cincinnati, Ohio; American Circular Loom Company, T. H. Bibber, Chelsea, Mass.

The meeting at Put-in-Bay amply fulfilled both in attendance and in range and quality of the papers presented the prediction made last year upon the election of President Turner. A feature of the programme was that quite a number of the papers presented a collaboration of several authors. A larger number of new faces than usual were noticeable among the central station people, and the disproportion between these and the supply men was not as pronounced as usual. Taken altogether, the convention was the best in the history of the association.

Owing to the stormy weather on the lake just previous to the convention, which caused some irregularity in the boat service and consequently the arrival of members, the first session was not called to order Wednesday morning, August 15. By afternoon, however, the attendance was sufficient to open the first session of the convention. After some routine business, President M. E. Turner, of Cleveland, gave his address, in which he called attention to the present wave of sentiment going over the country in favor of rate regulation by State legislatures and city councils. He urged upon the members that, in view of the fact that such legislation was likely to come up, they should keep strict accounts of costs of supplying electric light and power service, in order that they may have reliable figures when the time comes that they are needed. He called attention to the improvements in lighting units made since the last convention.

The president's address was followed by the reading of a paper on "Waste Products of a Central Station," by J. A. Bendure, of Lima.

WASTE PRODUCTS OF A CENTRAL STATION.

The paper furnished a discussion of the advantages to the central station of going into the district heating business, but confined itself to steam heating. The ability to supply steam has often enabled a company to secure contacts for light and power which it would not otherwise have obtained. This then in turn increases the load and the profits from the electric end, and also increases the amount of exhaust steam that can be sold for heating. That the service is of special value and is popular wherever introduced is evidenced by its rapid growth and the many requests for extensions of mains and service connections with which every manager is favored. The author stated that the results of operation of heating systems by a large number of electric companies have demonstrated that it is reasonable to expect a revenue from the sale of steam at least equal to the cost of fuel used at the power plant for electric light and power, and extra for steam for heating purposes.

In the discussion of Mr. Bendure's paper, Mr. W. E. Russell, of Massillon, expressed disappointment that Mr. Bendure had not taken up also hot-water heating as well as exhaust steam heating from a central station. There was some further discussion, and Mr. Bendure, in closing, explained that hot-water heating had been omitted purposely because he had nothing favorable to say for it. He thought the rates for exhaust steam heating should be fixed at a point at which the company could make money even if it had to supply live steam.

H. L. Wallau, of Cleveland, read a paper on "The Use of Barriers in Alternating-Current Switchboard Construction for Potentials Below 4,000 Volts." This was followed by other papers as follows: "Mercury Arc Rectifiers," by P. D. Wagoner, Schenectady, N. Y.; "The Operation of Alternating Current Motors on the System of an Electric Light Plant of 1,000 kw Capacity or Less," by E. H. Beil, Youngstown, Ohio; "Recent Developments in Single-Phase, Alternating-Current Motors," by G. Percy Cole, St. Louis, Mo.; "Electric Motor Applications," by J. Henry Klinck, Pittsburg, Pa.; "Under What Conditions Has It Been Found Advantageous to Use Potential Regulators?" by W. E. Richards, Toledo, Ohio.

On account of the necessity of crowding a full day's programme into half a day, the discussion of all these papers, abstracts of which follow, was postponed until the next morning.

BARRIERS IN ALTERNATING-CURRENT SWITCHBOARDS.

The author gave an instructive discussion of the causes for excessive rises of potential in circuits containing both condensance and inductance and showed that many low-potential switchboards as now constructed are not capable of withstanding the abnormal conditions to which they may be subjected. The weakness is especially noticeable with reference to that portion of the boards, across which arcs may form when fuses blow due to a short-circuit on the line. It was suggested that boards which are defective in this respect may be remodeled by the use of barriers so installed that each polarity has a compartment by itself. Soapstone is an excellent material for barriers. It is very tough, can be sawed into very thin slabs, can be cut and drilled with perfect accuracy, and it is absolutely non-absorbent.

MERCURY-ARC RECTIFIERS.

The paper by Mr. Wagoner gave an account of the mercury-arc rectifier developed by the General Electric Company. After setting forth the theory of the apparatus, a detailed description with illustrations was given of a commercial outfit such as has been developed for charging automobile storage batteries.

ALTERNATING-CURRENT MOTORS ON THE SYSTEM OF AN ELECTRIC LIGHT PLANT OF 1,000 KW OR LESS CAPACITY.

The author cited the experience of a certain company with alternating-current motors. Originally the power service was 500-volt, direct current exclusively, but about six years ago the installation of alternating-current motors was begun. Since that time the company has been pushing the alternating-current business almost exclusively, except in elevator work, and at the present time it has about equal power loads on each service. On the alternating-current service motors ranging in capacity from ⅛ to 100 hp are connected, and very little disturbance to the lighting results from their operation. As a rule individual transformers are installed, the exceptions being in the smaller sized motors, say up to three horse-power, which are often connected directly with lighting installations. In many instances motors are started up under comparatively light loads, as in machine shops, laundries, etc., where the motors are connected to the line shafting from which the machines are driven by countershafts. In other cases the full load is on from the start, a notable instance being that in which a 20-hp motor runs a roller coaster at one of the parks. The total capacity of the alternating-current motors now installed is approximately 700 hp, yet the total cost of repairs on the motors from the time of the first installation up to date has been less than $100.

SINGLE-PHASE MOTORS.

The paper outlined the constructional features and the operating characteristics of the Wagner single-phase induction-repulsion motor, the Schuler modified form of the induction-repulsion motor and the compensated series motor. The Schuler motor differs from the more usual Wagner machine in that, in addition to being provided with a commutator on which are placed brushes directly connected together in order to give to the machine the starting characteristics of the repulsion motor, it is supplied on the other end of the rotor with three collector rings connected into the secondary winding in three-phase relation. After the rotor has attained about one-half speed the polyphase resistance, which is connected to the secondary through the slip rings, is gradually decreased and finally short-circuited as the rotor runs up to full speed. The machine utilizes a combination of the torques of the single-phase induction motor and of the repulsion motor, and is stated to have exactly the torque characteristics necessary for elevator and hoist service. The compensated series alternating-current motor has the same characteristics as the direct-current series motor and is used chiefly for railway work. The author discusses the advantages of the single-phase circuits for distribution, which are in many cases sufficient to offset the increased cost of the single-phase motors in comparison with that of either the polyphase or direct-current machines.

ELECTRIC MOTOR APPLICATIONS.

The author enumerated some of the difficulties incident to the use of motors under various conditions and stated that a successful motor application can be made only when the characteristics of the driven machine are thoroughly known, and a motor of suitable design is used to operate it. The requirements of the machine must be supplied by the motor, not the reverse; for the machine is installed to do certain work, which is perfectly definite in character and which must not be changed under any circumstances. A direct-current motor working under load may have its speed varied by change in the voltage impressed on the armature terminals or by change in the field strength. By employing a three-wire, balanced-voltage generator it is possible to use 120 volts to supply the light circuits, and 120 and 240 volts for the motor circuits, the motor operating at the higher speeds on the 240-volt circuit, and at the lower speeds on the 120-volt circuits. By using a motor which has a two-to-one speed variation on a single-voltage circuit, the two-voltage arrangement gives a speed range of four-to-one.

The author described a type of motor having a speed range of four-to-one on a single voltage, which the Westinghouse Electric & Manufacturing Company has designed for use where it is not desired to install the three-wire system due to the limited lighting load. This type differs from the more usual one on account of the use of poles bolted to the frame midway between the main field poles. The auxiliary poles are used for the purpose of securing proper commutation, not only by the use of auxiliary fields, but also by such neutralization of the armature reaction as may be necessary to secure this result. The coils on the auxiliary poles are connected directly in series with the armature and consequently have at all times the armature current flowing through them, thus producing a magnetizing effect which can be made of any desired value for a given demagnetizing effect of the armature current.

VOLTAGE REGULATORS.

After outlining the necessity for a voltage regulator in systems supplying both motors and lamps with current from the same circuits, the author displayed several charts which served to show the excellent performance of a certain voltage regulator under severe service conditions. The regulator, which was used on an alternating-current system, consisted of a relay device which operated a boosting or lowering transformer which changed the e.m.f. by .6-volt steps throughout a range of 6 volts up or down. The e.m.f. of the auxiliary transformer was controlled by a switch which was given a step-by-step motion by means of a magnetic clutch driven from a line shaft. The direction of the motion was determined by the position of a relay voltmeter which was so connected to a potential transformer and a current transformer through a compensating device that a rise or fall of the e.m.f. consumed in the line actuated the armature of a dynamometer and established contact with the circuits of the magnetic clutches.

Thursday morning the president called for a discussion on papers read the previous afternoon. Mr. Leo A. Phillips, of Sanderson & Porter, in discussing the question of single-phase, alternating-current elevator motors, cited a case where a customer wanted to run an electric elevator on the end of a long, single-phase, alternating-current lighting circuit. It was feared that this would cause too much disturbance on the line, and the customer was induced to invest in a direct-current electric elevator and a storage battery from which to operate it. The storage battery was charged from a motor-generator set operated off the lighting circuit. It was sufficient to charge the battery once a week, this taking about eight hours during the daytime. The battery consisted of 58 cells, having a capacity of about 3,800 watt-hours. This was sufficient for 100 trips of the elevator. The elevator took 2¾ to 3 kw-hours per car mile.

Mr. H. L. Wallau spoke of one advantage of having single-phase motors on the lines as against polyphase motors. It would sometimes happen that one fuse would blow on a polyphase motor, unbalancing the phases and causing considerable disturbance as well as being detrimental to the motor, without, however, shutting down the motor entirely. Were it a single-phase motor, this could not occur, as the opening of a fuse would shut down the motor and the attention of those using it would be called to the matter.

Mr. Cole, in closing the discussion on his paper, thought the arrangement of motor-generator, storage battery and direct-current elevator motor was too complicated for most purposes. The present single-phase elevator motors would cause no disturbance on the line. In response to some questions which had been asked about organ blowing outfits, he spoke of a new apparatus for this purpose, which consisted simply of a fan driven by a motor, the whole being enclosed in a galvanized iron case to muffle the noise. The fan would deliver air in whatever quantities needed and there was no necessity for automatic regulating devices, as the motor and fan ran at constant speed and delivered the amount of air needed. Single-phase motors had proved their superiority over polyphase in irrigation pumping in California because of the fact that single-phase motors could be started from a distance. These irrigating pumps could be located at various points, perhaps a mile or more from a central switch house. By simply throwing the switch to any pump, the motor would start automatically, so that it was not necessary for the attendant to visit each pump house to start the motors, as was necessary with polyphase motors.

The next subject taken up was that on "Meter and Billing Records," which was introduced by short papers by Messrs. F. E. Valentine, Piqua; C. E. Inman, Warren; D. W. Low, Alliance, and Geo. Hayler, Joplin, Mo.

METER AND BILLING RECORDS.

Mr. Valentine contented himself with recommending the appointment of a committee to investigate and report on a system of central billing and recording. Mr. C. E. Inman described forms of a bill and electric meter card used by the Warren Water & Light Company. Mr. D. W. Low gave a number of forms used by the Alliance Gas & Electric Company, and Mr. George Hayler presented some of the best points found in record forms obtained from about 50 central stations located in the United States and Canada.

President Turner, in introducing the discussion of this subject, said that the records of the smaller companies throughout the State were in deplorable condition. He earnestly hoped that some simple system for the use of these companies could be worked out. The larger companies were already fairly well provided for. Nearly every company had a different system. The suggestions made in the paper by Mr. Low, although they appear somewhat complicated in the paper, were not so in reality and could easily be adopted by any small company.

A representative of the Library Bureau being called upon, stated the experience of his company in supplying card index record systems to electric lighting companies of Ohio, and said in all his company's experience there was only one case where two companies in the State used the same form, which well illustrated the great diversity of forms and methods. No company seemed to be satisfied to accept exactly those used by another company.

Then followed a paper by H. C. Ayres, Greenville, Ohio, entitled "Methods of Selling Current as Applied to Cities of 20,000 Inhabitants."

METHODS OF SELLING CURRENT AS APPLIED TO CITIES OF TWENTY THOUSAND INHABITANTS.

The author outlined the objections to the flat rate and to the straight meter rate and proposed a method of charging which eliminates the objections to each method. The customer is required to pay a certain small flat rate for each kilowatt of his installation, and in addition thereto he must pay a certain meter rate for all power consumed. The flat rate is determined by the fixed costs of the station, while the meter rate is determined by the running expenses. The advantages of this rate were stated to be as follows: It accurately represents the cost plus a profit in the case of each individual customer; it is a rate upon which yearly contracts can be made; it is a rate which will be attractive to the long-hour customer; it is free from objectionable meter or discount complications, and the income to the station and the bills to the customers will not vary as greatly as on a straight meter basis.

Mr. Valentine wished to know how customers liked the new system of charging outlined by Mr. Ayres. Mr. Ayres, later in the discussion, replied that the system was very well liked by customers and resulted in increased business. Mr. Wallau described the two-rate system in vogue in Cleveland, where stores and similar customers paid 12½ cents per kw-hour until an amount of power has been consumed equivalent to forty hours' use of the connected load per month. For all current used over this, the charge was 5 cents per kw-hour. In residences the actual connected load was not taken as a basis for figuring the rate, but a certain proportion of the connected load was figured according to definite rules. Mr. Ayres said that the system of charging he described in his paper had not been applied to resistances, as the high fixed charge would cause many small customers to use other illuminants.

Thursday's session was completed by the reading of the papers by Messrs. R. L. Johnston, of Akron, and Warren E. Russell, of Massillon, on "Methods Employed in Getting New Business and Retaining Old Business Where Natural Gas Competition Exists" and by the report of the committee on "Cost of Determinations." No session was held in the afternoon.

METHODS FOR OBTAINING NEW AND RETAINING OLD BUSINESS.

Mr. R. L. Johnston said that one of the strongest points in obtaining new business was to convince prospective consumers that they cannot afford to use gas with the accompanying risk and unpleasantness, at the same time setting forth the possibilities of the electric light for decoration and improving the appearance of the home and store. The best method for retaining old business is to make old customers satisfied with the quality of light, the reasonableness of the rates and the honesty and courteous treatment on the part of employees. Mr. Warren E. Russell gave interesting details of the manner in which the business of the Massillon central station had been built up. Advantage was taken of newspaper advertising and copies of an electrical periodical for popular reading were sent at intervals to prospective consumers, of whom a card catalogue is kept. He recommended sending out a circular letter monthly containing matter timely for the season, and if addressed to ladies, to dwell particularly on the cleanliness of electricity. As to wiring and fixtures, he considers it advisable to give any responsible householder all the time within reason to pay the bill, or include a certain percentage thereof in successive monthly bills for current. He believes that central stations are all coming to the free renewal of lamps, but if consumers pay for lamps they should be instructed as to when renewals are desirable. He recommended strongly that central station men should at once take up the matter of introducing electric flatirons, following these with other electric heating and cooking devices.

Friday morning the convention opened with the reading of a paper on "Line Construction," by B. L. Chase, and a paper by E. E. Noble, of Cleveland, on "Resuscitation from Electric Shocks."

LINE CONSTRUCTION

The paper dealt with the constructional features of pole lines, especially those using wood poles, and discussed at length the proper location of the line and the material to be used for pins, cross arms, guys and for the poles. The author stated that the line proposition resolves itself down to a careful study of all contingencies, the installation of good material, thorough workmanship, rigid inspection and proper maintenance of every detail, as it is only by constant attention to these that the required service may be obtained. It is imperative that high-tension lines be placed above and entirely clear of all other wires. In general wood poles are preferable to iron poles for high-voltage transmission. Michigan and Idaho cedar make excellent poles. The poles should be set approximately 44 to the mile. Hard yellow pine serves best for cross arms and for ordinary construction will give good results, but for heavy corners and junction poles where the strain is great oak arms should be used. For high-tension lines all cross arms should be double, and a block securely bolted between the arms about eight inches from the end will materially add to their strength.

RESUSCITATION FROM ELECTRIC SHOCK.

The paper gives an account of some researches of two Cleveland physicians as to the probable cause of death from electric shock. The conclusions are that death from the passage of heavy current through the body is due either to temporary stoppage of the heart or contraction of the muscular fibres of the heart, whose function is to force the blood to the general circulating system and the lungs. There is also a fall of arterial blood pressure. The physicians claim that their experiments showed that unless a relatively large part of the current passing through the body traverses the heart, the shock would not necessarily prove fatal, and that by the prompt application of artificial respiration a patient may be restored. It was stated that an examination of the blood showed that electric currents "up to 2,300 volts" cause no chemical or other changes in the blood itself, nor any change in the tissue of the brain or spinal cord or other nerve structures. (This is contrary to the evidence of autopsies of criminals executed by the electric current, where the presence of numerous lesions were noted.) The physicians recommend a method of resuscitation which is already well known to electricians, and the author of the paper suggests the wearing by those exposed to high voltages of a light metallic gauze jacket next to the skin, or a system of metallic bracelets worn around the upper arms and connected by means of flexible conductors, and a belt of some similar material worn around the waist or some part of the body below the heart.

The main question brought up in the discussion of the paper on line construction was as to the minimum permissible size of wire for primary distributing circuits. Mr. Valentine said that many maintain that nothing less than No. 6 should be used on such circuits and would like to know what members of the association thought about it. The majority seemed to be using nothing smaller than No. 6, although one member reported using as small as No. 10 on unimportant branches. Another member had been using No. 8 on such branches. Mr. E. J. Bechtel, of Toledo, thought that in places of any importance No. 6 should be used for mechanical reasons. The discussion drifted back into the question of rates.

Mr. Ayres wanted a satisfactory introduction of the rate outlined in his paper. Mr. Bendure did not favor the fixed readiness-to-serve charge or the two-rate system in smaller towns. He thought there was an analogy between the electric light business and the drygoods or any other business. A merchant's profits would depend on the amount of business he did, and no merchant would think of trying to charge enough for his goods to cover fixed charges for a small volume of business. A merchant was expected to do a large enough business to cover these fixed charges. If he did not, it was his own fault. He had taken out 25 or 30 meters from the premises of small customers who objected to a 75-cent minimum bill, and he thought it would be hard to get them on any kind of a two-rate or readiness-to-serve system of charges.

Mr. Maxon, in refutation of this, gave his experience to show that the plan was good for small cities. In his town he had worked at a two-rate system of charging whereby each customer paid 12 cents per kw-hour for the first thirty hours' use of the maximum number of lights connected, after which the rate for further power consumption was 3½ cents per kw hour. In answer to some things said in this discussion, which seemed to indicate that some of the members thought the readiness-to-serve rate of charging did not treat all customers alike, Secretary Gaskill explained that there was no discrimination between customers; that the same contracts were open to all. It had been found that the business men liked the system of a fixed charge plus a low kw-hour rate. Residences had not been put on this contract.

Mr. Ayres, in answer to a question, made a rough guess that about 50 per cent of the company's customers got a better rate as the result of the change to a fixed charge plus a low kw-hour form of contract. Mr. Bechtel said that there was not an analogy between electric lighting and the drygoods business as Mr. Bendure had indicated. The drygoods merchant's chief investment was in the stock he carried and his permanent investment was a small per cent of the total business. He thought the whole matter should be sifted down to a question of equity between consumers rather than a question of equity between the company and consumers, and this was a good way to explain the matter to consumers. The method of charging should be such as to distribute the costs fairly between different classes of consumers.

Mr. H. J. Mauger, of Schenectady, N. Y., spoke on the use of electric heating devices to increase load between peaks. To introduce such devices it was necessary that the first cost and the cost of maintenance and renewals on such devices be brought down so that they would be within the reach of ordinary customers. The indestructibility of a heating device also had in some cases much to do with the cost of operating it. For example, in the General Electric Company's egg boiler, eggs could be boiled by the use of but one tablespoonful of water, as it would not hurt the apparatus to run dry. By using this small amount of water and using the steam to cook the egg, the current need be used but a short time, whereas if enough water had to be boiled to cover the eggs, it would cost much more. It was a good plan to put out electric heating devices on trial, especially flatirons. Mr. Foote, of Jackson, Mich., had recently disposed of one hundred flat irons in this way, simply sending them out on trial, and all had been sold within a short time.

Mr. J. Kermode, of Cleveland, read his paper, entitled "Some Practical Suggestions on the Wiring of Residences and the Facilities given to Consumers for Increased Use of Electricity."

HOUSE WIRING.

The paper outlined the scheme of wiring for a modern eight-room house in order to bring out the fact that a moderate-sized house may be lighted in the most modern and satisfactory manner at an expense that will compare favorably with that for any other illuminant. For the parlor it is suggested that there be used several baseboard receptacles at widely separated points so as to allow the rearrangement of lamps without destroying the results to be obtained. In the combined reception room, library and living room there should be used a center chandelier, the lamps of which are arranged on two circuits and controlled from as many of the most convenient points as possible. The basement lamps should be of the high-low type and controlled by a switch at the head of the stairs, so that on entering the basement one would find in every room a light sufficient to show the way to any particular point where more light can readily be obtained. Sufficient outlets should be installed at various points in the house in order to permit of the use of curling irons, hot water heaters, heating pads, sewing machine motors, refrigerator motors and many other devices. The special arranging of the wires and the use of three-point or four-point switches make the installation somewhat more expensive than usual. It should be remembered, however, that the poor results which are often obtained from electric light and the high cost for the current used are very often due to the improper arrangement of the lamps and to the inadequate means for controlling them.

In the discussion of this paper Mr W. E. Russell spoke of some very artistic wooden fixtures which had recently been placed on the market. Mr. Mauger called attention to the fact that rarely are provisions for heating circuits made in the wiring of a house, and that the amount of current required for many of these devices is so great that they cannot be run on ordinary lamp circuits. Mr. Young, of Ada, had found that the first cost of heating appliances was the greatest barrier to their introduction. Mr. Mauger agreed with Mr. Young that this had been the case. He hoped that it would not be so long.

Mr. J. R. Cravath, of the ELECTRICAL WORLD AND ENGINEER, said that he had devoted considerable attention to the class of work outlined by Mr Kermode in his paper, and in most respects agreed with him as to the proper location and arrangements of lights in such a residence. The policy of looking carefully after the wiring of residences would bring good returns to any central station company. He made several suggestions as to various details of lighting arrangements in different rooms in modification of those mentioned by Mr. Kermode, including the use of a chandelier reading light as against an inefficient portable lamp on the table and the use of portable wall brackets in a bedroom, where the location of furniture was sometimes changed.

On Friday afternoon a paper on "Tests on Tantalum Lamps," by Prof. William Ambler, of Cleveland, was read by the secretary, the author not being present.

TESTS OF TANTALUM LAMPS.

Two lamps were tested, one with the clear and the other with the frosted bulb. The consumption of the former was 1.75 and of the latter 2.0 watts per mean horizontal candle power. On the basis of mean spherical candle power the consumption was 2.23 watts and 2.67 watts per candle power, respectively, the corresponding figures for a clear globe carbon filament lamp being 3.72 watts. The clear tantalum lamp was thus found to take 57 per cent. and the frosted lamp 64.5 per cent. as many watts per horizontal candle power as the carbon lamp, which latter had a consumption of 3.1 watts per horizontal candle power; and the tantalum with a clear bulb took 60 per cent. and the frosted lamp 72 per cent as many watts as the carbon lamp on the basis of spherical candle power. As compared with the carbon filament, it was found that it requires practically twice the change of voltage across the tantalum lamp to cause the same change in light. During a life of 1,000 hours both the tantalum lamp and the carbon lamp fell off 28 per cent. in candle power, while the increased consumption of current in the case of the tantalum lamp was 37 per cent., and in the case of the carbon lamp 33 per cent. These figures show that the energy taken by both the tantalum and the carbon lamp is practically constant during the life of the lamp. In Germany the cost of the tantalum lamp is 80 cents in barrel lots, as compared with about 10 cents for the carbon lamp. With these prices a calculation is given showing that there will be a saving by the use of the tantalum lamp only when the cost of energy is above 5 cents per kw-hour. This, however, does not include the value of burned-out lamps; allowing 50 per cent. of the original cost as the value of a burned-out lamp, there will be a saving of 35 per cent. in favor of the tantalum lamp with energy at 10 cents per kw-hour; with energy at 5 cents per kw-hour the saving amounts to 31.5 per cent., and at 3 cents to 13.5 per cent.

As all of the papers to be read at this session were on new high-efficiency lighting units, the discussion of this paper was deferred until others had been read. Mr. E. R. Roberts, of Pittsburg, Pa., then read his paper on "The Utility of the Nernst Lamp to the Central Station."

THE NERNST LAMP.

The first part of the paper discusses the subject under the heads of efficiency, color, assortment of units, power factor, high voltage and maintenance. The remainder of the paper treats of the specific advantages of the Nernst lamp in central station service, and gives the results of experience with it in a number of central stations. At present some 250 central stations use the Nernst lamp.

The paper of Mr. F. W. Willcox, of Harrison, N. J., on "High Efficiency, High Candle-Power Incandescent Lamps," was then read.

HIGH EFFICIENCY CARBON FILAMENT LAMPS.

The paper by Mr. Wilcox was devoted to the new type of carbon filament lamp which formed the subject of a paper read by Mr. John W. Howell at the recent A. I. E. E. Asheville meeting, which is rated at 2.5 watts per candle-power. The several forms of holophane reflectors used with this lamp were described and curves given illustrating the superiority of the new filament over the old carbon filament. It is stated that the new filament is obtained by applying an additional process to the present carbon filament, which includes heating in an electric furnace to a temperature of 3,000 to 3,700° C., this firing being performed both before and after treating. This results in producing an exceedingly pure form of carbon having considerably less specific resistance and greater density than the older filament. The process also changes the temperature coefficient from negative to positive. For this latter reason the term "metallized" has been employed to describe the new filament, although it contains no metal.

The discussion of the above three papers was then taken up.

Mr. W. D'A. Ryan, of Lynn, Mass., referring to Mr. Roberts' paper on the Nernst lamp, said that there was undoubtedly a field for a lighting unit intermediate between the incandescent and the arc lamp. He thought, however, in discussing the Nernst lamp, it should be remembered that this lamp is essentially a reflector lamp, and in comparing it with the arc lamp it should be compared not to the arc with its natural distribution of light, but with the arc equipped with the proper reflector. Referring to the statement in the paper that the efficiency of the Nernst lamp was easily twice that of the incandescent, he cited tests which he had made on a single-glower Nernst lamp one year ago, which gave a consumption of 4.11 watts per mean spherical candle power. Another test on a single glower lamp made last March gave a consumption of 4.10 watts per mean spherical candle-power. A six-glower Nernst lamp gave a consumption of 3.88 watts per mean spherical candle-power. An incandescent lamp of the kind ordinarily rated as a 3.1-watt lamp (horizontal rating) gave a consumption of 3.76 watts per mean spherical candle-power. An incandescent lamp commonly known as a 3.5-watt lamp (horizontal rating) gave a consumption of 4.24 watts per mean spherical candle-power. The Nernst lamp, therefore, occupied a position midway between the 3.1-watt and the 3.5-watt incandescent lamp. He maintained that the fair way of comparing the efficiency of such illuminants is in watts per mean spherical candle-power. He verified Mr. Roberts' statement that one three-glower Nernst lamp is the equivalent of a Humphrey four-burner gas arc. He cited a test he had made with a Humphrey gas arc with the ordinary equipment of opal globe and reflector burning 14 cu. ft. of gas per hour with gas at a pressure equal to a 2-in. water column, equipped with Welsbach mantel. This combination had a mean spherical candle-power of 86.8. The maximum candle-power of 135 was about 10° above the horizontal. The mean spherical candle-power of the three-glower Nernst lamp was 71.6 with opal globe and 75.3 with sand-blasted globe. The mean lower hemispherical candle-power with the Humphrey gas burner was 97.5; the same for the three-glower Nernst lamp with opal globe was 97.3, and with the sand-blast globe 119.6.

Mr. Roberts, in closing the discussion, maintained that the mean lower hemispherical candle-power should be the practical standard used in comparing illuminants of this kind, as that was the important factor.

Mr. Willcox said that if the mean lower hemispherical candle-power is taken as the basis of comparison, arc and incandescent lamps must be equipped with reflectors before such comparisons are made, otherwise they are of no value. The new incandescent lighting unit described in his paper has a mean spherical candle-power consumption of 3.05 watts per candle. The lamp equipped with reflector gives a mean lower hemispherical candle-power for 2.5 watts. He said that although the new lamp has been made so far only in the larger sizes, it would probably be developed for the smaller sizes.

COST DETERMINATION.

The report of the committee submits a classification of costs under main heads as follows: Income or receipts, with 8 sub-heads; construction accounts, with 14 sub-heads; general expense accounts under the main heads of operating and maintenance, with 7 sub-divisions of the former and 8 sub-divisions of the latter; distribution expense accounts under the sub-heads of operating and maintenance, with 6 sub-divisions of the former and 8 sub-divisions of the latter; general expense accounts, with 11 sub-heads. The paper concludes with an illustration of the application of the system to a specific case.

The closing event of the convention was the lecture on "Illuminating Engineering," delivered on Friday evening by Mr. W. D'A. Ryan, of the General Electric Company. The hall was crowded, with many ladies present, who paid close attention to the lecture and accompanying illustrations. The lecture was a general treatment of the subject of light and color, with some reference to illuminating engineering, the various points being illustrated by special apparatus designed expressly for the purpose. A number of interesting and instructive color experiments were shown, which had a practical bearing on the lighting of large areas, such as stores and the like. At the conclusion of the lecture a "pari-chromoscope," or color booth, was exhibited, which showed the effect of the incandescent, arc, Nernst and mercury lights upon various textile fabrics exposed to these various lights, and the change in color of certain materials when transferred from one booth to another. Mr. Ryan dwelt on the improvement possible in arc lighting by the use of a light balancing selective diffuser, giving a considerable increase in the efficiency on the store counter level when arc lights are used through producing a perfectly steady and white light.

LETTER TO THE EDITORS.

The Patent Law Situation.

To the Editors of Electrical World and Engineer:

SIRS:—For the last 15 years articles have appeared at intervals in the technical press calling attention to the inadequate method of obtaining justice in disputes based upon patents. The last one, by the well-known patent attorney, Mr. Edw. P. Thompson, of New York,* clearly shows some shortcomings of the present method, but he puts matters rather mildly when he says: "As the judge in court is only a legal man, a suit at patent law is nothing more than a burlesque or comedy in the eyes of a technical man."

Many a man who has the experience of wrong decisions, as well as others who only know about them, charge the judge with being interested or bribed. I, myself, firmly believe in the fairness and strength of character of the judges in American courts, in spite of the many wrong decisions by them and the resulting hardship to many law-abiding citizens, but I wish to point out that the well-known inefficiency of courts in properly dealing with technical cases lowers the prestige of these courts considerably, and may be a direct cause for seeming and actual disregard of laws and ordinances by many.

The concentration of power in large corporations and trusts has also become a feature of the electrical industry, and oppressive methods for removing competition are but natural consequences. Patents are singularly well adapted to further this end, for under the pretext of the desire to enforce laws and rights, suits can be brought which would make manufacturing unprofitable to enterprises of moderate capitalization. Well planned attacks by attorneys trained for years in such practice, testimony from experts having flexible consciences, and the inexperience of judges in technical matters are three formidable factors for systematically practicing anarchy under the guise of law.

Some ten years ago or more steps were taken by legal profession to overcome the greatest wrongs by presenting a bill before Congress for the creation of a "Court of Patent Appeal." Nothing has been heard of this so far. My inquiry at that time into the probable effectiveness of such an organization resulted in statements which may be summarized somewhat as follows: "It is not all that may be desired, but it is the best we can get at present."

In other words, if a firm has been persecuted for several years and has paid thousands of dollars for legal defence, it should be possible to appeal to a court where the subject may be expected to be reasonably well understood and which would enable the weaker party to get justice and not be crushed out of existence. Time has passed for calling atention to facts; action is required by those desiring a remedy from the present state.

Patents are interstate grants and rights and the Federal Government can be appealed to for the desired change. Below is outlined a plan which it is confidently believed will lead to the desired results if every manufacturer of electrical, mechanical or other devices protected by patents, and every inventor, lawyer or other person interested will respond promptly. It is not believed that a Patent Court of Appeals will give the desired relief and the plan here submitted consists in part in ascertaining from as many representative firms of various industries, lawyers, patent attorneys, judges and inventors, which system may best remedy for existing shortcomings. The plan consists in the execution of the following steps:

1. Everybody interested is requested to examine carefully the various remedies or suggestions submitted at the end of this letter and to select from them the form which he considers best adapted to give the greatest amount of justice at the least expense, or if none of these forms suit, to suggest another way, accompanying the suggestion with a brief explanation. The answer should not be formulated in its final shape before the subject has had four weeks' consideration.

2. The present communication should be shown by inventors, manufacturers and engineers to others, especially manufacturers in other branches, and to patent attorneys and lawyers in their locality, for consideration, judgment and reply in accordance with clause 1.

3. The answers, which shall be considered strictly confidential,

---

* Electrical World and Engineer, Vol. 45, No. 13, Page 634.

are to be addressed to and collected by the editors of the Electrical World and Engineer and the *American Electrician*, such communications to be marked "Patent Law Reform."

4. The correspondence thus collected is to be forwarded to the Bureau of Commerce and Labor, or as suggested by an eminent jurist of St. Louis, if the correspondence is voluminous, and representative firms, engineers and attorneys recognize the importance of this matter, a memorial may be prepared and handed, with the communications, by a Congressman or the chairman of the Ways and Means Committee, to the President of the United States, who, according to his judgment, may turn the matter over to the proper department or make suitable recommendations to Congress for its attention and action.

5. In this latter case instructions to Congressmen and Senators by all interested may be desirable, explaining the purpose and results hoped for and asking for their co-operation and support of a bill that will bring about the desired results.

For consideration and selection, the following modifications of the present practice are respectfully submitted in all such legal cases involving patents.

1. The court shall call to its assistance in ruling and deciding, in a technical suit, an expert uninfluenced by either complainant or defendant.

2. A court shall obtain an expert from the Patent Office selected by the Commissioner of Patents or head of the department in which the patent is classified.

3. A court shall call to its assistance an expert from the Patent office and another practical or theoretical expert as the case at hand may dictate.

4. The judge shall associate with himself a practical and theoretical expert. State or Federal laws to indicate who shall pay for these services.

5. The creation of a lower and upper Patent Office Court as a separate department of the Patent Office. In such a case the complainant informs the lower court that X is infringing his patent No. ——— and presents his side; in due course X is notified by the lower court (as at present in a case of interference) to present his case.

a. If considered necessary, lower court official hears cases in different sections of the country at fixed seasons of the year.

b. All matters not involving patents or technical matters to be referred to a local court for decision.

6. Suits involving patents to be handled as heretofore, but all testimony to be sent to Washington, for an opinion and assistance from a commissioner, examiner or officer of a department created for this purpose as a separate branch of the Patent Office and manned from the corps of examiners and commissioners of the different departments. Such official to be present at the final hearing of the case and to assist the court in judging the merits of each side.

7. A court of final appeal to be permanently located in Washington and to be formed by the heads of departments or legal lights of the profession.

The opportunity is now open to the individual reader to enter these primaries and give his decisive vote for reform, better patent protection and court ruling. The earnest and vigorous support of everyone interested is desired.

St. Louis, Mo. Ludwig Gutmann.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Testing Alternators.—Parshall.—A communication referring to a method which is on the Hopkinson principle, two similar alternators being necessary. These are mechanically connected by a special coupling which allows the two armatures to be displaced by any desired angle. He conducted the tests with two 385-kw, 2,200-volt alternators running at 300 r.p.m. The results of the tests show that when two similar machines are equally excited the phase of current and e.m.f. obtaining in the circuit corresponds with close approximation to that of an alternator running on a non-inductive load. The set was belt-driven and a dynamometer was employed to measure the torque applied. Besides determining the efficiency of the alternators at different loads, the author obtained quantitative results with regard to the armaure reaction and its effects upon the field magnets. The method was also applied for resolving the total losses into their components.—Lond. *Elec.*, July 21. The paper is described in full in the *Jour.* of the British Institute of Civil Engineers, Vol. 130, p. 247.

Iron Loss.—Lydall.—An account of experiments in which the author investigated how far the Steinmetz hysteresis law holds good with high densities, such as 20,000 c.g.s. lines per square centimeter, a value which is reached in almost all direct-current generators at the roots of the teeth on the armature. From his experiments it appears that it is fairly safe to assume for practical purposes that the hysteresis loss varies as the 1.6th power of the induction even up to the highest values. At higher inductions (above about 18,000) there is, however, an additional eddy-current loss which depends on the saturation. To explain it he considers the possibility of eddy currents in the end plates of the armature caused by a magnetic flux entering them from the poles. The author gives an explanation based on this idea.—Lond. *Elec. Rev.*, June 23 and July 7.

Voltage Drop of Transformers.—Hahnamann.—An illustrated description of a simple graphical method for determining the voltage drop of transformers.—*Elek. Zeit.*, July 27.

Lights and Lighting.

Small Incandescent Lamp.—Laffargue.—Some notes on a new small incandescent lamp, the filament being made from an alloy—zirconium being one component. The lamps require only small e.m.f's, such as two or four volts, so that only one or two storage cells are necessary. Some data are given on a 2-cp lamp which at four volts consumed 0.46 amp. (this gives a specific power consumption of 0.92 watt per cp). This is compared with an ordinary incandescent lamp of 2 cp, which at 8 volts consumes 0.95 amp., corresponding to a power consumption of 3.8 watts per cp. While this new lamp is more expensive in first cost, the cost of operation is much less on account of the higher efficiency.—*La Nature,* July 29.

Train Lighting.—An illustrated description of the Leitner-Lucas system of train lighting which has already been mentioned in the Digest. Some remarks on the Rosenberg system by Dalzeel and Rosenberg are published in the correspondence columns of the same issue.—Lond. *Elec.*, July 7.

Electrochemistry of the Metallic Arc.—Ladoff.—The first part of a summary reviewing the researches of various investigators on the metallic arc.—*Electrochem. and Met. Ind.*, August.

Power.

Electric Driving of Reversing Rolling Mills.—Some illustrated notes on the Ilgner system. The energy-storing fly-wheel on the motor-generator set from which the individual motors of the rolling mills are supplied with current should consist of one steel casting so as to be able to withstand the severe stress to which it is subjected. Its diameter is as a rule limited by considerations of transport. Its maximum peripheral speed should not be more than 295 ft. per second. A 42-ton fly-wheel with a rim weighing about 34 tons and rotating at the maximum speed mentioned is able to give out 7,500 hp for nearly 5 seconds for a 15 per cent reduction in speed. This

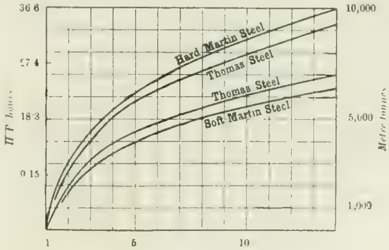


FIG. 1.

is much more than is needed to pass a bloom of about 2.5 tons once through the rolls. Tests have been made by Koettgen on the work consumed in rolling with different steels. Fig. 1 embodies the results of these tests, and shows the work done in lengthening a bloom weighing 4,900 pounds, and measuring at the outset 5 ft. 7 in. by 16½ by 16½ in. These curves enable the energy to be calculated for any kind of steel and iron works, the operating conditions of which are known.—Lond. *Elec.*, July 27.

Direct-Connected Motors in Repair Shops.—An editorial pointing out that the usual practice of street railway repair shops is to group drive the repair shop machinery by tramway motors which have passed their period of usefulness for car service under the severe conditions of the present day. It is thought, however, that the cost of operation could in many cases be lowered by the substitution of modern equipment. In very small repair shops conditions will seldom justify the extended use of direct-driven tools. But as the size of repair shops increases the opportunity to apply individual motors to heavy machines doing intermittent work or operating with a wide range of speed variation, grows greater until in the highly specialized shops of large systems a broad field of usefulness is found for both kinds of service. Small machines like grinders, hack saws, medium size lathes and shapers constantly used are generally better driven in groups, but in the heavier work with high-speed steels and variable cuts the individual motor deserves wider recognition.—*St. R'y Jour.*, August 12.

Electric Drive at a Powder Mill.—A description of the electric installation of a new powder mill in Morrow, Ohio. Induction motors are used, and to prevent explosions all electric wires of all the motors except in two cases are placed outside the buildings and the power is carried in by a shaft projecting through the wall.—*Eng'ing Record*, August 12.

Tidal Power.—Saunders.—A discussion of the utilization of tidal power with numerous illustrations. The author endeavors to show that the problem is "not such a fantasy as many people imagine."—*Eng'ing Review*, August.

Steam Turbines and Reciprocating Engines.—Gray.—A comparative analysis of the performances of steam turbines and reciprocating engines in four steamers of the Midland Railway Company. The great superiority of the turbine steamers is shown in detail. The difference of the initial cost is not great and amounted to only 1½ per cent of the total cost of hull and machine.—Lond. *Eng'ing*, August 4.

Diesel Engine.—Behrend.—An illustrated discussion of the usefulness of the Diesel engine in electric stations, especially in stations of small and medium size.—*Elek. u. Polyt. Run.*, July 15.

Spinning Mills.—Some illustrated notes on the use of electric motors in spinning mills.—*La Nature*, July 29.

Single-Phase Transmission.—Nunn.—Illustrated notes on the Telluride plant.—*Elec. Jour.*, August.

TRACTION.

Regenerative Control of Tramway Motors.—Some notes on results obtained on 41 cars in Birmingham with the Raworth regenerating system.—Lond. *Elec.*, July 21. In the Johnson-Lundell regenerative tramway motor the aim is not only to save by regenerating current when the car descends an incline or is brought to rest, but also to avoid practically all starting resistances. To this end the armatures are provided with a double winding and with two commutators, and at starting the rush of current is kept within reasonable limits by connecting all four armature windings in series. The field magnets are provided with a number of coils which may be connected in groups in series, or connected some in shunt and some in series, to form a compound winding, by an auxiliary controller or field changer. When the car is accelerating or running normally the motors are connected as series motors pure and simple. Speed regulation is obtained chiefly by connecting the motor armatures in various ways across the supply. When the motorman wishes to stop or to slow down, he presses with his thumb a button on the top of the controller handle; this causes the motors to be converted to compound-wound machines. By moving the handle simultaneously to one or the other of the notches the driver has it in his power to regulate the degree of braking.—Lond. *Elec.*, August 4.

Petrol Omnibuses versus Electric Tramcars.—Luntley.—A paper read before the British Municipal Tramways Association. The cost of operation of omnibuses is higher than that of tramways; one of the principal items of the expense of the former appears to be the maintenance and renewal of tires. The earning capacity per mile is less with an omnibus than with a tramway. The following cost of operation of omnibuses for 36 passengers is given, the figures being the cost per omnibus mile. The operating charges (petrol, wages, etc.), 9.352 cents; maintenance and renewals, 5.850 cents; general cost, 0.6 cent; interest and depreciation, 4.6 cents; total cost per omnibus mile, 20.402 cents.—Lond. *Elec.*, July 7.

Seebach-Wettingen Line.—Herzog.—Some notes on electric traction on the Seebach-Wettingen line by means of single-phase current at 15,000 volts. The author discusses especially three systems of suspension of the trolley wire which have been experimented with.—*L'Eclairage Elec.*, July 29.

London.—The voluminous report of the Royal Commission on London traffic with a map showing the existing and the proposed tramways.—Lond. *Elec.*, July 21.

Tramway Exhibition.—A long illustrated description of exhibits at a recent tramway and railway exhibition in London.—Lond. *Elec.*, July 7, 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Combined Lighting and Traction Stations.—Rider.—A paper read before the British Municipal Tramways Association. The author speaks especially on the financial results obtained with combined stations and on the advantages of supply from such stations. In his opinion there should be one electricity supply department for a town and it should provide all energy required and for whatever purpose. It should feed into the overhead wires of the tramway department just as into the wiring of any building, and, as a result of this it should provide all underground feeder and distributing cables. By adopting the maximum demand system of charging, all energy can be fairly supplied on the same terms, whether to tramways, to public lighting or to power users. But the initial price should be kept high and for as short a period as possible, while the second price should be kept as low as it is possible to make it. All classes of consumers will then be charged at rates in accordance with their use of the supply and the "long hour" demand of the tramways will result in a very low actual price per unit. With a proper system of charging, current can be supplied cheaper from a combined station than from a separate station. The paper was discussed at length.—Lond. *Elec.*, July 7.

Polyphase Motors on Single-Phase Circuits.—Garcelon.—Some notes on methods of starting and running polyphase motors with cage-wound secondaries on single-phase circuits. Fig. 2 shows a method of connecting a two-phase motor and resistance through a double-throw switch. Curves are given by the author showing results of a test of this arrangement. These show that the starting torque depends on the value of the resistance in series with the starting phase. The torque increases as the resistance is decreased until a maximum is reached, when, if the resistance is still further decreased, the torque falls off very rapidly. This is explained and the vector diagram of the arrangement is given. For a given motor the value of the resistance to be used is best determined by a simple test. Place a non-inductive resistance (water rheostat) in series with one phase and adjust it until a desirable torque is obtained.

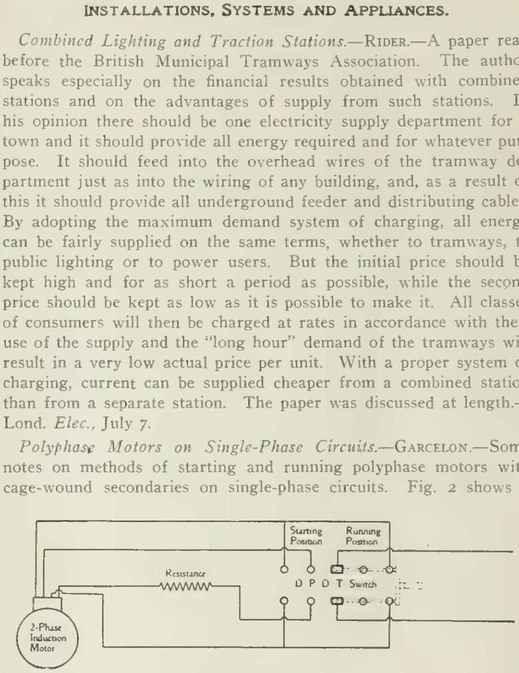


FIG. 2.

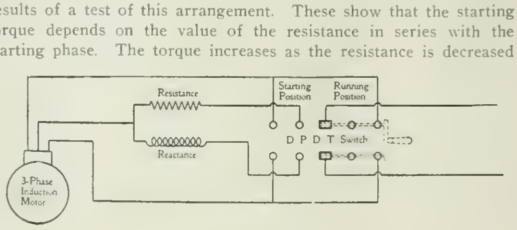


FIG. 3.

Then measure the volts across the rheostat and the current in the starting circuit. The volts divided by amperes will give the ohms required. Fig. 3 shows a three-phase motor connected for operation on a single-phase circuit. In this case both inductance and resistance are used for starting. The current in the different circuits is split as before, but here there are three currents, each of which is out of phase with the other two. This motor could be started with either the resistance or the inductance alone. Resistance will give better results than inductance because the motor winding itself is almost entirely inductive. The author thinks that in general the most satisfactory method of splitting the phase is the use of a simple non-inductive resistance which may readily be improvised.—*Elec. Jour.*, August.

Sub-Station.—An illustrated description of the Acton sub-station, which is supplied with two-phase current at 10,000 volts and 60 periods per second, and converts them into direct current by means of motor-generators. The motors are induction machines. The construction of the sets is described and illustrated.—Lond. *Elec. Rev.*, July 7 and July 14.

Three-Wire Distribution in Workshops.—Birkett.—An article advocating the more extended use of three-wire distribution in factories and workshops and describing an installation of this kind in a large engineering works.—Lond. *Elec.*, July 21.

Switchboards.—Peck.—In a continuation of his illustrated serial on modern practice in switchboard design, the author describes hand-controlled, high-tension switchboards.—*Elec. Jour.*, August.

Controller.—An illustrated description of a new two-voltage or series-parallel controller for electric motors, designed to obtain a long range of speed by supplying a motor with two voltages by the three-wire system or for use with the series-parallel machines.—Lond. *Elec.*, July 7.

ELECTROPHYSICS AND MAGNETISM.

Definitions.—Breisig.—A paper read before the Berlin Electrical Society suggesting some definitions of the electric properties (especially self-induction and capacity) of conductors, especially systems comprising two or more wires. The paper led to a very animated discussion, and the subject is to be further discussed by a special committee.—*Elek. Zeit.*, July 6.

Wattless Current.—A long article giving without mathematics and without analogies an explanation of what is meant by a wattless current.—Lond. *Eng'ing*, August 4.

Electrons.—Lorentz.—The first part of a French translation of his German paper on the results and problems of the theory of electrons.—*L'Eclairage Elec.*, July 29.

ELECTROCHEMISTRY AND BATTERIES.

Niagara Falls.—Some notes on the development of electrochemical industries at Niagara Falls during the first decade of their existence. The Pittsburg Reduction Company started operation August 26, 1895, while on October 19 of the same year the current was turned on at the plant of the Carborundum Company.—*Electrochem. and Met. Ind.*, August.

Efficiency of Furnaces.—Richards.—In a continutaion of his serial on metallurgical furnaces the author discusses in detail the calculation of the efficiency of various metallurgical furnace processes and points out that it is important to know the absolute (not the relative only) figure of the efficiency. The author then gives a summary of thermochemical data for alloys.—*Electrochem. and Met. Ind.*, August.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrical Instruments. Taylor.—An article on the handling of electrical instruments in relation to their accuracy. The author first discusses the influence of stray magnetic fields. There are more opportunities for errors of this kind in measuring large currents than in measuring small ones. Instruments containing permanent magnets should be placed at a safe distance from each other, from two to three feet apart. Alternating and direct-current ammeters and wattmeters made for large currents are likely to have only a turn or two in the coils carrying the main currents It is then a matter of importance in connecting them, to bring the leads to them in such a way that they do not form a loop which can set up a magnetic field aiding or opposing that of the instrument winding. The best way of doing this is to keep them very close together, preferably twisted together for some distance away from the meter. The author then discusses the correction required for energy losses in the instrument itself. Mutual induction between the shunt and series coils of wattmeters is often a more important item than the self-induction of the shunt coil in causing errors in measurements at high frequencies or low power factors. A rough check showing whether the mutual inductance in a wattmeter is excessive can be made by short-circuiting the series coil while the shunt is connected to the line at normal voltage at a frequency of 60 cycles or higher. If the movable element is freely pivoted and does not show any deflection, the mutual induction between the coils is probably not high enough to cause any serious error. The author then discusses general precautions necessary in the handling of instruments and the usual troubles caused by an overload of one kind or another. Finally zero errors are discussed. To add the zero error algebraically to the observed reading seldom gives exactly correct results. Sometimes it introduces an error greater than if no correction had been attempted. In general it is safer to reset the zero reading or to assume that the zero error has not changed the calibration at the upper part of the scale than to attempt to correct for it. Indiscriminate resetting of the zero reading by means of the usual spring adjustment is not to be recommended. If the error has been caused by bending the index it is better to bend it back again, even though the displacement was slight.—*Elec. Jour.*, August.

Damping the Oscillations of Galvanometer Needle.—Einthoven.—A description of a method in which, as indicated in Fig. 4, a condenser, C, is connected in parallel with the galvanometer, G. To explain the action of the condenser the author first assumes the mass of the movable portion of the galvanometer to be negligible and also neglects any damping effect. If then the capacity of the condenser is zero the sudden application of a potential difference between P and P_1 will cause the galvanometer to assume suddenly the corresponding condition of equilibrium. If, however, a certain amount of capacity is present, a certain time will be required for the needle to get into its new position. The mirror image (or the quartz thread) will move then in the same way as a condenser is charged or discharged. The author shows mathematically that by adjusting the capacity and the resistance it is possible to adjust the damping effect at will. The condenser method can probably be used only with measuring instruments having a large internal resistance and a short period of oscillation. It may be used to advantage with the quartz-fibre galvanometer if one wants to measure variations of current of very short duration. For this purpose a very short and tightly stretched quartz thread should be used.—*Elek. Zeit.*, July 27; from *Ann. d. Phys.*, Vol. 16, 1905, p. 20.

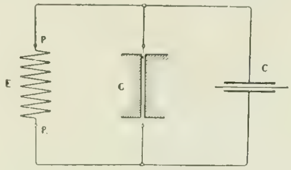


FIG. 4.

Photometric Lamps.—Wild and Fleming.—Several communications. Wild says that the method of ageing is of great importance. It is not sufficient simply to age for any given number of hours, but the ageing should be stopped at that point at which the rate of change of candle-power is a minimum when taken over an extended period. A standard lamp selected and aged on these lines can be relied upon to change by not more than one per cent with 100 hours of use. Fleming recommends large bulbs; a preliminary ageing of the filament by running it in a temporary bulb is essential and such ageing should be conducted so as to bring the lamp into the condition in which the candle-power becomes constant for a short time; in other words, until the lamp reaches the flat part of the candle-power life curve. After that the filament should be transferred to the second large cylindrical bulb for final exhaustion.—Lond. *Elec.*, July 7, 14, 21.

Wattmeter Correcting Factors.—Edgecumbe, Wilson, Drysdale.—Several communications with respect to this matter.—Lond. *Elec.*, July 7, 14, 21.

Tesla Transformers.—Drude.—A paper giving formulas for the rational construction of Tesla transformers.—*Ann. d. Phys.*, Vol. 16, 1905.

Factory Testing.—Workman. In a continuation of his illustrated serial on factory testing of electrical machinery he deals with the determination of the power curves of induction motors.—*Elec. Jour.*, August.

Electric Oscillations.—Gehrcke.—An illustrated account of experiments made in the German Reichsanstalt on the measurement of the wave length of electric oscillations such as used in wireless telegraphy. The Slaby multiplication rod is recommended as a working standard for calibrating other instruments for measuring wave lengths. For calibration, Lecher's arrangement of double wires is used since the use of a single wire leads to errors.—*Elek. Zeit.*, July 27.

Telegraphy, Telephony and Signals.

Wireless Telegraphy in One Direction.—Artom.—"Righi has shown analytically that a combination of two electric oscillations, rectangular to each other and having equal intensity, equal frequency and a phase difference of ¼ wave length, will lead to the production of oscillations with rotating polarization. If the theoretical requirements are strictly fulfilled there will result circularly polarized waves in a certain direction. This direction is the axle of symmetry perpendicular to the plane in which the oscillations take place." Artom has endeavored to utilize this arrangement for wireless telegraphy. If in Fig. 5 the same alternating current passes through *M N* and *N P* the arrangement may be made so that the currents *Ja* and *Jb* have the same intensity, but are displaced in phase by 90°, by shunting *N P* by a condenser, *C*, of proper capacity. If r_2 is the ohmic resistance and L_2 the self-induction of *N P* the two conditions to be fulfilled are

$$2\pi n L_2 = r_2 \quad \text{and} \quad 4\pi^2 n^2 L_2 C = 1,$$

where *n* is the frequency. If now in Fig. 6 *M N P* are the three poles of air gaps placed at the three corners of a right-angle triangle with equal sides, *N P* and *M N*, the self-induction, *S*, and the capacity, *C*, may be chosen so that the above two conditions are fulfilled. We then get two discharges of equal amplitude, of which one (*M N*) may be considered to result from a primary oscillating circuit, the other (*N P*) from a resonator. In practice the arrangement is that shown in Fig. 7, where the poles, *M* and *P*, are connected to two systems of aerial wires of equal length, but perpendicular to each other. "These systems of wires are then the starting point of oscillations of equal amplitude with a phase difference equal to ¼ wave length. The combination of both oscillations produces electromagnetic waves with rotating polarization which are propagated in the direction of the axle of symmetry perpendicular to the plane through the two antennas." The main feature of the system is that the waves are sent in a special direction whereby energy is saved and messages cannot be intercepted by receivers outside of the direction of the wave. Some notes are given on experiments made by the Italian Navy in 1903 and 1904 with this system. In these experiments it was shown that the waves are really transmitted in a straight direction. With this system Artom claims that the vertical wires do not need to have the great length required with other systems. Thus between Monte-Mario and Maddalena, a distance of 160 miles, messages were transmitted successfully with wires which were only about 30 meters (98 ft.) over the ground.—*Elek. Zeit.*, August 3.

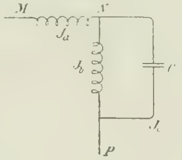


FIG. 5.

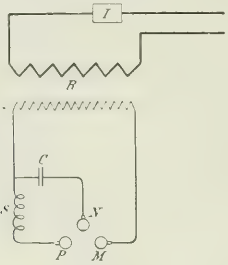


FIG. 6.

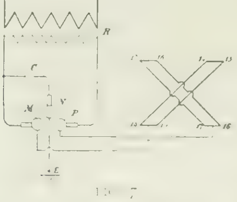


FIG. 7.

Wireless Telegraphy.—Sachs.—An account of experiments on the rôle which the earth plays in wireless telegraphy. He concludes that the earth is not the seat of the electric waves, but on the contrary the earth and all conductors connected with it have a more or less unfavorable effect on the transmission of the waves. The conditions may be somewhat different in ocean telegraphy.—*Dingler's Polyt. Jour.*, August 5.

Miscellaneous.

Export Trade.—Digby.—A very full discussion of the engineering exports of Great Britain, Germany and the United States during the last five years, with an analysis of the relative importance of these three great manufacturing nations in each of the most valuable markets for export trade. The results are illustrated graphically by diagrams.—*Eng'ing Mag.*, June, July, August.

Laboratory.—An illustrated description of the new electrical engineering laboratories at the Liverpool University.—Lond. *Elec.*, July 7.

BOOK REVIEWS.

Mathematische Einführung in die Elektronentheorie. (Mathematical Introduction to the Theory of Electrons.) By A. H. Bucherer. Leipzig: B. G. Teubner. Cloth, 148 pages, 14 illustrations.

It is only a little while since electrons were first conceived of, and now we have a preliminary mathematical theory of their behavior and actions. This volume is devoted to that study. One of the principal hypotheses of the modern theory of electrons is that the ether is stationary in matter and that matter is permeated by the ether in such a manner that the ether is not displaced by the displacement of matter. This view is, to a certain extent, opposed to that developed in Maxwell's original theory.

The book is written in vector algebra and is very condensed in its expression. The ground in common between optics and electron movements is carefully investigated. By the advanced mathematical student interested in optics and in electricity, the treatise will be found timely and instructive.

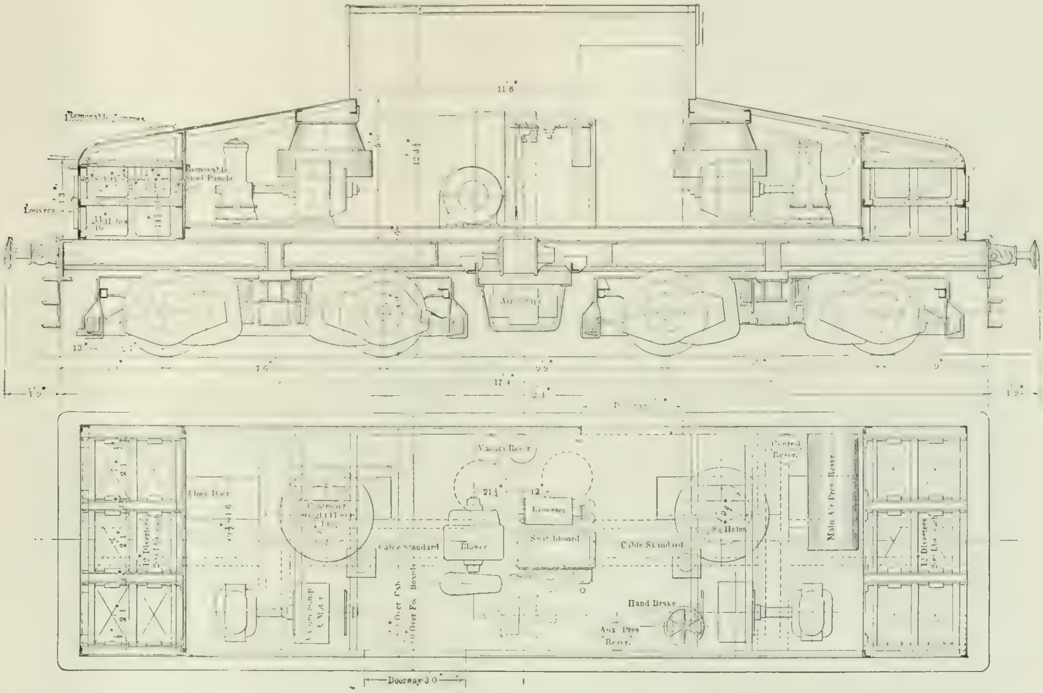
Traité Théorique et Pratique D'Électricité. (Theoretical and Practical Treatise of Electricity.) By H. Pecheux. Paris: Library Ch. Delgrave. 720 pages, 800 illustrations. Price, 17 francs.

The author of this work is the professor of physics and chemistry at the École Nationale d'Arts et Métiers d'Aix. The work itself represents in large measure the course of lectures on the subject of Electricity given in that institution. The treatment is that of a textbook on applied electricity from the standpoint of the physicist. The magnetic circuit is particularly well treated, and the development in this direction is alone sufficient to make the book noteworthy.

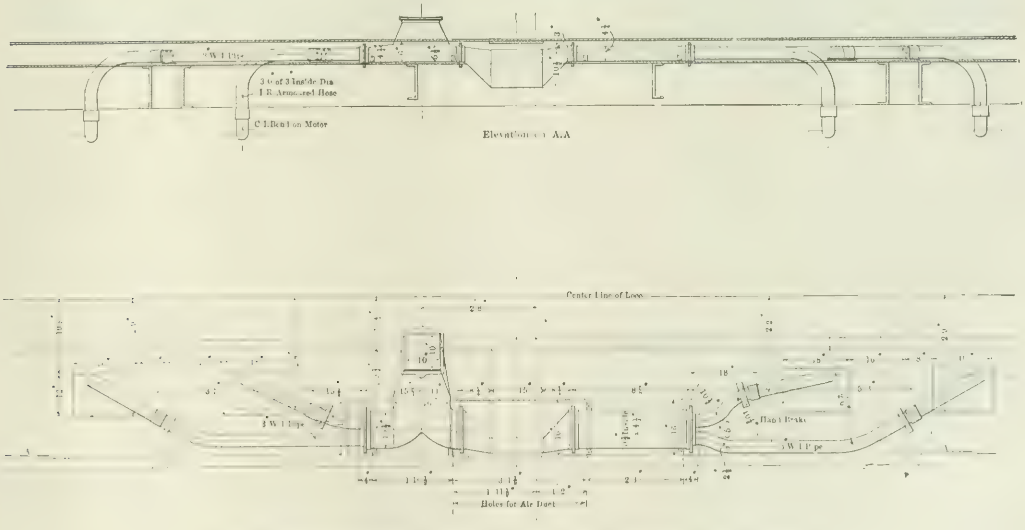
The style is clear and practical, the mathematics in general not difficult, and numerous arithmetical examples occur throughout the book. The first section is devoted to electrostatics, the second to electrodynamics, and the third to electrical applications. As a textbook for the use of high school students the book is excellently designed.

New Westinghouse Electric Locomotive.

The accompanying illustrations show a type of electric locomotive made by the British Westinghouse Company for the London Metropolitan Railway, of which ten are to be supplied for heavy hauling service. The first locomotive has been already delivered and the others will soon follow.



Figs. 1 and 2.—Sectional Views of Electric Locomotive.



Figs. 3 and 4.—Sectional Views of System for Ventilating the Motors.

The locomotive equipment consists of four motors, the normal ratings of which are 200 hp each; but by aid of the forced ventilation, which is supplied by an air-blowing set, the motors are rendered capable of developing 250 hp each with perfect safety. The locomotive is also equipped with both the Westinghouse automatic air brake and vacuum brake, and each is coupled to the foundation brake gear in such a way that either may be manipulated and caused to apply the brakes without making any changes whatsoever in the connections.

These locomotives are able to haul a train weighing 170 tons, exclusive of the locomotive, between Baker Street and Harrow at a maximum speed of 36 m.p.h.; and a freight train of 250 tons, exclusive of locomotive, over the Circle at a maximum speed of 27 m.p.h. The motors are of the usual series-wound railway type, and there is nothing novel in the winding. The drawing, Fig. 3, shows the details of the ventilating air ducts. The air is admitted to the motor at a pressure of 4 ozs. per square inch, and the mouth of the duct is so formed as to distribute the entering air over the entire end of the armature and field coils. The cover of the motor is of the ventilated type, so that this air, after it has absorbed the heat generated in the armature and in the field coils, is discharged into the atmosphere.

There are four motors with each locomotive, and these are arranged in pairs. Each pair of motors has a separate turret controller of the Westinghouse electro-pneumatic type. These controllers are manipulated by a single master switch and are not of the automatic type. The switches, however, are closed with the step by step method usual with tramway type controllers, this being necessary owing to the vast amount of shunting of freight and passenger trains in sidings.

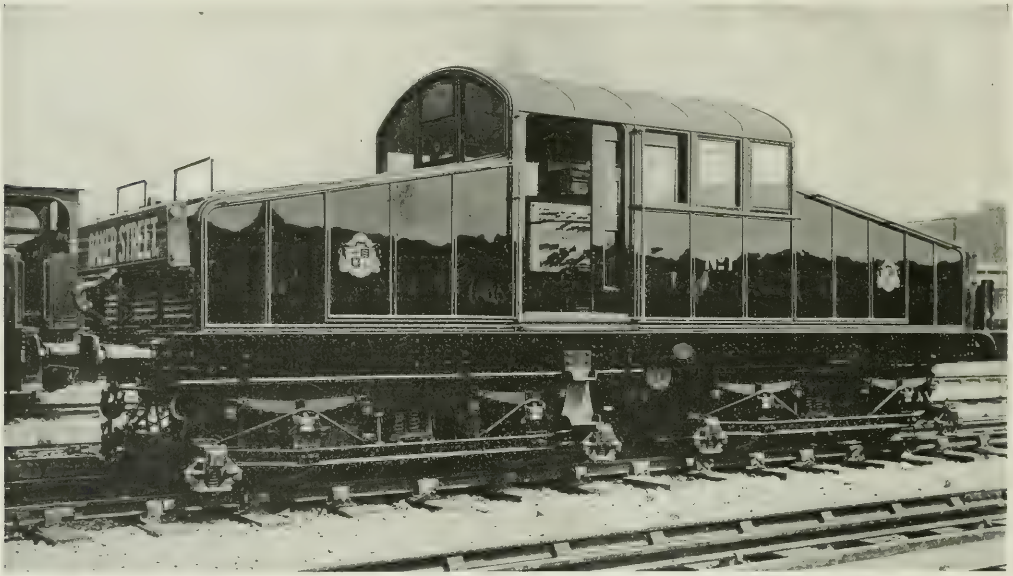


Fig. 5.—Electric Locomotive for the London Metropolitan Railway.

The blower is fitted with a resistance which can be switched in shunt connection with the field coils, so that the speed may be increased 25 per cent., and the pressure of the air thereby increased from 4 ozs. per square inch to 6 ozs. per square inch. This arrangement will be used when the motors are working under the most severe conditions of service.

At a test on June 20, the first locomotive delivered was coupled to a freight train weighing 270 tons and made a number of successful trips between Willesden Green and Uxbridge. It has also been tested on the Harrow line, between Baker Street and Uxbridge, on passenger traffic with equally good results. A view of this locomotive is given in Fig. 5, which shows the arrangement of the trucks. The weight on each wheel of the locomotive is 12,530 pounds.

The ten locomotives on order will be used for hauling the Great Western trains through the northern part of the Circle between Edgware Road and Aldgate, for conveying the main line passenger traffic from Pinner, Rickmansworth, Verney Junction, etc., between Harrow and Baker Street, and also for hauling freight trains over both the Circle and St. John's Wood Line. Owing to the length of the trains and the cramped conditions existing at the termini, it has been necessary to keep the length of the locomotives down to the lowest possible limit. This has been effected by using motors [illegible] than the usual and equipped with forced ventilation [illegible]

Ohio Lighting Convention Exhibits.

The exhibits at the Ohio Electric Light Convention last week were not numerous, but a large number of supply men attended. (See report on page 350.)

Westinghouse Companies Exhibit.—The exhibit of the Westinghouse Companies, which occupied a large parlor on the ground floor of Hotel Victory, was attractive and complete. The exhibit comprised a full line of portable electrical measuring instruments alternating and direct-current arc lamps, transformers, lightning arresters, switches, alternating and direct current for motors, ammeters, voltmeters and wattmeters. The prepayment wattmeter which was on exhibition attracted much interest. A complete line of samples of Sawyer-Man incandescent lamps was displayed in a glass case. On a large display board were shown fuses of sizes suited to various voltages. The corridor of the hotel on the ground floor where all of the exhibits were made was illuminated by Westinghouse alternating-current arc lamps. Samples of Nernst lamps were also exhibited. The following representatives of the various Westinghouse interests were in attendance at the convention: Westinghouse Electric & Manufacturing Company—C. B. Humphrey, manager detail sales, Pittsburg; C. B. Dusinberre, manager Cleveland office; R. W. Beebe, Cleveland office; N. C. Draper, Cleveland office; W. C. Egert, Cleveland office; J. W. Schantz, Cincinnati office; Lawrence Moore, Detroit office; W. P. Jend, Columbus office; J. H. Klinck, Pittsburg office. The Westinghouse Air Brake Company—T. W. Newburn, Cleveland office. The Westinghouse Machine Company—J. H. Wagenhorst, Cleveland office. Nernst Lamp Company—Max Harris, sales manager, Pittsburg; E. R. Roberts, Pittsburg office; James Anderson, Columbus office; J. F. Hoover, Buffalo office; C. H. Davis, Detroit office. J. C. McQuiston, superintendent of the Westinghouse Companies Publishing Department, Pittsburg.

The Benjamin Electric Manufacturing Company, of Chicago, had a parlor where Mr. S. R. Fralich showed its line of arc "bursts," both ceiling and pendant forms; also samples of its regular lighting specialties. Mr. Fralich reports good success within the past year. One of the recent installations was for the United Railways of St. Louis, consisting of two-light series car clusters.

The Library Bureau, represented at Cleveland by Mr. T. E. Crawford, Ohio agent, and Mr. Horace A. McKee, of Chicago, showed an interesting line in one of the parlors on the ground floor of card record-keeping systems, including samples of outfits in use by the Cleveland Electric Illuminating Company and the Northern Ohio Light & Traction Company. The line consisted of card meter-reading systems and meter-record systems, billing systems and miscellaneous central stations accounting of all kinds. Mr. H. A. McKee, of the Chicago office, was also in attendance. There were also shown vertical systems of handling correspondence for electric lighting companies, and forms used by Chicago Edison Company and Pennsylvania Gas & Electric Company, Peoria, Ill.

The Fort Wayne Electric Works was represented by Mr. A. A. Serva, who showed a new prepayment integrating wattmeter, for which strong claims are made. This meter was designed by their Mr. J. J. Wood, the well-known inventor.

The General Electric exhibit was in charge of Mr. H. I. Mauger, of Schenectady. With him were the following: N. R. Birge and R. E. Russell, Schenectady; F. W. Wilcox, J. I. Solomon, of the Edison Lamp Wks., Harrison, N. J., and W. D. A. Ryan and G. H. Stickney, of Lynn, Mass; W. J. Hanley, Cincinnati. The piece de resistance of the General Electric Co. at this meeting was by all odds the illustrated lecture by Mr. Ryan; but the exhibit was an interesting one, covering a complete line of electric cooking devices, including flatirons, cigar lighters, glue pot, etc. Indestructible and interchangeability as to parts are prominent features of this system of heating apparatus.

The following companies were represented at the convention by the gentlemen whose names are given:

Allis-Chalmers and Bullock E. M. Co.—F. C. Colwell, Cincinnati, O.

American Circular Loom Co.—Thos. H. Bibber, Chelsea, Mass.

Atlas Engine Co.—John A. Bechtel, Cincinnati, O.

Banner Electric Co.—R. T. Hamilton, Youngstown, O.

Benjamin Clusters.—S. R. Fralick, Chicago, Ill.

The F. Bissell Co.—F. M. Knierim, Toledo, O.

Bryan-Marsh Co.—F. W. Godfrey, Chicago, Ill.

Doubleday-Hill Electric Co.—Elliott Reynolds, Pittsburg, Pa.

Duncan-Hobson Electric Co.—C. W. Hobson and S. A. Dobson, Dallas, Texas.

Electric Appliance Co.—Perry R. Boole and George H. Porter, Chicago, Ill.

The Erner & Hopkins Co.—H. B. Rogers, Columbus, O.

F. D. Lawrence Electric Co.—C. S. Kuntz, Cincinnati, O.

Nagel Electric Co.—H. E. Adams and Ernest J. Paradis, Toledo, O.

National Carbon Co.—A. G. Summerell, Cleveland, O.

John A. Roebling's Sons Co.—J. W. Brooks, Cleveland, O.

Sanderson & Porter.—Leo A. Phillips, New York, N. Y.

Standard Electric Co.—G. F. Meyers and R. C. Stueve, Cincinnati, O.

Stanley-G. I. Electric Mfg. Co.—Laurence Clark, Chicago, Ill., and W. A. Ekberg, District Manager, Cincinnati, O.

Stanley Instrument Co.—F. J. Alderson, Great Barrington, Mass.

Turbine Engineering Co.—L. G. Read, New York, N. Y.

Wagner Electric Mfg. Co.—G. Percy Cole, St. Louis, Mo.

Buckeye Electric Co.—F. W. Bliss, Cleveland, O.

Cleveland Electrical Supply Co.—S. Griesser, Cleveland, O.

Duncan Electrical Mfg. Co.—W. H. Sinks, Lafayette, Ind.

Burke Electric Co.—J. W. Leech, Erie, Pa.

Miller-Selden Electric Co.—W. H. Selden, Jr., Detroit, Mich.

Post-Glover Electric Co.—E. L. Van Winkle and P J. Williams, Cincinnati, O.

Warren Electric Mfg. Co.—W. M. Lenhart, Sandusky, O.

New Harmonic Ringer for Party Lines.

The principle of the harmonic system of selective party line signaling is now very well known. In brief, the system may be described as follows: Every reed has a natural period or rate of vibration, and by applying small impulses of force to this reed, it can be made to take up that particular vibration. If the same amount of energy were applied at a different rate, this particular reed would not respond. This fact being recognized it remained to design a ringer having a reed or armature which would be acted upon by electrical impulses sent over the telephone line from a suitable ringing machine in the telephone exchange. The accompanying illustrations show a ringer which is the outgrowth of a considerable number of experiments along this line, and it is confidently asserted by the makers that all the previous disadvantages have been overcome.

In Fig. 1 is shown a front view of this new ringer. The method of adjusting the positions of the gongs should be particularly noted. The studs to which the gongs are fastened are inserted in slots at either end of the yoke which joins the two cores of the ringer. Through these studs there passes a threaded set-screw, on the outer end of which is a square head with two flanges. These two flanges rest in the upturned grooves on the ends of the yoke. The stud is held down to the yoke by means of two lock-nuts and a spring washer, which is placed over the threaded end of the stud immediately under the yoke. This method of fastening the studs makes a very firm connection. In adjusting the positions of the gongs it is necessary merely to turn the two set-screws in either direction, thereby bringing the gongs either nearer or farther away from the tapper.

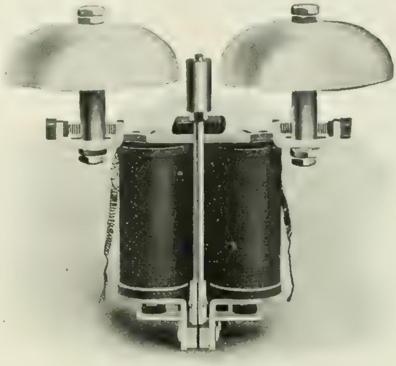


FIG. 1.—FRONT VIEW OF HARMONIC RINGER.

The tapper, it will be noticed, is a cylindrically-shaped bar at the top of the tapper arm. It is securely fastened to the tapper arm so that there is no possibility of that part of the ringer ever getting out of adjustment. In order to furnish the four different ringers necessary for the different party lines, four tappers of different lengths have been made. The tapper arm is securely riveted to the armature, and the armature is riveted to the steel spring upon which the tapper mechanism vibrates.

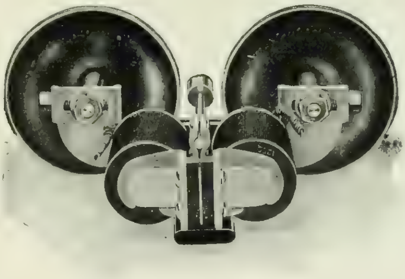


FIG. 2.—END VIEW OF RINGER.

In case it is desired to change the ringer in a certain telephone instrument to another party on the line, it is necessary merely to loosen the lock-nuts at the lower ends of the spools, which makes it possible to remove the whole armature and tapper mechanism, and another set can be inserted in its place. This simple operation does away with the old system of transferring wires onto different clips in the different telephone instruments, and also makes it possible to connect all of the telephones on the line in exactly the same manner throughout.

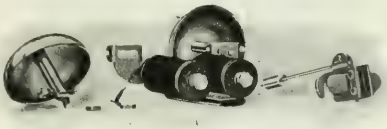


FIG. 3.—PARTS OF RINGER.

Fig. 2 shows an end view of the ringer and gives a fair idea of the construction of the armature end of the ringer. Fig. 3 shows part of the ringer disassembled, and indicates the general construction of this ringer. The adjustment of the space between the armature and the magnets is accomplished by the pole pieces, which are screwed into the cores of the magnets. These pole pieces can be raised or lowered, and any of the necessary adjustments may easily be obtained.

This ringer is very efficient on account of the fact that the permanent bar magnet is in metallic contact with the armature of the ringer. Another very important advantage which this harmonic ringer possesses resides in the fact that it can be placed in any common-battery telephone to take the place of an ordinary single-party polarized ringer. This is especially valuable to operating companies who wish to change their ordinary instruments to four-party instruments without the expenses which would otherwise be necessary in the installation of entirely new telephones. It may also be stated that when this ringer is used in any telephone the appearance of the same from the outside differs in no way from the ordinary ringer, and unless a person opened up the telephone and examined the ringer it would be impossible to tell the instrument equipped with this ringer from a single-party telephone.

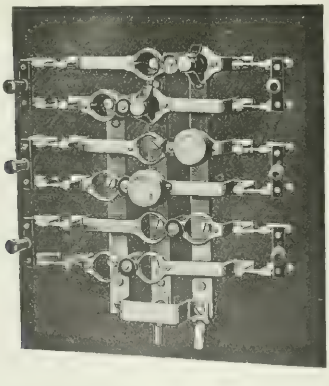
This ringer is being placed upon the market by the Kellogg Switchboard & Supply Company, Chicago, which was a pioneer in the development of the four-party harmonic system of selective party-line signaling.

The Universal Direct-Connection Panel.

Among the many annoying details of the interior wiring business, the troubles due to panel boards are, perhaps, the most difficult to overcome. It is evident that the panel is the most conspicuous part of a concealed-wiring installation, and that the use of make-shift apparatus for this portion of the equipment should not be tolerated. To procure a suitable panel from the manufacturer, frequently involves a delay in the completion of the undertaking, because it is almost out of the question for a single dealer to keep on hand a complete stock when the requirements of the various installations are so essentially different. The universal direct-connection panel, illustrated herewith, has been designed to eliminate the trouble mentioned above.

This panel can be used for two-wire or three-wire work, with plug, link or enclosed fuses. Each tablet being adaptable in this way, it is only necessary for the contractor or dealer to have on hand a few sizes of fuses and switch panels to be certain of supplying from the stock exactly the board required. In addition to this valuable feature these boards are smaller than any other approved tablet at present to be found on the market.

In the construction of these boards, the circuit terminal of the switch base is carried over the bus-bar and formed into a fuse plug receptacle, so located that the fuses make direct connection with the bus-bar. By this means the bus-bars are covered by the branch bars, and an accidental short circuit involving the mains is practically impossible. When the fuses are removed all the exposed metal work except the main terminals is disconnected.



SIX-CIRCUIT TABLET SHOWING ADAPTATIONS.

This panel is manufactured by Johnson & Morton, Utica, N. Y., which company has given considerable attention to the working out of the details of the board, all parts being of the best material and workmanship.

Electric Flatirons.

Apropos of our recent editorial on the support that central station managers should give to electric heating devices, we note that the General Electric Company has just placed an improved flatiron on the market. It is said some 5,000 have already been shipped and that one of the largest laundries in the world is using them exclusively.

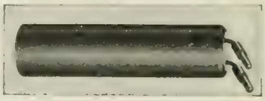


FIG. 1.—RESISTANCE UNIT.

The heating unit of this iron is a resistance coil of liberal cross-section enclosed in a metal shell. This coil is so designed that the heat flows to the work as fast as it is generated. The iron thus remains evenly hot under the most constant use, and no work is delayed by a cold iron or scorched by an overheated one. The resistance unit is of the highest efficiency and durability and may be easily renewed when necessary. Only enough metal is used to carry the heat from the resistance unit to the work, the requisite weight being in the handle. This gives a far better balance to the iron than was possible in the old kind. The handle is made of fibre and remains cool. The iron is so shaped as to insure an even temperature at its face, and its high polish greatly facilitates the work. It is so designed as to meet practical laundry needs, and has been found to be far easier to insert in plaits and ruffles than the ordinary kind.

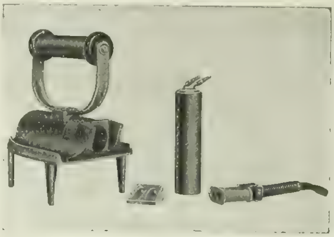


FIG. 2.—PARTS OF FLATIRON.

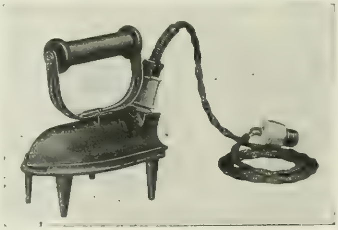


FIG. 3.—FLATIRON COMPLETE WITH FLEXIBLE CORD AND PLUG.

Each flatiron is furnished with a stand, eight feet of special flexible cord and a porcelain detachable plug which fits the heavy brass contacts of the iron. Repeated endurance tests, made by allowing the iron to remain 1,000 hours on its individual stand, with the current turned on, have conclusively proved the durability of the General Electric flatiron.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE was, on the whole, very satisfactory. While holiday making and taking goes on briskly, so that all the resorts are doing well in spite of rather poor weather, great preparations are evident on every hand for fall and winter trade. The conditions are summed up by *Dun's Review* as follows: "It is becoming a year of superlatives in the business world; prices of the sixty most active railway securities have reached the highest point on record; output of pig iron in the first half of 1905 not only far surpassed any preceding six months' production, but exceeded every full year prior to 1898; prices of hides are at the highest position since the Civil War; wool quotations have not been as strong since the early eighties; shipments of footwear from Boston are close to the maximum, and, including all shoe centers, the movement this year is beyond precedent; foreign commerce in July surpassed the corresponding month in any previous year." As a general thing all these conditions are good, but the price movement might easily be pushed now to a dangerous point by undue speculation. "Lest we forget" is a good motto, and sober activity a good plan. *Bradstreet's* remarks: "Fall trade, while not yet under full headway, is steadily gathering force. Buyers are more numerous and their operations more confident than at any previous time this year. Contributory favorable influences at leading Western markets have been needed rains in the corn belt, which all but assure a record crop, barring an early frost. Good weather for harvesting and threshing except in portions of the Northwest, continues to reveal very favorable results in both Spring and Winter sown grains. Combined cereal yields will probably exceed all past years in both quantity and quality. Relatively high prices for agricultural products, manufactured materials and staple products do not deter buying operations. Collections, on the whole, have improved slightly, and even in the South, except in a small area of the fever-infected zone, trade and collections are alike better than anticipated earlier, while the West and East also return more favorable advices." The copper market has continued strong, and prices for Lake and Electrolytic were 15.87 to 16, with apparently a limited supply. Casting copper was quoted at 15¼ to 15½.

ELECTRICAL WIRE MANUFACTURE.—The Wire & Telephone Company of America has taken over the plant of the Empire Wire Company and the Electric Wire Works of Rome, N. Y. The latter has a plant for the manufacture of bare and magnet wire. All the old contracts made by the Empire Wire Company will be carried out by the new concern. The company will maintain its general offices and works at Rome and branch office at 43 Exchange Place, New York. The directors are: C. F. Niles, president; J. S. Dyett, vice-president; Walter C. White, vice-president; H .T. Dyett, secretary and treasurer; Oliver Shiras, chairman executive committee. The directors are these and S. C. Houghton, Robert A. Downey, F. M. Potter, Jr., and Thomas H. Stryker. A new building is to be erected by the company for an insulating department and telephone supply department. The new building will be of brick construction 50x250 feet in size and will be arranged so that it can be extended. The improvement will involve an outlay of $60,000 and when completed the company will be ready to make bare wire, magnet wire, telephone instruments, switchboard cables and cords, etc., in large quantities.

TELEPHONE EQUIPMENT FOR DECATUR, ILL.—The International Telephone Manufacturing Company, of Chicago, has been awarded a contract to furnish a complete new central office equipment for the Macon County Telephone Company, of Decatur, Ill. The board will be a full multiple lamp line signal equipment especially arranged for magneto service and in such a manner that it can be changed to full central energy with double line supervisions without discarding any of the equipment already installed and without interfering with the service. It is proposed by the Decatur Company to change to full central energy as soon as it is found convenient to overhaul the outside construction, changing that to full multiple instead of common return and grounded lines. The re-equipment of the central office, besides affording much more rapid and satisfactory service to the subscribers, will result in a direct saving to the company, as the exchange can be operated at a saving of fully one-fifth of the operator hire, to say nothing of the decreased cost for maintenance.

BIDS FOR CHICAGO SANITARY EQUIPMENT.—Bids will be received until October 11 by the Board of Trustees, Sanitary District, Chicago, for furnishing electrical apparatus and materials and for installing same in the power house of the Sanitary District of Chicago near Lockport, and transmission line along the right of way. Bids may be submitted as a whole or separately on the following: Main switchboard and instruments, transfer boards, oil circuit-breaker switches and knife switches, remote-controlled rheostats for generators, bus-bars and bus-bar and circuit compartments, conduits, service-wiring, transformer and generator connections, transformers and lightning arresters, transmission line towers or poles, erecting towers or poles, copper and aluminum conductors, erection of cable, high tension insulators, electric traveling crane. The cost is reported to be $160,000. Address S. D. Griffin, clerk, Lockport, Ill.

EQUIPMENT FOR APARTMENT HOUSES.—Mr. Percival R. Moses, 320 Fifth Avenue, New York, has been retained as consulting engineer for five six-story apartment houses filling a complete block on the north side of West One Hundred and Thirty-Seventh Street, between Broadway and Riverside Drive, the Transit Realty Co., owners, Moore & Landsiedel, architects. There will be an isolated plant to supply these buildings with heat, light and power, located in the westerly building, consisting of three 125-hp boilers, three simple automatic high speed engines of 100, 80 and 65-hp capacity, direct-connected to 60, 50 and 40 kilowatt, direct-current, compound wound, 110-volt dynamos. There will also be a storage battery to take care of fluctuations in voltage due to elevator load.

CONTRACTS IN GERMANY.—Contracts are in the market for electric power and lighting, electric railways, water and sewerage works, gas works, public baths and buildings, etc., as the case may be, to be paid for out of bonds issued by the following German municipalities, to the amounts set opposite each: Dresden, $9,520,000; Halle, $1,166,000; Worms (Hessen), $714,000; Reinscheld, $497,000; Loerrach, Baden, $266,000; Erfurt, $238,000; Breslau, $208,000; Kissingen, $160,000; Hirschberg (Schlesien), $95,000; Balingen, I. W., $75,000; Rudesheim-on-the-Rhine, $54,000. Electric railways are also to be constructed as follows: From the city of Crefeld to the two manufacturing towns, Suechtein and Viersen; from Kreuznach, a celebrated bathing resort, to Muenster and Stein.

NEW YORK CENTRAL SHOPS.—The New York Central Railroad is preparing to enlarge its machine shops at some points, and plans have been filed with the Bronx Building Department for several structures to be erected at Sedgwick Avenue, High Bridge, New York City. A one-story frame electric locomotive shop 24x176 feet in size will be erected, besides a roundhouse, to cost $24,000, a sand house, shops and an office building. These structures are to be erected to be used in connection with the electric service. In addition to that the company will erect a two-story brick power station at 153d Street and Sheridan Avenue, New York. The station will be 61x242 ft. in size and will cost about $58,000.

BELL TELEPHONE OUTPUT.—The instrument report of the American Telephone & Telegraph Company for the month ending July 31 is as follows:

	1905.	1904.	1903	1902.
Gross output	114,897	80,348	69,194	59,935
Returned	63,979	42,842	44,116	34,054
Net output	50,978	37,506	25,078	25,881
Since December 31:				
Gross output	1,012,517	672,032	669,258	649,044
Returned	347,521	290,032	279,257	260,321
Net output	664,996	382,000	390,001	388,723
Total outstanding	5,145,560	4,161,517	3,450,321	2,914,735

THE CROCKER-WHEELER COMPANY is in receipt of an order for a 200-kw, three-phase, 60-cycle, engine-type alternating-current generator for the Ivorydale, Ohio, lighting and power plant of the Proctor & Gamble Company. This machine is a duplicate of the first Crocker-Wheeler alternator ever built, which was installed ten months ago in the Atlanta plant of the Proctor & Gamble Company. The high efficiency and excellent performance of the earlier machine led the purchaser to order a duplicate.

TELEPHONE EXCHANGE CONTRACT.—The Central Union Telephone Company has awarded to the firm of V. Jobst & Sons, of Peoria, the contract for building the new four-story office building which the company will erect there this year. The building will be the headquarters for the Illinois division of the Bell Telephone system. The bid of Jobst & Sons was $50,000.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has been awarded a contract at Fitchburg, Mass., for the construction of a complete subway system for the Fitchburg Gas & Electric Light Company. This makes the fifth city in Massachusetts in which Mr. Gest has constructed conduit systems.

NEW CARBON COMPANY.—One of the Cleveland papers has the following as to the projected new carbon company already noted in these columns: "A new carbon company probably will be incorporated under the laws of this State next week. It will enter the field as a competitor of the National Carbon Company. The United States Carbon Company will be the nucleus of the new concern, which will have another name. The plans of the new company were briefly outlined by M. B. Daly, manager of the East Ohio Gas Company, who recently purchased the United States Carbon Company. Mr. Daly said that the new company probably would be capitalized at $500,000. Men of sufficient means were interested, he said, to make it appear that the enterprise would be successful. "The men who are interested in the new concern believe that the field is large enough to warrant the investment of their money," said Mr. Daly. "I am not authorized to state who are associated with me in the venture. It is possible that the names of some of them will not appear among the names of the incorporators. This is not backed by Rockefeller interests. I will not say, however, that some of the men interested do not have Standard Oil Company associates. John D. Rockefeller has no direct interest in the company. We expect to have friendly relations with our competitors. The plant in Cleveland will be enlarged and improved at an estimated cost of about $100,000. Mr. Daly said that if the company's business required it other plants might be established, mostly in Ohio. The company probably will be organized and officers elected within ten days."

POWER PLANT FOR GOLDFIELD.—It is stated that the wonderful new mining camp in Nevada, Goldfield, is to have a new electric power company, another railway and a cyanide and chlorination plant of 500 tons daily capacity. Three million dollars has been pledged to carry the project through. Millionaire coal, iron and oil men will control the affairs of the company. For the past six months Colonel E. F. Browne and J. M. Hower, Jr., president and principal owner of the Dorcas mill at Florence, Col., have been giving careful attention to the project. They have secured over 1,000 acres of coal land near Coaldale, 47 miles in an air line northwest of Goldfield. The land has been paid for and prospected, and in a blanket vein which has an average thickness of five feet coal that will do for steam purposes has been proven up in a dozen or more places. Water has been developed on the ground, and it is estimated that it can be pumped to the mill at a cost of three cents for each 1,000 gallons. An electric railway will be constructed from the mill to Goldfield, and a preliminary survey has already been made.

POWER PLANT FOR SPRING RIVER.—Mr. F. A. Sager, of the Arnold Company, engineers, Marquette Bldg., Chicago, Ill., writes in regard to the power plant for the Spring River Power Company, that the electrical equipment for this plant has been purchased, viz.: One of the 2,000 kw Westinghouse units that was installed at the Louisiana Purchase Exposition, together with the necessary 6,600-33,000 volt, step-up transformers, switching apparatus, steam driven exciter set, lightning arresters, etc.; while 2,400 hp of Heine boilers have been purchased. Bids have been received and contracts will soon be let for other equipment, including condensers and the necessary pumps. The plant will be at Varck, about three-quarters of a mile from the hydro-electric plant recently installed for the Spring River Company, and will be operated in parallel with it, to supply additional power to the mines in the vicinity of Joplin and Webb City.

NAVY SUPPLIES WANTED.—Bids will be received until Sept. 5 by the Bureau of Supplies and Accounts, Navy Dept., Washington, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Motor, electrical supplies, arc lamps, ventilating sets, starting rheostats; also Sept. 19 to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., the following: Motors, circuit breakers, electrical wire. H. T. B. Harris, Paymaster-Gen., U. S. N.

THE UNITED ILLUMINATING COMPANY OF MAINE has established a purchasing office at Belfast, Me., with Mr. C. F. Gardner in charge. The United Company owns and operates the following plants in Maine: Belfast Gas & Electric Company, Eastport Electric Light Company, Farmington Electric Company, Fort Fairfield Electric Company and Winsor Gas Company. This constitutes quite a large system for which considerable apparatus, supplies etc., are needed from time to time.

INDEPENDENT TELEPHONE MERGER.—A committee composed of E. J. Balbridge of Duquoin, J. B. Bundy and D. M. Parkinson of Carbondale and Dr. Willard of Anna, representing the local independent telephone companies of Southern Illinois, has completed the work of invoicing the stock of these companies, and has arranged for other details pertaining to the proposed merger of the local companies into a gigantic telephone combine.

NEW YORK POLICE WIRES.—Bids will be received until Aug. 31 by Wm. McAdoo, Police Comr., for furnishing electrical conductors and placing electrical conductors underground. It is said to be likely that a large amount of work will soon be offering also in connection with the fire alarm system, which is now sadly in need of extension and improvement.

Financial Intelligence.

THE WEEK IN WALL STREET.—The strong report of the Government as to the crop conditions was followed very naturally by activity and buoyancy in the stock market, for the large figures and high percentages came to reinforce an outlook already favorable. The effect on railroad securities was naturally very marked, but industrials and all other stocks benefited. While a peaceful outcome of the negotiations at Portsmouth is hoped for, the resumption of hostilities is now hardly likely to have any serious depressing effect on the American market; although the whole public is devoutly praying that the sword may soon be sheathed. The fact that bank clearings are 27 per cent. better than last year tells its own story. It is true, prices look high on the stock list, but in many quarters there is a strong belief they will go much higher; and it is not to be forgotten that several large railway systems have increased their dividend rate since 1904. The following little table is of interest, as to electrical stocks and those of a kindred nature:

	Aug. 19, 1905.	Aug. 19, 1904.
Allis-Chalmers, com.	17⅛	11
Allis-Chalmers, pf.	56	50
Am. Dist. Tel.	31½	22
Amer. Tel. & Tel.	143	139
Gen. Elec. Co.	184	165
Manhattan Elev.	166¾	154¾
Pressed Steel Car, com.	47	33
Pressed Steel Car, pf.	96⅝	76
Toledo Rys. & Lt.	34¾	21
United Rys. Invest. Co., com.	72½	14
United Rys. Invest. Co., pf.	89	53
U. S. Steel, com.	36⅝	11⅞
U. S. Steel, pf.	104½	58¼
Western Union Tel.	93¾	89¾
Westinghouse Elec.	171½	159¼

These figures are eloquent as to improvement in all respects, but of course do not stand alone, but are symptomatic. On the subject of prices, the Wall Street firm of Edey, Brown & Sanderson, well-known in electrical circles, says: "The prices of securities have, it is true, risen to an average height about equal to that in the fall of 1902 before the commencement of the gradual decline terminating in what was well termed 'the rich man's panic.' Therefore some might argue that the majority of stocks have again reached a point in height from which they must inevitably fall. The argument, however, is fallacious in that the premises in each instance are radically different. The railroad corporations of the country have enjoyed since then a great era of growth, and their value has been enhanced accordingly. The leading industrial companies have learned a lesson in conservatism which has grounded them on a more solid foundation. Enhancement in value of corporate isues which has taken place in the meantime is bound to be reflected in the market price, and we believe that a discrepancy exists between the market price and the actual value of standard securities at the present which still leaves room for considerable further improvement in prices. We base this belief primarily on the enormous traffic which must come to the railroads, and the largely increased wealth which will come to the country as a whole from the harvesting of this year's crops for such brilliant prospects." Below are given the closing quotations for August 22:

NEW YORK

	Aug. 15	Aug. 22		Aug. 15.	Aug 22
Allis-Chalmers Co	17	17⅛	Electric Vehicle	19	19
Allis-Chalmers Co. pfd	59	57	Electric Vehicle pfd	24	..
American Tel. & Cable	90	90	General Electric	183⅝	182⅝
American Tel. & Tel	143	142⅛	Hudson River Tel	..	..
American Dist. Tel	30	30	Interborough Rap Tran	218	215¾
Brooklyn Rapid Transit	70⅛	69⅛	Metropolitan St. Ry	125¾	129⅛
Mackay Cos	..	41	N. Y. & N. J. Tel	..	..
Mackay Cos. pfd	..	74	Marconi Tel	..	..
Electric Boat	32	36	Western Union Tel	93⅝	93¾
Electric Boat pfd	75	75	Westinghouse com.	170	159⅝
Electric Lead Reduction	..	..	Westinghouse pfd	..	..

BOSTON

	Aug 15	Aug. 22		Aug. 15	Aug. 22
American Tel. & Tel	143⅛	142⅛	Western Tel. & Tel. pfd	*99	..
Cumberland Telephone	117	117⅝	Mexican Telephone	1	
Edison Elec. Illum	253	..	New England Telephone	135	133⅝
General Electric	183	182¾	Mass. Elec. Ry	18	18
Western Tel. & Tel	*18		Mass. Elec. Ry. pfd	61	62

PHILADELPHIA

	Aug. 15	Aug. 22		Aug. 15	Aug. 22
American Railways	53	..	Phila. Traction	..	..
Elec. Storage Battery	81	83	Phila. Electric	8⅝	8 13/16
Elec. Storage Battery pfd	..	..	Phila. Rapid Trans	28¾	28⅛
Elec. Co. of America	11¼	11⅝			

CHICAGO

	Aug. 15	Aug. 22		Aug. 15	Aug. 22
Chicago Subway	..	..	National Carbon pfd	115	115
Chicago Edison		155	Metropolitan Elev. com	24	24
Chicago City Ry	*196		Union Traction	..	..
Chicago Tel. Co	..	..	Union Traction pfd	..	..
National Carbon	63	63			

* Asked.

PHILADELPHIA ELECTRIC.—With regard to the proposition of the Philadelphia Electric Company to reduce the cost of city lighting about $118,000 a year, the following from Philadelphia is of interest: "It was generally remarked that it was good business policy for the Philadelphia Electric Co. to reduce its price to the city for electric lighting. A disposition to recognize the ideas of those in control of municipal affairs, it is suggested, may go a long way toward warding off competition. While the Durham organization was in power, a larger appropriation from the city for lighting, and an increased number of lights was forthcoming almost every year, and there was no reduction in price. The net profits of the company in the meantime have been increasing from $100,000 to $150,000. As there is to be no larger number of lights in 1906, under the Mayor's schedule, and the present reduction in rates will lop-off over $100,000 revenue to the company, it is believed that next year may produce a comparatively small increase in the company's profits, should the present bid be accepted by the city. However the city lighting constitutes but a part of the company's business. The domestic lighting is well established, but should a competitor enter the field and a rate war be started it would be unfortunate for the company. A few years ago the Philadelphia Electric Company had of necessity to get the rates it received from the city to take care of the interest of its capital obligations, but the business has grown so that a substantial surplus is earned annually. Without any increase, earnings on a basis of those in 1904 would be over 70 cents per share on the 1,000,000 shares of stock now $10 paid in, and the present dividend on this amount is but 50 cents, and it is probable that 1905 will show some increase in profits. Despite denials it is believed in many quarters that there is good opportunity for extension of electric lighting in Philadelphia. Officers of the United Gas Improvement Co. are in the electric company board and are reported to be large holders of its stock. The opinions of 'outsiders' or competitors, are sometimes valuable, and in this connection is recalled what the attorney for the Commonwealth Electric Co. said, some six months ago, when the Mack management in the Keystone Telephone Company was trying to dispose of its conduit space and were talking about establishing an opposition electric lighting company. Their circular claimed that the average consumption of current per capita (exclusive of street lighting is only about $1.75 per annum 'which is the best evidence that the electric lighting business has never been developed in Philadelphia In Boston, for instance, the average consumption per capita, is $5.57; in Butte, Mont., $7 per capita; Chicago, Ill., $2.59; Cincinnati, O., $3.20; Los Angeles, Cal., $8; Providence, R. I., $4.58; St. Louis with a population of only 575,000, consumes nearly as much current as Philadelphia with a population of 1,300,000. This is exclusive of street lighting, St. Louis being largely lighted by gas."

PENNSYLVANIA LIGHTING DEAL.—Note was made in these columns recently of the merger and consolidation of 15 electric light and gas companies in Luzerne County, Pa., into one company, with a capital of $1,000,000. The officers of the new concern are: C. H. Geist, of Philadelphia, president; H. W. Noble, Detroit, Mich., vice-president; C. B. Kelsey, Grand Rapids, Mich., secretary and treasurer. The corporations absorbed are the Wyoming Valley Gas and Electric, the Hazelton Gas Light, the Nanticoke Gas, the Plymouth Suburban Gas, the Hanover Township Gas and Illuminating, the Wyoming Gas and Illuminating, the Consolidated Gas Company of Wyoming; the People's Gas Company, of Swoyerville; the Swoyerville Electric Light Company, Shawnee Electric Light, the Dorranceton Light, the Hillside Light, the Courtdale Electric Light, the Luzerne Electric Light and the Kingston Light and Power companies. Mr. W. E. Anderson, formerly superintendent of the Bergen County Gas and Electric Company of Hackensack, N. J., has accepted the position of general manager of the merged Geist companies.

BOSTON ELEVATED is absorbing the West End Railroad outright. The terms of the consolidation thus far agreed upon are that the Boston Elevated is to issue $16,080,250 preferred shares to purchase the West End. St. Railway Co. shares, of which there are at present outstanding $6,400,000 8% cumulative preferred and $0,689,250 7% common stock. It is further agreed that the $16,080,250 new preferred shares to be issued by the Boston Elevated will not be considered in computing the rate of dividend paid by the Boston Elevated upon its present outstanding stock under the provisions of the special act under which it was chartered. The new preferred stock to be issued will probably have a par value of $100, while the par value of the West End shares is $50. With this change in the par value the new shares carrying a 4% dividend rate would show a dividend return equal to the 8% rate on the present 8% preferred stock, par $50. The West End preferred shares are now selling at $114 a share, showing a dividend return of 3.50%, while the common stock is selling at 97½, a dividend basis of 3.58%

WESTERN TROLLEY PROPERTIES.—Four Boston electric traction properties in Indiana and Ohio are said to have been sold to the United Gas Improvement Co., of Philadelphia. They are the Indianapolis & Northwestern Traction Co., the Indianapolis & Western, the Columbus, Buckeye Lake & Newark and the Columbus, Newark & Zanesville roads, all of which were built, financed and managed by Tucker, Anthony & Co. It is understood that the sale involves the transfer of about $14,000,000 in cash and securities. The stocks are all sold for cash. The United Gas Improvement Co. has large traction interests in Indiana and Ohio and as the above four properties are well paying and growing roads, and possess strategic value in connection with the present owned United Gas Improvement roads, especially those running into Indianapolis, their purchase would seem to be justified by the Philadelphia interests. These properties have bonds of $6,500,000, preferred stock of $2,100,000, and common stock of $5,600,000.

INDEPENDENT TELEPHONE EXPENDITURE.—About $4,000,000 has been spent on improvements by the independents of Indiana in the past year. Among the improvements being made may be mentioned the following: The Mutual Telephone Company of Shelbyville is rebuilding its entire plant; the Crawfordsville Company is laying a large amount of cable; at Columbus additional telephones are being installed at the rate of fifty telephones per month; $15,000 additional is being expended in rebuilding the plant at North Vernon and in improving the lines; the New Long Distance Telephone Company has installed new circuits to Franklin, Greenwood and Veedersburg, and two new circuits from Indianapolis to Bedford; the Lafayette Company is expending about $75,000 on improvements; at Kokomo nearly three hundred new applications for telephones have been filed, and the capacity of the plant will have to be enlarged to accommodate these.

LIGHTING DEAL AT HELENA, MONT.—J. G. White & Co., of New York, and associates, have acquired the street railway, electric lighting and gas properties at Helena, Mont., known as the Helena Light & Traction Company. The electric railway system consists of about seventeen miles of line, the greater portion of which is single track. Current for both the street railway and the electric lighting system is supplied by the Missouri River Power Company. The incandescent and alternating power distribution is three-phase, sixty-cycle, 220-volt, and rotaries installed in the substation provide a direct-current power system of 550 volts. Howard S. Reynolds, superintendent of the operating department of J. G. White & Co., has been appointed manager of the company, and will leave shortly for Helena to assume his duties.

POWER IN MAINE. The Messalonskee Electric Company, Oakland, Me., is to build another power station to develop 1,500 hp by water and 600 hp by steam auxiliary. It is possible that the steam plant will be established in connection with the company's existing plant. There is some question as to the distance which the power will be transmitted, and until this is decided the matter of electric generating apparatus will not be finally settled. Water turbines and other appliances of a hydraulic plant will be required. Mr. Leonard Metcalf, engineer, 14 Beacon Street, Boston, is the engineer for the plant.

FINANCING AN OHIO TROLLEY.—Luther H. Leber, son of J. Gilbert Leber, of York, Pa., has succeeded in negotiating a bond issue of $1,000,000 for the construction of the Shelbyville & Ohio River Electric Railroad Company's line through Carrollton, across the river, and to Eminence. Articles of incorporation have been filed at Frankfort. The work of securing right of way is in progress, and it is said the construction of the line will begin immediately after this is accomplished.

DIVIDENDS.—The King's County Electric Light & Power Co. has declared its regular quarterly dividend of 2 per cent. on its capital stock, payable Sept. 1. The Pressed Steel Car Company, Pittsburg, has declared the regular quarterly dividend of 1¾ per cent., payable August 29. The Philadelphia Company of Pittsburg, controlling the electric street railway lines in that city, has declared the semi-annual dividend of 2½ per cent. on the preferred stock, payable Sept. 1.

GOOD EARNINGS.—The Detroit United Railways report gross earnings for July of $502,865 against $452,998 last year and in 1903 also. The surplus for seven months is $489,546, a gain of over $150,000. The Toledo, O., Railways & Light Co. reports July gross at $171,904 against $153,377 last year, and the sixth months' surplus at $222,257 against $157,917 in 1904. These are healthy gains.

POWER BONDS.—Harvey Fisk & Sons, New York, will underwrite $10,000,000 of bonds of the McCall's Ferry Power Company, which proposes to build the large power plant at York, Pa., to supply electric power to Philadelphia, Lancaster and adjacent towns.

General News of the Week

The Telephone.

MOBILE, ALA.—A special meeting of the stockholders of the Home Telephone Company has been held for the purpose of approving a proposition to increase the capital stock to $350,000 and to issue bonds in a like amount, the proceeds to be used in the extension and betterment of the plant.

SANTA CRUZ, CAL.—P. Kerr Higgins, of Los Angeles, has sent an application to the City Council to construct and maintain a telephone system for this city for a term of 50 years.

VALLEJO, CAL.—F. E. McBeth, for the Home Telephone Company, has applied for a franchise for Vallejo for fifty years, the company to spend the sum of $40,000 in construction of the system over a period of two years.

OAKLAND, CAL.—It has been recommended by the Judiciary Committee of the Council to authorize the Board of Public Works to advertise for bids for placing all wires used by the fire alarm and police telegraph department underground. The sum of $8,500 is to be appropriated.

CORONA, CAL.—An application for a franchise for the term of five years for a telephone and telegraph system, erecting poles, etc., in the streets and alleys of this city, has been made by A. C. Wood, a director of the Corona Telephone & Telegraph Company, capitalized at $25,000. The Council has adopted a resolution granting the sale of the franchises for thirty years and fixing October 1st as the date of the sale.

FLORENCE, COL.—The Colorado Telephone Company will erect telephone buildings there and at Canon City, the construction to begin early next year. About the same time the company will begin rebuilding the entire system in these two cities and will install the central energy systems. Thirty-five thousand dollars will be necessary to thoroughly equip Florence and more money will be needed at Canon City.

ROME, GA.—The Southern Bell Telephone Company will expend about $40,000 in improvements. A lot has been purchased corner of Broad Street and Fourth Avenue on which will be erected a handsome exchange. All of the wires on Broad Street will be put under ground.

MALAD CITY, IDAHO.—The Utah Independent Telephone Company has made application to the County Commissioners for a franchise.

COEUR D'ALENE, IDAHO.—The Rocky Mountain Bell Telephone Company will extend its line from St. Maries to St. Joe. A through circuit will also be put in from Harrison to Spokane by way of this place.

ATHENS, ILL.—The Indian Point Telephone Company has voted to sell its interests to the independent company which is establishing a system in this county.

WASHINGTON, ILL.—The Farmers' Mutual Telephone Company, of Washington County, Ill., has been formed; capital, $1,000. Incorporators, J. J. Randall, C. H. Buhmester and J. McDowell.

SPRINGFIELD, ILL.—The Central Union Telephone Company will spend a quarter of a million dollars here. Of this $100,000 will be used in underground wires in fire districts, and the remainder in buildings.

BLOOMINGTON, ILL.—Since the Kinlock syndicate got control of the Home Telephone system, plans have been formulated for improving the service. The company will probably go before the City Council with a petition asking for permission to place telephone wires underground throughout the city. It has already underground work in the business section.

EAST ST. LOUIS, ILL.—The Bell Telephone Company is having plans drawn by Eames & Young, architects of St. Louis, for an exchange building to be located on the corner of Eighth Street and Missouri Avenue, to be 75x100 feet, three stories in height, concrete foundation, of brick, stone and terra cotta; of strictly fireproof construction, steam heat, plate and art glass, electric elevator, tile floors, composition roof, copper gutters, iron and steel beams and columns, combination light fixtures; estimated cost, $75,000.

HUNTINGTON, IND.—It is stated that the Bell Telephone Company will rebuild its plant here at a cost of $20,000.

NOBLESVILLE, IND.—The Central Union Telephone Company, which for several years has had but few telephones in this county outside of the toll stations, is preparing for an extensive invasion of the local field. The company is proposing to make a low rate. A number of Indianapolis and local business men have under consideration the organization of a new independent company.

HUNTINGTON, IND.—Huntington's local telephone service is to be greatly improved before the end of the present year. Additions and alterations at a cost of $20,000 will be made as soon as the material arrives. Several miles of cable will be strung, part of it under ground, and the whole plant will be improved. The switchboard will be enlarged to accommodate at least 200 more telephones.

MALLARD, IA.—The Mutual Telephone Company has been incorporated by F. J. Lodes, president; O. A. Brownlee, secretary; capital, $12,000.

EXIRA, IOWA.—The Exira & Audubon Township Mutual Telephone Company now has several telephones in service and new ones on hand to put in as soon as the poles can be finished. Oscar Wheeler, president of the company, has the contract to put up the additional line needed.

LARNED, KAN.—The Pleasant Valley Telephone Company has been formed with a capital of $2,000.

WHITING, KAN.—The Farmers' Mutual Telephone Company has been organized with a capital of $9,600.

BALTIMORE, MD.—Upon the complaint of the Maryland Telephone & Telegraph Company and the filing of a bond for $5,000, an injunction has been granted by Judge Dobler restraining the Consolidated Gas, Electric Light & Power Company and its agents from cutting or removing the Maryland Telephone Company's wires from two poles on the east side of Exeter Street, and from interfering in any manner with the repair and replacing by the Maryland Telephone Company of two 10-pin cross-arms and wires on the poles.

BESSEMER, MICH.—The Michigan Telephone Company is extending its line from here to Sidaw to connect the Gogebic Range with Marquette and the copper country.

ST. JOSEPH, MICH.—The Twin City Telephone Company will expend $25,000 in improvements. A multiple switchboard is being installed. The Bell Company with which the Twin City Telephone Company connects is planning to expend $35,000 in St. Joseph.

GRAND RAPIDS, MICH.—The capital stock of the Citizens' Telephone Company will be increased from $2,000,000 to $3,000,000. The increase in the capital stock is for the purpose of erecting new exchanges and improving the old ones in the territory of the company.

ONSTEAD, MICH.—At the annual meeting of the Onstead Telephone Company the following officers were elected: President, L. S. Mann; vice-president, E. C. Turner; secretary, J. B. Daniels; treasurer, C. W. Greenleaf; board of managers, L. S. Mann. chairman; Fred Stoddart and Warren Shepherd.

AKELEY, MINN.—Work has been started for the construction of the local telephone exchange.

VIRGINIA, MINN.—J. Shanedling will erect a two-story brick office building to be occupied by the local telephone exchange.

COBDEN, MINN.—A franchise has been given the Springfield & Citizens' Mutual Telephone Company to enter the village.

GLENWOOD, MINN.—A new telephone company has been organized with a capital of $5,000 and a local exchange will be put into operation.

MINNEAPOLIS, MINN.—The telephone and electric light companies confront a proposed cost of $2,000,000 to put their wires under ground within the limits of the city of Minneapolis.

LEWISTOWN, MONT.—The Lewiston Telephone Company will reconstruct its lines and build a two-wire line to Great Falls.

BOZEMAN, MONT.—The Rocky Mountain Bell Telephone Company has purchased a site for the new telephone exchange which will be erected soon.

HELENA, MONT.—The management of the Lewistown Telephone Company announces that the system as far as Great Falls will be practically rebuilt at an expense of about $25,000.

INDEPENDENCE, MO.—Theodore Gary, the Macon capitalist who recently purchased the Home Telephone system in this city, proposes starting improvements on the plant.

NOVINGER, MO.—The Novinger Telephone Company was incorporated August 10, with a capital stock of $2,400. The incorporators are W. F. Niece, F. M. Gilliland, H. C. Truitt, Phil. Weber, J. B. Kriner and others.

ST. LOUIS, MO.—The American Phantom Circuit Telephone Company filed articles of incorporation last week with a capital stock of $10,000, full paid. The incorporators are: R. C. Stubbs, E. H. Cary, of Dallas, Tex., and Joseph R. Lowry, St. Louis.

HUNTINGTON, NEB.—The Cedar County Farmers' Telephone Company has been formed with a capital of $5,000.

STEUBENVILLE, OHIO.—A new automatic telephone exchange will be installed here by the Phoenix Company. The cost will be about $20,000.

TOLEDO, O.—An appropriation of $200,000 for extensions and reconstruction has been made by the Central Union Telephone Company for Toledo. Most of the money is to be expended in outside construction. In addition to considerable extension work in the way of poles, conduits and cables some of the older circuits are being rebuilt.

TEDDA, OKLA.—The Caddo Telephone Company has been incorporated by George H. Studebaker and Ora H. Studebaker. The capital stock is $5,000.

BAKER CITY, ORE.—On account of the present inferior telephone service, prominent business men contemplate the early organization of an independent telephone company.

DECORAH, PA.—The Bell Telephone Company has been installing a new exchange in Decorah. According to Mr. O'Rourke, the superintendent, this exchange connects with three hundred farmers adjacent to Decorah, and they have a connection with more than eighteen hundred independent telephones in his district.

PLANKINTON, S. D.—A new telephone company has been organized here with T. W. Taubman secretary and R. C. Drake treasurer.

HUMBOLDT, S. D.—The Humboldt, Hartman & Wellington Telephone Company has been incorporated. Capital, $10,000. Incorporated by John Hartman and Geo. W. Ingalls.

NASHVILLE, TENN.—At the last meeting of the City Council, permission was asked to withdraw the telephone measure granting to C. A. Thatcher and Ernest Mitchell a franchise in the city to operate a telephone system.

Councilman John Langham made the request, as he had introduced the measure, but as the unanimous consent of the Council has to be secured before a measure is withdrawn, the bill was killed on second reading. Councilman A. B. Anderson objected to its withdrawal, and stated that it would be a good time for the Council to again go on record as opposed to two telephone systems in Nashville. Councilman Canfield said that he was also opposed to the withdrawal of the bill, as there had been considerable time spent on the matter. The bill was, therefore, rejected.

TIMPSON, TEX.—The Timpson Telephone Company has been organized here. J. B. Bussey is one of the incorporators.

SHERMAN, TEX.—The North Texas Telephone Company has been organized here. It has a capital stock of $10,000. The incorporators are R. J. McHugh, of Fort Worth; S. W. Poerter and S. D. Donoho, of Sherman.

DALLAS, TEX.—The Southwestern Telegraph & Telephone Company is making improvements to its telephone systems in Cleburne, Laredo and other towns of the State. The long-distance system is being extended to Rockport, Ingleside, Portland, San Diego and other places.

MONTELL, TEX.—The Citizens' Telephone Company has been organized at Montell to operate a system from Uvalde to Barksdale. A. S. Baylor, T. S. Sutherland, James Whitecotton, L. V. Wallace and Travis F. Jones are the incorporators. It is an independent company.

SAN ANTONIO, TEX.—It is stated that the matter of enlarging the telephone system of the San Antonio Telephone Company will be considered at the coming meeting of the board of directors. D. A. Walker, of Columbus, Ohio, is president of the company, which is an independent concern.

AUSTIN, TEX.—The Commercial Telephone Company, of Texas, was sold at auction here Aug. 2 for $110,000, being bought in by a committee representing the bondholders. The sale resulted from a suit of the stockholders to secure on $400,000 of bonds, which is said to have been defaulted. Extensive additions are announced by the new management.

PARK CITY, UTAH.—The Utah Independent Telephone Company has purchased a site here for the erection of an exchange building.

LYNCH'S, VA.—Lynch's Telephone Company has been formed. Incorporators: W. Fauntleroy, president; W. S. Frazier, secretary and treasurer; W. T. Webb, general manager, all of Lynch's, Va. Capital stock, maximum, $5,000.

KAUKAUNA, WIS.—Work on the new telephone exchange to be installed in this city by the Fox River Valley Telephone Company will be commenced next week.

NEENAH, WIS.—The Wisconsin Telephone Company has decided to lay an underground system not only along Commercial Street north from Wisconsin Avenue, but all along Wisconsin Avenue. A new switchboard has been ordered and a new telephone exchange will be built.

CRANDON, WIS.—The stockholders of the Crandon Telephone Company have met to do preliminary work necessary to organize the company. The directors elected were W. W. Waite, Egbert Wyman, J. L. Haile, C. O. Decker and S. A. Gifford. The directors have elected the following officers: J. L. Haile, president; W. W. Waite, vice-president; E. Wyman, secretary; S. A. Gifford, treasurer.

CHEYENNE, WYO.—The Bell Telephone Company will soon inaugurate improvements in its system here at an estimated cost of $20,000.

Electric Light and Power.

CITRONELLE, ALA.—This town desires a promotor to furnish electric lighting to the town. Address H. A. Healy, commissioner of electric light.

OPELIKA, ALA.—The capacity of the Opelika Electric plant is to be increased to furnish power for the street railway, light and power to Opelika and Auburn. Capital, $300,000.

DARDANELLE, ARK.—Bonds have been sold by the city for an electric light plant, and the building of the plant is to be started immediately.

SAN FRANCISCO, CAL.—Chas. C. Moore & Co. were awarded the San Luis Obispo Gas & Electric Company's contract for a complete steam plant. The National Electric Company will supply a 200-k.w., 3-phase belted generator. Babcock & Wilcox boilers and Peabody oil burners are included.

LITCHFIELD, CONN.—The new power plant of the Litchfield Electric Light & Power Company, in the village of Bantam, is making great progress. Lines are being strung to the surrounding towns of Litchfield, Washington, Washington Depot and New Preston, and there is reason to believe that Milton, Morris and Bethlehem will soon be lighted from this power. The electric plant and power house are neat and well equipped and appointed. Nutting & Turkington, electrical engineers, of Litchfield, have contracted with the company to operate the plant for a stated price per year.

FARMINGTON, CONN.—Civil Engineer H. T. Keith, of Mt. Washington, has been working on the engineering problems of the proposed development of the river for transmitting electric power. He asserts that the project now stands on a solid basis, that about $100,000 has been subscribed by Hartford and Boston capitalists. It is planned now to build the dam over the Sandisfield line, or a half mile beyond the Otis southern border. The dam will be forty feet high and an iron tube will run from it four miles down the river to New Boston, where the power house will be built. The fall is 80 feet to the mile, in one of the miles 100 feet, so that the total fall will be nearly, if not quite, 350 feet. Including with this the power collected at the dam itself, the total horse-power to be developed will be between 4,500 and 5,000. This will be transmitted electrically to Hartford and Springfield for lighting.

LA GRANGE, GA.—Bids will be received until September 5 by the electric light commission for all machinery and construction work and building for a complete electric light plant.

DUBLIN, GA.—The City authorities are preparing to extend and greatly improve the electric light system of the city. Negotiations have been entered into with the Fort Wayne Electric Works by which the system of the city will be changed from a high to a low frequency. The present arc lights in the city will be taken down and inclosed arcs will be substituted. At present there are 2,300 incandescent lights in the city. The new system will provide for an increase of 700.

SUGAR CITY, IDAHO.—The Fremont County Light & Power Company has been organized here, with a capital stock of $25,000. James Siddoway, of Teton City, is president of the organization.

FREEBURG, ILL.—The Village Board has decided to erect a $10,000 municipal lighting plant.

EAST ST. LOUIS, ILL.—The Citizens' Electric Light & Power Company has let the contracts and work will soon begin upon improvements in the lighting system on the East Side, which will cost an aggregate of $150,000. The entire system of wiring in the city will be changed, much of it being taken down. The three-phase system is to be established. Cables of 500,000 circular mills will take the place of 14 and 16 wires now in use along the principal streets.

DANA, IND.—The citizens have voted to install an electric light plant.

CONNERSVILLE, IND.—The McFarlan Carriage Company has arranged to use electricity as a power in place of steam. Sanborn & Marsh, electrical engineers and contractors, of Indianapolis, are equipping the factory with ten motors. One dynamo will furnish the power for the several motors to be installed. This machine will have a capacity of 125 hp.

DECORAH, IA.—F. M. Hughes, City Clerk, states that the citizens on August 15 voted to grant a franchise to the Decorah Electric Light Company.

SPIRIT LAKE, IA.—Municipal ownership at Spirit Lake has proven a failure and the water works system and electric lighting plant are to be turned over to a private concern. With this end in view a special election will be held Aug. 19 to grant a franchise to the parties who will take over these public utilities for a term of twenty-five years.

CAMPBELLSVILLE, KY.—J. L. Atkinson, president Campbellsville Lighting Company, states that the construction of the new plant will be under the supervision of Mr. B. S. Kincort, Supt. The company will expend about $5,000.

ARCADIA, LA.—A company has been organized here with a capital of $5,000, with J. L. Dalton as president and M. L. Tooke as secretary and treasurer. The company has bought the Dalton-Lord electric light plant located here and will make considerable improvements and additions.

AUBURN, ME.—The Lewiston & Auburn Electric Light Company has made a five-year contract with the city to light the streets. The city agrees to pay to the company monthly for said lighting service, at the rate of $55 per year for each arc lamp and $12 per year for each incandescent lamp.

BALTIMORE, MD.—Current has been turned on in the big new power station at South Baltimore, which will furnish electric light and power under the franchise of the Maryland Telephone and Telegraph Company. The company starts off with about 1900 subscribers for 96,000 lights of 16 cp.

HOLYOKE, MASS.—The City electric light station is to be reconstructed, enlarged and extended.

SPRINGFIELD, MASS.—The Hampden Electric Company has purchased a large part of the Westfield Little River basin with the ostensible purpose of developing a big power plant on the river. A right has also been secured to erect and maintain transmission lines.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company will put into effect a reduction in its tariff to customers on Oct. 1, 1905. The basic rate will be changed from 16⅔ cents to 15 cents per kilowatt-hour, and will allow a reduction of 10 per cent for prompt payment, making the net price 13.50, as compared with a net price heretofore of 14.17 cents. The company will supply free renewals of lamps.

MARINE CITY, MICH.—The Edison Electric Light & Power Company, of Detroit, is securing franchises between Detroit and this city. There may be some trouble at Algonac and St. Clair as each has a municipal plant.

HART, MICH.—The Hart Common Council has granted a 10-year franchise to the Pere Marquette Light & Power Company for furnishing current to that village. The company will dam Ruby Creek, build a turbine plant and furnish light and power for Pentwater, Hart and Shelby. The contract here will provide for the renting by the company of electric outfits from the switchboard out for a term of 10 years, current to be furnished for street lighting at 6 cents per kw.-hour.

MONROE, MICH.—The City Council Aug. 10 passed a resolution for the sale of the municipal lighting plant to the General Constructing Company, Ltd., for $25,000, including a 10-year contract and franchise for lights at $56 per year. Both the sale and contract will have to be ratified by the people at a special election. Geo. T. Wolf, of Three Rivers, is one of the stockholders of the company.

COLUMBIA, MO.—Columbia has voted to issue $10,000 worth of bonds for the construction of improvements to the water and light plant, which has been owned by the city for two years. This issue is in addition to a $100,000 issue at the time the plant was bought. The municipal experiment is said to have been very successful in Columbia so far.

KANSAS CITY, MO.—The Kansas City Electric Light Company will lay down new conduits.

HELENA, MONT.—Samuel T. Hauser, of Helena, formerly governor of Montana, states that it is proposed to construct a dam over the Missouri River to furnish Helena and Anaconda with electricity.

MEREDITH, N. H.—The Meredith Electric Light Company has been sold and an entirely new management has control, J. A. Rodgers, of Providence, being the present manager and secretary.

GORHAM, N. H.—The new lighting rates of the Cascade Electric Light & Power Company went into effect August 1. There is much kicking at the increase in the cost of lights on the flat rate. In some cases the increase will amount to over 75 per cent. Many people are having meters installed.

GORHAM, N. H.—Work has been started on a water power plant on Mr. McMillan's farm Shelburne, using the Androscoggin River. Mr. Fred G. Stuart, of Gorham, has the contract to do the carpenter work and build the head gate, tail race, etc. The power is to be used for the generation of electricity.

NUTLEY, N. J.—The Town Council has granted a 4-year contract to the Public Service Corporation for the lighting of the streets of the town at $16 per lamp per year.

CAMDEN, N. J.—The Wyoming Gas and Electric Company has been formed in Camden, N. J.; capital, $15,000. Incorporators, John A. MacPeak, William L. Edsell, F. R. Hansell.

RENO, NEV.—The sale of the Reno Power, Light & Water Company to Brown, Engenger & Co., of San Francisco, which had an option on both the Reno and the Washoe Lighting & Power Companies, has been announced.

SYRACUSE, N. Y.—The City of Syracuse is soon to award a new contract for its municipal lighting. The Syracuse Lighting Company, which has the present contract, has a monopoly of the business in Syracuse and is the only prospective bidder. There is some opposition to this condition, however, and there is agitation in favor of making municipal ownership of the lighting business an issue in the approaching city election campaign. Last year the Syracuse Lighting Company was paid $128,155.41 by the city. It is announced that the Niagara, Lockport & Ontario Power Company will deliver power in Syracuse by next March, the power to be supplied by the Ontario Power Company's plant on the Canadian side of the Niagara River and transmitted across the State over the West Shore Railroad right of way. Although the main purpose of the company in delivering power at Syracuse is for the use of the New York Central-Andrews syndicate in the operation of electric cars, there is a possibility that the company will secure a franchise so as to be able to enter the electric lighting field in Syracuse.

FAYETTEVILLE, N. C.—It is proposed to expend about $20,000 on the municipal electric light plant and line extension, the work to include the installation of two boilers of 300-hp., one or two engines, a 250-kw. alternator and two 120-kw. generators. Mr. W. T. Jones is superintendent.

GALION, OHIO.—The Crawford County Gas & Electric Company intends constructing a new power house here at a cost of $40,000.

TIPTON, ORE.—W. A. McNaughton, of Tipton, is arranging for the construction of an electric power plant on Strawberry Creek.

ALEXANDRIA, PA.—The Juanita Light & Power Company has been incorporated. Capital, $10,000.

PHILADELPHIA, PA.—The Philadelphia Compress Electric Light & Ice Company has been formed with a capital of $30,000.

PHILADELPHIA, PA.—The Philadelphia Electric Company bid on August 15 for furnishing electric arc lights for the year 1906, $99.42 per light per year (average), total cost, $1,073,272.

DOYLESTOWN, PA.—By order of the Court, the Bucks County Trust Company, trustee under the mortgage, has sold to R. D. Brown all the property and franchises of the Standard Telephone & Telegraph Company. The price paid was $50,000.

McCALL FERRY, PA.—A mortgage of $10,000,000 has been filed in the Recorder's office at York to secure a bond issue for the McCall's Ferry Power Company, which proposes building a power plant on the lower Susquehanna River, near McCall Ferry. The Knickerbocker Trust Company, of New York City, is reported to be named as the trustee for the stockholders.

COLUMBIA, S. C.—The Columbia Electric Street Railway, Light & Power Company proposes to install a 240-kw. rotary converter.

ANDERSON, S. C.—The Hatton Shoals Company has been organized with a capital of $150,000 to develop 5,000 horse-power on Tugaloo River, 16 miles east of Anderson. A. T. Smythe, of Charleston, is one of the directors. R. S. Ligon is president of the Company.

ANDERSON, S. C.—The stockholders of the new Hatton's Ford Power Company at Anderson recently met and organized by the election of a board of directors, who then chose officers, with R. S. Ligon, of Anderson, president. It is estimated that 6,000 horse-power is available at the shoals to be developed. The company is capitalized at $150,000 and will offer power for light and manufacturing purposes.

CLARKSVILLE, TENN.—The Queen City Electric Light & Power Company proposes to install a 500-kw. Curtis turbine, a 200-kw., 3-phase alternating-current generator, a 250-kw. motor-generator set, a new switchboard, three water-tube boilers, etc.

HOUSTON, TEX.—The San Saba Light & Ice Company has increased its capital stock from [illegible] to [illegible].

JEFFERSON, TEX.—The Jefferson Ice, Light & Power Company has decided to construct an electric light plant.

SAN ANTONIO, TEX.—The San Antonio Gas & Electric Company proposes to install a 500-kw., alternating-current generator.

DALLAS, TEX.—The Dallas Electric Light & Power Company will erect an electric light plant, the [illegible].

SAN ANTONIO, TEX.—C. A. Zilker, of Bloomington, Ill., is promoting an organization with a capital of $500,000, to build an electric light plant.

SALT LAKE CITY, UTAH.—The County Commissioners have granted Emil J. Raddatz a franchise to construct and operate an electric transmission system to Bingham Junction and Sandy.

OGDEN, UTAH.—Oregon Short Line officials contemplate the early construction of an electric plant, which will furnish power for the entire railroad system of the city. An order for needed equipment will be placed within the next few weeks.

ST. JOHNSBURY, VT.—The St. Johnsbury Electric Company has closed all contracts for improvement to its plant.

RADFORD, VA.—The Grason Electrical Corporation will build a power house at Graysontown, 8 miles from Radford, and will light the towns of Christiansburg, Childress and Riner, furnish power for a contemplated line from Cambria to Christiansburg, and to factories. Guy Grayson is president and W. C. Grayson, vice-president.

BLAINE, WASH.—The Blaine General Electric Company has been incorporated with a capital of $50,000.

PULLMAN, WASH.—Extensive improvements are to be made to the city electric light plant. D. F. Staley is mayor, and H. V. Carpenter, chairman electric light committee.

LOOMIS, WASH.—Mr. John Boyd is pushing work on the tunnel project of the Palmer Mountain Tunnel & Power Company, for which the initial plant is to be driven by a 750-hp. turbine, already ordered. The current is needed for the development of mining in the vicinity.

BURLINGTON, WIS.—The citizens have voted to raise $12,000 for a municipal electric light plant.

JANESVILLE, WIS.—The Janesville Electric Company proposes to extend its system to Milton and Milton Junction. P. H. Korst is manager.

PRINCETON, WIS.—The citizens on Aug. 5 voted to issue $12,000 bonds to purchase the plant of the Citizens Electric Light & Power Company.

PLATTEVILLE, WIS.—The Platteville Electric Light & Power Company will, this fall, add a 50-kw. generator and a 80-hp. engine, direct connected. Early in the year 1906 the company contemplates installing machinery to double the present capacity of the plant. J. H. Evans is secretary.

MADISON, WIS.—The State Board of Control is considering the construction of an electric light plant at the Mendota State Hospital, to cost about $17,000.

FLORENCE, WIS.—The Pine River Improvement & Power Company has been incorporated with a capital of $100,000 by E. W. Hopkins and E. A. Edmunds.

FOND DU LAC, WIS.—The Independent Light, Heat & Power Company has been incorporated with a capital of $25,000 by Robt. R. Freeman, G. R. Hoffman and Frank D. Fulton.

LARAMIE, WYO.—The franchise of the Laramie Electric Light & Fuel Company has been revoked and a franchise granted to an Indianapolis firm represented here by W. E. Sterne of Littleton, Col.

VICTORIA, B. C.—The citizens have voted to issue $11,000 bonds for the purpose of increasing the capacity of the electric light plant.

LAS VEGAS, N. M.—The City Council has granted a 50-year franchise for street railways and electric lights to Wm. A. Buddecke, of St. Louis, Mo., owner of the present electric railway system. Extensions to the system to cost $15,000 have already begun.

ST. MARYS, ONT.—The citizens have voted to issue $15,000 bonds for the extension of the electric light plant and water works.

NAPANEE, ONT.—Mr. Kelch, of Montreal, Que., is preparing plans and specifications for the proposed electric light plant, to cost about $35,000.

MEAFORD, ONT.—The ratepayers of the town of Meaford will vote on a by-law to raise $12,000 by debentures for the purchase of the electric light plant, to install machinery and to purchase power from the present company to operate the plants. There is much opposition to municipal ownership.

WINDSOR, ONT.—Under the name of the Detroit River Tunnel Company, the Canadian Tunnel Company and the Michigan Tunnel Company have combined. This was effected at a meeting held at Windsor, Ont., and the companies were combined in order to expedite the actual work of construction. The new company is capitalized at $3,000,000, which is merely a nominal figure. Chief Engineer W. S. Kinnear, of Michigan Central, is in charge of the enterprise, and has appointed B. Douglas tunnel engineer, J. C. Mock electrical engineer and A. C. Everham terminal engineer.

ST. CATHERINES, ONT.—Mr. Frederic Nicholls, president of the Toronto Niagara Power Company, and Col. Pellatt, a director, recently visited the city of St. Catherines, and disclosed to the Mayor and several of the City Aldermen a plan of mammoth railway development in the Niagara Peninsula, which the company has mapped out, and which, when carried out, will make St. Catherines one of the greatest electric railway centres on the continent. The company will build electric lines between St. Catherines and Stony Creek, connecting with Hamilton and eventually Toronto, while the main line will run from Stony Creek to Buffalo.

OTTAWA, ONT.—It is understood that the officers of the Canadian Pacific Railway are considering the advisability of utilizing electricity, instead of steam, in the operation of their trains on the boundary system in British Columbia. An electrical company in the Pacific province is making preparations for the development and supply of electricity along Kootenay River, for the operation of mines and smelters. The officials will first make a test of electricity for haulage power on an extensive scale for heavy grades on Rossland Hill, and if it proves satisfactory, the company's boundary lines will be operated by electricity in the future.

WESTMOUNT, QUE.—Improvements are to be made here at a cost of $200,000, including the construction of an electric light plant. Ross & Holgate, of Montreal, Que., are the engineers in charge.

The Electric Railway.

HOLLISTER, CAL.—The purchase of a large power plant on the Tuolumne River has just been made from which power will be brought to run the projected Kemp Van Ee Electric Railway from Santa Cruz to Hollister and to the cement works in San Juan Valley. The plans of the syndicate are about completed, and it is said that in a few weeks a crew will be set to work laying rails and erecting necessary buildings. The power plant will cost $500,000.

NAPA, CAL.—The complete street car service is soon to be inaugurated in Napa, Cal., all cars starting from Lincoln Avenue, that city, and making connections at the depot in East Napa for Vallejo. Six round trips will be made daily between Napa and San Francisco, passengers taking boats at Vallejo to connect for San Francisco. In a few weeks work will be completed, extending up the valley to St. Helena and Calistoga. This is the first single-phase electric railway on the Pacific Coast.

ROCKVILLE, CONN.—The work of building the Rockville, Broad Brook & East Windsor Street Railway is now well under way. The road will connect with the Hartford, Manchester & Rockville trolley line at West Street in Rockville, and the cars will be run to the Market Street terminus over their tracks. The Rockville & Broad Brook Company has a traffic agreement with the Hartford, Manchester and Rockville Company for twenty-five years. This arrangement will compel the Hartford & Manchester Company to increase its motive power.

EAST ST. LOUIS, ILL.—The Marion & Johnson City Railway Company, with its principal office at East St. Louis, has been incorporated with a capital stock of $10,000. The incorporators and first board of directors are W. S. Forman, H. K. Browning, Fred Pausch, C. M. Forman and J. E. Walker, all of East St. Louis.

ALGIERS, LA.—The New Orleans Railways Co. will lay a number of cables across the river for the purpose of furnishing lights to Algiers.

BANGOR, ME.—The annual meeting of the stockholders of the Bangor Railway & Electric Company has been held. The directors chose officers as follows: John R. Graham, president; Frank Silliman, vice-president; F. L. Oliver, treasurer; George T. Sewall, of Old Town, clerk; and C. A. Pearson, Jr., auditor.

BANGOR, ME.—At the annual meeting of the stockholders of the Bangor & Northern Railroad, formerly the Penobscot Central, the following officers were chosen: John R. Graham, president; Charles F. Woodard, vice-president; E. C. Ryder, clerk; F. D. Oliver, treasurer; John R. Graham, Charles F. Woodward, Charles D. Stanford, Charles V. Lord and Franklin A. Wilson, directors.

MENOMINEE, MICH.—Articles have been filed with the Secretary of State of Michigan incorporating the Menominee & Escanaba Railway Company, which proposes to build an electric line connecting the cities of Menominee, Menominee County and Escanaba, Delta County. The capitalization is $300,000. Construction will be started next spring. The line will follow as nearly as practicable the Chicago & Northwestern road.

JEFFERSON CITY, MO.—The Kansas, Lee's Summit & Eastern Electric Railroad has been chartered, with a capital stock of $750,000. The following are the incorporators: J. J. Apperson, L. W. Branham, W. A. A. Summitt and others.

SYRACUSE, N. Y.—The Syracuse Northern Traction Company has been incorporated with a capital stock of $1,000,000 to take over the interests of the Syracuse & South Bay Railroad Company, and also the rights and franchises of the old Oneida Lake Railroad Company, and to provide for the extension of the line now in course of construction between Syracuse and Oneida Lake to Brewerton, Bridgeport and Shackelton's Point. The incorporators of the company are H. H. Plumb, W. K. Niver, W. B. Burns, G. D. Chapman, W. R. Kimball, F. L. Barnes, G. T. Skiff, W. M. Brown, C. N. Watson, L. L. Waters, F. T. Pierson, C. A. Bridgeman, E. G. Connette, G. C. Towle and D. L. Balsley.

RENO, NEV.—The construction of an electric railway from this city to Lake Tahoe, a distance of about 35 miles, is being advocated by local capitalists, who have already had preliminary surveys made. It is planned to secure power from a point on the Truckee River not far distant from Reno.

YOUNGSTOWN, OHIO.—The long-talked-of consolidation of the Pennsylvania & Mahoning Valley Railway with the Youngstown & Sharon Railway & Light Company is about to be consummated. It is understood that E. N. Sanderson, of New York, will be president of the consolidated company, which will control a large interurban system and all the gas and electric lighting systems of Warren and Youngstown, O., and Sharon, New Castle and Greenville, Pa.

HARRISBURG, PA.—The Cherry Tree & Indiana Street Railway Company, with a capital stock of $120,000, has been chartered to build 22 miles of line in Indiana County. T. D. Davis, of Indiana, is president.

WESTMINSTER, S. C.—The Oconee County Railway Company proposes to build an electric railway from Westminster or Seneca, S. C., to Townville and Fair Play, S. C. The line will divide at Oakway, with one branch via Tokeena to Townville, and the other via Tugaloo to Fair Play. It will be 24 miles long. J. J. Haley, of Westminster, is interested.

SARATOGA, WYO.—A company will be formed here for the purpose of building an electric railway from this city to Walcott. Power for the purpose will probably be secured from the North Platte River. Capital for the enterprise is to be raised by local subscription.

MONTREAL, QUE.—It is stated that the Montreal & Southern Counties Railway Company has obtained right of way over the Victoria Bridge and will now proceed with the construction of an electric railway between this city and Longueuil.

New Industrial Companies.

THE MAGNETA COMPANY, of New York, has been incorporated to manufacture clocks, capital, $50,000. Directors, William Hommel, Thomas Morgan and William D. Moore, New York.

THE RIVAL ELECTRIC COMPANY, of Knoxville, Tenn., has been formed. G. E. May is general manager, and Guy Helmer is secretary-treasurer. The company will do a general electrical contract work.

THE BURN-PETERIT MANUFACTURING COMPANY, with a capital of $300,000 paid in, at New Haven, Conn., will make gas and electric lighting fixtures and will occupy a portion of the plant of the W. S. Burn Company in Fair Haven.

Legal.

TELEPHONE CONDUIT NEGLECT.—In the appeal to the Supreme Court of Pennsylvania of the defendant in the case of White vs. Keystone Telephone Company, of Philadelphia, the judgment below was affirmed. The plaintiff was injured by falling, after dark, over a pile of paving stones that had been left on the sidewalk of a dimly lighted street. The sidewalk was three feet wide the pile of stones a foot high and no means were taken to give notice of the obstruction. The only question raised by the assignments of error was whether the case should have been withdrawn from the jury because of the failure to connect the defendant with the commission of the negligent act. It appeared from the plaintiff's testimony that a few days before the accident the defendant secured a permit to lay conduits on the street, and had begun the work, and was occuping the street for that purpose; that on the day of the accident the paving stones had been removed from the cartway and piled on the pavement, the conduits laid, and the trench refilled with earth; that on the morning after the accident the same workmen who had removed the stones from the street and piled them on the pavement, placed them back on the street. While there was no direct proof that the stones were piled on the pavement by the defendant's workmen, the circumstances shown reasonably led to that conclusion, and excluded any other conclusion equally reasonable. There was sufficient evidence to make out a prima facie case.

SAFEGUARDS IN TROLLEY BARNS.—In the appeal of the defendant in the case of Young vs. People's East Electric Company, the Supreme Court of Iowa has sustained the decision of the lower court. The defendant corporation operates a street railway system in the city of Burlington, Iowa. By arrangement between said railway company and the Post Office Department of the United States, mail boxes are attached to appellant's cars for the reception and transportation of mail deposited therein. At certain intervals a carrier in the postal service is required to visit the central barn or shed in which the cars are stored and collect the mail from the boxes, a duty which at the time of the accident complained of was being performed by the plaintiff. On the evening of the 12th of November, 1902, the plaintiff went to the car barn, and in attempting to reach a car standing some distance within the door, fell into a pit or opening in the floor, and was thereby injured. It is alleged that the defendant was negligent in having placed on the car track a block from which a spike protruded and over which plaintiff claims to have stumbled into the pit. It is also alleged that the pit was usually kept covered, affording a safe way over which plaintiff had been accustomed to pass, but that on the night of the accident it had been negligently left uncovered, and, the barn being dimly lighted, plaintiff was thrown into the opening without fault on his part. The defendant denied all charges of negligence on its part, but the court held otherwise.

Obituary.

MR. L. A. SOMERS.—L. A. Somers, a veteran telegraph man, died at the home of his son in Cleveland, O., on August 17, of dilatation of the heart. He was sixty-six years old. He had been connected with the telegraph industry practically since its inception, having been associated with J. H. Wade, Anson Stager and other well known Western Union officials. Mr. Somers was chief operator of the Government War Department telegraph, controlling the telegraph service in the Civil War, with headquarters at Washington. For the last thirty years he had lived in Cleveland, and had been the manager of the gold and stock department of the Western Union Company in that city and nearby places for many years.

Educational.

UNIVERSITY OF ARIZONA.—The University has recently issued an attractive booklet illustrating the interior and exterior of the various buildings located upon the campus. The University, which comprises a college of agriculture and mechanical arts and a school of mines, is located at Tucson, Arizona, at an elevation of 2,400 feet, where it is stated the climate is remarkably mild, dry and healthful. Tuition is free to residents of Arizona, a moderate charge being made to non-residents.

THE WORCESTER POLYTECHNIC INSTITUTE, of Worcester, Mass., has announced the establishment of a chair of electrical railroad engineering. To take charge of this branch of the instruction, Mr. Albert Sutton Richey, chief engineer of the Indiana Union Traction Company, has been elected a member of the faculty, his title being assistant professor of railroad engineering.

Personal.

MR. P. A. VALENTINE, of the Armour interests, is said to be slated as the new president of the Illinois Tunnel Company of Chicago, which has now such an extensive freight subway system there.

MR. JACOB CLOOS consulting electrical and mechanical engineer at Milwaukee Wis., has his headquarters there at 605 Matthews Building. He has also opened a branch office at 1408 Berlin Street, La Crosse, Wis.

MR. W. McBRIDE, sales agent of the Standard Underground Cable Company has become president of the Fort Pitt Spring & Manufacturing Company, with headquarters from September 1 in the Farmers' Bank Building, Pittsburg.

MR. E. H. DAVENPORT, an old telephone man, who has lately been connected with the Norwalk (O.) *Evening Herald*, has gone to Columbia City, Ind., to take the position of manager of the Whitley County Telephone Company, an independent system with several exchanges.

MR. ROBERT R. LIVINGSTON has accepted a position with the Engineering Company of America, and will make his headquarters at 74 Broadway, New York. He was formerly connected with the Allis-Chalmers Company and more recently with Mr. W. S. Barstow in electrical engineering work.

MR. C. A. COFFIN, president of the General Electric Company, has, we regret to say, been suffering from a quite severe attack of inflammatory rheumatism at his home in Lynn, Mass., the attack being intensified by hay fever. With his wonted resilience, however, Mr. Coffin has made a rapid recovery and is reported much better.

PROF. H. S. CARHART, on his way to the British Association meeting in South Africa, was last heard of from Madeira on board the Union steamer Saxon, August 1st, when he reported Prof. Perry, Prof. Darwin and Sir W. and Lady Crookes in the jolly party all doing well, and to use his classic Britticism, having an "elegant time."

MR. HERBERT FLEISHHACKER, of San Francisco, who is the secretary of the American River Electric Company and the Truckee River General Electric Company, was married Aug. 9 to Miss May Greenebaum, daughter of Sigmund Greenebaum, of the London, Paris & American Bank. Mr. and Mrs. Fleishhacker will spend their honeymoon in Europe.

MR. JOHN J. MOORE.—Mr. John J. Moore has become identified with the United States Light & Heating Company in which he will represent the Starbuck and Hawley control. Mr. Moore was identified, years ago, with the car-building industry and at a later period with various lines of electrical development, including pioneer work in establishing electric lighting in New York City and State. The busines of the company, whose affairs Mr. Moore will watch, is the lighting and heating of railroad cars by electricity. Mr. Moore is one of the best known of the early Thomson-Houston representatives.

MR. H. B. SALE, the new vice-president of the Indianapolis Telephone Company and general manager of that company and of the New Long Distance Telephone Company, has given his entire attention to the two companies during the six years of their existence. Having then had considerable experience in practical telephone management, he was elected secretary of the two companies on their organization, and later secretary and treasurer. He is familiar with the entire business of the two companies and also with the telephone situation all over the state. He has been prominently identified with the work of the national association. He is a man of active mind, great energy and fine business ability and is recognized as one of the best posted men on telephone affairs in the entire country.

MR. LOUIS HOLLWEG, who was elected president of the New Long Distance Telephone Company and of the Indianapolis Telephone Company, to fill the vacancy so tragically created by the sudden death of Mr. Sheerin, is now devoting his entire time to the telephone business. He is giving the business the same thorough attention that has contributed to his success in other lines. Mr. Hollweg has been prominently identified with the business of Indianapolis and of Indiana for many years. He acceded to the unanimous wish of the directors of the local and long-distance telephone companies to become the active president of each and to give his time and attention to the telephone business. He is a man of pleasing personality as well as of marked busines ability. He is the head of the great importing and wholesale queensware house of Hollweg & Reese.

MR. HOWARD S. REYNOLDS, superintendent of the operating department of J. G. White & Company, of New York, has resigned to assume the management of the electric light, street railway and gas properties in Helena, Mont., recently acquired by the White Company and allied interests. Mr. Reynolds graduated from the Massachusetts Institute of Technology in 1894 with the degree of B. S., and in 1895 was with the Lowell, Lawrence & Haverhill Street Railway, after which he was with the Boston Elevated Railway and the Brockton Street Railway, in various capacities. For six years he was with Stone & Webster, first as a draughtsman and street railway construction superintendent and later as manager of their electrical and gas properties in Columbus. He then resigned to become associated with J. G. White & Company.

MR. W. S. DORAN.—One of the most pleasant valedictory dinners among the electrical fraternity of London was that given to Mr. W. S. Doran on the occasion of his leaving England to return to the United States, by about a hundred of his confreres in the British Westinghouse Company and other friends. The dinner was held in the large banqueting hall of the Hotel Cecil and was a huge success in every way. Mr. Doran, who is well known both in America and England, started his career with the Southwark Foundry & Machine Company, of Philadelphia, being afterwards connected with the United Gas Improvement Company, also of that city, as manager of gas plants. In 1888 he entered the employment of Henry R. Worthington, of New York, doing much good work for the Navy and Army Departments. In 1892, he was made general supervising agent of the Worthington branch offices, and was in full charge of all the selling business of the Worthington Company in the West, with headquarters at Chicago. Mr. Doran went to England in 1899, for the Worthington Pumping Engine Co., in London, and in 1901 he joined the British Westinghouse Company, paying special attention to the organization of the branch offices, and also looking after important contracts with the railway companies and other corporations. Two of the more important contracts of this character which he has been successful in concluding being the complete installation of the power and lighting system at the Midland Railway Company's Heysham Harbour plant, and the contract for all the electrical apparatus for the corporation of Belfast tramway system. Mr. Doran has been appointed manager of the power department of the Allis-Chalmers Company, and will hereafter have his headquarters in Milwaukee. He has proved one of the most successful of the many American engineers who have gone over to England, and will be regretted by many friends whom he has made there, having established for himself a popularity with British engineers of a lasting character. He returns to the United States with the good wishes of all his friends, and is a very valuable acquisition to the staff of the Allis-Chalmers Co.

Trade Publications.

DRUM STRANDING MACHINES.—The Alton Machine Company, 126 Liberty Street, New York, has issued Bulletin No. 62, illustrating a new type of drum stranding machine carrying 18 drums.

TELEPHONE SPECIALTIES.—The Yonkers Specialty Company, in its latest catalogue, illustrates the Metropolitan cable clip, the New York ground clamp and the Metropolitan expansion plug for making attachment to walls.

COFFEE MAKING BY ELECTRICITY.—In an artistic little pamphlet the General Electric Company describes and illustrates in detail an electric percolator for making coffee, by means of which it is stated the most delicious coffee can be prepared in a few minutes.

TAPES, COMPOUNDS AND RUBBER GOODS.—The Clifton Manufacturing Company, Jamaica Plain, Mass., in a recent publication, gives a descriptive list of the long line of insulating tapes and compounds and rubber goods of its manufacture. The Clifton iron conduit is also noticed.

THE LORD ELECTRIC COMPANY, Boston, Mass., in Bulletin C, just issued, illustrates various forms of Shaw non-arcing lightning arresters, which it manufactures. A good description is given of the principle of construction of this arrester. The Shaw non-arcing static discharger is also described and illustrated.

GAS PRODUCER.—The Morgan Construction Company, Worcester, Mass., has issued a 50-page pamphlet, printed on coated paper and handsomely illustrated, describing in full detail the Morgan continuous gas producer. The various details of the apparatus are illustrated and a number of views given of gas producer plants installed and now in operation.

REFRIGERATING MACHINERY.—The De La Vergne Company is sending out two handsome folders relating to its refrigerating apparatus. Aside from the interest of the text, those who get up trade literature will appreciate the very effective design of the folder, which can scarcely fail to cause it to be taken up for examination by those who find it on their desk.

MARSH BOILER FEED PUMPS.—The American Steam Pump Company, of Battle Creek, Mich., has issued a pamphlet describing its line of Marsh boiler feed pumps. Almost a score of different types are illustrated and very complete descriptions and data given. Cross sectional and detail cuts show very clearly and fully the design and construction of the pumps.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, reports a constantly increasing demand for its transmitter, especially for toll line switchboard use and for long-distance service. These transmitters, provided with especially prepared granular carbon, have a very strong, clear and natural tone, and do not "fry" or "pack" from usage.

THROUGH MATTER TO MIND.—Mr. W. H. Mallock is a brilliant and illuminating writer, even when he deals with an abstruse subject. His peculiar gifts are exemplified in an article "Through Matter to Mind," reprinted in *The Living Age* for September 9th from *The Contemporary*, in which he marshals some of the arguments of Theism against the negations of science.

CONSTANT-SPEED INDUCTION MOTORS.—Circular No. 200 of the Commercial Electric Company, Indianapolis, Ind., has for its subject a line of induction motors for constant speed, which this company is now placing on the market. In the design of these motors the services were retained of Mr. H. M. Hobart, of London, well known as an authority on polyphase design.

NERNST LAMPS.—The last issue of the "Nernst Central Station Bulletin" contains an interesting article on "The Use of the Nernst Lamps as a Peak Broadener," which suggests the establishment of a two-rate system providing for a high rate during peak hours and a low rate during other hours. Such a system would work to the advantage of all concerned when high-efficiency Nernst lamps are used.

JENNEY MOTOR DRIVE.—Bulletin No. 201 of the Jenney Electric Manufacturing Company, Indianapolis, Ind., illustrates a Jenney motor drive applied to a large flat-bed printing press. The motor is of the Jenney Universal type and is provided with special windings to meet the conditions under which it is to operate, and especially to take care of vibrations incident to the operation of a flat-bed printing press.

LIGHTING SPECIALTIES.—The H. T. Paiste Company, Philadelphia, Pa., has issued bulletin No. 25, dealing with panel boxes, cut-outs and entrance switches. The panel boxes are made of wood and lined throughout with asbestos board, and are of simple but pleasing design. The cut-outs and entrance switches are provided with porcelain bases, and are characterized by durability of parts and neatness of appearance.

TELEPHONE SWITCHBOARDS.—The Kellogg Switchboard & Supply Company is distributing a neat folder presenting some "Kellogg Facts" which serves to call attention to the pioneer work of the company. The company announces that it can fill the present demand for party-line service by its harmonic system, which does away entirely with all ground connections at the subscriber's station.

BARRIETT GENERATORS AND MOTORS.—Bulletin No. 4 of the Barriett Electric Manufacturing Company, Cincinnati, O., illustrates by excellent half-tones printed in color the various types of the Barriett motor. The frontispiece is a portrait of the late S. L. Barriett, the caption stating that he was the inventor of the self-oiling bearing and the automatic starting release rheostat, two inventions now employed on all modern electric motors.

CRANE VALVES.—The July and August Advance Circulars of the Crane Company, Chicago, are devoted respectively to butterfly hot water radiator valves and combination back pressure and exhaust relief valves. The former valve is operated by the foot, a quarter turn opening or closing the steam passage. The back pressure and exhaust relief valves are for condensing or non-condensing engines and are made in horizontal, vertical and angle patterns.

FLANGED PIPE JOINTS.—The Crane Company, Chicago, Ill., has issued bulletin No. 7FJ, which is characterized as a brief treatise concerning the merits of the various styles of joints used in attaching flanges to wrought pipe. There are described in detail screwed joints, "Cranelap" joints, "Craneweld" joints, shrunk joints, rolled joints and shrunk and riveted joints. Each joint is dealt with thoroughly and the advantages and disadvantages of each are pointed out.

NORTHERN VERTICAL MOTORS represent the most recent developments in electrical equipment for vertical shaft drive. The Northern designers have eliminated the trouble due to lubrication of the vertical shaft. The equipments supplied by the Northern Electrical Manufacturing Company, Madison, Wis., are so arranged that there will be no trouble due to oil spilled from the bearings falling on the commutator and the driven machine. Bulletin No. 50 illustrates some novel arrangments of Northern Vertical motors.

ELECTRICAL AND STEAM MACHINERY.—Bargain List No. 4 of Joseph H. Thompson, Jr., 11 Broadway, New York, contains 12 pages of closely printed items descriptive of bargains in new and second-hand electrical and steam machinery. Among the various classes listed are direct-connected and alternating-current units, belted direct-current and alternating-current generators and motors for all standard voltages, arc dynamos, arc lamps, railway motors and cars, steam engines, both simple and compound, and boilers.

MOTOR-DRIVEN MACHINES.—The Electro-Dynamic Company, Bayonne, N. J., utilizes circular No. 13 to outline the advantages of individual motors for driving machine tools and points out the features of the inter-pole, variable-speed motors which render them especially adapted to this class of work. It will be recalled that these motors are equipped with ball bearings for the purpose of giving a high efficiency and insuring smooth running. It is stated that the bearings require a little vaseline twice a year, no other attention being necessary.

GAS PRODUCERS.—In an artistically prepared catalogue entitled "Morgan Continuous Gas Producer," much information of value is presented to all who are interested in economical ways of generating and applying heat. The details of tests made by Robt. W. Hunt & Company, showing an average efficiency of 92 per cent. are given, and the points of the producer that made possible this efficiency are set forth. The pamphlet, 6x9, 50 pages with embossed cover and numerous illustrations, is issued gratis by the Morgan Construction Company, 40 Exchange Pl., New York.

DE VEAU TELEPHONES.—The De Veau Telephone Manufacturing Company has issued the 12th edition of its catalogue of standard telephone apparatus and standard wiring diagrams. All of the various types of De Veau apparatus are illustrated and described, directions are given for the installation of intercommunicating telephones and wiring diagrams are printed covering every class of interior telephone connection apt to be made. The same company has issued a smaller catalogue devoted specifically to the De Veau automatic switchless intercommunicating telephone, which is shown in a number of wall and desk types.

DISTRICT STEAM HEATING.—In a catalogue which ranks with the edition de luxe type of this class of publication, the American District Steam Company, Lockport, N. Y., sets forth the principles of district steam heating, its merits as a business enterprise and describes in detail all of the various apparatus and devices employed in connection therewith. The publication has rather the character of a treatise on the subject than that of an ordinary catalogue. The commercial and engineering features are brought out, plans of distribution systems given, and a section is devoted to methods of charging for heat service.

ELECTRIC TRUCKS.—No. 50 of the "Record of Recent Construction," a serial publication of the Baldwin Locomotive Works, is devoted to electric motor and trailer trucks. This handsome pamphlet comprises 32 pages, in which the left-hand pages are devoted to excellent half-tone cuts of motor trucks printed on a tinted background. The data of 13 types of motor and trailer trucks are given. There is no descriptive matter, the text opposite the illustration showing the type consisting of very complete data of the main dimensions of the truck, the dimensions of the material used in its construction, of the wheels and axles and of the springs. With one exception the illustrations are made from trucks furnished to various railway companies.

CENTRAL STATION PERIODICAL.—The latest addition to the ranks of central stations issuing a periodical having for its purpose the extension of business and to convey to consumers electrical information likely to interest them, is the Union Light & Power Company of St. Louis. The title of the publication is "Electric Light and Power," and it is made attractive by the use of three-color illustrations. The issue for August gives details concerning the electrical features of the Tyrolean Alps electrical installation at the World's Fair, and contains articles and notes on alternating current motors for elevators and refrigeration, sign board lights and electricity at home. Brief descriptions are also given of a motor-driven machine shop, of a large hotel and of a manual training school.

OIL FILTER CATALOGUE.—We have recently received from the Burt Manufacturing Company, of Akron, O., a very handsome catalogue which describes in detail the various oil filters and exhaust heads manufactured by this company. It illustrates and describes the "Cross," "American" and "Warden" oil filters, the "American" Oil Filtering System and the "Burt" and "Standard" exhaust heads. The valuable information which it contains in reference to the filtering of oils makes it a valuable work of reference, worthy a place on the desk of anyone operating a power plant. It also describes fully the "unit type" of oil filters, which is used in connection with the American oil filtering system. Everyone interested in the running of a power plant is invited to write the Burt Manufacturing Company, Akron, O., for a copy of this handsome publication.

SMALL SINGLE-PHASE INDUCTION MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued Bulletin No. 3105, describing a line of ⅛-hp. and 1-6-hp. single-phase induction motors designed for starting automatically under full load. Each motor is provided with a squirrel-cage secondary winding, and is equipped with two primary windings, the main coil and the starting coil. The motor is started as a split-phase machine. It is stated that each motor is carefully tested on the proper load, and before leaving the testing room is required to operate under an overload at least 20 per cent. greater than the rating. The motors are constant-speed machines. Two or three speeds of the driven machines may be obtained, however, by the use of 2-step or 3-step cone pulleys. Bulletin No. 3952 of the same company describes a complete line of such pulleys for both flat and round belts.

GENERAL ELECTRIC TRADE LITERATURE.—The extensive publishing business of a large manufacturing company conducted along modern lines is made evident in some indexes just issued by the General Electric Company. These comprise indexes to bulletins, descriptive catalogues, pamphlets, supply catalogues, flyers and price-lists. The subjects of the many hundred of publications entered in these indexes cover almost the entire range of modern electrical application, aside from telephony, telegraphy and storage batteries. This range is illustrated by the following partial list of subjects of bulletins and other publications issued during the month of July: Service cut-out; electrically-driven turbine house pumps; Thomson recording wattmeter, type "C"; pendant switches; porcelain ceiling boards; Edison socket ring; enclosed fuse cut-outs; combination service switch and cut-out in iron box; combined switch and enclosed fuse cut-out for car lighting; ceiling rosette with enclosed fuse; double-pole knife switches; motor controlling rheostats; arc lamp hangers and cut-outs; type "H" oil transformers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUGUST 15, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

797,015. INDUCTION ARRESTER; Edward C. Paramore, Philadelphia, Pa. App. filed Dec. 1, 1904. In order to avoid the effect of induction from outside wires in a telephone circuit, a pair of primary coils are wound on a single spool, and a secondary coil is placed in circuit with one of said primary coils. The device is placed in the telephone line intermediate the usual induction coil and the receiver.

797,048. CIRCUIT BREAKER; Harry P. Davis and Arthur B. Reynders, Wilkinsburg, Pa. App. filed Feb. 27, 1904. May be utilized as an automatic circuit breaker or as a circuit closing switch. Each of the arms is independently operable by an independent toggle joint. Both or either one of the toggles may be tripped to actuate the circuit breaker.

797,049. ELECTRICAL TERMINAL CONNECTION; Isaac DeKaiser, Wilkinsburg, Pa. App. filed Nov. 21, 1903. A method of securing the terminals of any apparatus, consisting of a split block having an annular chamber therein which is clamped around a section of the wire having a ring or beading formed thereon.

797,050. INSULATOR; William W. Dunsmore, Falconer, N. Y. App. filed Aug. 24, 1904. The insulator comprises a two-part plug having a zig-zag groove therethrough. The plug is screwed through the cross arms in the direction of the wire, which is led through the zig-zag recess.

797,054. FUSE TERMINAL; Howard W. Gibbs, Newburyport, Mass. App. filed Dec. 9, 1904. A fuse plug comprising a tube of insulating material in which is a packing material and the fusible conductors. The terminals are formed of notched plates which engage flanged collars upon the tube.

797,059. MEANS FOR COOLING PUMP MOTORS; Per J. Hedlund, Stockholm, Sweden. App. filed Jan. 12, 1905. A motor especially adapted for oil pipe lines. The motor is wholly enclosed in an enlargement in the pipe and has openings for the circulation of the oil which cool and lubricate the same.

797,060. CONTROLLER FOR ALTERNATING CURRENT APPARATUS; Ray P. Jackson, Wilkinsburg, Pa. App. filed Jan. 23, 1905. (See Current News and Notes.)

797,061. CONTROLLER FOR ELECTRIC MOTORS; Ray P. Jackson, Wilkinsburg, Pa. App. filed June 6, 1904. (See Current News and Notes.)

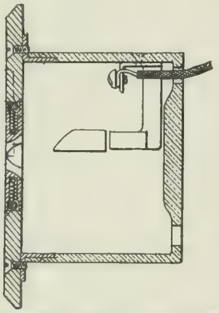
797,065. ELECTRIC SWITCH; Benjamin S. Luther, Boston, Mass. App. filed Apr. 4, 1904. A circuit-breaker for heavy currents in which the contact blades are on a plunger at the rear of the panel board. A lever extending through the board clamps the plates firmly on their contacts by a toggle joint action. Supplemental carbon breaks are provided.

797,090. LAMP SOCKET; William Uschmann, Schenectady, N. Y. App. filed June 1, 1904. A socket has a revoluble sleeve upon which are contact rings or segments. When the lamp is turned the circuit therethrough is made or broken.

797,103. ELECTRIC CLOCK; Martin Fischer, Zurich, Switzerland. App. filed Nov. 20, 1903. In order to synchronize the secondary with the master clocks, each secondary clock is set to gain slightly and a mechanical device is provided to stop the secondary clock at certain intervals, for example, every minute, by which it is made to synchronize with the master clock.

797,110. STORAGE BATTERY; Gustave K. Hartung, New York, N. Y. App. filed April 30, 1904.

797,112. PROCESS OF CONVERTING OLEIC ACID INTO STEARIC ACID; Alexander de Hemptinne, Ghent, Belgium. App. filed Feb. 7, 1905.



797,215. Plug Box for Electric Circuits.

797,141. BLOCK SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; Frank R. McBerty and Malcolm E. Launbranch, Chicago, Ill. App. filed Sept. 9, 1904. In order to admit only one car to a single track section at a time, a contact disk is stepped around by the entrance of the car into the block, and pressure spring is made to overtake the same when the car leaves the block. Quick acting magnets are used which serve to open the circuit of the corresponding instrument at the other end, so that the entrance of two cars into the block from opposite ends at the same time will be prevented.

797,169. SPACE TELEGRAPHY; Ferdinand Braun, Strassburg, Germany. App. filed Feb. 6, 1899. (See Current News and Notes.)

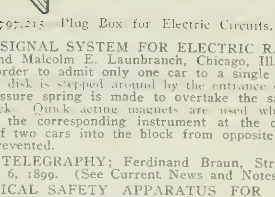
797,180. ELECTRICAL SAFETY APPARATUS FOR SIGNALING ON RAILWAYS; Henri Cousin, Paris, France. App. filed Apr. 3, 1905. In order to enforce caution signals, an apparatus is provided for making a train stop absolutely effective when a danger signal is passed, but which allows the train to pass the train stop in case of a caution signal, if the engineer blows his whistle to indicate that he is on the look-out.

791,187. CAR SIGNAL; Frederic H. Ensign, Los Angles, Cal. App. filed Sept. 20, 1904. In order that a motorman may be informed of the movements of the car ahead, a reflector is used in connection with the rear signal lamp which makes certain movements when the brakes are applied, and at other times, and thereby produces a prearranged signal.

797,191. RAILROAD TRAIN SIGNAL; Samuel E. Foreman, Paducah, Ky. App. filed Mar. 28, 1905. A pair of trolley conductors are led along the track and each train carries contact rollers to make a complete circuit. When the resistance of such circuit falls below a certain amount by virtue of the trains coming too closely together, gun powder is exploded to warn the engineers.

797,215. PLUG BOX FOR ELECTRIC CIRCUITS; Henry G. Osborne and Edward Richter, New York, N. Y. App. filed May 23, 1904. A plug box having a pair of spring doors on its front face which are deflected inward when the plug is inserted and close after the same so as to exclude dust and moisture. When the plug is withdrawn the doors again automatically open and close.

797,217. OPERATING MECHANISM FOR CONTROLLERS; William D. Pomeroy, Norwood, O. App. filed Dec. 8, 1903. In order to avoid sparking of the contacts, the control cylinder is not rigidly attached to its handle, but has a loose connection with an intervening spring. As the handle is turned the cylinder follows with a series of quick movements which eliminate injurious sparking.



797,226. Combination Flatiron and Stove.

797,226. COMBINATION FLAT IRON AND STOVE; Earl H. Richardson, Ontario, Cal. App. filed Dec. 9, 1904. An electric flat iron having a heating coil, and also having an arrangement by which it can be turned upside down to constitute a stove.

797,252. ELECTRIC SWITCH; Milan V. Ayres and Daniel E. Hennessy, Everett, Mass. App. filed Feb. 9, 1905. The trolley wire has a tube in which is contained a quantity of mercury, and when the wire is deflected by the passage of a car, the mercury breaks contact with one or another terminal immersed therein.

797,254. MEANS FOR TRANSMITTING ELECTRICITY TO VEHICLES ON ELECTRIC RAILWAYS; Attilio Beer, Venice, Italy. App. filed Aug. 18, 1902. The current is supplied from boxes buried in the roadbed at predetermined intervals, to a conductor extending the length of the train and carried thereby. The boxes are normally closed by a cover which is raised by a mechanical attachment while the train passes.

797,271. ELECTRIC SWITCH; Gano S. Dunn, East Orange, N. J. App. filed Aug. 25, 1903. In order to avoid the excess current in a motor armature while the field cores are building up, an air cylinder is arranged to momentarily cut in resistance after each movement of the controller arm.

797,324. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Dec. 10, 1903. A tube of insulating material has metallic caps at each end to which the fusible material is secured, and additional caps which lie over the same and protect the whole.

797,325. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Dec. 18, 1903. In order to more securely connect the parts together, the same screws which secure the end caps in place are effective to hold the terminals of the conductors within the tube.

797,342. TROLLEY WHEEL; Frank E. Bryan, Niles, O. App. filed Dec. 24, 1904. The trolley wheel has spiral grooves on the periphery thereof which serve to lead the conductor back into place when it has jumped out of position.

797,355. TROLLEY MOUNTING; George E. Henry, Vincennes, Ind. App. filed Nov. 9, 1904. The bearings for the wheel in the harp are made hollow and filled with graphite for the purpose of lubrication.

797,369. WATER RHEOSTAT; William D. Pomeroy, Norwood, O. App. filed Dec. 1, 1903. The cover of the box has triangular metallic blades which dip into the water to varying amounts so as to secure a greater or less resistance.

797,394. THIRD-RAIL GUARD; Melchior Zugermayer, East Rutherford, N. J. App. filed Apr. 19, 1905. The third rail is protected by a covering open only at one side. A sliding wall is arranged to close this side except when displaced by the passage of a car.

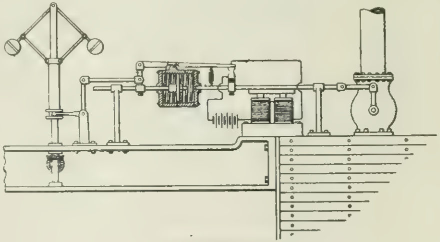
797,396. ELECTRIC MOTOR; Ralph E. Barker, Lynn, Mass. App. filed Oct. 26, 1903. For the purpose of preventing the field coils of small fan motors from sagging down at their unsupported end portions, wires are bent so as to project under the same.

797,398. ELECTROFLUID PRESSURE SWITCHING MECHANISM; Walter J. Bell, Los Angeles, Cal. App. filed Aug. 25, 1904. The switchpoint is moved in either direction by a pneumatic cylinder having an ordinary D valve. The valve is swung backward and forward by a pair of solenoid magnets.

797,416. GOVERNOR; William L. R. Emmet, Schenectady, N. Y. App. filed Mar. 27, 1901. The engine valve is connected with the governor by a dash pot mechanism which causes the closure of the valve to lag considerably behind the movements of the governor. The effect is to avoid the recurring oscillations of alternators in parallel.

797,424. ELECTRIC FIRE ALARM APPARATUS; Eugene Fuller, Arctic Center, R. I. App. filed Jan. 28, 1905. Relates to fire alarms in which a signal lamp is displayed. When the lamp has once been displayed by an enunciator or other means, a local circuit is closed which maintains the current until the latter is cut off by an authorized person.

797,433. ELECTRIC SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed Nov. 4, 1904. The controller arm has a pair of pawls thereon which engage notches and hold the arm after each step or movement, until a releasing device is manipulated to disengage the pawls.



797,416. Governor.

797,454. ATTACHMENT PLUG; Henry T. Paiste, Philadelphia, Pa. App. filed Jan. 20, 1904. The usual corrugated shell which constitutes the threaded portion of the plug is telescoped on to a smooth cylindrical part with a recess in which cement is flowed.

797,457. CONDUIT THREADER; Charles B. Rodgers, Bordentown, N. J. App. filed Mar. 25, 1904. The conduit threader has a grappler thereon which can be manipulated by the movement of a cord to remove obstructions from the interior of a conduit.

797,472. ATTACHMENT PLUG; George B. Thomas, Bridgeport, Conn. App. filed Feb. 3, 1905. A cylindrical insulator carries a threaded shell which is held in place thereon by its flanged end which is clamped beneath the base of the insulator.

797,490. INSULATED RAILWAY RAIL JOINT; Bancroft G. Braine, Brooklyn, N. Y. App. filed July 23, 1902. The two ends of an insulating fish plate are offset from one another so as engage opposite sides of the rail. The connecting web goes between the abutting ends of the rail section.

797,498. BLOCK SIGNAL SYSTEM; Fred B. Corey, Schenectady, N. Y. App. filed Jan. 21, 1905. A semaphore arm is driven by a motor into two extreme positions which correspond to danger and safety respectively. Circuits are provided by which the caution circuits stop the motor at an intermediate point so as to hold the semaphore arm half way raised.

797,517. MEASURING INSTRUMENT; John H. Kimball, Lynn, Mass. App. filed Aug. 25, 1904. Relates to the journal bearings of the rotating member in a meter and is designed to prevent vibration and looseness. The bearings are spring-pressed toward one another and one of the engaging surfaces is of a non-metallic material.

797,518. SYSTEM OF ELECTRICAL DISTRIBUTION; Sigvald Krohn, Berlin, Germany. App. filed Nov. 2, 1899. Is designed to secure constant potential without resort to over-compounding the generator. A motor in the working circuit works against the tortion spring so that its angle of movement varies with the power. The motor is connected to a switch which throws storage batteries into circuit when the load falls off.

797,526. SWITCH; Frank R. McBerty, Evanston, Ill. App. filed Dec. 21, 1903. In order to avoid mistakes the end of a telephone spring jack is closed in such a way that the plug cannot be inserted therein unless it is specially formed with a sort of key adapted to that particular spring jack.

797,544. SPACE TELEGRAPHY; Ferdinand Braun, Strassburg, Germany. App. filed Feb. 6, 1899. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, SEPTEMBER 2, 1905. No. 10.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................................1139 Monadnock Block
PHILADELPHIA OFFICE................................929 Chestnut Street
CLEVELAND OFFICE.................................402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **16,000** *copies are printed. Total circulation for 1905 to date,* **487,000.**

NEW YORK, SATURDAY, SEPTEMBER 2, 1905.

CONTENTS.

Editorial 373
Long-Distance Telephony in Mexico........ 376
Lighting Developments in San Francisco........ 376
The British Telephone Agreement........ 376
An Everlasting Electrical Fortune........ 376
A Statue to Franklin in France........ 377
The Action of the National Reciprocity Convention........ 377
Convention of League of American Municipalities 377
Lighting and Railway Interests Consolidated in Nevada........ 377
Municipal Ownership in Australia........ 378
Convention of International Association of Electricians........ 378
A Thumbnail Sketch of Mr. Westinghouse........ 379
Subway Developments in New York Suburbs 380
Current News and Notes........ 380
Electrical Engineers of the Times.—XXV. Henry Floy 382
Waterside Station No. 2 of the New York Edison Co.—I........ 383
Prof. Darwin on the Atom........ 386
Hydro-Electric Developments of the Ontario Power Company.—II........ 387
Relations of the Central Station with the Public. By W. F. Kingan........ 389
The Osmium Lamp 390
Regulation of Electric Rates in Massachusetts.—I. By Alton D. Adams........ 391
Practical Information on Central Station Meters........ 392
Tests of the Tantalum Lamp........ 394
Recent Electro-Chemical Developments........ 395
New York Central Third Rail........ 396
The Increasing Use of the Fan Motor........ 397
Plotting Saturation Curves 397
American Trolleys in Manila........ 397
Illuminating Engineering and Central Stations. By J. R. Cravath........ 398
New Telephone Patents 399
LETTER TO THE EDITORS:
Efficiency of Spark Coils. By C. A. Carpenter........ 400
Digest of Current Electrical Literature........ 400
Intercommunicating Telephones 404
Electrical Equipment for the West Shore Railroad........ 404
The Manufacture of Electric Automobiles........ 405
Westinghouse Core Type Transformers 406
Burke Three-Wire Generator 407
Fort Wayne Alternating Current System of Arc Lighting........ 407
Balancers for Edison Three-Wire System........ 409
Recent Work with Walrath Gas Engines........ 409
Use of the Nernst Lamp in Yonkers........ 410
Electrical Recording Instruments 411
Smith Type of Storage Battery........ 412
Regrinding Globe Valve........ 412
Industrial and Commercial News........ 413
General News of the Week........ 417
Weekly Record of Electrical Patents........ 423

CANDLE-POWER RATINGS.

At the recent convention of the Ohio Electrical Association perhaps the most interesting session was that of an afternoon devoted exclusively to consideration of the new incandescent sources of electric light—the Nernst lamp, the graphitized carbon filament and the metallic filament. It was brought out that 250 central stations are now using the Nernst lamp, and data given of some tests of the tantalum filament entirely verify previous highly favorable reports on this lamp. The merits of the several illuminants under discussion led to a rather animated passage of arms between representatives of manufacturing companies; and while the advisability of allowing such discussions on the floor of a convention may as a rule be questioned, we must confess that in this particular instance we are heartily glad that the matter of the relative "practical efficiency" of illuminants for commercial purposes was brought up, for by assisting in focusing attention a great deal of misconception which seems to have gathered around the question of the efficiency of lighting units may finally be cleared up. This misconception has arisen as a result of the radically different ways in which different electrical illuminants have been rated. In scientific work only mean spherical candle-power is used in comparisons. Commercially, the incandescent lamp is nominally rated at its horizontal candle-power, the arc lamp is not rated by candle-power at all, and the Nernst lamp is rated sometimes by vertical or downward candle-power and at other times by mean lower hemispherical candle-power. That is, each lamp is rated so as to conceal its defects in light distribution. The incandescent is weak in light along its axis, the Nernst lamp in one hemisphere, and the arc, in its enclosed form, at least, gives a lower efficiency than it is wise to mention in any discussion dealing in efficiency alone. It is thus no small wonder that there is a "confusion of tongues" when the luminous efficiency of electric lamps comes up for discussion.

There is only one rational way for the comparison of artificial sources of light as to efficiency, and that is on the basis of mean spherical candle-power, measurements being made on the naked source. This method accounts for the total light given off by the source of illumination, and the ratio of the consumption of energy to produce this light, to the total light produced as determined by mean spherical measurement, is the only true efficiency. (Throughout, by the way, and in order not further to confuse the subject, we employ the word efficiency, not in its correct meaning of the ratio of candle-power to watts, but in its commercial meaning as above stated.) By many, however, it is, and perhaps always will be, maintained that this does not furnish a commercial basis for comparing different illuminants, for the reason that in many cases the light in certain directions is wasted so far as practical illumination is concerned; and also that in order to bring out the best practical efficiency, reflectors or globes, or both, are in cases necessary to redirect and diffuse the light. Owing to the variety in shape and surface of globes and reflectors, and the impracticability of testing all of the sources with exactly the same kind of these fittings, it is obvious that so-called efficiencies obtained under so-called "practical" conditions—which conditions in each case are, moreover, subject to different commercial definition—cannot possibly be comparable with each other. Perhaps the best practical solution of the puzzle would be for our prominent central station organizations to agree upon and adopt a definition of commercial candle-power of electric lamps and insist that manufacturers express the efficiencies of lamps according to the terms of this definition. A precedent for such action was set by the National Electric Light Association in 1894, when it cleared up the muddle of arc light ratings by specifying that a 2,000-cp arc light should be one requiring for its maintenance 450 watts as measured at the electrodes.

It would seem to be entirely fair to the various manufacturers of incandescent lamps if a definition similar to the following were adopted: That the standard commercial efficiency of incandescent lights be expressed by the ratio of the watts as measured at the lamp terminals, to the mean spherical candle-power; and that when efficiencies are given they be accompanied with a specific statement as to whether the light was measured bare or with globes or reflectors, or both, in the latter cases giving a specification of these fittings. Until some action like that proposed above is taken by a body or bodies having sufficient weight to insure their recommendations being observed, the endless discussion of relative efficiency avails nothing, but merely brings into further disrepute the term "efficiency" as applied to incandescent lamps. The effect of such a rating would be to encourage good distribution of light instead of paralyzing it, and one would have the choice between using an illuminant at its face value or redistributing the light to suit his needs. Reflectors and diffusers are necessary to really efficient illumination, and the basic question regarding a lamp from the standpoint of intelligent engineering is the total luminous flux which it puts at the user's disposal, not the light which is given in some direction selected by each maker as most favorable to his product. The mean horizontal candle-power rating answered a good purpose so long as all incandescent lamps were made after the same general plan; but with the advent of the new illuminants it has outlived its usefulness and should be superseded by the only rating that deals out even justice to all illuminants—that based on an integration of the total luminous flux. The American Institute of Electrical Engineers has formally pronounced in favor of rating on the basis of mean spherical candle-power. Steps toward the mean spherical candle-power rating were also taken by the National Electric Light Association some years ago, but there was not then the great diversity in lamps that now exists, and nothing substantial was accomplished. The time now appears ripe for final action.

ILLUMINATION AND COMPETITION.

It has been said a number of times in the past few years, by those whose study of the matter puts them in a position to know, that there is a far greater chance to make important gains in efficiency by proper attention to the engineering of illumination than by efforts directed anywhere else along the line between the boiler room and the consumer of electric light. It has also been pointed out at electric light conventions by some of the foremost men in the business that after all is said and done the principal business of a central station company is that of selling "light." The auditors are altogether too much accustomed to nodding their heads wisely in assent to these statements and letting it go at that, without taking the trouble to go into the matter of illuminating engineering thoroughly and determining in what ways the central station company can secure greater efficiency in the use by the customer of the light produced. The article by Mr. J. R. Cravath, elsewhere in this issue, brings this subject up again, as did also the practical paper on "The Wiring of Residences," by Mr. J. Kermode, read before the recent Ohio Electric Light Association Convention, and published in abstract in our last issue.

The fact of the matter is, it is the business of the central station man in these days of severe competition to see that his customers are getting the most possible for the money they are paying the company for electric lighting service. The central station always has a competitor in the shape of some other illuminant. Although electric light in some cases is at a disadvantage as regards the cost of simply producing a given number of units of light, it is usually possible in these cases with the aid of a knowledge of illuminating engineering to deliver a larger percentage of the light produced as useful light to a customer with electric light than with other illuminants, so that electric light can be put on more nearly the same footing as to cost.

It is notable that the companies which give most attention to customers' installations are usually the ones which have made the greatest success of the lighting business. The central station manager who sits down with a long face and says that customers will not take the advice of the company in lighting matters because they think the suggestions are made with some ulterior motive, is often, we fear, one whose suggestions have been such as to give customers cause for suspicion. Nothing can win a customer's confidence and friendship more than pointers on the part of the company as to methods by which he can economize in the use of light, or get more for the same money. It is not possible, especially in large cities, for the central station company to keep close watch of the installations of every customer, but it has been demonstrated that in all but the largest cities the company can, by continued effort, establish a precedent that its advice be sought on matters of illumination before the electric lighting of any place is planned. This does not mean that the actual work of wiring is to be taken out of the hands of the local wiring contractors, but that the company cannot afford to ignore what is going on beyond the service switches. Until such time as architects seek the aid of illuminating engineers, the central station company must itself look out for these matters, or at best throw its influence in that direction.

LIGHTNING.

Talk as you please of the vast progress made in electrical appliances, and chuckle as you may over the prospects of this twentieth century, there is one device that looms grimly and reproachfully out of the neglected shadows of the past. We refer to the lightning rod, which is to-day substantially in that state of development in which it was left some years since by the late B. Franklin, F.R.S. In spite of all the erudite researches since his day our knowledge of the actual character of lightning has not greatly advanced. It is high time that the one form of electrical energy which does not have to be paid for by meter or otherwise were studied with its own thoroughness. There have been many speculations about it and a few experimental investigations, but none in the least commensurate with the importance of the subject. Not only is lightning the cause of great actual destruction of life and property, but it seems to have a grudge of long standing against electrical systems in general, and is to-day one of the most formidable difficulties in the way of electric lighting and power enterprises. One installs lightning arresters of course and hopes that they may do some good, and they are a needed safeguard; but one feels very much more comfortable after the storm blows over leaving the lines and transformers still intact.

We have rather come to the opinion that the chief trouble with the lightning arrester question is still lack of knowledge regarding the thing which is to be arrested. We all assume and probably correctly, that lightning being in the nature of a condensed discharge, is essentially oscillatory in its nature. The virtual capacity involved and hence the frequency is an unknown quantity, like the potential concerned in the discharge. It is certain that lightning flashes sweep over very great distances ranging from a few hundred feet up to several thousand, but the voltage from which these prodigious striking distances result cannot yet be evaluated. If the nearly linear relation connecting voltage and striking distance within experimental data holds under the conditions found in the heavens, one would have to estimate the voltage of a thousand-foot flash at 100,000,000 volts or thereabouts. But the experiments reach with certainty only about 500,000 volts, and how things go far beyond that nobody knows. Nor can one more than guess at the nature of the discharge. On rare occasions an apparently simultaneous volley of flashes is seen between clouds that would apparently indicate a violently oscillatory discharge, while more commonly one sees isolated flashes, likely enough still oscillatory, but with a totally unknown rate of damping. If the damping is sufficient to reduce the discharge practically to a single rush, then what is the gradient of the wave front which determines its virtual frequency? Some of these questions may be at least approximately answered by a photographic study of flashes, perhaps with the aid of rotating mirrors; and such a study conducted at two adjacent stations would certainly disclose some valuable data as to the dimensions and position of lightning flashes.

It would certainly have a considerable scientific value, which is itself a sufficient reason for undertaking it, and it is by no means improbable that information of a very practical value might be the outcome. Present devices for the protection of apparatus and lines against lightning are based on the conception of lightning as a rapidly oscillatory discharge. It is possible, however, that some lightning at least may have a pretty slow period, or may be damped into virtually a single rush, of a sort which cannot readily be choked back. Certainly lightning is of an immensely variable character, so that generalizations regarding it are altogether unsafe. The trouble with the experimental study of lightning is the comparative rarity of lightning itself at any one station, a rarity that for practical purposes is increased nearly three-fold by the shortness during the lightning season, of the hours of darkness during which a photographic method could be applied. It strikes us that the damage done annually by lightning is sufficient to justify the Weather Bureau in undertaking some such systematic investigation of the subject as might lead to better preventive measures. There is just the sort of persistent attention required that it is extremely difficult to obtain save with professional observers who can be on the watch without being called off by other duties. With work intelligently distributed among the various stations a few years would see the accumulation of a great deal of valuable information without any very great expense. If the work led to the prevention of even a small percentage of the damage annually done by lightning it would pay merely as a matter of business. It is particularly a matter for the government to take up on account of the public nature of the service, and the comparatively small opportunities of any single private observer or group of observers.

RADIO-ACTIVE MATTER IN THE ATMOSPHERE.

A recent paper in the *Philosophical Magazine* by A. S. Eve, describes a research at McGill University to determine the number of ions in the air of that neighborhood, with a view to ascertaining how much radium would be necessary at or near the surface of the earth in order to produce a like number. The air of the physical department at McGill University is unfit for such experiments, owing to the scattered presence of radioactive substances in all parts of the building; but the engineering department building was considered as untainted by abnormal radioactive matter. An empty water tank in this building, 8 meters high and 1½ meters square, of iron 3.5 cms. thick, was selected for the experiment. A carefully insulated wire was suspended in air in this tank for three hours at a time, while maintained negatively electrified to a potential of about 10 kilovolts by an active influence machine. At the end of this time the wire was removed and found to be radioactive, as determined from its charge-dissipating properties. By comparing the radioactivity with that produced in a zinc cylinder containing air exposed to radium emanation, it was finally deduced that the air within the empty water tank was as active as though it had contained half a gramme of radium bromide per cubic kilometre. The ionizing properties of the air in the tank and in the building were found to be of the same order of magnitude as those of air taken outside the building.

The deductions from the measurements are of much interest. If the atmosphere covering the land surface of the earth is as active from an ionic standpoint as the air in Montreal, for an elevation of a kilometre, 600 tons of radium bromide evenly distributed over that surface would continue to produce emanation sufficient to equal in its effects those observed in this case. Moreover, if radium salts occur distributed uniformly in the crust of the earth to an extent sufficient to account for the observed temperature gradient in the earth, the layer of surface soil containing this small proportion of radium, sufficient to ionize the air to the observed extent, would be only a few metres thick. The number of ions constantly being produced in the atmosphere by the earth's radium, or other causes, is reckoned from these observations to be approximately 10 ions per second per cubic centimetre, an estimate which agrees satisfactorily with those made from similar observations in other localities. It seems very desirable that the experiments described should be repeated in numerous localities over the globe, both on land and sea, in order to ascertain whether the ionizing properties of the atmosphere are uniformly distributed; or whether they vary from one region to another.

In the light of these and similar experimental results, it is easy to understand why the harvest of researches into the electric properties of the atmosphere has hitherto failed to show any clear relation to the state of the weather. If the earth is constantly exuding an ionizing emanation, then the superincumbent layers of air will be electrified from below by the ions liberated under the influence of this emanation. An electrometer brought into electric communication with the surrounding outdoor air by a burning match, or a water atomizer, will acquire a charge due to the earth-borne material, and not due to aerial movements except in so far as these may disturb the natural disengagement of ions. Again, it seems clear that in the case of an aerial insulated conductor such as a telegraph wire, its apparent defect in insulation will be attributable to free ions in the surrounding air, independently of the leakage over the surfaces of the glass or porcelain insulators. The movement of ion-laden air past the wire in transverse winds should also be expected to vary the insulation leakage. The ordinary telegraph wire is too poorly insulated at its supports or contacts to render such observations of much value, but lengths of aerial wire insulated with care, on oil insulators, might afford important material for scientific investigation. These atmospheric ions have so recently become recognized that there has not been time to determine their influence upon natural laws. It is quite possible that they may exert an appreciable effect in the production of rain or take some share in the activities of the organic world. A large amount of patient investigation will doubtless be necessary before such questions can be answered; meanwhile, although we must be prepared to accept beliefs cautiously, we must also be ready to bid farewell to all surprise, so wonderful have been the electric revelations of the past decades.

Long Distance Telephony in Mexico.

The city of Torreon, Mexico, is to be made the central point for an extensive system of long-distance telephone lines which are to cover a large portion of Northern Mexico. The concession for this proposed system was obtained from the Mexican Government about three years ago by John Woessner, an American resident of Saltillo, Mexico. At the present there are two independent telephone systems in Torreon, each of them having large lists of subscribers. Both systems were recently improved in many particulars. Mr. Woessner already has built long-distance lines from Torreon to Gomez, Palacio and Lerdo, and to the more distant city of Durango. Mr. Woessner says that one of the most important points which he desires to reach is Monterey, and the matter of extending the system to that place is now under consideration with every prospect that it will be carried into effect. The distance is about 200 miles. Mr. Woessner stated further that if the negotiations now pending are consummated so as to obtain an entrance into Monterey, the work of construction will soon be begun and that the line will be completed and ready for operation in about three months. One of the systems in Torreon is operated by Mr. Woessner in connection with his long-distance lines. He has installed the most up-to-date equipment in the local exchange. Many of the leading ranchmen of this part of Mexico have urged Mr. Woessner to extend his system to their places and this may be done. Some of the ranches are already connected with Torreon by private lines and these may in time be taken over by the Woessner system. Some of the richest country in the Laguna valley will be embraced in the territory covered by the lines of the long-distance telephone system and the people who live upon these plantations will be placed in direct communication with all of the markets of Northern Mexico.

An extensive system of independent long-distance telephone lines centering at Chiguahuapan and extending to the capitals of all of the districts of the State of Puebla was formally inaugurated a few days ago. An independent telephone line from Cholula to Acatepec, in the same State, has been placed in operation.

Lighting Developments in San Francisco.

The lighting situation in San Francisco is still influenced by consolidation rumors, many indications being to the effect that the California Gas & Electric Corporation will dominate the merger. The San Francisco Gas & Electric Company's stock has advanced during August from $62 to $77 per share on reports that there was an offer for the entire holdings at a high figure. While it is said that the California Gas & Electric Corporation made a standing offer for the San Francisco Gas & Electric Company for a long period, other propositions have been made. Mr. Edwin Hawley, who is close to the Western Pacific Railway Company, has been credited with a connection with one of the offers and F. H. Ray, who appraised the Gas & Electric Company's plant is supposed to have acted in his interest. Just where the San Francisco Coke & Gas Company will come in, if at all, cannot be said at present. It has just begun operations giving the first competition in gas lighting for several years. It has been asserted that Standard Oil interests are behind this concern, which has sold bonds to the amount of $2,500,000. It has been reported that this company is not desirous of selling out, but would sell if a high figure were offered, or it would undertake to buy out the other companies under certain conditions. There is a possibility of the Mutual Electric Light Company selling out, but as its business has been increasing and its new plant is showing great economy in operation, many of the stockholders prefer to have it remain independent. While it is not at all certain that the present negotiations will result in a sale when submitted to a vote of the San Francisco Gas & Electric Company's stockholders, the field is a very attractive one and large capital might be profitably employed if it were properly covered with modern gas and electric plants. Although the California Gas & Electric Corporation has not admitted that it will distribute gas in San Francisco, it is significant that its gas engine reserve plant, which is nearly completed six miles from the city, will use illuminating instead of producer gas. The works are laid out so as to permit of increasing the capacity six-fold when desired, and by use of high pressure the city could be supplied.

The British Telephone Agreement.

The report of the Select Committee on the agreement between the National Telephone Company and the Postmaster-General has been issued. It recommends that, with certain modifications and provisions urged by the Committee, in the general public interest the agreement should be approved by the House of Commons. If this approved be given, the agreement will come into force on August 31 of this year, and the transference of the National Telephone service to the State will take place on the last day of the year 1911.

With regard to the treatment of the National Company's employees after the transference, the committee propose that all officers and servants who shall have been not less than two years continuously in the service of the company on December 31, 1911, shall as from that date become officers and servants of the Postmaster-General on the terms of hiring and conditions of employment which obtain in the grade to which they are transferred.

The committee recommend an undertaking by the Postmaster-General that no servant of the company taken over by the Post-Office shall suffer by the transfer whenever it takes place; and that the employees of the company shall have the option of either continuing on the same terms as to pensions which they now enjoy under the company, or of adopting the superannuation terms and conditions of the Post-Office service. The committee do not think that the coming into operation of the agreement will place the staff in any worse position than that in which they stood on February 2, 1905.

An Everlasting Electrical Fortune.

We are glad to give prominence to the accompanying extraordinary announcement of the Joyce Manufacturing Company, of Columbia, of which John Joyce, Macdowall, Saskatchewan, Canada, is president. The matter appears as an advertisement in the New York daily papers:

"Wanted.—Vice-president for above company; must deposit $5,000; will receive 50,000 shares fully paid up and non-assessable stock, besides wages and emoluments, and double your money back in three months. This is a good, safe opportunity of one million a year, as you have world-wide monopoly.

"This company is formed for the purpose of manufacturing patented machinery in its own factories in all parts of the world. It has several lines of patented machinery as well as a power electric engine. This is a perpetual power engine. I have a small working engine in my workshop. I mean just what I say. I have also a land and water vehicle. This will push all automobiles out of the market. The inventor has sold all these inventions to the company for one million two hundred thousand shares, which leaves eight hundred thousand to be sold to stockholders, of which one hundred thousand shares have been sold. There are still fifty thousand shares to be sold at the present price, which is one hundred dollars for one hundred shares. No more will be sold at that price. Now, if you have one hundred dollars, this is the time to grasp a competency for life and your heirs after you, for when our factories are established in all parts of the world you may depend on it dividends will net you in yearly twenty times the amount of what you paid in, namely, two thousand yearly. This is no wildcat scheme, but a bona fide world-wide monopoly that will outrival any steel trust or railway corporation. There is no watered stock, neither will there be any preferred stock, nor any such nonsense as selling and buying on margins; that the shares will rise to thirty or forty dollars a share is quite probable before these six hundred thousand shares are sold. But remember no less than one hundred shares sold on one certificate. We have no debts in this company; neither do we intend to contract any if possible. Shares will remain at 2,000,000 for all time. It will be the business of the directors, whoever they may be, when they see a good invention of meritorious points placed on the market, to buy into the company so that the monopoly will still remain in the company ad infinitum. For investigation write to the president or call at Manufacturers & Inventors' Electric Co., 82 Nassau Street, or at the head office, directed on head lines of this adv. For position of Vice-President or for shares in the company call at head office or write to ———."

A Statue to Franklin in Paris.

When the 200th anniversary of the birth of Benjamin Franklin is celebrated, on January 17, 1906, the kindly regard in which the memory of the first American Minister to France is held in Paris will be shown, says the New York *Tribune*, by the dedication of a bronze statue of Franklin, given to the city by John H. Harjes, at present the resident member in Paris of the firm of Morgan, Harjes & Co. The statue, which will be a replica of the one in front of the Philadelphia Post-Office, will be placed in the small, grass-covered plot in the Rue Franklin, near the Place du Trocadero and just in front of the Trocadero Palace, which has been given for that purpose by the Municipal Council of Paris. The pedestal will differ from the one supporting the figure at Philadelphia, which has been deemed too massive for the site to be occupied in Paris.

As early as May 23 last Mr. Harjes formulated his offer to M. J. Bouvard, administrative director of the services of architecture and promenades of the city of Paris, and, after some negotiation in June last, addressed M. Delcasse, then Minister of Foreign Affairs, asking him to use his influence toward expediting matters on account of the shortness of time before the anniversary. This letter, written the day before M. Delcasse resigned, was answered by M. Rouvier, his successor, in an exceedingly friendly spirit and conveying the necessary favorable report. As time was precious, Mr. Harjes had anticipated a favorable answer by cabling to John J. Boyle, the New York sculptor, who produced the Philadelphia statue, giving him instructions to begin work at once on the replica. Since then Mr. Harjes has received word from the sculptor that the statue will be delivered at Havre by December 15 next. It was originally intended that the gift should come from the citizens of Philadelphia, and an attempt was made to have it presented under the auspices of the University of Pennsylvania, but little progress was made, and the plan was finally abandoned.

In speaking of this, James M. Beck, who made an oration at the dedication in Philadelphia, on June 14, 1899, said a few days ago: "The delay in realizing this project has had at least one advantage, in that the statute will now be erected at a time when the entire world will commemorate the 200th anniversary of Franklin's birth; and it will fortunately come at a time when the relations between France and the United States are exceptionally cordial. The historic link that binds the two countries together has already been marked by statues of Washington and Lafayette, which have been erected in the city of Paris as the gift of American citizens; but these expressions of our good feeling would be deficient if no statue were erected in Paris of Franklin, who lived for nine years at Passy, and whose diplomatic work at Paris with the French government made the success of the Revolution a possibility."

The Action of the National Reciprocity Convention.

The following "platform" or series of resolutions was adopted by the recent national reciprocity convention at Chicago, attended by about 800 delegates and commercial or agricultural representatives.

The National Reciprocity Convention, representing more than 200 agricultural, commercial and industrial associations of the United States, by delegates assembled at Chicago August 16 and 17, 1905, hereby makes the following declaration of principles:

Whereas, The agriculture, manufactures and other industries of this country have expanded to such an extent that they can no longer depend upon the home market for the consumption of their entire product; and

Whereas, The export trade has become a vital support to many of our industries; and

Whereas, The present commercial attitude of the United States, largely owing to our failure to carry into effect the reciprocal trade provisions of Section 4 of the Dingley law, is antagonizing foreign nations, whose good will we desire and on whom we have hitherto depended as purchasers of our surplus products; therefore, be it

Resolved, First, that this convention, recognizing the principle of protection as the established policy of our country, advocates immediate reciprocal concessions by means of a dual or maximum and minimum tariff as the only practical method of relieving at this time the strained situation with which we are now confronted;

Second, that eventually the question of the schedules and items to be considered in reciprocal concessions be suggested by a permanent tariff commission, to be created by Congress and appointed by the President, which shall consist of economic, industrial and commercial experts;

Third, that it is the sense of this convention that our present tariff affords abundant opportunity for such concessions without injury to industry, trade or the wages of labor.

Fourth, that we urge action upon Congress at the earliest time possible.

Convention of League of American Municipalities.

Five hundred delegates, representing cities and towns in all sections of the country, were present on August 23 at Toledo, O., at the opening session of the ninth annual convention of the League of American Municipalities. Mayor Finch of Toledo welcomed the delegates, and the response was made by Mayor Crolius of Joliet, Ill., president of the league. The president's annual address was the feature of the first session, and dealt with the achievements of the league and its opportunities for future usefulness. The report of Secretary MacVicar shows all expenses paid and a balance in the hands of the treasurer. The receipts for the year were shown to have been $2,500.

At the afternoon session, Charles Hague of New York City addressed the convention on "Fire Department Water Supply," J. W. Wood, chief engineer of St. Louis, spoke on "St. Louis's Municipal Lighting Plant," and "Street Cleaning" was discussed by Mayor Silas Cook, of East St. Louis, Ill. In the evening Peter Witt, city clerk of Cleveland, spoke on "How to Tax Real Estate," and "The Abatement of the Smoke Nuisance" was treated by Smoke Inspector King, of Indianapolis.

Municipal ownership of public utilities was the question which aroused earnest discussion. The conflict of views among the members, made apparent by the initial discussion, was intensified by Mayor Dunne of Chicago, whose speech in defence of municipal ownership was the feature of the session. Mr. Dunne covered all the points in favor of public ownership, which he advocated in his recent campaign for mayor, and he expressed himself as being firm in the belief that the people of his city, along with citizens of other cities, should own and control these public utilities. When asked how soon he expected to secure public ownership in Chicago, he replied that he did not know, that the question had been presented by him to Council nearly two months ago, but that no action has been taken, and that he is powerless to do anything without the co-operation of Council.

Mayor Woodward of Atlanta, who led the fight against municipal ownership, replied to Mr. Dunne, holding that private ownership of utilities, properly controlled, is of greater public benefit than if owned by municipalities.

Lighting and Railway Interests Consolidated in Nevada.

The Nevada Power, Light & Water Company is the name of the new company combining the lighting, railway and water interests in Reno, Nevada. The company has $1,000,000 capital stock and $750,000 bonds, $300,000 of which are reserved for the purpose of retiring a like amount of the Nevada Power, Light & Water Company 6 per cent bonds. The 6 per cent sinking fund bonds now offered have been issued in order to acquire a controlling interest in the Washoe Power & Development Company and in the Nevada Transit Company.

There are no bonds against either of these companies and none can be issued in the future. The Reno Power, Light & Water Company owns the water works supplying the cities of Reno and Sparks (combined population 15,000), water power plant, electric light plant, gas plant, ice plant and cold storage plant, all of which supply the two cities named. In addition it owns about 5,000 acres of land in and about the city of Reno, susceptible to irrigation. This land is valued at $30 per acre, or $150,000. Of the properties to be acquired the Washoe Development Company owns a power plant located on the Truckee River, the only available power site left within a radius of 250 miles. The Nevada Transit Company operates an electric railway connecting the two cities of Reno and Sparks, which are about four miles distant. The Washoe company is acquired on a basis of $225,000, and the Nevada company on a basis of $100,000. The proceeds of the bonds will be used entirely in payment of the stock of these two companies. An estimate of the value of the Reno Power, Light & Water Company properties before acquiring the two companies named was $806,424, against which $512,000 bonds are issued. This value does not include water rights and franchises. The gross earnings of the company for the year ended March 31, 1905, were $156,597, and the operating expenses $61,653. The net earnings were $94,943. The total interest charges on $512,000 were $30,720. It is expected that the acquisition of the two companies named will increase the net earnings of the company at least $40,000 per annum, making total net earnings of about $135,000, against which the interest charge on the entire $750,000 bonds will be $45,000.

◆

Municipal Ownership in Australia.

Mr. W. J. Sowden, editor and proprietor of the Adelaide (South Australia) *Register, Journal and Observer,* who is a commissioner of his government sent here and to other countries, has made some interesting remarks recently on the effects of government and municipal ownership. Mr. Sowden is president of the national reform political organization, which is to the general government what the Citizens' Union is to the municipality of New York. "We have had a sad experience with government ownership," said Mr. Sowden, who is quartered at the Hotel Manhattan. "Nearly all of our public utilities are administered by government, with the result that politics dominate them and the public service is woefully misadministered. Not all of the tramways are in the hands of the government, but with the slovenly example of the government railroads and government tramways to copy we find ourselves in a sad way.

"To begin with, the service is controlled by the premiers of the various provinces, who represent the dominant political parties and run the railroads largely as personal political properties. The roads do not pay properly, the tariffs on passengers and goods are high compared with yours, and the employes, having life posts, are not amenable to discipline or to public sentiment. The eight-hour law is in force everywhere.

"What is true of the government roads is true of the government telephone and telegraph lines, which are not managed with the efficiency and economy of your private corporations. I notice that our government institutions require more employes than your private enterprises; there is no question that wasteful and extravagant practices obtain. We are constantly confronted with radical demands by the socialists. Our socialists differ from your socialists. They demand the nationalizing or taking over by the government of all public and semi-public enterprises. Consequently, manufacturing and other private industries are threatened, capital is timorous and the people are in a state of unrest.

"These socialists want every avenue of activity administered by the state. They are advanced labor agitators, in a measure, and they are reactionary. The result of their agitation is to send up the rate of interest on public and private loans, and it is a fact that British capital is loaned to Canadians at an average of one per cent less than to us. Because of this unrest and lack of faith in the future our people are letting their savings lie at a low rate of interest in the savings banks, instead of using them in extending business.

"The socialists, for instance, induced the government to go into the refrigerating business, and in Adelaide a sheep freezing plant for export meat was established. The government has even gone into the locomotive building business, with the result that private and corporate industry in that line has been throttled. The employes of this plant openly went so far as to suppress activity on the part of the workers, admonishing apprentices that they must do as little as possible, doing what they did as slowly and badly as they could. They even had rules and regulations limiting the amount of a workman's effort. So flagrant did the reactionary and disorganizing policy become that Judge Gordon, on the floor of Parliament, denounced the practice, with the result that a law was passed which in a measure restored the activities of the plant."

Convention of International Association of Municipal Electricians.

The tenth annual convention of the International Association of Municipal Electricians was held at the Reed House, Erie, Pa., August 23, 24 and 25. Mr. Walter M. Petty, the president, called the meeting to order at 10 a.m., and after a prayer by Rev. A. C. Ellis, Hon. R. J. Saltsman, Mayor of Erie, made an address of welcome. In this the Mayor referred to the points of interest in Erie, some of which points had historical significance. He extended the freedom of the city to the members and their friends, especially the ladies.

Responding for the association, Mr. J. B. Yeakle, of Baltimore, thanked his honor for the kindly words of welcome and also congratulated the city upon its pleasant location on the shores of Lake Erie, and its many beautiful homes.

Mr. Petty, the president, then delivered his address, the theme of which was "Suggestions as to Increasing Our Membership and Adding to Its Value." Mr. Petty suggested the division of the association into sections, each devoted to some particular branch of municipal electrical engineering. Several other schemes for making the work more valuable were advanced.

The first paper on the programme considered at the afternoon session was that by Capt. William Brophy, of Boston, Mass., which, in the absence of the author, was abstracted by Mr. Yeakle. After discussing the various details of fire alarm telegraph systems, the paper stated that 98 per cent of the failures of fire alarm systems are due to the circuits, and that the present overhead system was characterized as a relic of barbarism that should be discouraged by every fire alarm superintendent who values his reputation or has the interest of those he serves at heart. All overhead circuits should be insulated with the best known material, and this in turn covered with a protection from the elements, abrasion, etc. As to cables, these should also be of the highest quality, and the practice of installing cables in conduits also used by other classes of cables was characterized as an outrageous abuse. Some of the old underground cables have proved to be utterly unreliable. In some cases the imperfect operation of cables is not wholly due to inherent defects and to the ignorance, dishonesty, rascality and graft of those who purchase them, but also in a measure to the ignorance, carelessness and neglect of those who have had charge of them. Duplicate or triplicate operating stations are advocated, in order that the destruction of one shall not affect the operation of the whole fire alarm service. Even if in a fire-proof structure, operation is menaced by lighting and high-voltage dynamo currents. In a large city like Boston, sub-stations should be established in various localities. In New York there should be two or more operating stations placed midway between the ends of the city and the main central office. The system of interlacing circuits is only a partial remedy for open circuits or grounds for the reason that the average citizen and many of the police force would go to another nearby box on a different circuit.

The discussion which followed was participated in by Messrs. Yeakle, Murphy, Foster, Hatch, Thompson, Berry and others. There were expressed ideas showing that many believe in the bare wires for fire and police telegraph systems. Many also differed with Capt. Brophy in his opinion that more than one central office is advisable.

Following Capt. Brophy's paper was read one by Mr. C. E. Diehl, on "The Advisability or Inadvisability of Fusing Fire and Police Telegraph Boxes." Mr. Diehl's conclusions were that fuses in these boxes would prove more of a nuisance and danger than a protection. The modern box is now equipped with a cut-out device that permits its introduction into the circuit only when it is required, and if the line and instruments at central offices are protected by fuses it is not necessary or advisable to have fuses in the boxes. The concensus of opinion agreed with Mr. Diehl.

Mr. Louis Gascoigne, of Detroit, then read his paper on "Underground Construction." After discussing the several types of underground conduit, Mr. Gascoigne stated that an experience extending over eighteen years had led him to favor iron pipe, which, if properly treated, will last indefinitely. The cost for excavation is considerably lessened with such conduit, it can be laid in a narrower trench and long sections can be laid at one time. While the cost of clay conduit is only 5 cents a foot, to lay it costs 22 cents per six-duct foot; and while the cost of 2-in. iron pipe is 12 cents a foot, six 2-in. iron pipes can be laid for about 18 cents. Insulated paper cables, lead-covered, were approved, but for fire alarm and municipal telephone purposes all conductors should be in twisted pairs and of a size that may be used for either purpose. He considered that conduits should be constructed by municipalities and rented to all companies. The greater part of the paper is confined to a consideration of the subject of municipal electric lighting, three cases being considered, one that of a small village, another of a large city and the third that of the Detroit municipal plant. In the case of the village, which has a population of 1,200, estimates were secured for the cost of a plant for 26 arcs and 500 incandescent lamps, but it was concluded that it would be more advisable to enter into a contract to light the streets with acetylene gas lamps, which was done. The second case was that of a city with a population of 125,000 people, which has a plant built for 2,000 street lamps, there being no commercial service. Merely the data of this plant and the investment, operating and other costs are given. The Detroit plant is described in very full detail and the history of its management given from the beginning. The management of the plant is severely arraigned, and the conclusion arrived at that while the plant has nearly paid for itself in the past eleven years, there is a large expense in the near future, and the secret of what success it has met has been due to the fact that it has not attempted to give commercial service.

Discussing the paper, some members stated that iron pipe was subject to corrosion and no amount of treatment could remedy this. Messrs. Murphy, Bosch, Allensworth and Thompson also discussed the paper.

After an adjournment for luncheon, the paper by Mr. C. L. Williams, of Laurel, Miss., entitled "Erection and Maintenance of Electric Lighting Plants," was read by title. The paper considered the subjects under the heads of depreciation, building fuel, labor, boilers and engines. This paper was awarded the "Medal of Merit" by the association. The paper is based upon data received from central stations throughout the United States of small capacities employing only overhead circuits. An abstract of this paper will be printed in another issue.

The next paper read was that by Mr. A. L. Hatch, of Detroit, Mich., entitled "Electric Light Engineering." This was discussed by Messrs. Cambridge, of Columbia, Mont.; O'Hearn, of Cambridge, Mass., and several others. The discussion brought out the very great differences that exist in the charges for electric lighting in different places.

At the opening of the morning session of August 24, a paper by Mr. T. C. O'Hearn, of Cambridge, Mass., was read by the author. The title of the paper was "The Need of a Rigid Inspection by the Municipality." Messrs. Thompson, Hatch, Yeakle, Petty, Donohue and Foster discussed the paper, the opinions being almost unanimous that it was the function of the municipality to inspect and control all wiring.

In connection with the discussion the report of the representation to the National Conference on Standard Electrical Rules was received and discussed, and the secretary was instructed to send out notices to the members requesting their criticisms and suggestions upon the latest issue of the insurance code.

Following this discussion the paper by Mr. H. R. Allensworth, of Columbus, Ohio, entitled "The Effects of Electrostatic Influence in Telephone and Telegraph Circuits" was read. After setting forth the principles of electrostatic induction, the effect on telephone and telegraph circuits was considered and remedies suggested for counteracting troubles from electrostatic effects. The paper was discussed by Messrs. O'Hearn, Hatch and Gascoigne.

At the conclusion of the discussion the members visited the Burke Electrical Works, which were inspected under the guidance of Mr. Burke and others of the company. At 9.30 a.m., on August 23, the "Question Box" was taken up and several queries were answered and discussed.

Following this came the reports of officers and committees. The treasurer's report was received with great applause, it showing the finances to be in a very healthy condition. New Haven, Conn., was selected as the place for the next convention.

The names of the officers-elect are given below. To each member of the Executive Committee was assigned responsibility for a branch of the work of the association, as noted in parentheses. President, Jerry Murphy, Cleveland, Ohio. Vice-presidents—William Crane, Erie, Pa.; H. R. Allensworth, Columbus, Ohio; B. A. Blakey, Montgomery, Ala; F. A. Cambridge, Winnipeg, Man. Secretary, F. P. Foster, Corning, N. Y.; treasurer, C. E. Deihl, Harrisburg, Pa. Executive Committee—T. C. O'Hearn, Cambridge, Mass., chairman (Inspection); A. S. Hatch, Detroit, Mich. (Electric Lighting); J. B. Yeakle, Baltimore, Md. (Fire Alarms); Louis Gascoigne, Detroit, Mich. (Underground Construction); W. M. Petty, Rutherford, N. J. ("Question Box"); James Grant, New Haven, Conn. (Membership); W. H. Thompson, Richmond, Va. (Associate Members); W. Y. Ellet, Elmira, N. Y. (Aerial Construction). Finance Committee—W. D. Clayborne, J. F. Macdonald and H. C. Bundy.

During the sessions of the members the ladies, who were entertained by a ladies' committee, were conveyed in carriages and trolleys to various places of amusement. Each evening members and guests were treated to trolley rides, one of the places visited being Waldameer, a neighboring amusement resort. At the conclusion of the final session a "fish fry" was served at Four Mile Creek. The usual courtesies of free service were extended by the Western Union and Postal Telegraph Companies and the Bell and Mutual Telephone Companies, for both local and long-distance service.

A Thumbnail Sketch of Mr. Westinghouse.

In the September *American Illustrated Magazine* there is a biographical sketch of Mr. George Westinghouse by Robert Mayhew. It is quite interesting. We quote the subjoined passages: "At 59 George Westinghouse stands as the originator, organizer and responsible directing head of industries employing thirty thousand persons, on whom seventy-five thousand more are directly dependent, and indirectly supporting twenty-five thousand persons in addition to these. None but the German manufacturer Krupp comes to mind as equaling Westinghouse in industrial importance. Where Krupp built with destruction in view, the genius of Westinghouse ever has been directed to improving and enlarging the arts of peace. The financier whose manipulations in the field of speculation give a false value to securities of doubtful merit, who, when he has boosted prices to an attractive figure, steps from under after pocketing the profit of the faith of the public, may be of some use as a patron of the arts and gentleman sports, as the supporter of great private estates, as a generous tipster of menial servants, and in other ways in which money may be prodigally kept in circulation, but does he compare in usefulness with the great nurseryman who conceived and fostered and to-day guides and controls the parent plant and the spreading branches of the Westinghouse works?

"George Westinghouse is a great big man physically and mentally. His is a giant's body, but his mind outclasses it. He is shrewd, far-sighted, goes straight to the heart of any problem, grasps every point of a subject quickly, separates the practical from the chimerical immediately, and enters enthusiastically into anything that appeals to him as of merit. Once convinced himself, he has no difficulty in convincing others. He is bland and smooth, reasonable within human bounds, but impatient of opposition. That which he enters into he dominates, not through the mean spirit of pride of power, but from the consciousness of inherent superiority, a self-confidence justified by his own accomplishments in a long career of conspicuous success.

"There is some love of display in Mr. Westinghouse, but it is not personal vanity of a mean order. It is the bubbling of his enthusiasm and pride in the works that bear his name. They are so highly organized, so clean and well kept, that when Mr. Westinghouse entertains a real party he sets the tables in one of the shops and serves a banquet to as many as a thousand guests there. Look into his great, gray eyes; note his kindly smile; feel the warmth of his hearty grip as he shakes your hand—it's no bloodless bloodsucker you're meeting. His talk is all of achievement.

"Stock values hold little interest for him except as they have a bearing on flotations of new issues made necessary by demands for enlarging capacity. The dividends his companies pay tell the story of their success. His relations with financiers are not those of a jobber in securities; his enormous enterprises legitimately demand legitimate financing. And, though he dominates his companies to such an extent that he is the whole thing in fact, the utmost confidence is reposed in him; so much so that, though his electric company has not made a report nor held a stockholders' meeting for eight years, nobody seriously objects to this fact, which in another concern would amount to a scandal and lead to court proceedings."

Subway Development in New York Suburbs.

As a result of the success of electric traction underground, the plans already approved by the Rapid Transit Commission provide for many new subway routes in the Bronx. One of the most important of the Bronx rapid transit lines to be built will be that along 138th Street, Southern Boulevard and Westchester Avenue to the former village of Westchester. This line, which may be extended later to Pelham Bay Park, will have three tracks, and will connect with the First Avenue Subway in Manhattan. Another important subway in the Bronx will be that along Alexander Avenue from the Harlem River, where it will connect with the First Avenue Subway. This will be a four-track line, and will do much to relieve the crush on the Third Avenue elevated, as it parallels the elevated for the whole of its route.

A line which will open up a large section now depending upon surface cars for transportation will be the lately approved extension of the present Subway-Elevated on Westchester Avenue from West Farms to the Mount Vernon city line, the terminal station to be situated at 241st Street and White Plains Road. This extension will cross the Bronx River over a double-decked steel bridge at West Farms Road, and it will also cross the Bronx-Pelham Parkway over an ornamental structure. The viaduct will have two tracks as far as the Bronx River and three tracks beyond to the terminal.

The Third Avenue Subway will enter the Bronx just east of the Third Avenue Bridge. This will also be a four-track line, and will do much for the great business center of the Bronx, in which it will have its terminal loop. It will furnish a direct route to the Battery from the heart of the Bronx. The Jerome Avenue Subway and Elevated, which has long been contemplated, and is now approved, will extend from the Harlem River, at 155th Street, through a tunnel under the high ridge just north of the Harlem, to 168th Street, and thence over a viaduct up Jerome Avenue to the entrance to Woodlawn Cemetery at Woodlawn Road. This will be a three-track road for the greater part of its length, and will tap a territory now without proper transit facilities, but having a considerable population. The Gerard Avenue Subway will extend from 138th Street and Third Avenue to 169th Street and Jerome Avenue, forming a junction with the road to be built along the latter thoroughfare. This line will be entirely underground, except at its junction with the Jerome Avenue line, and will consist of two tracks, which, it is thought, will be sufficient to meet the demands of the territory it will reach. All these systems will demand in the aggregate an immense amount of electrical plant and material for equipment, and of supplies and current for operation.

CURRENT NEWS AND NOTES.

EDISON CONVENTION.—The annual convention of the Association of Edison Illuminating Companies will be held at the Hotel Champlain, Clinton County, N. Y., on September 12, 13 and 14, when a large attendance from member companies is expected. Mr. J. B. McCall, of Philadelphia, is president.

IOWA INDEPENDENT TELEPHONY.—The Iowa Telephone Association has held a meeting and decided to adopt the National-Interstate district plan of organization. District meetings will be announced by the officers of the associations at an early date, and the organizations in the various districts will be perfected in the near future.

TROLLEYS IN CHILI.—The Valparaiso Electric Tramway Company is extending its line to Vina del Mar, a suburban town seven miles distant from this city. An electric car system for Conception, with an interurban line from Conception to Coronel and Talcahuano, is being projected, and will be built within the next year, but the plans are not completed. The system will be constructed upon the American plan and financed by an American company.

ACCIDENT AT DANVILLE, ILL.—Advices from Danville, Ill., of August 28 say: "Two men were fatally hurt and three others were severely burned this afternoon by the bursting of a sixteen-inch steam pipe at the Danville electric light plant. Danville is in darkness to-night and no street cars are running." The Danville Street Railway & Light Company has an extensive system, with sub-stations, etc.

PRESIDENT AND PLUNGER.—Although it was stated officially that he would not do so, President Roosevelt shortly after 3 o'clock p.m., on August 25, went aboard the Holland type submarine boat commanded by Lieut. Charles Preston Nelson and remained under water off Oyster Bay for fifty-five minutes. He made a close study of the electrical mechanism and handled it for himself during the manœuvers.

PUBLIC LECTURES IN NEW YORK CITY.—The Department of Education of the City of New York has issued a report on the course of public lectures held during the winter of 1904-1905. The total number of lectures delivered during the season was 4,645, and, although this number was twenty lectures less than had been given in the previous season, the attendance showed an increase of about 30,000, reaching a total of 1,153,991. Forty-nine of the lectures dealt with the general subject of physics, while sixty-five treated specifically of electricity and magnetism.

TELEPHONIC LITIGATION.—Hon. O. S. Berry of Carthage, Ill., has been appointed and approved as the fifth member of the committee on Litigation and Legislation of the National Interstate Telephone Association, a vacancy being left by the officers when making up this committee in order to give Illinois representation when the state had been organized. The other members of the committee are: Dwight E. Sapp, Mt. Vernon, Ohio; Edward E. Clement, Washington, D. C.; Breckenridge Jones, St. Louis, Mo.; J. B. Ware, Grand Rapids, Mich.

TELEGRAPHERS' SOCIAL CONVENTION.—The Old-Time Telegraphers' Association and the United States Military Telegraph Corps are holding their annual conventions this week in New York City, with headquarters at the Waldorf-Astoria. It is ten years since they were here last. At the meeting on Tuesday of the Old-Timers, Mr. W. H. Young, of Washington, D. C., was elected president to succeed Mr. John C. Barclay. Mr. W. L. Ives was elected vice-president and Mr. John Brant secretary. The festivities of the week include a big banquet at the Waldorf on Thursday night.

NEW WIRELESS SYSTEM.—A special dispatch from San Francisco of August 23 says: "A new wireless instrument weighing but a pound and a half, and under exhaustive tests giving better results than the more cumbersome machines now in use, has been invented at the Benicia Barracks by Hugh Annis, a young soldier of the Signal Corps. The machine has transmitted and received messages between Mare Island and the Yerba Buena station time after time. The apparatus is being used at the barracks. Placed on the ground, the machine will signal the footsteps of a man walking a hundred or more feet away. The materials used in construction are simple. Annis is a graduate in electrical engineering of Purdue University.

PACIFIC-CANADA CABLE.—The Postmaster-General of Canada, Sir William Mulock, who left Canada shortly before the close of the last session of Dominion Parliament, has returned to Ottawa. He attended the Pacific cable conference held in London from July 20 to 28. The conference, consisting of representatives from all the governments interested in the cable project, prepared a report which states that the financial loss, on the operation of the cable, was largely due to the action of New South Wales in having granted special concessions to a rival company, the Eastern Telegraph Company, and also to similar action on the part of the State of Victoria. The Australian commonwealth, however, with the avowed object of terminating these concessions, entered into another agreement with the Telegraph Company designed to bring the concessions to an end at a fixed date. It appeared that the arrangement has failed to accomplish the purpose aimed at. The Pacific cable conference, having obtained legal advice to that effect, had, in its report, called upon the Australian government to amend the agreement, so that the objectionable concessions might absolutely terminate in 1913. Should the Telegraph Company refuse to consent to the change, however, the agreement, as respects New South Wales, will continue in perpetuity, and therefore seriously prejudice the interests of the all-British Pacific Cable.

A VISIT TO NIAGARA has been made by Prince Louis of Battenberg, who is in command of the British squadron about to cruise in American waters. Last week he visited the Falls, travelled by trolley up and down the Gorge, and inspected the power plants.

LONDON POWER ACT.—The proposed act for unifying current generation in London—the "Power Bill"—has gone over for the present session and will, it appears, have to be taken up *de novo* at the next session of Parliament. There would seem to be every likelihood of its final passage, and steps are being taken with that in view by various local authorities needing current.

THIRD-RAIL PRECAUTIONS.—The Rockaway division of the Long Island Railroad has hitherto been freely open to foot travel, but now the third rail is going down, it is being shut in by heavy wire fence out to Far Rockaway. Elsewhere, precautions are being taken to protect the road from the foolery and incaution of such members of the community as take delight in trying the effect of interposing their bodies as a short circuit.

TELEPHONY IN MISSOURI.—Twenty telephone exchange owners and managers, composing the Independent Telephone Association of the Second and Third Congressional Districts, met August 23 at Chillicothe, Mo., for the purpose of discussing toll rates and the improvement of service between the large towns in the district. A. Barnes, of Hamilton, is president of the association and presided at the meeting.

A SINGLE-PHASE ROAD FOR INDIANA.—Mr. W. H. Schott, of Chicago, president of the Terre Haute & Indiana Southern Railway, states that the construction of the company's proposed single-phase line will be begun in the near future, possibly this month. It is to be 70 miles long and will connect Terre Haute and Linton with belt lines to the coal district. The road will be standard gauge and operate twelve cars. The power station and the repair shops will be located at Shelbourne. Mr. Schott himself will act as chief engineer of the company.

INTERURBAN TRAFFIC MEN ORGANIZE.—For the betterment of the service generally and to encourage interchange of traffic among the various local interurban electric railways, the Toledo Interurban Traffic Association, composed of the general freight and traffic managers of the different roads, has been organized, with C. T. Chapman, of the Toledo & Western, with headquarters at Sylvania, as chairman; Robert Dittenhaver, of the Toledo & Indiana, with headquarters at Delta, treasurer, and J. S. Young, of the Maumee Valley & Toledo Railways & Light Company, as secretary. The organization will be made permanent.

THE DETROIT ELECTRIC TUNNEL.—Work on the railroad tunnel which is to be constructed under the Detroit River between Windsor and Detroit was begun last week, when a force of men was set to work sinking the shaft on the American side. A similar shaft will soon be sunk on the Canadian side. While there is still much preliminary surveying and testing to be done, the location of the tunnel is practically decided upon. The actual length of the underground portion of the tunnel will be two and six-tenths miles, and the distance from surface to surface about three miles. It is estimated that between two and three years will be occupied in the construction.

TROLLEY SHORT STORIES.—The Detroit United Railway announces the opening of a short story contest to the children regularly enrolled in the schools of Wayne, Oakland, Macomb, St. Clair and Genesee Counties, through which the lines of the company pass. The contest will be open a sufficient length of time, about nine weeks, to give every boy and girl a chance to become settled in the year's school work and give proper time to the composition. There are to be three prizes, the first of $25, the second $15, and the third $10. The theme of the story is to be confined to some incident, experience or anecdote descriptive of travel on the electric cars. No story must be more than 2,500 words or less than 1,500 words in length. The compostion must be absolutely original. A committee, consisting of three of Detroit's best writers, authors or newspaper men, will pass upon the manuscripts submitted. It is planned to publish the first prize winner and possibly all three winners in the daily newspapers.

CHICAGO MUNICIPAL TROLLEYS.—About 1,100 cars, costing nearly $6,000 apiece and involving a total expenditure of approximately $6,500,000, are said to comprise the equipment of the proposed Chicago Municipal Street Railway, as suggested by the report of expert Dupont, of Detroit. The report has been completed by its author and is now in the hands of Special Traction Counsel Clarence S. Darrow for submission to the Transportation Committee of the City Council, which will handle the problem. Mr. Dupont has submitted a plan for a traction system of 264 miles, which can be ready in 1908 at a cost of $25,000,000. He asserts that the net income will exceed $2,800,000 per year.

NEW SUBMARINE BOAT.—John P. Holland, the submarine inventor, has announced that he has perfected a boat that he is confident can be operated under water at a speed of twenty-five knots an hour. Mr. Holland completed plans for the boat two months ago and they were sent to Washington. They call for a boat eighty-five feet long, eight feet six inches wide and seven feet draught. The vessel will weigh 95½ tons. "I am confident I have solved the high-speed problem for the submarine boat," said Mr. Holland. "I shall have a boat of full size constructed with money supplied by private parties. It will require in the neighborhood of $125,000 at the start. The report of the government test shows that a full size boat, built according to my plan, should make thirty knots, but I will be satisfied if it makes from twenty to twenty-five."

TROLLEY UNION DEPOT AT TOLEDO.—L. E. Beilstein, general manager of the Toledo Railways & Light Company, is making plans for a union passenger station for the interurban roads entering the city. The company owns almost the entire square bounded by Beach, Huron, Superior and Jackson Streets, in the downtown section of the city. The union freight station is now located on this site, and it is intended to erect a building there of several stories and about 500 feet long, where the roads could have their offices. A proposed feature is to have the passengers take the various cars by way of a basement, descending stairs from the waiting room with passages leading to any desired track. In this way there would be no crossing of tracks. The entire rear of the building would be devoted to tracks and it would have a shed covering of glass and structural work.

A RULE FOR SUCCESS.—When Mr. L. F. Loree was president of the Baltimore & Ohio, one of the subsidiary lines of the Pennsylvania, a young man in search of a position was sent to him from the Reading Railroad, writes C. M. Keys in *The World's Work* for September. The youth was recommended by a vice-president of the Reading. Mr. Loree asked him a multitude of questions about what he could do. The applicant, who was seeking a clerical position at the head office, had been an assistant comptroller for a small electric line, had worked in the freight department of the Lehigh Valley and had helped the comptroller of the Reading to keep accounts. He knew the routine of practically every department. At the end of the interview Mr. Loree said: "Young man, you know too much and too little. The rule on the Baltimore & Ohio is, 'Know a little, but know it perfectly.' We want specialists on these lines. We do not want our transportation men figuring on the methods of gathering traffic, nor do we want our traffic men figuring on the operating details. Specialize and you will succeed on the Baltimore & Ohio."

DELICIOUS INCONSISTENCY.—The New York *Herald* is glorying in the fact that the automobile service of the Paris edition beats the telegraph service of the French government in speed, and at the same time has applauded the transfer of the private telephone system in England to the hands of the Post-Office. Let us quote: "As our readers are aware, huge bundles of *Heralds* for Trouville leave Paris every morning at 4 o'clock, and, under most unfavorable circumstances, reach their destination three hours later. The magnitude of this feat is manifest only when the performance is contrasted with the results achieved in the telegraph department. The *Herald* is indebted to the government for its characteristic, though by no means unique, opportunity to make such a comparison. The *Herald's* sporting correspondent in Trouville telegraphed his account of the Grand Prix de Deauville early Sunday evening and the despatch arrived at its destination at the *Herald* office on Monday morning, some fourteen hours later. The *Herald* is completely satisfied with its victory."

POWER FOR ORANGE GROWERS.—The farmers and orange growers in the vicinity of Pomona, Cal., are organizing a company to build an electric power plant with which to furnish power for all pumping plants in the vicinity and operate a belt trolley line, connecting all the near-by towns and ranches, including Chino, Ontario, Claremont, North Pomona, Lordsburg, San Dimas and Covina.

MAGNETIC SURVEY YACHT.—The Carnegie Institute of Washington, D. C., has asked the Department of Commerce and Labor to reclassify the yacht Galilee, so that it will not be compelled to enter and clear at customs ports, while engaged in making a magnetic survey of the North Pacific Ocean. The yacht has been chartered at San Francisco by the department of terrestrial magnetism of the institution. Four scientists have been engaged to make the survey, for which $25,000 has been appropriated, and the work will probably cover a period of three years. The yacht is now registered as a merchantman, which would require that it clear at all domestic and foreign ports entered. To escape this provision, the yacht would have to be registered as a pleasure craft. Under either classification the Department of Commerce and Labor would have to stretch a point, technically, and an effort will be made to give the Carnegie Institution the relief sought.

LECTURES AT THE NEW YORK TRADE SCHOOL.—Following the usual custom a series of evening lectures on steam and electrical engineering will be given during the coming fall and winter at the New York Trade School, First Avenue, Sixty-seventh and Sixty-eighth Streets. These lectures are intended for practical workers—stationary engineers, firemen, electrical workers and machinists. They present an attempt to fulfill a long-felt want for practical information and explanation of phenomena and experience of daily occurrence. The lectures take more of the nature of a conversation between the lecturer and his hearers, and questions are freely asked and explanations given accompanied by illustrations, and, where possible, by experiments. The main object of this course is to present in a simple and easy way to men of practical experience the reasons for the laws upon which their trade is based, and explanations of the phenomena that have led to the formulation of these laws. It is believed that in this way only can a man learn to do effective work, as a workman knowing only the rule of thumb is indeed laboring under a disadvantage, and unless trained to study he can hardly hope to obtain the necessary information from textbooks. The cost of attending each of the courses on steam and electricity is one dollar. Information as to dates and arrangements can be had on application to H. V. Brill, superintendent, New York Trade School, Sixty-seventh Street and First Avenue, New York City.

POPULAR SCIENCE.—Our sprightly contemporary, *The Electrical Times* (London), in a recent issue has some fun apropos of an article on lightning, written for popular consumption. The journal in which the article appears had, it says, "*Ideas* on the outside. On the inside, however, there were other things, particularly an article on 'When the Thunder Rolls.' It is written in journalese by a man —or lady—who is as ignorant about thunder as about English composition. I learn that 'to the generality of people storms of this nature burst upon them unanticipated, and if encountered in the streets of a town or the open country the only misfortune apprehended is a wetting . . . Lightning is only electricity highly concentrated . . . There are agents which attract it, and others which repel or cut off its contact . . . Among repellants are glass, silk, wool and feathers, when dry.' As a 'perusal of the glass and thermometer will always give the scientific student a timely foreknowledge of coming events,' no doubt the writer of the article, when he anticipates the encountering of a thunderstorm, will dress himself in such agents as dry feathers. I suggest he add tar, as being also a good repellant agent. If the writer is a lady, I withdraw the suggestion, and leave her costume to her own scientific judgment." Directions in absurd detail are given as to further protection from lightning and, continues our contemporary, "there is a cut of a sort of *Family Herald* young man and his wife sitting on chairs on a mattress in the center of a room, with the fire-irons under the hearthrug."

Electrical Engineers of the Times.—XXV.

HENRY FLOY.

Henry Floy was born in Elizabeth, N. J., September 19, 1866. He is a son of James Floy, and a grandson of the Rev. Dr. James Floy, a noted Abolitionist. He graduated from Wesleyan University in 1889, after which he entered Cornell University, and in the space of two years completed the regular four-year course in electrical engineering. While at these universities he took an active interest in athletics, and was a member of the football teams of both institutions. In 1892 Wesleyan University conferred upon him the degree of Master of Arts.

Shortly after leaving Cornell Mr. Floy entered the engineering department of the Westinghouse Electric & Manufacturing Company, at Pittsburg, where he remained until 1896. For the same interests he spent the following two years in Chicago as engineer of that office, after which he took charge of the company's office in Minneapolis, representing it in all States throughout the Northwest as far as Montana. While in this position he had unusual opportunities to study long-distance electrical transmission and water power developments.

Having had seven years of varied experience in engineering work, Mr. Floy felt that he was now equipped to establish himself as a general consulting engineer, and in 1899, in conjunction with Prof. R. C. Carpenter, of Cornell University, he opened an office in the St. Paul Building, New York City, where he has been located ever since. The firm of Floy & Carpenter continued for three years. During this time many important engineering projects were undertaken by them. Subsequently Prof. Carpenter was compelled to relinquish his duties because of ill health and pressure of college work.

HENRY FLOY.

By the installation of a 25,000-volt underground transmission system in St. Paul, Minn., Mr. Floy gained a wide reputation. This was among the first, if not the very first, really high-tension underground transmission in the world. A complete account of this work was given by Mr. Floy in a paper which he presented before the American Institute of Electrical Engineers, November 23, 1900.

Among the projects engineered by Mr. Floy are the plants of the St. Louis Smelting & Refining Company in Missouri and Illinois; several installations for Mr. Flagler's hotels in the South, notably the Ormond Hotel, Ormond, Fla., and at Nassau, Bahama Islands; the Consolidated Electric Company, near Albany, N. Y.; the St. Croix Power Company, Wisconsin, and others. He has also been retained for important engineering work by the Newport News Ship Building & Dry Dock Company and the Standard Oil Company. Of recent years Mr. Floy has devoted considerable attention to modernizing shops and factories. The excellent results of his work in this direction in a number of large factories are well known, particularly in the several works of the National Lead Company. He is at present retained by the latter concern as consulting engineer for all of its plants throughout the United States.

Mr. Floy was a member of the Electrical Jury of the International Committee of Awards, at the World's Fair, St. Louis, 1904. He has also been a frequent contributor to technical journals, and is a member of the American Institute of Electrical Engineers, the Engineers' Club, the Phi Beta Kappa Society, the Cornell University Club, of New York, the Wesleyan University Alumni Association, and the Psi Upsilon Club.

Waterside Station No. 2 of the New York Edison Company.—I

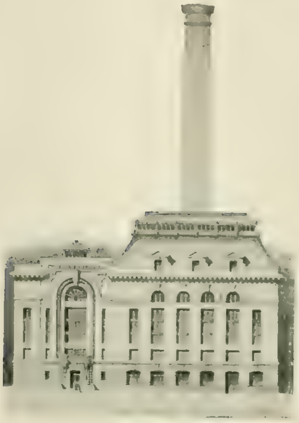


Fig. 1.—End View of Station.

An excellent illustration of the progress in electrical service for lighting and power is presented in the growth of the business of the New York Edison Company of New York City, which recently has necessitated the installation of a second mammoth generating plant to supplement its famous "Waterside" station. At the time of completion, late in 1901, of the original Waterside station, with the initial generating capacity of over 32,000 kw, it was thought that it would be able to provide, particularly when completed to its contemplated total capacity of over 64,000 kw, an ample supply of power for many years to come. But scarcely three years later it became evident that the original Waterside, although completed to nearly its maximum capacity, would within another year be entirely inadequate for the increasing demand. The outcome has been the design of the second large generating plant, known as "Waterside Station No. 2," to which this article is devoted.

The new plant, while following in general the lines of design of the older station, is remarkable further as an example of the evolution in power plant practice resulting from the perfection within a few years past of the steam turbine as a prime-mover. The New York Edison Company was the very first in this country to use steam turbines in its generating equipment, having installed and operated in its stations two 300-hp De Laval steam turbines as early as 1896. When the first Waterside station was being designed, the steam turbine had scarcely been considered in units of large capacity, but in this country at least, in connection with electrical generation, its development has been so rapid and successful that before all the generating equipment had been placed in the original station the advantages which it offered had become sufficiently apparent to warrant the installation of turbines instead of the last few engine-driven generating units as orginally intended, and instead of five engine units there were installed four 5,000-kw Curtis turbine generating units.

The new station involves, in addition to the use of turbines, other interesting departures from usual practice, in both design of buildings, and selection and arrangement of apparatus.

The history of the New York Edison Company begins with the historic Pearl Street station, superseded later by the more modern Duane Street plant, one of the very first where vertical marine engines were adapted for direct connection to multipolar, slow-speed dynamos. The system of the company grew until finally six generating stations of considerable size were in operation, in different sections of lower New York. In 1896 an annex station was located corner 72d St. and 5th Ave., one with an equipment of a 240-kw two-phase motor, driving two 100-kw, direct-current generators, the motor receiving two-phase high-tension current from the East 80th St. station; this was the beginning of high-tension transmission in connection with the company's development. Later, owing to the differences in time of the peak loads upon the various stations and the consequent desirability of interconnecting them in order to help each other out, several stations were equipped with converters, transformers, etc., for high-voltage transmission between stations; from this development the sub-station method of distribution, now in universal use for distribution over extended areas, followed logically. Sub-stations were then installed rapidly and, owing to the wide extensions of the low-tension street service thus made possible, the business of the company correspondingly increased. In fact, the Waterside generating plant has operated with an overload ever since its completion, and it has been almost impossible for the company to install new generating equipment rapidly enough to provide for the growth of the load. The result has been the design of a second Waterside station which will have an ultimate capacity of over 30 per cent greater than that of the original plant. Even with this and many other improvements now under way, the policy of the company points very strongly to the fact that it realizes that the growth of the service is as yet only in an early stage, and that the possibility of development through rendering a reliable, low-price and satisfactory service is almost beyond estimation.

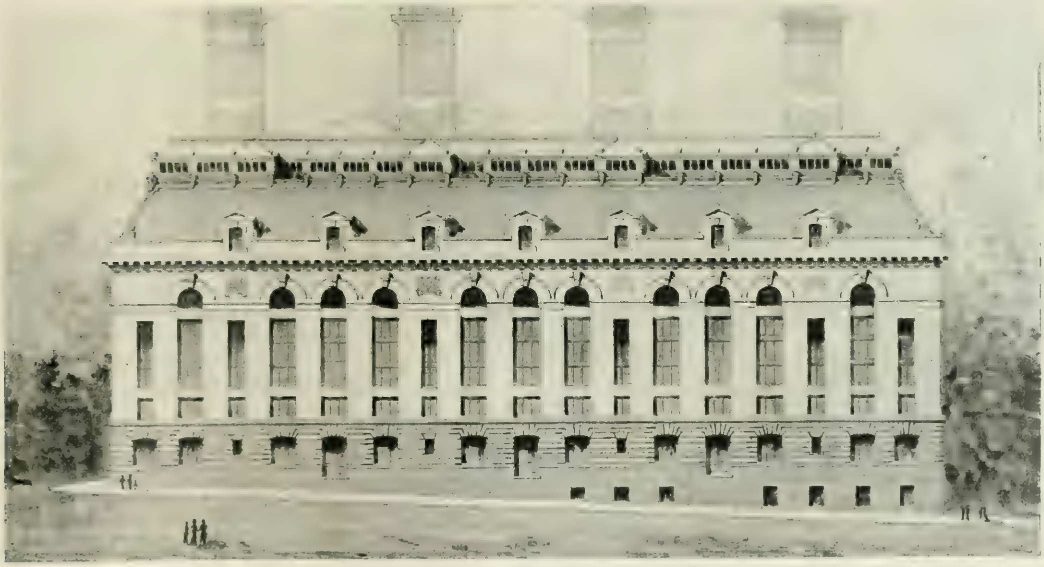


Fig. 2.—Waterside Station No. 2 of the New York Edison Company.

The actual growth of the company's distribution service will be evident from the large amount of additional sub-station equipment which it has been found necessary to install within the past two years, this amounting to over 45,000 kw in capacity of converters and the necessary auxiliary equipment. In this time, there have been installed three new sub-stations, located as follows: Clinton St., near Grand St. (2,000 kw), for supplying the lower East Side; West

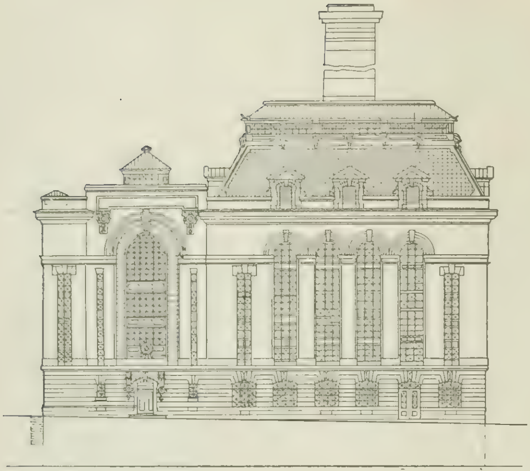


FIG. 3.—FRONT ELEVATION.

27th St., near 10th Ave. (2,000-kw), for assisting the 26th St. station in supplying the theatre and shopping district; and West 107th St., near Broadway (2,000 kw), for assisting in the residential district. There are now in all 19 independent sub-stations connected to and operated from the Waterside plant, embracing a total converter equipment of nearly 80,000 kw capacity, for the local street distribution service, not including a number of private sub-station equipments for the operation of certain industries. All but one of the sub-stations are provided with storage battery equipments which float on the direct-current distribution system, partly to assist the main generating station in carrying over the peak load, but principally to insure the service against even the slightest interruptions of current supply. Moreover, four of the former generating plants, now operated as sub-stations, still retain their steam generating equipments in reserve for further insurance against interruptions of service due to accident to any part of the high-tension transmission system; these stations, which are the Gold Street, the Duane Street, the Twelfth Street and the Twenty-sixth Street plants, are, however, operated regularly only during the period of heavy loads in the winter season.

One of the important questions connected with the design of the new Waterside station was the location. While the original Waterside had been located considerably to the north of the actual center of consumption of current from sub-stations at the time of its installation, still the trend of the growth of the service has shown with increasing force the wisdom of this selection. The tendency of the growth and development in the City of New York has been constantly toward the uptown districts during the past few years, and in all probability the locations of future sub-stations will lie to the north of Thirty-ninth Street. Accordingly there was nothing to be gained in the selection of a site far removed from the present Waterside station, while a location adjacent or alongside would realize the many advantages from interconnection both on the electrical and steam ends for the most favorable utilization of apparatus. While Waterside No. 1 and Waterside No. 2 will be provided with tie connections, both in the electrical and steam equipment, independent feeders from each will supply the several annex stations over different subway routes, thus providing the advantage of two independent sources of current supply with the economies of joint operation. These, and the consideration of advantage of unified supervision in one location, led to the selection of a site immediately adjoining the original Waterside, where the two stations, although limited from actual interconnection of buildings by an intervening street, are nevertheless near enough together to permit of a most advantageous arrangement of interconnection of the steam and of the electrical systems.

For the new station the entire city block immediately to the north of that occupied by the original plant was secured, thus providing for the new plant facilities for receiving its coal supply by water shipment and a permanent supply of condensing water, equal to those enjoyed by the other. The block occupied is bounded on the west by First Ave., on the sides by 39th and 40th Sts., and to the east by the East River. The new plant will occupy the entire length of the block, 338 ft., whereas the original station occupies only 272 ft. 6 in. of its plot. The space of 125 ft. adjacent to the river's edge will not be built upon, as it may eventually be reclaimed by the city for use as a river front street; but upon it will be located the coal and ash handling tower and equipment. This location provided excellent foundation facilities for the accommodation of heavy machinery, solid rock of the mica schist variety having been found to underlie the entire area. The loose earth above was removed entirely and the rock leveled off or excavated to receive the grillages for the column footings. At the river end of the block the rock lay much farther beneath the surface, so that while at the First Ave. end the rock had to be excavated to receive the column footings, toward the river, piers from 10 ft. to 30 ft. high were necessary to reach to their level. For the circulation water inlet and discharge tunnels, a trench approximately 35 ft. wide by 30 ft. deep had to be excavated.

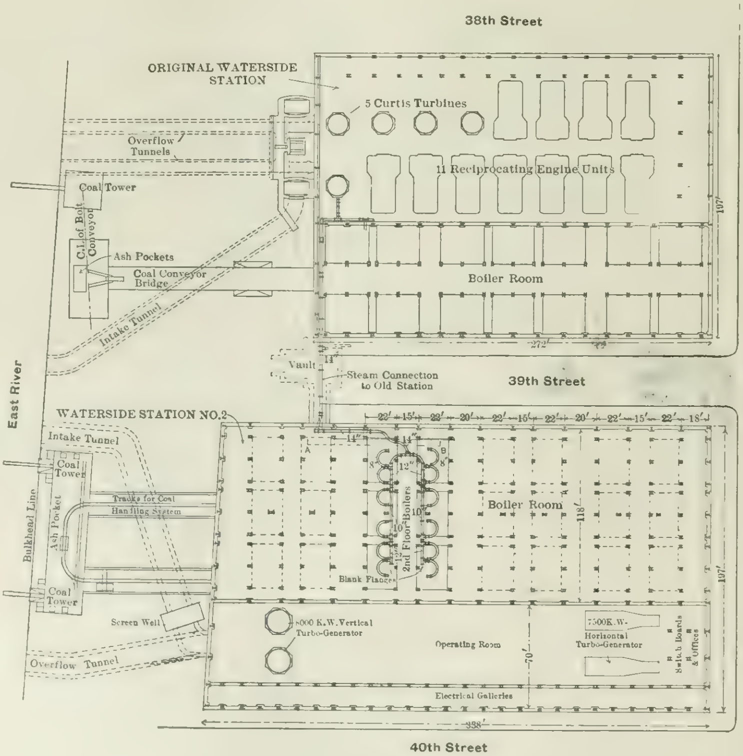


FIG. 4.—PLAN OF THE TWO POWER HOUSES.

The boiler room section consists of a 20 ft. basement, one 36-ft. and one 34-ft. story for the boilers and above this a space of 50 ft. up to the general roof level, which is devoted to the coal storage bunkers; the coal-handling system will be accommodated in the roof monitors. The turbine section involves a 25 ft. basement for condenser apparatus and a main turbine room with a clear height under roof trusses of 88 ft. The group of side galleries at the 40th St. side of this room consists of six mezzanine galleries above the main floor for the electrical switching equipment, and a basement gallery for a sub-station and reserve exciter storage-battery equipment. As in the original Waterside station, a system of galleries will be provided at the First Avenue end of the turbine room for the accommodation of the main station switchboard and control board apparatus from which the entire electrical equipment of the station will be supervised and controlled.

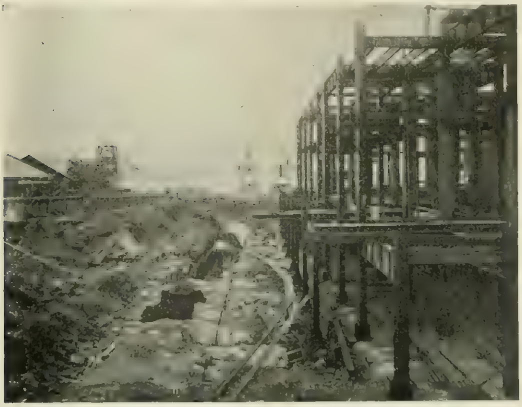


FIG. 5.—STEEL WORK OF BUILDING.

The architectural treatment of the exterior while similar to that of the original station is somewhat more ornamental and pleasing. A base of granite extends nearly to the height of the second story, above which rise brick walls of a soft brown color surmounted by a terra cotta cornice. All the wall and dormer window trimmings are of terra cotta, while the roof monitors are of copper finish. The roof of the boiler house is covered with Spanish roll tile on the mansard portion, while all flat sections of the turbine and boiler room roofs are of slag concrete construction covered by flat tiles. A feature of the exterior is the window treatment, all windows being surmounted by a terra cotta architrave which rises from an entablature of terra cotta surrounding the structure. The window in the First Ave. end of the turbine room received special treatment with a very pleasing effect, and is surmounted by the name of the company, also in terra cotta.

The power house building is of steel frame and brick and concrete construction, forming an absolutely fireproof structure throughout. The sectional view of Fig. 7, page 386, shows the principal details of the steel work and coal bunker structure. The boiler-room and turbine-room floors are of very heavy construction, designed for uniform loadings up to 600 lbs. per sq. ft.; the floors are all of concrete upon the Roebling system. In addition the structure carries, on the boiler room side, five large anthracite coal bins to hold a total of 20,000 tons, when all are filled. The coal bins are of reinforced concrete construction with vertical stiffeners of I-beams embedded at intervals. The roof structure above the turbine room is carried by trusses of 57½ ft. span, surmounted by a 20-ft. monitor for lighting and ventilation. The boiler-room roof, monitors and coal-handling apparatus are carried by a series of 72-in. plate girders and 15-ft. Pratt trusses, all of 90-ft. span. The turbine room is traversed by a 50-ton Shaw traveling crane of 52½-ft. span between runway rails.

The station has been laid out to accommodate ultimately ten steam turbine generating units of 7,500 or 8,000-kw capacity each, giving thus a total station capacity of over 100,000 hp, or, with 50 per cent overload rating, of over 150,000 hp. At first, however, only four turbines will be installed, two of these to be of the Westinghouse-Parsons type and the other two of the General Electric Curtis type.

The new 7,500-kw Westinghouse turbine units will differ little from their well known 5,000-kw machines, the same general type and form of unit being preserved in the new design. As to the bulk of the new Westinghouse unit, it will be 50 ft. long, 17 ft. wide and 15 ft. high, occupying thus a total floor space of 850 sq. ft., or 0.113 sq. ft. per kilowatt capacity. It will thus be only about four feet longer than the 5,000-kw turbine unit, while the width will remain practically the same. These turbines will operate at 175 lbs. pressure and 100 degrees of superheat, and the speed will be normally 750 r.p.m. Under the above conditions and a vacuum of 28 in., the steam consumption at full load will be approximately 16 lb. per kw-hour. An important feature of the new design is that its best economy will be secured around full load, although heavy overloads may be carried at any and all times without material sacrifice of efficiency. The design also permits of the turbine developing its full-rated load while being operated without the assistance of the condensers to reduce the back pressure.

The turbo-generators connected to the Parsons type turbines will embody a new enclosed construction which will be effective in entirely eliminating the hum peculiar to high speed turbine generators. They are of the 4-pole type and are wound so as to deliver either 6,600 or 11,000 volts. As connected they will deliver three-phase current at a voltage of 6,600 and frequency of 25 cycles per second. The stationary armatures will consist of a cast-iron frame with laminated core and coils set in partially closed slots; the field cores will be built up of steel castings, with slots milled in the poles to receive the windings, the coils being formed by straps wound flat in the slots and the slots closed by brass wedges. Their efficiency will approximate 97.5 per cent at full rated load, and they will be able to sustain 50 per cent overloads for three hours without dangerous rise of temperature of windings.

The two Curtis turbo-generators to be supplied by the General Electric Company will have normal ratings of 8,000 kw with 50 per cent overload capacity for 2 hours. Except for the increase in size, these turbines will closely resemble the 5,000-kw Curtis turbines now in operation in the original Waterside station. Their diameter at the base will be slightly over 15 ft., while the height over governor dome will be 32 ft. Their total weight will be approximately 700,000 lbs. each. In accordance with the latest practice of this company, the water type of step-bearing will be used for supporting the weight of the vertical shaft. The turbines are designed to operate under a steam pressure of 175 lbs., with 100 degrees of superheat.

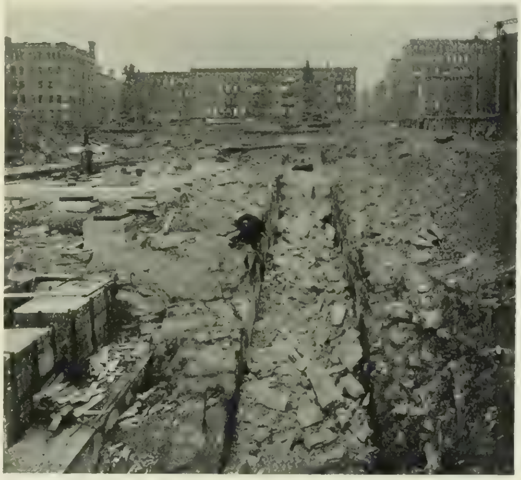


FIG. 6.—EXCAVATION FOR CONDENSING TUNNEL.

The generators of the Curtis units have a rating which will permit them to carry a load of 9,000-kw for 24 hours, or an overload of 50 per cent (12,000-kw or 16,000-hp) for two hours. The generators are of the four-pole type, and operating at the normal speed of 750 r.p.m., will deliver three-phase current of a potential of 6,600 volts and frequency of 25 cycles per second. One of the notable features of this new design is the increase of speed, the older 5,000-kw units having been designed to operate at a speed of about 500 r.p.m.

The boiler and coal-handling plant, the exciter, electrical control and storage-battery equipment will be considered in a concluding article.

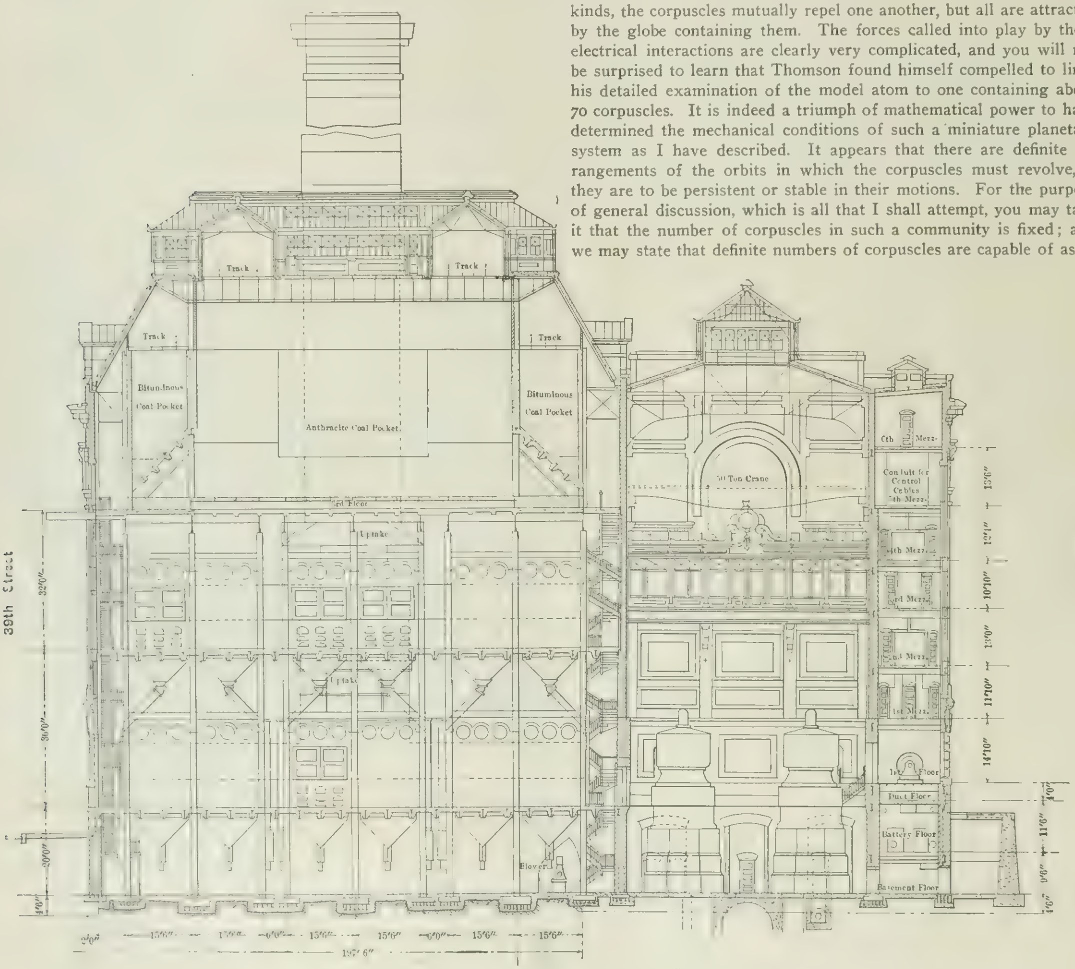


FIG. 7.—SECTIONAL ELEVATION OF WATERSIDE STATION NO. 2.

Prof. Darwin on the Atom.

In his recent presidential address before the British Association in South Africa, Prof. G. H. Darwin said, in effect: "Within the last few years the electrical researches of Lenard, Röntgen, Becquerel, the Curies, of my colleagues Larmor and Thomson, and of a host of others, have shown that the atom is not indivisible, and a flood of light has been thrown thereby on the ultimate constitution of matter.

"It has been shown, then, that the atom, previously supposed to be indivisible, really consists of a large number of component parts. By various convergent lines of experiment it has been proved that the simplest of all atoms—namely, that of hydrogen—consists of about 800 separate parts, while the number of parts in the atom of the denser metals must be counted by tens of thousands. These separate parts of the atom have been called corpuscles or electrons, and may be described as particles of negative electricity. It is paradoxical, yet true, that the physicist knows more about these ultra-atomic corpuscles and can more easily count them than is the case with the atoms of which they form the parts. The corpuscles, being negatively electrified, repel one another just as the hairs on a person's head mutually repel one another when combed with a vulcanite comb. The mechanism is as yet obscure whereby the mutual repulsion of the negative corpuscles is restrained from breaking up the atom, but a positive electrical charge or something equivalent thereto, must exist in the atom, so as to prevent disruption. The existence in the atom of this community of negative corpuscles is certain, and we know further that they are moving with speeds which may in some cases be comparable to the velocity of light—namely, 200,000 miles a second. But the mechanism whereby they are held together in a group is hypothetical. It is only just a year ago that Thomson suggested, as representing the atom, a mechanical or electrical model whose properties could be accurately examined by mathematical methods.

"Thomson's atom consists of a globe charged with positive electricity, inside which there are some thousand or thousands of corpuscles of negative electricity, revolving in regular orbits with great velocities. Since two electrical charges repel one another if they are of the same kind, and attract one another if they are of opposite kinds, the corpuscles mutually repel one another, but all are attracted by the globe containing them. The forces called into play by these electrical interactions are clearly very complicated, and you will not be surprised to learn that Thomson found himself compelled to limit his detailed examination of the model atom to one containing about 70 corpuscles. It is indeed a triumph of mathematical power to have determined the mechanical conditions of such a miniature planetary system as I have described. It appears that there are definite arrangements of the orbits in which the corpuscles must revolve, if they are to be persistent or stable in their motions. For the purpose of general discussion, which is all that I shall attempt, you may take it that the number of corpuscles in such a community is fixed; and we may state that definite numbers of corpuscles are capable of association in stable communities of definite types. An infinite number of communities are possible, possessing greater or lesser degrees of stability. Thus the corpuscles in one such community might make thousands of revolutions in their orbits before instability declared itself; such an atom might perhaps last for a long time as estimated in millionths of seconds, but it must finally break up, and the corpuscles must disperse or rearrange themselves after the ejection of some of their number. We are thus led to conjecture that the several chemical elements represent those different kinds of communities of corpuscles which have proved by their stability to be successful in the struggle for life."

Hydro-Electric Developments of the Ontario Power Company.—II.

THE PIPE LINE.

THE intake works and forebay, which were described in the preceding section of this article, were designed to intersect water for a generating station having a capacity of not less than 180,000 hp, but it has since been decided, owing to the ample supply of water, to develop 200,000 hp with an installation of 22 units of 10,000 hp each, thus allowing two spare units. It was decided to use three pipe lines to convey the required quantity of water for this development from the gate house to the cliff above the generating station. The first of these pipes, a view of which is given in Fig. 8, is now in position. It has an internal diameter of 18 ft. and is 6,160 ft. long from the head gate to the center of the first penstock with which it connects. The other two conduits will be approximately 20 ft. in diameter, and will probably be built of reinforced concrete. In this first pipe will flow the water for the wheels connected to 60,000 hp of main generators and their exciters, also a reserve unit of 10,000 hp.

The three conduits to be employed in this installation are of especial interest as they are the largest ever used for a like purpose. After leaving the gate house the course of the pipe lines passes under the stream that flows into the river after its circuit of Dufferin Islands, and then through Queen Victoria Park to a point opposite Goat Island, terminating in a distributor and a spillway. Here penstock shafts and tunnels run through the cliff to the power station in the gorge below. In the headblock the 18-ft. pipe has a center elevation of 534 ft., and where this pipe joins its first penstock in the cliff its center elevation is 506 ft. The fall of this pipe in its course is thus 28 ft., and its center elevation at the first penstock is 47 ft. below the minimum elevation of water in the forebay. In its course through the park the pipe is made up of long tangent sections connected by a few easy curves, and the profile of the line is such that the pipe is almost wholly beneath the natural surface of the ground throughout its entire length. At points where some portion of the pipe line rises above the natural surface of the park earth is terraced over it, and through the whole distance the natural appearances are carefully preserved.

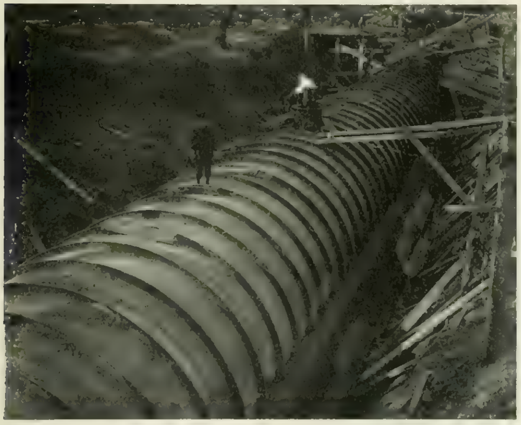


FIG. 8.—NO. 1 CONDUIT, SHOWING BULB TEES.

Structurally the pipe is made up of steel plates ½ in. in thickness, 8.5 ft. wide and 19 ft. long, which are connected at lap joints by double rows of ⅞-in. rivets. At intervals of 4 ft. along the outside of the pipe it is strengthened by 7-in. bulb tees of steel that were bent to its circumference and secured to the plates by rivets. (See Fig. 8). These bulb tees extend over the top half of the pipe and to a distance of 2 ft. below the center line on each side. Both the steel plates and the bulb tees for the pipe were bent to the required radius and punched for the rivets in a machine plant built for the purpose near the line. Before riveting the steel plates of the pipe together, they were drawn into position by temporary bolts that were passed through the rivet holes and subsequently removed. The pipe trench was excavated largely through rock, and when the pipe was first laid it rested on saddles of 12-in. square timbers spaced a few feet apart across the bottom of this trench. After the steel pipe was completed it was encased in gravel concrete having a thickness of 12 in. on top, 3 ft. on the sides and 12 in. on the bottom; that is, having a square section at the base. In order to prevent any possible damage to the pipe from electrolysis from the electric railway lines in the vicinity, it is connected by bonded terminals spaced 8 ft. apart over its length to a large conductor running lengthwise of the pipe in the ground above it, as shown in Fig. 9. The interior of the pipe was cleaned by sand blasting and then covered with several coats of paint. All imperfect joints were carefully caulked. A striking reminder of the size of this pipe may be noted in the fact that its diameter exceeds the combined heights of three ordinary men.

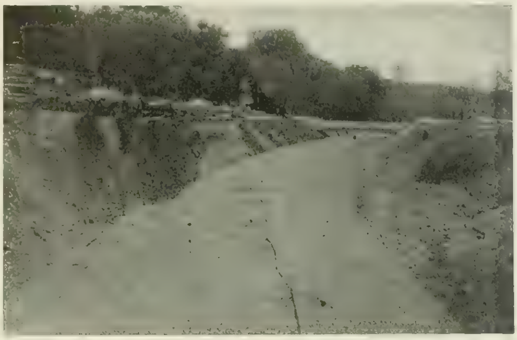


FIG. 9.—VIEW SHOWING CONCRETE COVERING AROUND CONDUIT, AND WIRE FOR PREVENTING ELECTROLYSIS.

On the cliff near Table Rock, above the power house, the 18-ft. conduit terminates in a distributor section. The trench for this section was excavated in solid rock, and through the limestone cliff beneath it four vertical shafts and horizontal tunnels for the penstocks were carried down to the power station in the gorge below. This distributor section is 260 ft. long, built up of steel plates ⅝ in. thick, stiffened with bulb tees and encased in concrete. It terminates in an overflow device and spill tunnel.

The distributor section delivers water for six generating units and a reserve and also provides water for two exciter units. The required amount of water for full-load conditions is about 3,800 cu. ft. per second, and the velocity in the 18-ft. main when delivering water at this rate is about 15 ft. per second. With this velocity the estimated loss of head in the 6,400 ft. of pipe is approximately 25 ft.

Six of the main penstocks leave the distributor section in pairs and descend vertically through the valve chambers and on to the bottom of the shafts at elevation 350, a drop of 156 ft. beneath the distributor. These penstocks are 9 ft. in diameter. A seventh penstock used for operation on either distributor No. 1 or No. 2 descends from the end of distributor No. 1 and crosses over diagonally and joins with the first penstock of the second distributor section,

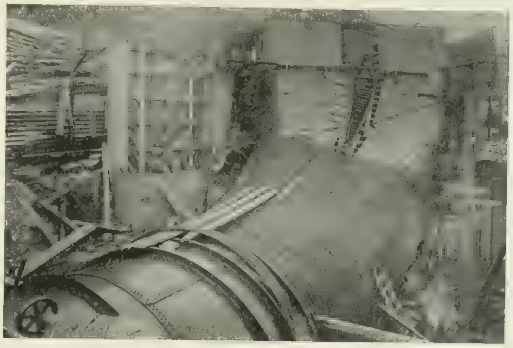


FIG. 10.—CONSTRUCTION VIEW OF APPROACH TO OVERFLOW.

which section has not as yet been constructed. Two exciter penstocks are taken off from the distributor at a point near the second pair of penstocks and descend vertically to a penstock and cable tunnel which enters the power house at an angle of about 30° from the horizontal.

The valve chamber is 16 ft. wide and 10 ft. high, extending the full length of the distributor section, the excavation for the conduit having been carried downward to provide this space for the penstock valves and the motors which operate them. Above this chamber the distributor section is supported by a continuous concrete arch. The shafts for the penstocks are 13 by 24.5 ft. in horizontal section, and are met at the bottom by tunnels of similar dimensions which lead into the generating station. The pairs of 9-ft. penstocks in these shafts and tunnels, with their centers 11.5 ft. apart are supported by concrete thrust blocks at the bottoms of the shafts, are centrally supported in the connecting tunnels, and again pass through concrete thrust blocks in entering the station. An expansion joint is inserted in the vertical leg of each penstock just below the valve chamber and in the horizontal leg a short distance from the thrust saddle at the elbow. These joints provide for any expansion or contraction of the penstock due to temperature change. From the center elevation of 357 ft. in the penstock tunnels the supply rises to the water wheels on the station floor above, of which the center elevation is 373 ft., or 133 ft. below the center of the main pipe line on the cliff above.

The inclined tunnel through which the exciter penstocks reach the generating station begins at a manhole about 57 ft. back on the bluff from the center of the 18-ft. main conduit and passes under it on the way down to the power house. There are contained therein not only the two 30-in. exciter penstocks, but also the cables for the main generators, and the control wires from the generating to the distributing station. Just before entering the power house the two 30-in. penstocks turn to a horizontal position and enter wheels with centers at elevation 380.8 ft. or about 125 ft. below the center of the distributor section.

A concrete tunnel at the end of the distributor turns upward to an open spill with adjustable crest over which the water passes to a spill tunnel. This spillway is so designed that a practically constant velocity will be maintained through the main conduit and abrupt changes in load will not result in a water hammer or any serious strain on the steel distributor section, but will affect only the height of discharge over the weir. The crest is built up of a series of stop logs and can be so adjusted that the flow in the main will be adapted to the requirements of any given number of units that may be installed at any time. A concrete structure finished with a rustic boulder facing will enclose the weir, and in external finish will present an appearance somewhat similar to that of the refectory building erected in the park a short distance below.

The discharge from the weir takes place through a helical tunnel, of steep initial pitch, which changes gradually in form from rectangular to circular as it leaves the weir crest. (See Fig. 10.) The helix makes approximately a three-quarter turn and preserves a smooth unbroken water column as it passes on through a 10-ft. pipe to the river. This discharge tunnel is designed to prevent erosion, restricted flow and excessive air suction on account of the danger in winter of the formation of ice from spray under forced circulation of air. The space between the pipe and the rock sides of the tunnel is completely filled with concrete.

THE POWER STATION.

A narrow ledge made by excavation of talus and limestone rock between the base of the 150-ft. cliff at Table Rock and the boiling Niagara Flood, a little below the foot of the Horseshoe Falls, is the site of the station that is ultimately to develop 200,000 electrical hp. The building itself, a cross-section of which is shown in Fig. 11, is an artistic concrete structure, low and massive, with flat roof, which appears as a jutting shelf from the cliff behind.

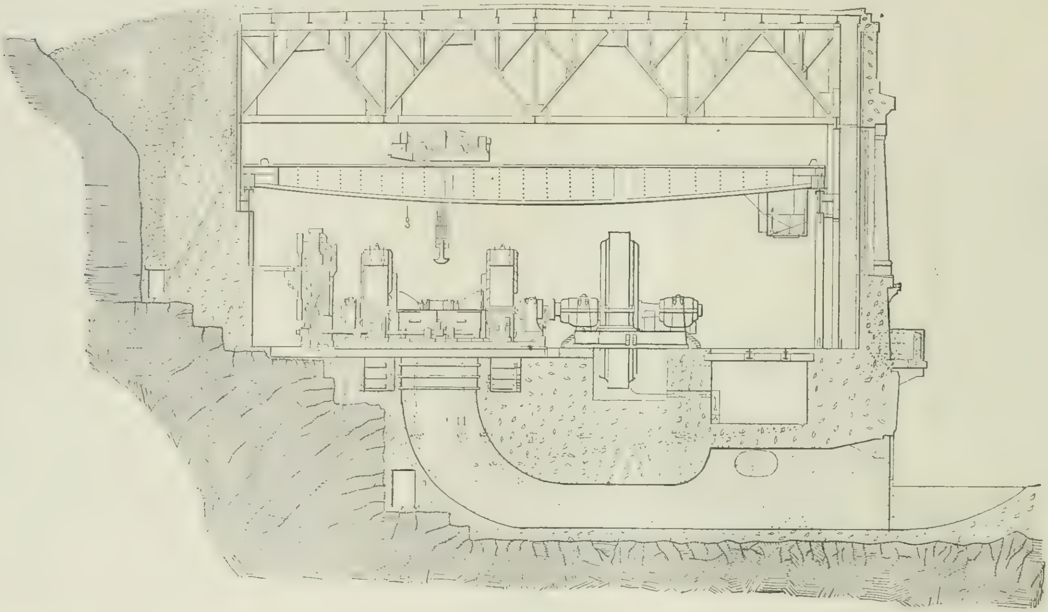


FIG. 11.—SECTIONAL VIEW OF POWER HOUSE.

The completed station will have an ultimate length of about 1,000 ft. and its width inside varies from 80 to 95 ft. The general plan of the station includes main generators, each connected directly to a pair of horizontal turbine water wheels so that the common shaft of the wheels and generators lies at right angles to the face of the cliff and river bank. On a gallery along the rear or cliff side of the station are located the exciting dynamos and their wheels, oil circuit-breakers for the main generator leads, a switchboard for the exciter and field circuits and a terminal board for the control wires. A service board for light and power distribution in the station and control of penstock valve motors is also placed on this gallery.

Each 9-ft. penstock runs to one pair of the horizontal turbine wheels which in turn drive a single electric generator. Upon entering the generating station the penstock divides into two parts, which go respectively to the wheels that form the pair. (See Fig. 12.) Each pair of these main wheels operates at 187.5 r.p.m., is rated at 11,390 hp, and when working at this rate requires about 636 cu. ft. of water per second under an effective head of 175 ft. As the elevation of low water in the forebay is 553 ft. and the centers of the main wheels in the power house are at elevation 373 ft., the total pressure head down to this point is 180 ft. Draft tubes from the turbines pass down below the tail water level, which, at times of full load, rises to elevation 353. Between forebay and tail water the minimum difference of level is thus 200 ft., and a friction loss of head in the main line and at other points leaves an effective head of 175 ft. for the main turbines at full load.

The separate steel draft tubes from the turbines of each pair unite at about the level of the bed plate and there join an extension formed in the concrete foundation and pass to the open tail water. Niagara River below the falls, because of its narrow channel, is subject to large fluctuations in level, but any danger of flood from this source is avoided by a concrete barrier which extends to windows 10 ft. above the main floor level and nearly 35 ft. above the normal water level as above noted. Just outside of the station wall there has been constructed a concrete tail race with a weir wall between it and the river. The top of the weir wall is at elevation 349.5, or nearly 7 ft. above the normal river level, so that the level of tail water is not affected by any ordinary fluctuations in the height of the river surface. When all of the turbines in the station are operating under full load, the water in the tail race will rise so as to discharge with a depth of about 3.5 ft. over the outside wall into the river.

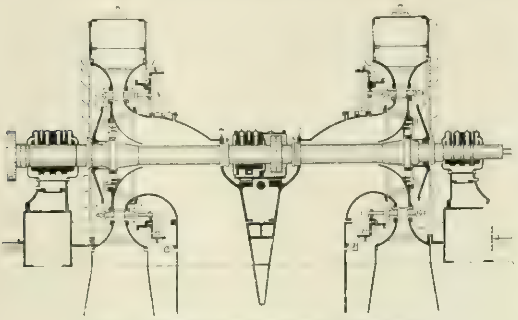


FIG. 12.—DETAILS OF HORIZONTAL TURBINES.

The generators are direct-connected to each pair of main turbine wheels through a horizontal shaft, as shown in Fig. 13. They are rated at 7,500 kw. 12,000 volts, 25 cycles and are of the three-phase type. Between the case centers of the pair of turbines on each shaft the distance is 17 ft. and this space is taken up in part by the draft tubes and a shaft bearing. At the tips of the runners of each wheel the diameter is 6.5 ft. The floor space occupied by each generator and its pair of turbines is about 49 ft. long in the direction of the shaft and 26 ft. 7½ in. wide. For the generator above the length of shaft from the center of coupling is about 20 ft. and the bed plate measures 26 ft. 7 in. at right angles to the shaft. The diameter of the generator shaft is 21 in., and the length of the cast iron pedestal that carries the shaft bearing is about 5 ft. 3 in. These generators are of the rotating field type with stationary armatures. The weight of rotating field including shaft, spider, punchings and coils is about 175,000 pounds. The diameter of the field is 15 ft. 2½ in., and the field consists of 16 poles.

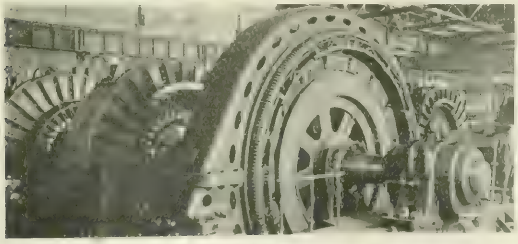


FIG. 13.—NO. 1 UNIT AS OPERATED IN JULY.

The external armature frame of the generator measures 21 ft. 6 in. in diameter and divides into two parts horizontally, and the weight of the entire machine is about 421,500 pounds.

Two impulse turbines with their centers at elevation 380.8 or about 28 ft. above the high tail water level, are each direct-connected by a horizontal shaft to an exciter which operates at 300 r.p.m. Each exciting dynamo has a capacity of 500 hp. operates at 250 volts, and, when running at full load, its connected turbine is expected to utilize 50 cu. ft. of water per second. The runners of these turbines are overhung on the generator shafts. A single exciter unit is sufficient to supply the exciting current for the six generators, but two are supplied in order to provide for emergencies. Current from the exciters may be used to operate the electric crane and the control circuits of the oil switches for the generators and the transformers. Provision is made for supplying the local service from either the alternating or direct current circuits. A storage battery to be installed will be used to operate the control circuits when necessary.

Over the main floor of the power house there is a 50-ton electric traveling crane with a lift of 30 ft. and a span between runway rails of 77 ft. 3 in. This crane has three direct-current motors for the hoist, trolley and bridge, respectively, in addition to which a high-speed, low-power hoist is provided. At full load the speed of the hoist is from 5 to 6 ft. per minute, of the trolley 75 to 80 ft. per minute, and of the bridge 150 ft. per minute. With no load the hoist speed is 12 to 15 ft., the trolley speed 90 to 100, and the bridge speed 200 ft. per minute.

Relations of the Central Station with the Public.

By W. F. Kingan.

PUBLIC utilities, such as those of lighting and street railway companies, stand out prominently before the public eye since almost every inhabitant residing in a small village of a great city has daily to come into contact with the product or conveniences offered by these companies. Consequently the policy and management of such corporations must be determined with great care to preserve good relations with the general public. As I take it, the policy of all such companies should carefully consider three **main** points, namely, duty to the public, duty to employes and duty to the stockholders. The first of these—duty to the public—will be noticed briefly in this article.

Never before in our memory has the press and public been stirred to such resentment and antagonism to trusts, corporations and the moneyed power as exist at the present time. This has come about by the unexampled growth in wealth of the country, the desire to get rich quickly, speculation, avarice and greed of individuals and great combinations of capital to control the necessities of life, which have created in the public a suspicion, to overcome which requires a definite policy on the part of those affected. Let a company ask a council for the renewal of a contract, the extension of certain lines or a renewal of a franchise and it is immediately made aware of the public state of mind just referred to. One fact is morally certain, public utility corporations are at heart desirous to have the public favor, to have it believe they are honest, that they are supplying the best product, that they are giving good service and charging a minimum amount for such service; nevertheless, the general public still remains suspicious. Is there a reason or reasons for such mistrust on the part of the public? There must be or it would not exist. The answer to this opens up the following questions:

Are we giving the best service; are we charging a minimum price for it; are we painstaking and anxious that every customer, young and old, small consumers or large consumers, receives from every official and every employe of the company the greatest degree of courteous treatment; that every request is met in a generous spirit and accorded the best compliance consistent with the interest of the company?

As to giving good service. What does this mean? It means that customers are supplied with the most efficient lamps or devices, that there is ever present at such devices, days, nights, Sundays and holidays an even and exact pressure, that all our work about the customer's premises is in accordance with neatness, good taste, security and safety; that customers are kept in touch with all the latest improvements in electrical devices, and their lamps periodically inspected and maintained clear and bright; that a constant campaign of education is maintained whereby customers are taught to see that in lighting the best effects are preserved with the greatest economy in current, and in power; that the best engineering advice is tendered heartily and free to the end that each user of power shall have the best distribution of motors and machinery that modern engineering ingenuity can devise for flexibility, security and economy. These studies in engineering for lighting and power when systematically and consistently carried out for the benefit of customers will do more than anything else to hold and interest patrons and make them an advertising medium of great value.

As to selling at a minimum price, this is complied with if we are generating and distributing current with a minimum of fixed charges and operating costs per unit and do not add too much profit to these charges. The station should be located, if steam is used, where land is cheap, where coal and water can be secured at the least cost. The buildings should be plain but substantial, the machinery the most economical, comprising the fewest units and including the best labor saving devices; in short, simplicity, strength, economy, and a minimum of moving parts. This, with high-voltage, large transformers, finely built lines, conduits and house services afford the means and opportunity to generate and sell the poduct cheaply, not overlooking two other important points—load curve and profit added to the cost of production.

The load curve is one of the most important problems in the electrical business. If we could store electric energy as simply and as cheaply as the gas companies do their product, nearly all the kinks would be taken out of the business and the unending war to arrive at a plan of equitable rates for all would soon disappear. As it is, we at an immense expense install a plant to take care of the peak load of about two hours, and it practically lies idle the other twenty-two. This compels the companies to charge a high price for light, and to be honest with ourselves that we are selling our product at a minimum price, we must go out into the highways and byways and get business outside of this peak load, and not be satisfied until we have filled out the load curve to make it have the semblance of a straight line. After we have searched out all the dark places that require light in day time and connected them up, and exhausted the field for fan motors, cooking and heating devices and motors, then and not until then, have we fulfilled our trust to the people though leaving no stone unturned to be in a position to give the cheapest light possible.

As to profits to be added to the cost of production, it should be only necessary to state that after providing for a reasonable depreciation, for insurance, taxes, employes' and public liability, for maintenance and operating charges, a fixed return on the actual capital outlay should be charged, which should not exceed 8 per cent., and the price for power should decrease just as fast as the profits exceed this fixed policy.

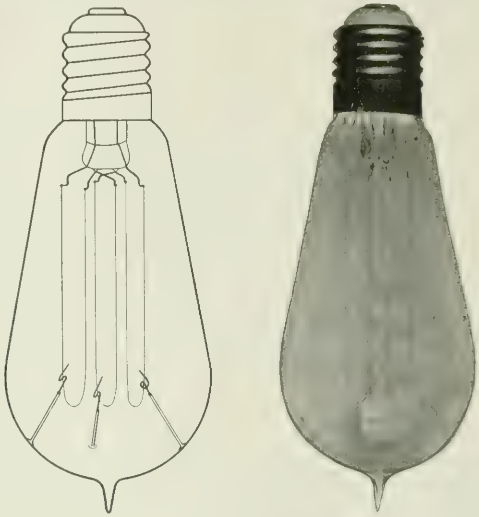
Third and finally, as to treatment of the public. This is a feature of company life that I fear receives scant notice, though one of the most vital to secure the co-operation and friendship of the public. Many companies assume an attitude similar to that of a victor in a conquered country. Officials are unapproachable, except through a line of guards, and an air of secrecy pervades; people are timid and suspicious, but pay their tribute because no other course is open to them. How they welcome a new company that arrives to do battle and give them freedom. Other companies are anxious to improve these conditions, but lack the necessary knowledge and tact. Men may be fine organizers, others clever at figures, and others are noted for their ability to keep down costs and improve production and output; but what every company wants is a good buffer, a man or woman of intelligence, discretion, address, good nature, patience, thoroughly understanding the company and its policy and whose desk is always accessible and convenient to the public who is always there to please, to humor to the utmost every whim or every customer who desires information or accommodation. Walk into a retail store on a good business street and you immediately meet an employe who asks smilingly what your requirements are and who is at once at your service; he will haul down everything in the store to show you and will send your goods home no matter how small or trivial. It is a constant study with them to show their goods to the best advantage, to please their customers and make them always at home in the store. These qualities the average corporate companies lack.

Information, adjustments of accounts and the thousand-and-one questions that arise daily are frequently turned over to young and inexperienced clerks who lack the tact and ability to straighten out complications affecting a company. It indeed would surprise one to know the extent to which this weak point is responsible for adverse criticism of lighting companies. Most people judge a company through the person they meet behind the wicket, and for this important position he should be one, who, like a good salesman, will bring business instead of turning it away.

The public demands the best service at a low cost. It grants valuable franchises and allows the streets to be torn up, undermined and planted with poles and the sky screened by wires and cables, and knows that it is the source of a company's prosperity. The company that desires to live in harmony and peace with its patrons must recognize its debt to the community that granted it corporate life and continuously supplies it with the sinews of war to maintain a profitable existence; it should give the people the best value for their money, have a policy and publish statements regularly; its contracts should be short and simple, with a minimum of strings attached, and it should endeavor to supply its customers with every device and every item of information that will improve the service and benefit its patrons.

The Osmium Lamp.

For some time the osmium lamp has been on the market in Germany and Great Britain, and the accompanying illustrations show this lamp as sold by the General Electric Company, Limited, of London. The lamp is the invention of Dr. Carl Ritter Auer von Welsbach, the inventor also of the incandescent gas mantel known in this country under the name of Welsbach mantel, and on the Continent under the name of the Auer mantel. The osmium lamp is made by the Berlin firm which also owns the patents of Welsbach on incandescent gas lighting. The affiliated Vienna firm has ceased to manufacture the osmium lamp, drawing its supplies from the Berlin manufacturer. In England the lamp is sold under the trade name "Osmi" and the German trade name is "Auer-Os" lamp.



FIGS. 1 AND 2.—THE OSMIUM LAMP.

The illustration shows a 50-volt, 25-cp lamp, guaranteed at 1.5 watts per cp. The filament, which has an approximate length of 15 in., is divided into three separate loops which are connected in series by means of two loops of platinum wire, the middle of each of which is fused by means of a glass head to the top of the stem carrying the two leading-in wires. Each filament is anchored in order to prevent the loops from touching. The anchoring device consists of a small glass rod, to the end of which is attached a turn of small wire of white refractory material, as shown in the illustration. Formerly these anchor terminals were made of metal, but as it was found that the filament always parted at this point the refractory material was substituted. It will be seen that the filament is anchored, not at its extremity, but somewhat above the turn of the loop. The lamps can be burned only in a vertical position.

During the first 200 hours of burning, or thereabouts, there is a slight increase of candle-power due to particles of osmium being fused together by the current passing through the filament. At the end of this period the candle-power reaches a maximum and decreases afterward. It was at one time stated that the actual life of the filaments might be as high as 5,000 hours, but that the useful life is only 2,000 hours, by useful life being understood the time during which the candle-power maintains 80 per cent of its initial value. The English company, however, guarantees a life of only 500 hours at a consumption of 1.5 watts per candle.

The price of the osmium lamp in Germany is 6 marks (about $1.50) retail, and 4 marks (about $1) in quantity. A half mark (about 12 cents) is allowed in Germany for burned out lamps. The English company allows practically the same amount, namely, sixpence. To adopt the lamp to the usual 110 and 220-volt circuits—it is only made at present for 50 volts—the English company supplies adapters for connecting to a single socket two, three or more osmium lamps in series. The cost of these varies from 62 cents for two-way to $1.37 for five-way adapters. It will be recalled that the different stages of the development of the osmium lamp have been characterized by a constant increase of voltage, and it is reported that the Berlin company has succeeded in making 110-volt osmium lamps of 35 and 32 cp, though this type has not yet been put on the market.

Regulation of Electric Rates in Massachusetts.—I.

By Alton D. Adams, LL. B.

A PRECEDING series of digests deals with the leading decisions of the Massachusetts Gas and Electric Commission in regard to questions and disputes of gas rates, etc. The present series takes up in like manner the leading decisions relative to the regulation of electrical rates in Massachusetts. The digests are numbered for convenience of reference.

(1.) Mayor vs. Chelsea Gas Light Company.

Chelsea was the origin of the first petition for the reduction of electric rates by the Massachusetts Commissioners. This petition was signed by the mayor and certain citizens of Chelsea, and was filed January 29, 1890. At that time the Chelsea Gas Light Company operated the only systems of gas and electric supply in that city, and the petitioners sought a reduction in both of these lines of service. On May 6, 1891, the Commissioners announced their decision, and refused to reduce the electric rates. The meter rate in Chelsea was 1.25 cents per hour for the operation of an incandescent lamp of 16 nominal candle power, at the time of this petition. Street lighting was being done under a contract that fixed the rate per arc lamp of 1,200 nominal candle power at 30 cents per night for all-night service, and the rate per incandescent lamp of 25 candle power, operated until 12:30 a. m. on twenty-five nights per month, at $14 per year.

On June 30, 1890, the capital stock of the Chelsea company was $300,000, and there were notes of $65,000 out against it. At the end of the following June the amount of notes payable had increased to $70,000. The capital stock of the company had all been issued before the electric business was taken up, and was represented only by the gas plant. In the electric plant there was an investment of about $80,000 at the time of the hearings on the petition, and this sum had been obtained from loans and earnings. During the year ending June 30, 1890, the Chelsea company had a net income amounting to $3,370.49 from its sales of electric energy, and this sum is about 5.2 per cent of the loans of $65,000 that had been invested in the plant. For the year ending June 30, 1891, the net electric earnings of the company were $8,028.95, and this is a little more than 10 per cent of the investment in the electric plant at that time.

(2.) Mayor vs. Chelsea Gas Light Company.

Again, in 1893, the mayor of Chelsea and certain consumers of the Chelsea Gas Light Company joined in a petition to the Commissioners for lower gas and electric rates. Before the hearings on this petition were had the company reduced its meter rate from 1.25 cent to 1 cent per hour for the operation of each 16-cp incandescent lamp, and the petitioners waived their request for any further reduction of the electric rates. This reduction went into effect July 1, 1893. During the year ending on the previous June 30, the company had a net electric income of $9,651.85, which was 9.2 per cent of its obligations of $105,000 in bonds and notes.

(3) Consumers vs. Malden Electric Company.

In the latter part of 1894, the first case before the Commissioners that involved the regulation of electric rates came up. This case was based on the petition of certain consumers of the Malden Electric Company, in Melrose, for regulation of prices on electric lighting. Complaint was also made as to the quality of the service, but the company took measures to remedy the defects about the time of the hearings, and no order was made on this part of the case. On all except public lighting the Commissioners reduced the maximum meter rate from 1.5 cents per 16-cp lamp per hour to 20 cents net per kw-hour from July 1, 1894, and refused to make any order as to contract rates with private consumers. The rate of 20 cents was made to apply in the entire territory covered by the Malden company. Petitioners asked for no change in the existing contract rates for street lighting, and the Commissioners made none.

Payment of the bill not later than the 25th day of the month was the condition on which consumers were entitled to the net rate fixed. In 1888, the year of its incorporation, the Malden company bought out the other electric lighting interests in that city, and issued about one-fifth of its $180,000 of stock and bonds in payment for licenses and franchises. Before their decision as to rates, the Commissioners had the report of the Malden company for the year ending June 30, 1893. On that date the company had a capital of $150,000, its bond issue was $100,000, and its notes payable were $111,526.36, a total of $361,526.36. During the year ending on the date named, the company earned $73,891.82 by sales of electric energy, had operating expenses of $44,136.72, and net electric earnings of $29,755.10. Of this last sum $11,330 was paid in interest, leaving $18,425.10 or 12.3 per cent on the capital stock. A dividend of 8 per cent, amounting to $12,000, was paid. Because of the uncertainty as to the portion of the income of the company that was derived from sales of electric energy at the maximum rate of 1.5 cents per 16-cp per hour, it is not possible to say how much the rate of 20 cents per kw-hour would have reduced the income during the year in question. In the following year, ending June 30, 1894, the gross electric income of the Malden company was $85,723.32, and the net income was $36,064.90, from which $12,600 in interest was paid, leaving $23,464.90, or 15.1 per cent on the capital stock. On July 1, 1894, the rate of 20 cents per kw-hour went into effect, and during the following year the Malden company had a gross electric income of $88,372.50, which was reduced by expenses to $36,533.62 net. Interest payments reduced this latter sum to $22,000.64, or 14.1 per cent on the capital.

The Malden company had a connected load of 21 arcs and 8,569 incandescents in commercial service, besides 190 arc and 1,614 incandescent street lamps on June 30, 1893. At this same date the electric company in Cambridge had connected 42 arcs and 5,842 incandescents for private consumers and operated 444 arc and 93 incandescent lamps on the streets. The maximum meter rate charged by the Cambridge company was one cent per hour for a lamp of 16 nominal candle power. In Lynn private consumers had 200 arc and 5,562 incandescent lamps connected to the electric system, and there were also 372 arc and 1,240 incandescent street lamps. By meter, the maximum rate of the Lynn company was 18 cents per kw-hour.

The Malden company operated commercial lamps on both the contract and the meter basis, and the Commissioners said that contract rates were inequitable between the company and consumers, and between the consumers themselves. Charges for street lighting were only about one-third as great as the meter rate per unit of energy, and this was said to be poor business policy.

Subsequent to its purchase of the property and rights of other electric companies, the Malden company had issued all of its stock for cash which was interested in its plant, but it had paid dividends from the beginning and had charged off nothing for depreciation. To the cost of generating and distributing electric energy, the Commissioners said that the item of depreciation must be added, and that dividends ought not to be paid with money needed to cover depreciation. On petition of the company, the latest date for payment of the net meter rate was changed to the 15th of the month.

(4) Selectmen vs. Woonsocket Electric Machine & Power Co.

By a special Massachusetts act of 1890, the Woonsocket Electric Machine & Power Company, a Rhode Island corporation, was authorized to acquire pole locations and construct electric lines in the town of Blackstone, in the former state, and was made subject to the Commissioners. Reports of the operations of the Woonsocket company do not appear, however, in the reports of the Commissioners.

In the first half of 1895 the selectmen of Blackstone petitioned the Commissioners to reduce the rate charged by the Woonsocket company for street lighting in their town. At that time the company was operating 29 arc street lamps of 2,000 nominal candle power each, all and every night. After a hearing the Commissioners fixed the rate at the maximum of 42 cents per lamp per night, or a lower rate if lamps of less candle power were used. The generating plant of the company was in Woonsocket, and its load there was much larger than that in Blackstone. A fair rate for lighting by the company in Blackstone was said by the Commissioners not to depend on what could be done by a small plant located there and operating only the local service. On this point the Commissioners also said: "A fair price for service in the town of Blackstone will be the fair general cost to the Woonsocket company for manufacture and distribution, including taxes and management, with an added amount ample to pay a fair dividend upon such a percentage of the capital fairly required for the entire electric business of the company as the volume of the Blackstone business bears to the entire business of the company." During the year ending June 30, 1894, for which the reports of the electric companies were before the Commissioners when they fixed the Blackstone rate of 42 cents per lamp per night, only two other places in the state were paying more than 40 cents per arc lamp per night for street lighting. The rate fixed for Blackstone was to go into effect on July 1, 1895, but the Woonsocket company refused to accept it, and notified the town and the Commissioners that the street lamps would be discontinued when the existing contract expired on the 15th of the same July. On August 15th following, the Commissioners issued an order, after a hearing on a petition by the selectmen, requiring the company to continue the operation of the street lamps at the rate fixed. The company neglected to comply with this order, and the attorney general brought suit in equity to compel the company to obey. Before the case came to a hearing in court, the town advertised for bids for street lighting, and contracted for the operation of its lamps with a new local company. This Blackstone company undertook the operation of 29 arc street lamps of 2,000 nominal cp on an average of 10.1 hours every night for $140 per year, or 38.3 cents per night. Poles and wires of the Woonsocket company were removed from the streets of Blackstone before the end of the year.

(5) Selectmen vs. Milbury Electric Company.

A petition for a reduction in the price and improvement in the quality of the street lights was presented to the Commissioners by the selectmen of Millbury in 1896. The Millbury Electric Company was then operating 33 arc lamps of 1,200 nominal candle power, and 6 incandescent lamps of 32 cp each, on the streets of that town during 1,374 hours per year, at the annual rate of $75 for each arc lamp and $20 for each incandescent lamp. After a hearing the Commissioners reduced the total amount payment to be made by the town for the lamps just named to $2,375, and said that three of the incandescent lamps should be treated as one of the arcs in all computations. On this basis the price fixed by the Commissioners amounted to $67.85 for each arc or for three incandescents. For additional arcs to the number of not more than seven the Commissioners fixed the rate at not more than $44 per lamp annually, and for any decrease in the number of lamps the yearly reduction per arc was to be $14.50. In case of a total failure of any lamp a pro rata rebate was to be made. These rates went into effect on December 28, 1896, the date of the decision. On June 30, 1896, the capital stock of the Millbury Electric Company was $17,000, and it had bonds of $16,000 and notes of $700 outstanding. During the year ending on the date just named the company had a gross income of $5,911.87 from its electric business, the operating expenses were $4,110, and the net income $1,801.87. In this same year the interest paid was $1,037.95, and this deducted from the net income left $763.92, or 4.49 per cent on the stock. The rate of $67.85 for each nominal 1,200 cp arc, 1,374 hours per year, as fixed by the Commissioners, amounts to 15.2 cents per kw-hour, on the assumption that each lamp received 330 watts. During the year the town of Bridgewater paid $70 for each of 35 nominal 2,000 cp arcs operated 1,132 hours on its streets. Assuming that these lamps absorbed 480 watts each, the price paid by Bridgewater was 12.8 cents per kw-hour. In reaching their decision the Commissioners said that those engaged in a public service are entitled to a reasonable return on their investment when the business is properly conducted, "but are not entitled, for the sake of such return, to impose upon a community additional burdens on account of careless or incompetent management." At the rate fixed it was said that a reasonable profit could be expected only after the company had substantially improved its methods, and this rate was intended to yield only a fair return on the capital required to erect a plant in a town like Millbury. Several changes and removals of the lighting plant had involved large losses, and had greatly reduced or entirely extinguished the value of the capital stock of the company. Investigation showed that much of the commercial lighting at contract rates yielded little or no profit.

Practical Information on Central Station Meters.

The greatest space occupied in the "Question Box" of the National Electric Light Association is that containing queries and answers relating to meters, no less than 63 pages being taken up by this department in the answer of 36 queries relating to all phases of the subject. The great diversity of opinion existing among practical men is shown most strikingly in the answers. Local conditions naturally are responsible in part for contradictory answers, but the conflicting opinions expressed without any statement of the conditions underlying them detract very materially from the value of the "Question Box."

Several queries to problems relating to prepayment and slot meters brought forth 12 answers. One central station man states that his experience with prepayment meters has been quite satisfactory; another that they are proving very valuable in building up a certain class of business, while a third said that his experience had been unsatisfactory, and a fourth reported that the largest gas companies are discontinuing their use. As to the effect on sales of slot meters, three replies stated that they increase sales, and a fourth gives the advice "Better put in a regular meter." Concerning the advisability of installing such meters for any consumer who wishes to have one, or to confine their use only to doubtful customers, two replies are to supply any customer who wants such a meter, and another that the largest field is in apartment houses.

No less than 32 answers were received to the very general query, "How to satisfy a customer that his meter registers his consumption properly." The gist of the replies is to show the customer how to read the meter, to explain to him what readings signify in lamp hours and dollars and cents, and to advise him to test the meter himself by burning a given number of lamps a certain period of time and noting the reading. Additional advice is to show that jewel wear makes a meter run slow; to test the meter in the presence of the consumer by reference to another meter of known accuracy; to have the meter tested by a competent and impartial outside party; to test the meter in the consumer's presence with a portable ammeter and voltmeter; to install a recording wattmeter which indicates the number of lights burned at different times and how long they burn; to have fitted up in the office a meter with as much of the interior visible as possible and so connected or cut off at will, the consumer being invited to see the operation of the meter under the various loads and satisfy himself that it does not register without load; to send out pamphlets giving instructions for reading meters and for making approximate tests as to their accuracy; to encourage customers to read their own meters and to compute their bills.

Answers to the number of fourteen are offered to the query, "What effective means if any have been found to make it impossible for a customer to beat a recording wattmeter, or what special precautions can be taken by electric light companies to detect the same?" Among the remedies offered are inspection and systematic testing at regular intervals, most of the answers dwelling upon this means; running both leads into the meter with a shunt or crossed connection under the case; placing another meter for a period on a service pole as a hint to the suspected thief; keeping the main cut-out and service block as widely separated as possible; connecting direct to service wire or running leads in iron conduit to meter; enclosing the meter in a strong wooden box; locating closely-rated enclosed fuses in enclosing wooden box; use of an all-glass cover, to require employes to report and watch suspected cases, reading the meters frequently; to require bookkeeper to report abnormal reductions in bills.

Eight opinions are expressed as to the percentage variation of meter readings allowable from no load to 50 per cent overload. Five favor two per cent, two three per cent and one "Not more than six per cent." The latter reply is from "Unsigned," and judging from the pessimistic views expressed on other topics over this signature it appears to conceal the identity of one who has a grudge against the public, and who might well have been debarred from the company of the other 226 contributions to the "Question Box" who stand openly for their opinions. One opinion favoring two per cent allowance suggests five per cent for commutator meters from no load to 10 per cent load, and another allows five per cent for starting load.

On the matter of granting a rebate to a customer whose meter has been found to creep, out of 20 replies, 19 favor doing so, though some point out that an admission that a meter is incorrect may in cases prove damaging; three replies are noncommittal and three are in the negative, including "Unsigned," who advises "Explain that the creeping has been effective only during the hours that the meter was idle (!), and that the result of the creeping during the month has an insignificant money value."

The effect on an alternating-current meter of a 10 per cent change in frequency was the subject of 10 replies. Of two opinions without qualification, one was that the meter would run slow at a smaller and high at a greater frequency, and the other that the effect would be exactly the reverse of this. Three others state that induction wattmeters ran slow on higher, and fast on lower, frequencies; four replies are that there is no appreciable difference, and a fifth that "the meter will probably creep."

The reason why a slight vibration during 12 out of the 24 hours causes a meter to run slower was the subject of 26 replies, of which 22 ascribed the cause to abnormal wear on the jewels and pivot, and four to sparking at the brushes in the case of a direct-current meter, which roughens the commutator.

Considerable diversity of opinion was expressed in reply to the query, "How often should consumers' meters be tested?" Of the 21 answers, the majority favored yearly testing, in some cases with the qualification that large meters should be tested several times annually. One advocated monthly tests, another quarterly and several half yearly tests. One answer was that a commutator meter should be tested every four months, but that once in two years was sufficient for an induction meter, while another assigned nine months for the former and eighteen months for the latter case. One opinion was a test for every million revolutions. Several replies indicate that those answering had no fixed rule.

There was similar lack of agreement in reply to the question whether meters should be tested on consumers' premises or carried to a test room. Of 20 answers, seven favored removal and testing at the station. The other thirteen advocated testing in place, several making the reservation that if needing recalibration or repairs the meter should be removed.

Eighteen out of twenty answering the query, "Should a charge be made for testing a meter at the request of a consumer," are decidedly in the negative. Of the other two one believed that the customer should be charged if a meter ran slow and another that he should be charged "With amount meter was slow." Some of the answers as to the best method of testing recording meters on the customer's premises went into considerable detail. Three recommended the use of the Sangamo testing set, consisting of a number of non-inductive resistances by which the load can be directly varied from about 10 watts to 200 watts, and then by means of a small current transformer for loads up to 3,000. A convenient method is stated to be a portable box giving different loads from 40 to 1,500 watts, in connection with a portable recording wattmeter with a dial that registers revolutions. Other methods are the use of a wattmeter and stop watch together with a calibrated resistance or lamp bank, for which latter the customer's lamps may be used; the use of an ammeter and voltmeter with the customer's lamps for a load; a portable lamp bank of six 100-cp lamps arranged to burn two in series on 220 volts or all in multiple on 110 volts; a registering standard wattmeter of a known degree of accuracy in series with a customer's meter; a standard recording wattmeter of the multiple-field type; the use of a resistance coil wound in tubes, each tube consuming 100 watts. Of seven answers to the query, "Are commutator type recording wattmeters correct for inductive loads?" four are in the affirmative without qualification, and one in the negative without qualification. One answer is that they are correct with power factors over 0.75, and another that the commutator type of wattmeters is not correct for inductive load, but that a properly constructed induction wattmeter with the compensating arrangement is correct on inductive loads of very low power factor; and four answers are that the type of meter in question is not correct on inductive load unless lagged.

All four answers to a query as to the relative status of the watt-hour meter as against the ampere-hour meter, favor the former, one stating that the latter is a thing of the past. A query as to whether the commutator type of meter has proved nearly equal to the best class of induction meters in alternating-current work, received sixteen replies, of which ten are in the negative. Of the five dissenting replies, four favor the commutator type without reserve, and the fifth also favors it with the qualification that if given the same amount of care in the way of periodic inspection it is equal to the induction type. Nothing new is brought out in a number of replies to a question as to what points are to be considered in deciding what make of meter to use in order to get the best results. The few replies given to a request for a cheap and accurate way of determining the flux density of wattmeter permanent magnets, indicate that there is no cheap method and that an accurate method is complicated. The concensus of opinion brought forth by a question as to the kind of damage to which a meter installed in the open air is exposed, was that they are subject to deterioration from the effects of moisture, which causes corrosion. Several condemn the practice of placing meters outside of buildings.

The question as to which of two single-phase meters used on a three-phase circuit should run more slowly brought forth four replies, three of which indicated that the writers did not appreciate the problem. The fourth gave the conventional three-phase vector diagram to show the phase relation of the currents and voltages, and thus explained the torque acting upon each meter.

There is a single reply to a query as to the average annual cost of maintenance of meters, which gives the figure of $1.33 for direct-current meters and 40 cents for alternating-current meters. A query as to what percentage of the investment in meters would be reasonable for the expenses of a meter department having charge of 1,000 meters received three replies, one of which named 5 per cent, another 6.5 per cent, and the third 10 per cent.

Twelve answers are given to a question asking the practice in regard to arranging with wiring contractors as to the location of meter loops. In eight cases the companies have rules regulating the matter to which contractors are required to conform. The rule of two other companies is that if meters are not located where they are accessible to meter readers, meters will not be installed, and one answer is that no satisfactory arrangement can be made with wiring contractors. As to whether a peep-hole in a meter cover induces a consumer to tamper with a meter, three answers are in the affirmative, and five in the negative. The query, "Do repolished meter jewels and pivots give as good service as new ones?" receives two replies, in the affirmative, two in the negative and a fifth that for certain conditions practically as good results may be obtained with repolished jewels, although a closer system of inspection may be required. The best place to locate a meter in a private residence is, according to seven replies to a query on this point, in the cellar or basement. Two prefer the attic, two prefer the kitchen and one favors any place where the reader can see the dial without the use of a light or ladder.

Fifteen replies as to the advisability of employing a meter man where there are 300 to 500 meters in use are unanimously in favor of having an experienced meter man on the station staff. As to the number of men required to handle a meter department of a station having 1,000 customers, two replies state that two men will be required; one says that several will be necessary, and five others that one man can attend to 1,000 meters. In one reply it is stated that one man can do all the reading and that if alone he can "go about quicker and will become more accurate." A company operating a 500-volt, direct-current, two-wire circuit for power loses from 10 to 15 meters in the spring from lightning discharges, although the lines, motors and meters are protected by lightning meters, and asked for a remedy. Of eight replies received, only two are to the point. One of these advises that the meters be grounded, and the other recommends insertion of heavy reaction coils in both lines between the arrester and the meter.

Tests of the Tantalum Lamp.

As noted briefly last week, Prof. Wm. Ambler read a paper before the Ohio Electrical Association giving the results of tests made on two tantalum lamps, one having a clear and the other a frosted globe.

The first test was on the change of resistance with change of voltage at the terminals of the lamp. In Fig. 1, curve *T* is that of a tantalum lamp, and curve *C* that of a 3.1-watt carbon filament lamp, each rated at 110 volts. These curves show that the tantalum filament increases in resistance with an increase of voltage, and, therefore of current and temperature, while the resistance of the carbon filament decreases as the temperature increases. The bearing of the increase in the resistance of the filament in the tantalum lamp on the change in candle power with the voltage is considered in detail later.

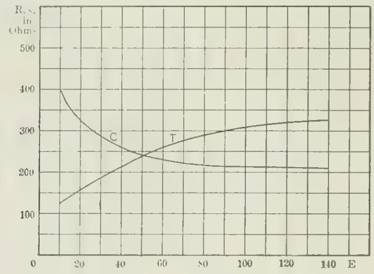


FIG. 1.—VARIATION OF RESISTANCE WITH VOLTAGE.

Measurements were made on the distribution of light from the tantalum lamps with both clear and frosted bulbs, and comparisons made with the light distribution from a 16-cp, 110-volt lamp with clear bulb and with a single-curl carbon filament. The horizontal distribution of light from each of the tantalum lamps was found to be practically uniform. The lamp with the clear bulb gave 22.0 for the value of the mean horizontal cp. The current at the rated voltage, 110, was .35 ampere, making 385 watts, or 1.75 watts per mean horizontal cp. The frosted lamp gave a mean horizontal cp of 19.8 watts and took .36 amp. at 110 volts, making 396 watts and 2.0 watts per candle. The rating given on the lamps is in the German or Hefner units, one unit of which amounts to .88 of the English unit of candle power. Values of candle power are given throughout in English units.

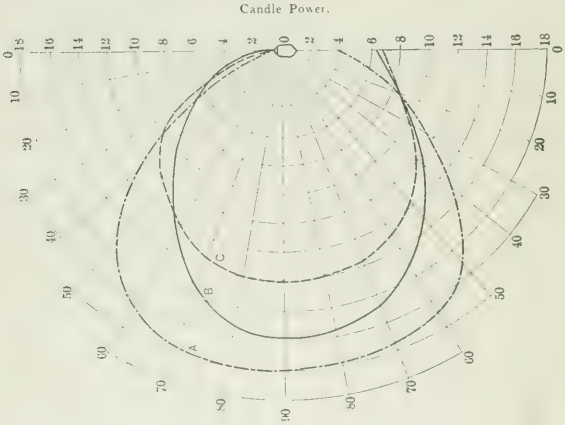


FIG. 2.—VERTICAL DISTRIBUTION OF ILLUMINATION.

In Fig. 2 are given the curves showing the vertical distribution of light from the three lamps. Curve *A* is of the tantalum lamp with clear bulb, curve *B* of the tantalum lamp with frosted bulb, and curve *C* for the carbon-filament lamp. Data for these curves were obtained by taking measurements of candle-power every ten degrees from the horizontal. While the tantalum lamps give much more light in a horizontal direction, the amount from the tip of the lamps is much less than that from the carbon filament lamp, though this is one with a single-curl filament. The tantalum lamp with the frosted bulb gives a much better distribution of light than the one with the clear bulb, as shown by the curves.

The mean spherical candle-power of the tantalum lamp with clear bulb was 17.2, requiring 2.23 watts per mean spherical cp. The frosted lamp gave 14.82 mean spherical cp, at 2.67 watts per candle. The carbon lamp gave 13.32 mean spherical cp, requiring 3.72 watts per candle. Comparing these values we find that the tantalum lamp takes 57 per cent and the frosted lamp 64.5 per cent, as many watts per horizontal candle power as the carbon lamp. The carbon-filament lamp has a consumption of 3.1 watts per horizontal cp. Also, the tantalum, with clear bulb, takes 60 per cent and the frosted lamp 72 per cent as many watts as the carbon lamp per spherical cp.

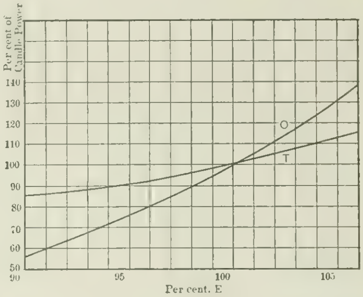


FIG. 3.—VARIATION OF ILLUMINATION WITH VOLTAGE.

Measurements were next made to determine the variation in the candle power with the voltage. The results are shown in the form of curves in Fig. 3. Values in per cent of normal voltage were taken as abscissae, and values in per cent of normal candle power as ordinates. Curve *T* is for the tantalum and curve *C* for the carbon filament lamp. The curves are similar, but the curve for the tantalum lamp is more nearly horizontal, showing that the change in candle power is much less than that of the carbon lamp for the same change in voltage. An increase of 4 per cent in the voltage caused an increase of 24 per cent in the candle power from the carbon lamp, while the same increase in voltage caused only a 9 per cent increase in the candle power from the tantalum lamp. It requires practically twice the percentage change of voltage across the tantalum lamp as that across the carbon lamp to cause the same change in light. This wide difference in the variation of candle power with voltage is due to the decrease in resistance of the carbon filament, and the increase in resistance of the tantalum filament with the increase in voltage.

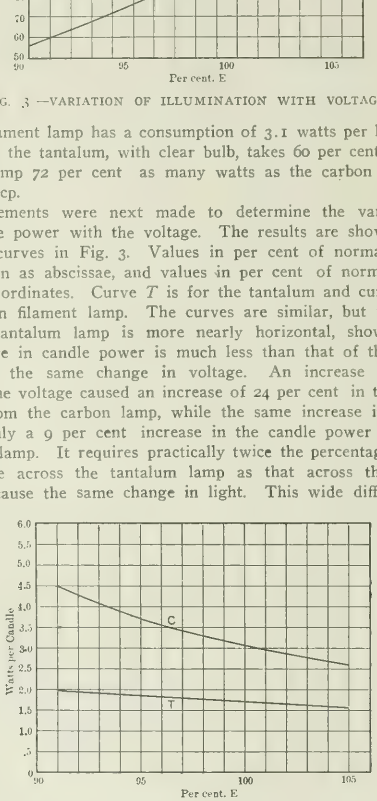


FIG. 4.—VARIATION OF SPECIFIC CONSUMPTION WITH VOLTAGE.

Fig. 4 shows the variation in consumption with the voltage. Values of watts per candle are taken as ordinates and per cent of normal voltage as abscissae. Referring to the curve *C* for the carbon lamp, it is seen that an increase in voltage of 5 per cent will cause a decrease in the number of watts per candle from 3.1 to 2.62, an increase in efficiency of 30 per cent. The same increase in voltage across the tantalum lamp would cause a decrease in watts per candle from 1.75 to 1.62, an increase in efficiency of about 12 per cent. With a decrease in voltage there results a corresponding decrease in efficiency.

The relation between candle power and life of the carbon and tantalum lamps is shown in Fig. 5 by the two upper curves. Candle-power values are taken as ordinates, and time of burning in hours as abscissæ. The curve for the tantalum lamp was the average of three lamps, the curve for each lamp differing only slightly from the average. The curve for the carbon lamp is the average of a large number of 3.1-watt lamps. During a life of 1,000 hours the tantalum lamp decreased in candle-power from 22 to 15.8, while the carbon lamp decreased in candle power from 16.5 to 11.5. This amounts to about 28 per cent in each case. These results show then that the falling off in the candle power of the tantalum lamp is practically the same as in the case of the 3.1-watt carbon lamp.

The two lower curves in the same figure show the change in consumption with life. The watts per candle taken as ordinates were obtained at the same time as were the measurements for the two upper curves. During the 1,000 hours the watts per candle increased from 1.75 to 2.4 in the case of the tantalum lamp and from 3.1 to 4.2 for the carbon lamp. This increase amounts to 37 per cent for the tantalum and 33 per cent for the carbon lamp. If we multiply the watts per candle by the corresponding candle power we find that the power taken by both the tantalum and the carbon is practically constant during the life of the lamp, a slight decrease occurring in each case.

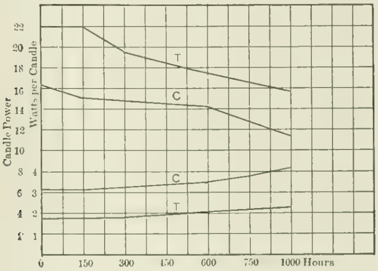


FIG. 5.—LIFE TESTS OF TANTALUM AND CARBON LAMPS.

In regard to the cost of the tantalum lamp, the representative of the German owners states that the lamps have not been placed upon the market in this country and that consequently no figures on the cost here are available. The cost of the lamps in Germany in barrel lots is 80 cents, as compared with about 16 cents for the ordinary lamp. Assuming this same relation between values to hold in this country, some comparisons were made. The useful life of each lamp may be taken as 500 hours. The average candle power for that time is 19.87 for the tantalum lamp with clear bulb, 17.88 for the tantalum lamp with frosted bulb, and 15.37 for the carbon lamp. The average watts per candle are 1.86, 2.12, and 3.25 respectively. Assuming energy at 10, 5, and 3 cents per kw-hour, the relation in cost can be expressed as follows:

Cost of energy per unit	$.10	$.05	$.03
Tantulum lamp, clear bulb	$.80	$.80	$.80
Energy for 500 hours	1.85	.93	.62
Cost of lamp and energy	$2.65	$1.73	$1.42
Tantulum lamp, frosted bulb	.80	.80	.80
Energy for 500 hours	1.90	.95	.63
Cost of lamp and energy	$2.70	$1.75	$1.43
Carbon lamp	.16	.16	.16
Energy for 500 hours	2.50	1.25	.83
Cost of lamp and energy	$2.76	$1.41	$.99

Dividing the cost in each case by the average candle power we obtain the relative cost and saving or loss by the use of the tantalum lamp. Taking the cost of energy as 10 cents per unit, 2.65 ÷ 19.87 gives the cost per candle for 500 hours for the clear tantalum lamp as 13.3 cents. This amounts to a saving of 26 per cent over the carbon lamp; 2.70 ÷ 17.88 gives the cost per candle for 500 hours for the tantalum lamp with frosted bulb as 15.1 cents. This amounts to a saving of 16 per cent; 2.76 ÷ 15.37 gives the cost per candle for 500 hours for the carbon lamp as 18 cents.

Carrying out the work in the same manner when energy is taken at 5 cents per unit, we find that the saving by the use of the tantalum lamp with clear bulb over the carbon lamp is 5.2 per cent.; by the use of the frosted tantalum lamp there is a loss of 6.7 per cent. With energy at 3 cents per unit, there is a loss of 11 per cent by the use of the clear tantalum lamp, and a loss of 23 per cent by the use of the frosted lamp.

These results show that there will be a saving by the use of the tantalum lamp only when the cost of energy is above or about five cents per unit.

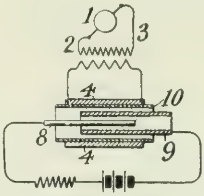
If we speculate upon the possible value of this new lamp we should consider the value of burned-out lamps. Allowing 50 per cent. of the original cost as the value of the lamp there will be found to be a saving when worked out as above of 35 per cent in favor of the tantalum lamp with the clear bulb with energy at 10 cents per unit. With the energy at 5 cents, the saving amounts to 31.5 per cent., and at 3 cents, to 13.5 per cent.

In conclusion, Prof. Ambler stated that it is evident that the success of this lamp will depend upon the ability of the makers to reduce the selling price of the lamp. There seems to be a probability of this in the direction of improved chemical and physical methods of manufacture, as the present high cost is due not so much to the value of the raw material as to the difficulty of working the metal into a fine wire.

Recent Electrochemical Developments.

ELECTRIC FURNACE.

The object of a patent recently granted to Henry Noel Potter is to produce at will any temperature intermediate between the usual temperature of an electric resistance furnace and that of an arc furnace. For this purpose he employs what is essentially a combination of a resistance and an arc furnace, the arc being produced between two electrodes within the resistance furnace itself. The inventor emphasizes the fact that under these circumstances the electric current will pass the gap at a lower voltage than is required under atmospheric pressure or under conditions of moderate heat. One of the applications of this principle, as applied to a tube furnace, is shown in the illustration. The tube furnace, 4, is supplied with alternating current from the transformer, 2, fed from the alternator, 1; simultaneously direct current is passed through the air gap between 8 and 9. With a modified design it is, of course, possible to use the walls of the tube furnace as one pole of the arc-gap.



ELECTRIC FURNACE.

ELECTROLYTIC PROCESS.

Two patents recently granted to John R. Parks refer to method and apparatus for extracting precious metals from ores. He first subjects the ore to mechanical treatment so as to collect the greater proportion of the precious metals in slimes for electrochemical treatment. When separated from the slimes there are obtained only the clean, coarse particles of mineral, which are not amenable to economic treatment by cyanide, and the values of which are subsequently recovered by smelting. The slimes are treated by an electro-cyanide process with a simultaneous supply of compressed air and agitation of the pulp.

H. Schuessler patents mechanical details of an electro-plating device specially designed for coating sheet-metal plates. The plating tank has an inclined bottom with a carrier for the plates moving longitudinally.

ELECTRIC DISCHARGES.

A new application of producing chemical effects by means of electric discharges is described in a patent of A. de Hemptinne for converting oleic acid into stearic acid and other similar compounds whose melting point is higher than that of olein. The process consists in subjecting the oleic acid to the action of effluvia in an atmosphere of hydrogen.

BATTERY INVENTIONS

In his nickel-iron battery T. A. Edison embeds the active material in small pockets of perforated nickel-plated sheet steel. For the purpose of keeping the weight of the battery as low as possible, the sheet steel must be very thin. On the other hand, it must be thick enough to give the desired elastic pressure so that the walls of the pocket are always in elastic contact with the active material. Edison experienced the difficulty that if the steel was made of sufficient thickness for the latter purpose, it could not be perforated in practice with the desired fineness, since the dyes became quickly worn out. For this reason he now uses steel thin enough to be readily perforated—about 0.0025 inch in thickness—and applies a greater thickness of plating of nickel than formerly—between 0.0005 and 0.00125 inch.

L. Langelaan patents mechanical details of construction of plates of active mass of lead cells, composed of single pieces and enclosed and held together by a protective envelope.

G. K. Hartung endeavors to avoid the use of metallic grids for supporting the active material in plates of the pasted type. He places the active material in expansible tubes mounted in frames and electrically connected to the terminals of the battery. The tubes are of non-conducting, acid-proof material, and carbon rods are embedded in the active material to conduct the current to the active mass.

D. L. Winters patents a copper oxide electrode for primary batteries in which an active mass of copper oxide is embedded in a zinc-coated perforated sheet-iron case. The coating of zinc is employed to set up local electrochemical action at the initial immersion of the plate in the electrolyte.

New York Central Third Rail.

Naturally, the matter of the type of third rail to be adopted for the New York Central electric traction system has received close attention on the part of those who are to make the selection. Extended tests with various types of third rail construction were made on the Schenectady experimental track, and finally after a thorough study of the subject by the New York Central Traction Commission the under-contract type shown in the accompanying illustrations has been adopted. The system is the joint invention of Mr. W. J. Wilgus, fifth vice-president of the New York Central Railroad Company, and Mr. Frank J. Sprague, who is a member of the New York Central Electric Traction Commission. The working details of the system, including a complete system of crosses, switches, approaches, etc., have been developed under the direction of Mr. E. B. Katte, electrical engineer of the New York Central.

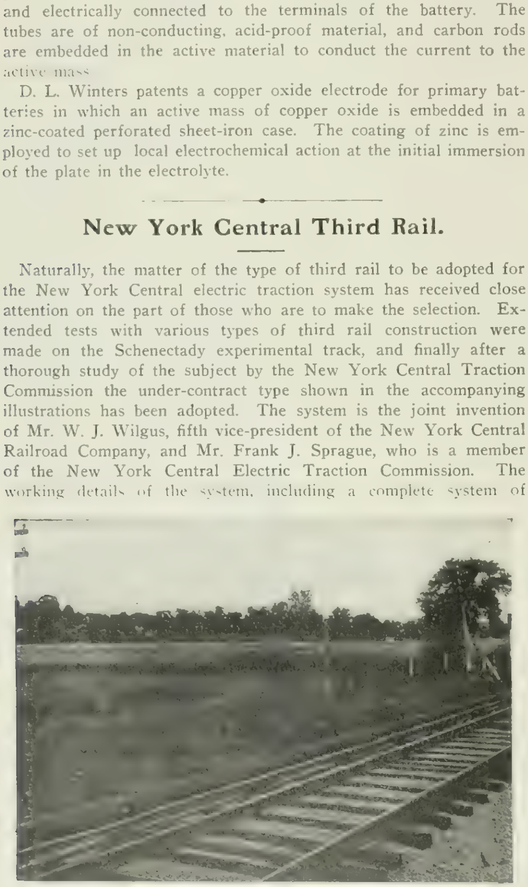


FIG. 1.—TRACK SHOWING THIRD RAIL ERECTED.

As will be noted in the illustrations, the third rail is supported every 11 ft. by iron brackets, which hold the insulation blocks by a special clamp. The blocks, which are in two pieces, are 6 in. long by [illegible] in. in thickness, and are designed so as to be interchangeable. Experiments are now being conducted with insulators of reconstructed granite, vitrified clay, rubber and indurated fibre to determine the relative advantages of these materials for the conditions under which they would be used. Between supporting brackets the upper part of the rail is covered by wooden sheathing. This sheathing, as shown, is applied in three parts, which are nailed together. At the joints where the third rails are bonded, and at the feeder taps, the wooden sheathing is mortised.

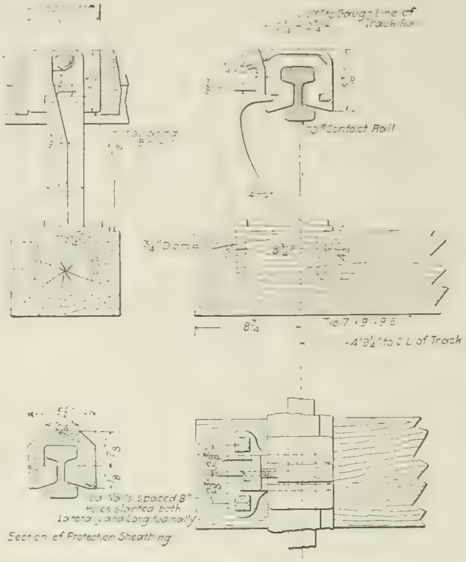


FIG. 2.—DETAILS OF THIRD RAIL CONSTRUCTION.

The third rail is not mounted rigidly in the insulators, but is given a little play for expansion and contraction, except at certain central points, where it is anchored. It weighs 70 pounds per yard, is of special section and composition, and has a resistivity between 7 and 8 times that of copper. Fig. 1 shows a section of track near Schenectady equipped with the new and old systems.

To afford the same clearance as would be permitted with a top-contact protected third rail, such as used on the Long Island Railroad, the New York Central third rail requires a location of from ½ in. to ¾ in. further out, but to secure a wider clearance, the New York Central engineers have decided to place the rail 1½ in. further from the gauge line, or a total of 29 in. This difference will not preclude the interchange of equipment with a suitable shoe which can be arranged so as to pass automatically from the under-contact to the top-contact third rail, and vice versa. The under surface of the New York Central third rail is 2¾ in. above the top of the service rail, while the upper surface of the Long Island third rail is 3½ in. above the top of the service rail. This difference can be taken up automatically by the spring pressure due to the shoe sliding on its under and upper surface in each respective case.

The principal reason for adopting the under-contact rail is that it can be more thoroughly protected, and hence is safer than the ordinary type of contact rail. There are no projecting live edges or bolts, and no slot between the third rail and its cover through which an animal or any person ignorant of danger can make contact with the live conductor. The only possibility of reaching the third rail is from below and by an upward movement, and this fact, it is thought, greatly decreases the chance of injury from shock. Other advantages which it is claimed are possessed by this arrangement over the ordinary type of third rail are: (1) There is less strain on the insulators, as the pressure from the shoe acts against instead of with gravity; (2) the board protection, having a continuous support, is less apt to crack and warp; (3) the rail is more protected from the weather, and hence less liable to corrode; (4) the contact surface is more thoroughly protected from sleet and snow; (5) the construction is self-cleaning, and as there is a much greater space between the lower portion of the third rail and the tie, there will be less danger of an accumulation of snow, ice and rubbish, and consequently less leakage.

The Increasing Use of the Fan Motor.

Although the uses of small motors are legion, scarcely a week goes by in which some new application is not made by progressive consumers of electricity. The fan motor is no exception, and the energetic efforts of central station and supply men long ago turned this convenient device to good account regardless of the season of the year. The use of the fan motor in keeping window panes clear from frost is now an old story, and the up-to-date photographer discovered not long ago that the process of drying plates can often be cut from several hours to twenty or thirty minutes by the use of the device as an evaporation accelerator. At the Cape Cod naval wireless telegraph station the Leyden jar chamber containing the spark-gap is fitted with a 65-volt fan motor which extracts the oxidized air from the apparatus to prevent excessive oxidation, and in the lecture tables of the most modern chemical laboratories found in educational institutions are installed gratings through which the fumes of chlorine and other irritating gases are drawn by fan motors at the other end of the connecting ducts. Autopsy tables are readily ventilated in the same general way. The Italian fruit dealer has now taken up the electric fan for out-of-door work, and with a few ribbon streamers attached it serves a most useful purpose in keeping flies, other insects and dust away from the fruit-stand, at a cost of probably not over $2 per month in the warmest weather.

◆

Plotting Saturation Curves.

By Alexander Millar Gray.

Perhaps the most important data of any direct-current generator or motor reside in its no-load saturation curve. This curve is always taken experimentally in terms of field amperes and terminal volts, but by a little manipulation the utility of such a curve can be greatly increased.

In Fig. 1 are three curves taken from the same generator for speeds of 100, 160 and 200 rev. per min., respectively. As the e.m.f. is a function of the speed, the curves are different at the different speeds; but, since the e.m.f. is proportional to the speed, the curves for different speeds can easily be interpolated, so that the saturation curve of the generator at any desired speed can be obtained at once.

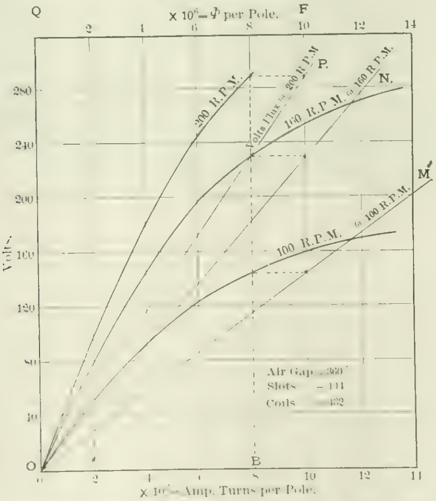


FIG. 1.—MAGNETIZATION CURVES OF A GENERATOR AT VARIOUS SPEEDS.

Since the flux due to a certain field current does not depend upon the speed, it is possible to put the saturation curve in a form such that it is independent of the speed, as shown in Fig. 2. The method of transposition from the curves of Fig. 1 to the curve of Fig. 2 is very simple. Consider any number of ampere turns as *O B*. These turns create flux *Q F* (Fig. 2) which in turn causes the generation of a certain voltage corresponding to each speed.

The irregular curve of Fig. 2 is thus plotted for various values of field current and field flux. The straight lines, *O M*, *O N* and *O P*, are drawn in such a way that at the field current corresponding to *O B* giving the field flux *Q F* (Fig. 2) there will be generated the e.m.f. OE_1 at 100 rev. per min., OE_2 at 1,600 rev. per min., and OE_3 at 200 rev. per min. As seen in Fig. 2, these values are found at the intersecting points of the lines *O M*, *O N* and *O P* with the horizontal line through *F*. The method of using the curve is as follows: Selecting any certain field current on the bottom scale, pass vertically up to the irregular curve, then horizontally over to the required speed curve, then vertically up to the top scale where will be found the value of the e.m.f. generated at that speed and field current.

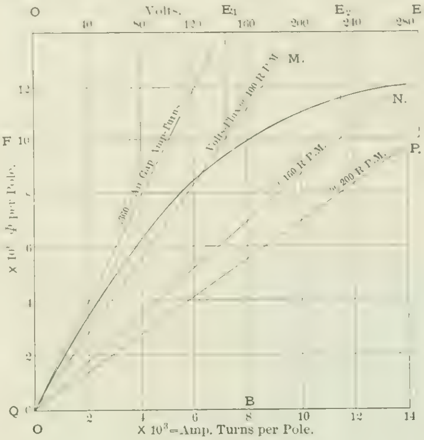


FIG. 2.—MAGNETIZATION CURVE FOR ALL SPEEDS.

With the curve as it now stands, all that is necessary in order to find the field excitation at another speed is a new speed line; whereas in Fig. 1 a new saturation curve must be plotted by interpolation.

◆

American Trolleys in Manila.

A long step forward in the Americanizing of the Philippines was celebrated recently at the official opening of the Manila Street Railway. The plant of the Manila Electric Railway & Light Company not only serves the purpose of supplying adequate transportation and lighting service to Manila, but it justifies the belief that it was possible to educate the ordinary Filipino technically, so that he could undertake skilled work as well as that of an ordinary laborer. Many Filipinos are now employed in the capacity of carpenters and machinists, as well as conductors and motormen on the cars, and do excellent work. During the past two and one-half years some 1,500 to 2,000 of the "little brown men" have been occupied in erecting the power house and car barns and installing a complete electric system. Their wages ranged from 50 to 70 cents per day, varying according to their occupation. The Filipinos were well satisfied with this small sum, because it was almost twice as much as they were accustomed to receive under Spanish rule. The main trouble was to keep them at work steadily. With their increased wages they felt that two or three days of consecutive labor were quite sufficient. By allowing them to observe innumerable feast days and letting them take a rest in the middle of the day when the heat was intense, experience has shown that the ordinary Filipinos may be rendered more willing to work.

A hard problem was to find a wood for ties and poles, and also for the car bodies, which would withstand the assault of the white ant and be practically weather-proof. As an experiment three kinds of wood were used for ties: the native wood called molave, California redwood, and an Australian wood. Further experimenting has been done by treating the ties with preservatives such as creosote, jodelite, solignum and carbolineum. The rails were painted with asphaltum, and in low-lying ground were laid in concrete. The only wood which seemed to be ant-proof was teak, and the cars were built of this material, combined with steel of a heavy design, which was carefully protected with rust-proof paint. Teak is a dense, hard wood which needs no chemical treatment. It is difficult to work with tools and to steam bend, and has such a beautiful appearance that the cars were finished in the natural color wherever possible.

The Manila climate is intensely hot and hurricanes are of common occurrence. The majority of the equipment consists of open cars, but several convertible and semi-convertible cars are being used for experimental purposes. Absolute simplicity was the keynote of the designs for the cars, so that there would be no difficulty in keeping the cars clean. The heavy, driving storms occur so frequently that extra precautions were taken to secure the comfort of the passengers. All cars are vestibuled and equipped with curtains of Pantasote mounted on extra heavy slats which will resist the strongest wind. The gutters, water ducts and cables for curtains are made of non-rusting metals, and the dashboards of extra heavy steel. There is a considerable overhang to the monitor roofs and the ventilation is so arranged as to readily dispose of any water which may collect.

Trolley Line in Manila, P. I.

The Manila Electric Railway repair shops are thoroughly equipped to design and build their own cars, and are conducting experiments with a view to using native woods. The present equipment consists of 95 passenger cars furnished with Westinghouse two-motor equipment throughout. On account of the lower price of teakwood in Europe most of the car bodies were purchased there, but the trucks were purchased in America. The power house contains four Westinghouse turbo-generators which produce approximately 4,000 hp of electricity for general power purposes, and lighting is furnished by the company as well as the power for the street railroad. The power house, car barns and other buildings are erected entirely of steel and concrete, all exposed metal parts being covered with paint to guard against deterioration.

Viewed as a whole, or in detail, the plant of the Manila company, which was built and is being operated by J. G. White & Co., of New York, is fully up to the most advanced standard of American practice, and it is a matter of no small importance that our Filipino fellow-citizens should have in their capital city such an object lesson and training school in up-to-date mechanical and electrical engineering.

Illuminating Engineering and Central Stations.

By James R. Cravath.

When those relics of the barbaric days of the central station business, flat rates and free wiring of customers' buildings, began to disappear there began a tendency on the part of central station companies to interest themselves only in the delivery of current at the customer's service switch without bothering as to whether the customer made efficient or inefficient use of the current taken for lighting. The central station man thought he had troubles enough of his own maintaining good service outside the building without attempting to advise customers as to methods of securing the best results from an illuminating standpoint. This tendency was unfortunate and many soon began to realize it. In every town the central station has one or more competitors. In the small towns it must compete with the kerosene lamp, the private gasoline or acetylene plant and the individual gasoline arc. In the larger towns gas and the isolated plant are added to the list. It is, therefore, of first importance to give customers of the central station the best illumination possible for a given amount of money. Furthermore, good lighting of one customer's premises forces others to increase and improve their lighting, and this in turn means increased revenue.

The average customer little realizes how easy it is to throw away a large amount of light, and many central station men have been so engrossed with problems of production and distribution that they have neglected illuminating engineering. To such the writer would suggest that between the boiler room and the customer's counter, desk or table there is usually no place where a little study can produce more marked improvements in efficiency than at the point where the light is utilized. The obvious moral is that the central station companies should pay more attention to illuminating engineering. In the small company, the manager, and in the large company, specialists in that branch of the business, should see to it that the frequent "horrible examples" of lighting that we have before us at the present day are not added to. Every influence should be brought to bear on new customers to have their lighting properly planned either by the company's expert or by some other competent engineer. In the small towns the planning of the lighting too often falls to some contractor who may be an excellent wireman, but knows little of illumination. In large cities in large buildings the lighting comes under the architect. The architect has neither the time nor opportunity to make a thorough study of illuminating engineering if he is to be a master of the other branches of his profession and I think the lighting of the majority of large buildings bears sad testimony to this fact.

Nor is the electrical engineering profession entirely guiltless as regards poor lighting designs. The writer has known cases where the illuminating engineering of large buildings has come under the direct supervision of the electrical engineer who designed the electrical plant and system of distribution in the building, and where the results were nearly as woeful as if they had been left to an architect. But we should not criticise these things too harshly, because as a matter of fact it has only recently begun to be realized how important a part illuminating engineering plays in the electric lighting business. Five years ago the term illuminating engineer was not a recognized part of the vocabulary of the electric lighting business.

It has been the experience of the writer and of others who have given some attention to the business of illuminating engineering that most of the work that they are called upon to do in this line is in redesigning or altering of lighting arrangements already installed that some one has unwittingly made a botch of. The day is coming (although it is by no means at hand) when this will be avoided by having the lighting designed right in the first place when the house is built. In the smaller towns it largely rests with the central station companies to see that this is done. In the larger cities it lies mainly between the central station companies and the architects.

While the general principles of good illumination are easily mastered the practical application of these principles to the cases that arise in practice requires considerable exact and technical knowledge of what the various appliances on the market are and what they will accomplish. The ignorance of some men in the practical end of the central station business as to some of these things is astounding. It is time for them to wake up and find out what can and should be done with the product they are selling (light) to make it most effective. It is as the owner of a large hall once remarked to the writer after he had just been to the expense of a general overhauling of the lighting arrangement because of the inefficiency of the first plan tried. He said: "The ordinary man isn't supposed to know about this lighting business, but these electrical fellows ought to know enough to avoid such mistakes."

One thing that has always been in the way of good illuminating engineering is that lighting seems to the average person such a simple thing that it is hard to realize that skill, experience and technical knowledge are necessary to do a good job.

Most large central station companies have connected with their soliciting or contract departments an engineer who makes a specialty of power business, who is able to go to the owner of the private steam plant and figure intelligently with him in the light of previous experience, to determine the size and cost of motors needed, and, in fact, to do a considerable amount of free electrical engineering work for a customer in order to get him started as such. It is rare to find equally good illuminating engineers with a company, but such a condition is not going to exist always.

◆

New Telephone Patents.

CIRCUIT SYSTEMS.

As is well known, the earliest central battery systems employed a retardation coil with battery in the middle, and the whole bridged to the circuit, as a means of introducing current into talking circuits. This was followed by the repeating coil, with the two parts, the calling and called, separated and a single battery feeding both sides. Since there has been developed the two-battery system with both repeating coil and single and double retardation coil feed. Mr. K. B. Miller now brings out a double-battery circuit with double retardation coil feed, but with the calling and called parties interconnected, in so far as concerns the talking circuits, through a repeating coil. The rudimentary circuit, practically self-explanatory, is shown in Fig. 1. Mr. Miller has assigned his patent to the Kellogg Switchboard & Supply Company.

A second patent, assigned to the Kellogg Company, is one granted to W. W. Dean, which relates to lamp signaling for multi-section switchboards. With such boards, of large ultimate capacity, it will be remembered that the lines are divided into group of approximately 5,000 each, and each group is given a complete multiple switchboard, with that group alone multipled, but with answering jacks for all four groups.

In making a call a subscriber must select his answering jack situated on the proper switchboard, he having of course one answering jack and line signal on each board.

Mr. Dean accomplishes the selection by means of four push buttons and three relays. The combinations required are: Ground on one side of line, ground on the other side of line, equal ground on both sides, unequal ground on two sides. By using three relays signaling may be accomplished on relay associated with each side of line and one differentially associated with both sides. The operation of the differential and either of the line relays gives two selections. The operation of both line relays and failure of differential gives a third, while the operation of all three, i. e., where ground is unbalanced, gives the fourth combination.

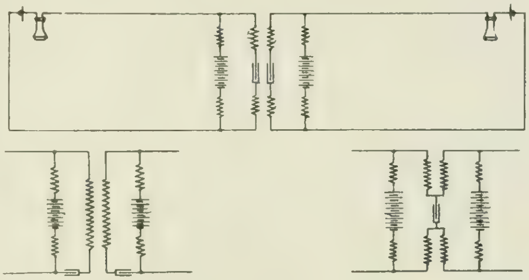


FIG. 1.—MILLER CIRCUIT SYSTEM.

COMBINED RINGER AND GENERATOR.

Fig. 2 shows in section a combined ringer and generator. When the generator armature is driven by the shaft, the home bell is rung through a mechanical connection between the armature and striker. When ringing current comes in from a foreign station this oscillates the armature of the generator, and through the mechanical connection strikes the bell. This apparatus is the invention of T. R. Campbell, of Aberdeen, S. Dak.

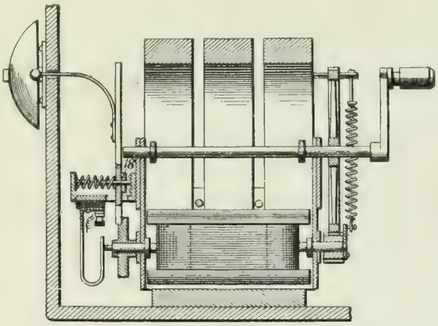


FIG. 2.—CAMPBELL COMBINED RINGER AND GENERATOR.

ANTISEPTIC DEVICE.

To the long line of transmitter antiseptic devices another has been added by O. H. Savage, of New York City. This consists of a metallic cap piece carrying an antiseptic pad, which is so associated with the transmitter as to be adapted to close over it when out of use.

◆

Searchlight on Pike's Peak.

A special dispatch August 29, from Colorado Springs, Colo., says: "To-night one of the greatest searchlights in the world will flash upon the west from the summit of Pike's Peak. Possessed of twice the power of the lights carried by great battleships, and built upon a track 120 ft. in circumference, with rotating contact, this marvelous light will fall upon the Kansas-Colorado State line, the Royal Gorge, Denver, and the Cripple Creek gold fields. The beacon may be observed 280 miles."

LETTER TO THE EDITORS.

Efficiency of Spark Coils.

To the Editors of Electrical World and Engineer:

Sirs:—I note with interest an editorial in the issue of August 12 entitled "A Field for Investigation" regarding the collection of data relating to the efficiency, etc., of spark coils. During the course of some work done for a thesis, I developed a method for the testing of spark coils and tested two coils of different make and design with the results noted below.

The work was very simple in principle and consisted in metering the watts and amperes primary input, and the secondary current and the watts developed in the spark. The watts input was measured with an ordinary low-reading Weston wattmeter, and the primary current with a hot-wire ammeter, adopted to give the effective value of the pulsating current. The value of the secondary current was determined by the use of the lamp bridge, described by Dr. Frederick Bedell in your issue of June 10, 1905, and which I developed for use in connection with this work. The heat development in the spark was measured by means of a calorimeter, which had previously been calibrated by means of a resistance coil inserted in it and warmed by the passage of a known direct-current, the rise of temperature for different expenditures of watts thus furnishing a basis for a calibration curve. It was assumed that all the energy not accounted for in the secondary copper loss and heat development at the spark was consumed in iron losess.

The coils tested were two in number; one built by Kohl for purely laboratory purposes and the other an Apple gas-engine coil designed for producing a hot spark rather than one of excessive length, as was the case with the German coil. The data of the tests are given below:

Coil tested	Kohl.	Apple.
Primary input, watts	7.89	6.3
Primary copper loss, watts	1.3	.52
Primary copper loss, per cent	16.5	8.25
Secondary copper loss, watts	.49	1.3
Secondary copper loss, per cent	6.2	20.6
Developed in spark, watts	.9	1.08
Developed in spark, per cent. (efficiency)	11.4	17.2
Total iron loss, etc., watts	5.2	3.4
Total iron loss, etc., per cent	66.0	54.0

These results were obtained in tests in which the coil was in continuous operation and not under actual conditions of engine ignition, i. e., intermittent action, but I send them to you for what they are worth, trusting that they may be of some little value. It seems as if the large iron loss might be somewhat reduced by making the core of finer wire, although the increase in cost of manufacture might not be counterbalanced by the increase in efficiency.

Wilkinsburg, Pa. C. A. Carpenter.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Kinetic Variation of Pressure of Generators.—Russell.—By the "drop in pressure" is meant the difference between the no-load and the full-load voltage when the machine is run at constant speed and constant excitation. While this value is of practical importance, it seems of greater importance to know how the voltage of a machine varies with its speed. The author refers to some recent investigations of Boucherot and Guéry. What one wants to know in practice is the percentage variation of the e.m.f. produced by an x per cent drop in the speed, or in other words, what is the ratio of the percentage variation of the e.m.f. to the percentage variation of the speed. This ratio in self-excited machines is called the kinetic factor of the e.m.f. for an infinitely small percentage variation of speed. The author shows how to determine the kinetic factor from the characteristic curve which shows how the e.m.f. generated varies with the excitation. The author first determines the kinetic factor of a series dynamo. In Fig. 1 OP is the total characteristic of the machine when the armature rotates with a constant angular velocity. The ordinate, PN, represents the total e.m.f., and the abscissa, ON, represents the current around the circuit. In this case the kinetic factor equals the ratio of TN to TO. It is to be noted that its value depends only on the strength of the current round the circuit, and consequently only on the strength of the magnetic field. The kinetic stability of the machine depends, therefore, on the strength of the magnetic field. For weak fields the kinetic factor is large and for strong fields it approaches the value unity. The author then discusses the case of a shunt dynamo and shows that the greater the value of the current in the shunt windings, the greater the value of the kinetic factor, and, therefore, the greater the stability of the running. As to the best value of the kinetic factor, it is said that if expense were no object the kinetic factor could be made equal to 1.1 for instance, by designing the machine so that the iron in the magnetic circuit was subjected to very high magnetizing forces at the normal load. In practice, however, a machine with a kinetic factor which is not greater than 2 at the normal load is found to satisfy all reasonable requirements. The author finally discusses the kinetic factor of an alternator with the exciter geared to the shaft.—Lond. *Elec.*, August 4.

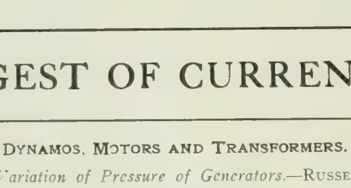


FIG. 1.—TOTAL CHARACTERISTIC OF SERIES-WOUND DYNAMO.

Polyphase Rotors.—Pumphrey.—Some notes on the winding of polyphase rotors. The author gives data collected from the leading English makers showing an enormous discrepancy in the secondary voltage in the rotor (between slip rings) in machines of the same size and the same primary voltage, but made by different manufacturers. This shows that it would be very difficult to standardize three-phase starting and controlling gears. Cases frequently arise where two motors of similar horse-power and connected on the same circuit, but of different makes, have rotor currents in the ratio of two to one. The cross-section of the copper required in one set of controlling gear is thus double that of the other, the resistances are of widely different design, and the prices also differ considerably. From the point of view of cheapness of starting and controlling gear, it is certainly advisable to work with low secondary currents and moderately high voltages. "Where female labor can be employed for rotor winding, it is essential to use thin wire, for obvious reasons, and practice shows that it is cheaper to wind thin wires in series than in parallel. This, of course, necessitates high voltages. On the other hand, where male labor is employed, it is usually less expensive to wind with thick wire or copper strip, and designers, as a result, prefer to employ large currents in the rotor, and correspondingly low voltages." Moreover, if the voltage is kept low, the insulation question becomes of less importance, and additional saving can be made in this direction.—Lond. *Elec. Rev.*, July 14.

Alternator.—Reyval.—An illustrated article describing a steam-driven generating set exhibited at the Universal Exhibition in Liege. The generator is built by the Alioth Company and gives 235 kilovolt-amp. at 3,000 volts with a frequency of 50 periods per second, when running at a speed of 500 r.p.m. It is of the revolving-field type and has 12 poles. The construction is described and illustrated in detail, and the dimensions are given in a table.—*L'Eclairage Elec.*, August 12.

Alternators.—Preuss.—An article, illustrated by diagrams, on a method of determining the stray flux of the exciting field of alternators.—*Elek. u. Poly. Rundschau*, August 1.

Testing Alternators.—Remar.—An article giving hints on the testing of alternators.—*Elek. Anz.*, July 30, August 3 and 6.

Dynamos with Commutation Poles.—ROTH. Some notes on observations which the author made with a machine provided with commutation poles, and which he considers to be not in accordance with the usual theory. Further investigations are suggested.—*Zeit. f. Elek* (Vienna), August 6.

LIGHTS AND LIGHTING.

Street Lighting in London.—Some notes on a decision of the corporation of the City of London to replace about 1 10th of its public arc lamps by incandescent gas lamps. The installation of the latter is only an experiment, but the experiment is to be performed under considerations distinctly unfavorable to the case of electric lighting. While the most modern system of incandescent gas lighting is to be installed the electric company is not given an opportunity to replace the arc lamps put in about 14 years ago.—Lond. *Elec.*, August 4.

POWER.

Single-Phase Cranes.—PERLEWITZ.—An illustrated article on single-phase cranes used in the Cologne-Dentz harbor. The mechanical equipment is described in great detail. The motors are single-phase machines of the Winter-Eichberg type. Each crane is provided with three motors, one of 40 hp and two of 10 hp each. The voltage is 500 and the frequency 50. The current is supplied from a transformer station which is directly connected to the 2,100-volt, single-phase supply system of the city. The motors are controlled by means of transformers by regulating the voltage at their terminals.—*Elek. Zeit.*, August 10.

Shunt Motors for Electric Cranes.—HILL.—An explanation of the advantages which the shunt motor offers for driving the hoisting gears of cranes, more especially when these gears are remote from the controller. The complete equipment for a shunt motor hoisting gear consists of the motor itself, a plain on-and-off electromagnetic brake, a drum controller and a shunt regulating switch placed conveniently. A circuit-breaker is also advisable. With this arrangement the controller is so designed that, on the first step, the motor-magnet is always fully excited, irrespective of the position of the shunt regulator, so that on this step a speed as slow as desired is obtained. The controller has contacts corresponding to and connected with the contacts on the shunt regulating switch. As it is moved over it cuts into the magnet circuit the amount of resistance determined by the position of the shunt regulating switch, so that when the controller is full on the speed of the motor corresponds to the position of this switch. When lowering, the shunt motor shows specially to advantage, as, when overhauled by the load, it commences to produce current, and the current so produced not only opposes a torque to the motion of the load sufficient to keep its speed within the limit set by the regulating switch (so saving wear of brakes), but it also feeds the circuit, and so helps to drive other machines. Some diagrams are given.—Lond. *Elec. Rev.*, July 14.

Lifting Electromagnets.—SCHIEMANN.—An article in which the author considers the action of lifting electromagnets by applying the principle of the conservation of energy. He develops the following formula: The mechanical work of electromagnets equals one-half the ampere turns multiplied by the variation of the magnetic flux due to the movement of the armature. Or, in other words, if the magnetic flux of an electromagnetic system of constant magnetomotive force varies it performs mechanical work equal to one-half the product of the number of ampere turns and the change of the flux.—*Zeit. f. Elek.* (Vienna), August 13.

Oil Fuel for Power Plants.—A continuation of the serial on the economy of steam power plants using oil fuel. Tables are given for the approximate cost of power at the switchboard per kw-hour for office building plants. It is estimated that a plant having two 50-kw units will develop power, based on oil at 75 cents per barrel, at a rate in the neighborhood of 3 cents per kw-hour, or less, depending on the load factor. A plant of 400 kw capacity at the same fuel rates will develop power at a net cost from 1.6 to 2.6 cents per kw hour, depending on the load factor, etc.—*Jour. of Elec., Power and Gas*, July

Tunnel Construction.—HERZOG.—A fully illustrated article on the construction of the Karavanken Tunnel in Austria. Electric power is being used for many purposes of the construction, and the authorities contemplate in future electric operation of the Karavanken Railroad.—*Elek. Bahnen*, June 24, July 4 and 14.

Electric Winding Machines.—HABETS.—The first part of an illustrated reprint of his paper which was abstracted recently in the Digest.—Lond. *Elec.*, August 11.

Gas Engines.—MATHOT.—A paper on the increasing use of large gas engines in Continental Europe.—Lond. *Elec.*, August 11.

Power Plant.—KNOWLTON.—An illustrated article on the power plant of the United Shoe Machinery Company, at Beverly, Mass. The electric generating equipment consists of two Curtis steam turbines, each direct-connected to a four-pole, 600-volt, three-phase, 60-cycle, 500-kw alternator.—*Eng'ing Record*, August 19.

French Power Transmission.—An illustrated description of the transmission plant of the Société d'Energie Electrique du Littoral Mediterranean, destined to supply power to Toulon. A voltage of 28,000 will be employed, which "is a big advance on anything of this nature previously attempted in France." The generating plant includes three sets each composed of a 1,000-hp turbine direct coupled to a 700-kw, three-phase alternator.—Lond. *Elec. Rev.*, July 21.

Innsbruck.—The first part of a fully-illustrated description of the hydraulic equipment of the Sill power plant utilizing the waterfalls of the Sill River for the generation of electrical energy for lighting and power purposes in Innsbruck, and for the operation of the Stubaital Railway.—*Elek. Bahnen*, June 14.

TRACTION.

Single-Phase Traction in Belgium.—DIETL.—A fully-illustrated article on single-phase traction in the Borinage district, which is the Southern coal region of Belgium. The railways in this district are owned, like all interurban roads in Belgium, by the Société Nationale des Chemins de Fer Vicinaux, which operates at present roads with more than 1,300 miles of track. This company was one of the first to introduce electric traction in Europe, but it could do so only on five of its lines, which in their character resembled street railways. All other lines were operated by steam, although the company always intended to introduce electric traction. When direct current at 600 volts was found to be uneconomical the company asked for bids for a three-phase system, but the tenders did not fulfill the expectations. It then concluded in March, 1903, to use the single-phase system, and this would have been the first commercial line of this system in Europe if there had not been delays in acquiring some land needed. The total length now equipped with the single-phase system is 12 miles, but this will be extended to 77 miles, which will be supplied from one point with single-phase current at 6,600 volts. For the lines equipped at present the voltage is reduced in transformers along the line to 600 volts, while for further extensions a higher voltage will be employed on the trolley wire in order to reduce the number of transformers needed. The company does not own a power plant, but buys the power from a lighting and power company. The frequency is 40 periods per second. The equipment of this power plant is described in detail. It contains only three-phase generators and for traction two phases only of the generators are used. The arrangement is illustrated in diagrams. There will be four transformer stations, operating in parallel on the network. Since there are telephone lines in the neighborhood which use the earth as return, the rails could not be used for the return traction current; there are, therefore, two overhead trolley wires. The motors are of the Winter-Eichberg type. Each motor car contains two 40-hp motors. The characteristic curves are not as good for a frequency of 40 as for a frequency of 25, but are said to fulfill all the requirements of the service. Regulation is obtained by series parallel control in connection with a regulating transformer; the connections of the stator winding (only) are changed, while the rotor windings are always connected in series. The regulating transformer is built as an autotransformer. There are no resistances used for starting, but a resistance is employed for the change-over from the series to the parallel connection. The system has been in operation since April 6, and has proven perfectly satisfactory.—*Elek. Bahnen*, June 3; more briefly in *Zeit. f. Elek.* (Vienna), August 13.

Ward Leonard System for Traction in Switzerland.—An account of experiments made by the Oerlikon Company with the Ward Leonard system. Some of the results of the experiments have now been made public. The locomotive weighs complete about 44 tons and it has been employed during the trials for hauling trains varying in weight from 125 to 255 tons. In connection with a 200-ton train (excluding the weight of the locomotive) a speed of 18 miles per hour on an 0.8 per cent grade is said to have been obtained; the power of the locomotive, measured at the rim of the driving wheels, being approximately 200 kw. During the run mentioned the power supplied to the low-pressure terminals of the step-up transformers at the power house averaged 300 kw. On level track this train accelerated to a speed of 18½ miles per hour in 57 seconds, the motors running sparklessly all the time. It is stated that the electric braking is so simple and efficient that it is always used in preference to braking with the compressed air outfit. The following data refer to a particular run on an 0.8 per cent grade, the locomotive hauling a 200-ton train: Line voltage, 15,000; speed, 16.8 miles per hour; average supply from the power house, 310 kw; average power at the rim of the driving wheels, 216 kw; total efficiency, 69.5 per cent. It is computed that the individual efficiencies are as follows: Motors and gearing, 86 per cent; motor-generator, 85 per cent; locomotive step-down transformer, 98.5 per cent; the exciter and air pump consumed 2 per cent of the total energy, and the losses in the overhead line amounted to 0.5 per cent. The watt-hours per ton mile came to 68.2 on the grade, and 23.7 on the level.—Lond. *Elec.*, August 4.

Interurban Railway in California.—A fully-illustrated description of the San Jose & Los Gatos Interurban Railway. The electric current is supplied from sub-stations which are fed from the large California power companies.—*Jour. of Elec., Power and Gas,* July.

Calcutta.—An illustrated description of the Calcutta electric tramways, which cover a total length of 23 miles of double track. This system is the largest and most important of the tramway systems of the East.—Lond. *Elec. Rev.*, July 14.

Underground Distribution of Power for Traction.—HEYWOOD.—An illustrated discussion of the requirements of feeders, ducts and conduits for underground power distribution for urban electric traction.—*St. R'y Jour.*, August 19.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Central Station Transformer Testing—Insulation Tests.—NESBIT.—An article illustrated by diagrams on the tests for finding the copper loss, the regulation and ratio, the iron loss, the temperature variation and the insulation of transformers. Complete insulation tests consist of insulation resistance, over-potential and puncture tests. For making all insulation tests it is desirable to have a portable testing transformer wound to give various voltages between 100 and 15,000 volts. In the absence of a regular testing transformer six or nine ordinary lighting transformers thoroughly insulated from each other and connected in series, as shown in Fig. 2, may be used. The transformers *A*, *B* and *C* shown in this sketch are used simply to insulate the high-voltage circuit from the source of power and to limit the strain to which the insulation of the six testing transformers are subjected (by reason of their high-tension windings being all connected in series) to 6,000 volts. These three transformers may be dispensed with and the high-tension windings of the remaining six connected in series. Grounding the middle point of this series will relieve it of excessive strains. If this ground connection is made it will be necessary to thoroughly insulate all the transformers, including the transformer being tested, from the ground. Before proceeding with the insulation test it is desirable to insert an adjustable spark-gap between the 10,000-volt leads of the testing transformers so as to make certain that the voltage strain from the testing transformers does not exceed that produced by 10,000 volts. If the voltage has a sine wave form 5,000 volts will jump through dry air between sharp needle points at a distance of 0.225 in.; for 10,000 volts this distance is 0.470 in., 15,000 volts 0.700 in., 20,000 volts 1.000 in., 25,000 volts 1.300 in., 30,000 volts 1.625 in. If the voltage has a peaked curve a given voltage will jump a greater distance. With a 10,000-volt circuit the procedure is as follows: Space the needle points on the spark-gap 0.47 in. apart, connect the spark-gap across the 10,000-volt circuit and insert all of the variable resistance in the primary circuit; now throw in the line switch and gradually cut out the variable resistance until the current jumps across the gaps, and note at what deflection on the voltmeter this jumping occurs. This will be the deflection to use in making tests on transformers for a 10,000-volt strain. The actual voltage may vary above or below 10,000 volts according to the form of the wave, but the transformer will receive a strain equivalent to that of a 10,000-volt sine wave. In making this test both high-tension leads of the transformer under test should be connected together and to one of the 10,000-volt leads. Connect all the low-tension leads together and to the other 10,000-volt lead with the low-tension leads also connected to the core and the case. Disconnect the spark-gap, throw in all the variable resistance, throw in the line switch and cut out the variable resistance until the voltmeter indicates the same deflection as was indicated when the spark-gap was ruptured. Hold the voltage at this point for about five seconds, then cut in the variable resistance and open the line switch. The insulation between the low-tension winding and the core may be tested in a similar manner by setting the spark-gap for the required voltage and changing the connection to the testing transformers. If there is a considerable discrepancy between the spark-gap method of determining the voltage and the voltmeter reading multiplied by its ratio of transformation, investigation should be made at once. Some notes are added on the calculation of the efficiency of transformers.—*Elec. Jour.*, August.

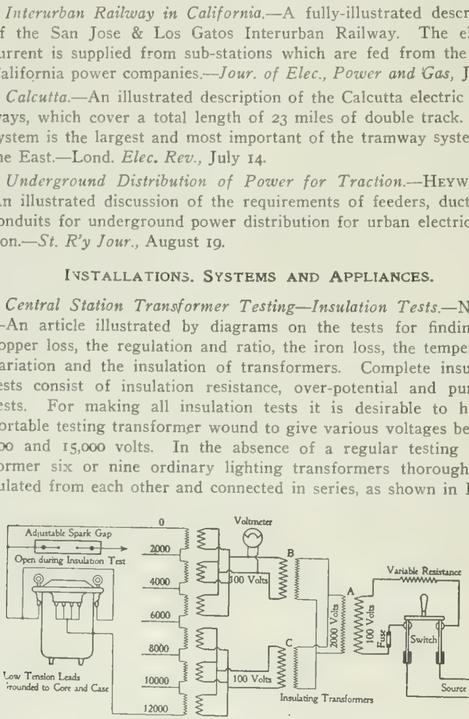


FIG. 2.—CONNECTIONS FOR INSULATION TEST.

British Gas-Driven Stations.—Reports on last year's accounts of the stations of Ryde and Walthamstow, both of which are gas-driven. The Ryde station sold during the last year 78,505 kw-hours. The total work cost was 6.04 cents per kw-hour sold; the cost, including management charges, was 10.04 cents. The capital expenditure was as high as $1,105.55 per kw. The load factor was 10.5 per cent. At Walthamstow the results were as follows, the figures in parenthesis giving the results for the year before last for comparison: The number of kw-hours sold was 1,062,446 (840,187). The total works cost was 2.72 cents (2.74) per kw-hour; the total cost, excluding capital charges, 3.28 cents (3.52), the total cost, including interest, repayment of loan 6.12 cents (6.78). The capital expenditure was $386.20 ($694.30) per kw. In an editorial note it is pointed out that this is not a favorable showing for gas-driven plants. "However suitable gas engines may be for driving small isolated electric light plants, they cannot compare with steam engines for small public supply stations." It is said that "undoubtedly far better results would be obtained from larger stations with units of larger size, but figures are still lacking to show whether the large gas engine will prove in the end more economical than the large steam turbine or the reciprocating engine." The high overload which the steam turbine can carry with economy is also greatly in its favor as compared with the gas engine, for it represents spare plant capacity in a factory of large size.—Lond. *Elec.*, July 28.

Berlin Electricity Works.—An abstract of the annual report of the Berlin Electricity Works from July 1, 1903, to June 30, 1904. A dividend of 9½ per cent is to be paid. By reducing the price of electric light numerous new consumers have been obtained and large consumers have been induced to quit generating current themselves. The following table shows the development, the figures representing kw-hours sold:

	1894-5.	1902-3.	1903-4.
Private lighting	5,916,970	14,514,303	16,727,266
Public lighting	359,200	1,817,876	2,016,797
Power purposes	1,070,926	24,728,948	30,326,974
Storage battery plants	....	2,361,021	3,245,878
Street railways	....	41,425,300	45,166,449
Consumption for the purposes of the company	119,028	921,231	1,018,040
Total	7,466,124	85,768,679	98,501,404

It will be seen that the consumption of current for power purposes and traction is considerably greater than for lighting purposes.—*Elek. Bahnen*, June 3.

Dublin.—Some notes on recent extensions of the Dublin electric station which up to the present contained four three-phase, 5,000-volt generators, two having an output of 1,000 kw each and two of 500 kw. Recently an additional 1,500-kw set has been installed.—Lond. *Elec.*, Aug. 4.

Motor Load Factor and Station Load Factor.—TAYLOR.—A communication referring to the differences in practice in giving discounts. Some allow discounts in direct proportion to the load factor of the individual consumer's motor, thus in great measure neglecting the station load factor, while on the other hand the Dundee system of charging practically bases everything on the station load factor. The author formulates some ideal cases to show that both methods are wrong. Both motor load factor and station load factor must be used with judgment, the one to determine charges outside the station and the other those inside it. In actual practice the station load factor diminishes with a decreasing motor factor even though the motor connections be increased in the inverse ratio.—Lond. *Elec.*, July 14.

Induction Motor as Generator.—BUTT.—A paper describing the use of a dismantled induction motor as a generator during hours of peak load in Johannesburg.—Lond. *Elec. Eng.*, July 21.

ELECTROPHYSICS AND MAGNETISM.

Evolution of Hydrogen from the Cathode.—SKINNER.—In a study of the cathode fall of various metals, in helium he found a continual evolution of hydrogen; the source of the same was located in the cathode, and he found that the quantity of hydrogen evolved by a fresh cathode obeys Faraday's law for electrolytes, and that a fresh anode absorbs hydrogen according to the same law. Sixteen different kinds of metals were tested as cathodes, and all except two were found to give off hydrogen at a measurable rate. It was found that the metal recovers a supply of hydrogen by diffusion from within. With fresh electrodes the hydrogen atom serves in all cases as carrier of the electric current from cathode to gas. With a gas filling of hydrogen, the atom serves also as carrier from the gas to the anode, by which it is absorbed. In helium on the other hand the hydrogen atom leaving the cathode discharges to the helium and this transmits the current to the anode, the negative helium ion discharging without being absorbed. Most remarkable of all is the fact that, though there is a considerable concentration of free positive ions at the cathode surface, they do not discharge to the metal so long as it furnishes hydrogen sufficient to carry the current. This condition may last several minutes. Even the positive hydrogen ion does not enter into electrical union with the metal, though a negatively charged hydrogen atom is readily absorbed by it.—*Phys. Rev.*, July.

Hysteresis Loss.—HERRMAN.—In 1896 Grau and Hiecke made experiments from which they concluded that the hysteresis loss in iron in a revolving field is about double that in a single-phase alternating field. The present author has repeated and modified these experiments and shows that this conclusion is not correct. It is impossible to detect any essential difference between the two kinds of magnetization.—*Elek. Zeit.*, August 10.

Magnetic Rotation.—WOOD AND SPRINGSTEIN.—An account of an experimental investigation of the magnetic rotation of sodium vapor. —*Phys. Rev.*, July.

Color in Platinum Films.—ISABELLE STONE.—An account of experiments on the production of color rings by cathode discharges, using a platinum point as cathode.—*Phys. Rev.*, July.

Radioactive Substances.—Illustrated notes on the methods of testing radioactive substances.—*Zeit. f. Beleucht*, July 30, August 10.

ELECTROCHEMISTRY AND BATTERIES.

Electric Furnace for Making Steel.—HARBORD.—A discussion of the large field which exists for the electric furnace in England. He refers to the large quantities of Swedish pig iron imported to England for use in open-hearth furnaces for the manufacture of special qualities of high-class steel for large forgings, axles, etc. Another important branch is the production of dynamo steel of exceptional purity and low hysteresis, and in this direction the electric furnace promises great things, since steel of the greatest purity, low in carbon and manganese, can readily be produced. "If we add to these the manufacture of all kinds of ordnance, armor plate, projectiles, rifle, bayonet and other high-class steel, we see that without attempting to compete with Bessemer or ordinary open-hearth structural steel there is an immense field open to the electric furnace." The author discusses the various types of electric steel furnaces, and thinks that "from a practical engineering and metallurgical standpoint there can be no doubt that the Heroult furnace is far better designed to meet the general requirements of the steel manufacturer than either the Stassano or Kjellin furnace." "That steel made in the electric furnace should possess superior properties to steel of similar composition produced either in a Swedish Bessemer converter or in an open-hearth steel furnace may seem at first to be claiming a great deal, but such appears to be undoubtedly the fact, and this is due probably to its production in what may be regarded as a practically neutral atmosphere under conditions in which the occlusion of gases and overoxidation are reduced to a minimum."—From Eng'ing Supplement of Lond. *Times; Iron Age*, Aug. 24.

Electricity in Water Works.—GERARD.—A long illustrated paper on the use of electric power in connection with the water works of Breda, Netherlands. Alternating current is taken from the lighting network which is operated on the three-wire system with 200 volts between the outers. In the water works electricity is used for the operation of the pumps and for the production of ozone for the sterilization of the water. Ozone is produced by means of silent discharges at 65,000 volts. One kw-hour is stated to give 7 grams of ozone. The cost of the filtration and sterilization of water is stated to be one cent per cubic meter, of which amount 0.234 cent is due to the ozone treatment. Twenty cubic meters of water are purified per hour.—*Bull. Mens. Soc. Belge d'Elec.*, August.

Aluminum Rectifier.—PETERS AND LONGE.—A preliminary account of experiments on the influence of the nature of the electrolyte on the efficiency of the aluminum rectifier.—*Elec. Zeit.*, August 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Small Resistances.—HAUSRATH.—A description of differential method for measuring small resistances. It is a modification of the differential method of Kohlrausch. The small resistances required in the latter are rendered superfluous by using a measuring wire with sliding contacts. As shown in Fig. 3, the measuring wire is formed by two parallel wires, and the condition $w'' = w'''$ is practically fulfilled by connecting the two sliding contacts with each other by means of an insulating material. A three-pole switch permits of connecting the source of current alternately with the higher or lower wire. The calculation requires the equality of the resistances w_1 and w_2. If an unknown resistance x is inserted, and the sliding contacts are so adjusted that the galvanometer shows no deflection, then $x = w'$ multiplied by a constant. The relation becomes especially simple if the measuring wire has a resistance of one ohm, and a shunt set of 1-9, 1-99, 1-999 ohm is used. The author describes and illustrates a shunt which is stated to be specially useful for his purpose. The method is especially suitable for testing conducting materials if the conductivity is to be found in percents of the conductivity of pure copper.—*Elek. Zeit.*, July 27; from *Ann. d. Phys.*, Vol. xvi, 1905, p. 134.

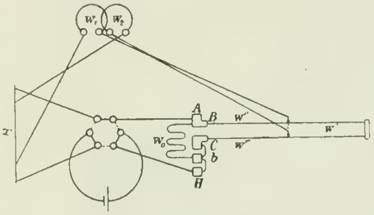


FIG. 3.—MEASURING SMALL RESISTANCES.

Measurement of Current by a Quadrant Electrometer.—STEWARD.—An abstract of a Physical Society paper on the methods in which a current flowing into a conductor connected to one pair of quadrants is measured by determining the velocity of the needle. This is the usual method in radioactivity work. Two cases are considered: First, that where the change in capacity of the electrometer due to the motion of the needle does not appreciably affect the capacity of the apparatus, and second, the more general case, where the capacity is treated as a variable.—*Phys. Rev.*, July.

Polarization of Standard Cells.—RAMSAY.—An abstract of a Physical Society paper on experiments made to determine the character of polarization of cadmium cells containing mercurous sulphate when connected to a battery.—*Phys. Rev.*, July.

Alternating-Current Laboratory Testing.—ROWE.—A continuation of his serial, illustrated by diagrams. In the present instalment he discusses synchronous motors.—*Jour. of Electricity, Power and Gas*, July.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy in Great Britain.—An article giving statistical data on the condition of wireless telegraphy in Great Britain for the first three months of 1905. Data are given on the number of messages transmitted, and it appears that the public has not availed itself to any great extent of the privilege of telegraphing to ships at sea, although the passengers on these ships have sent many communications to their friends on shore. During three months only 111 outgoing messages were handled, and of these no less than 21 failed to reach their destination. The number of incoming messages was 1,655. The total revenue to the Marconi Company from wireless telegrams to and from ships is estimated as $2,220 for three months, which is a small amount in view of the heavy establishment charges. Information is also given on the applications which have been made for wireless telegraph licenses under the British wireless telegraph act. Only 10 out of 73 applications are for commercial work or private business purposes. Some progress has been made in the case of applications from the two American companies—the DeForest Company and the National Electrical Signalling Co. (Fessenden system). The latter company has been granted a site at Machrihanish Bay (about 10 miles north of the Mull of Kintyre on the west coast of Scotland), and the DeForest Company has been offered the choice of the Hebrides and the west coast of Scotland (presumably at some distance from the Fessenden station). Both of these licenses are considered to be for "experimental" purposes, in the first instance at any rate. In summing up it is said that the most important application of wireless telegraphy continues to be for naval and military purposes and for signalling to and from ships at sea.—Lond. *Elec.*, July 28.

Automatic Intercommunicating Telephone.

The accompanying illustration shows a type of intercommunicating telephone whereby it is possible to call with the receiver either on or off the hook, and also to communicate with several stations simultaneously by pushing in two or more of the buttons at the same time. It is obvious that the set can be used to serve as a fire alarm by pushing all the buttons simultaneously and giving one long ring or other prearranged danger signal. One of the features of this apparatus is that buttons are restored automatically upon hanging up the receiver. The mechanism for talking and ringing has two [illegible] contacts; all the springs of the apparatus are made of phosphor bronze and the buttons of hard rubber. The communications are soldered and insulated with mica, and the insulation of [illegible] is of hard rubber. The interior wiring is tin covered and has a double insulation, one of cotton and one of silk. The apparatus, which can be arranged to connect with long-distance systems, is particularly applicable for intercommunicating services for school, flat and apartment-house systems. This instrument is made by the De Veau Telephone Manufacturing Company, New York.

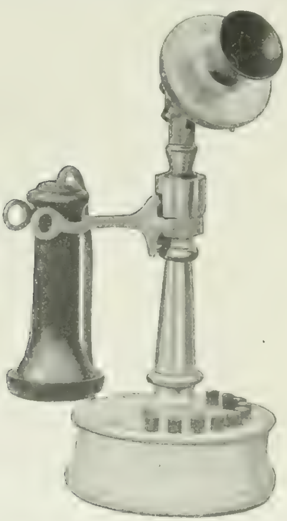


FIG. 1.—INTERCOMMUNICATING DESK TELEPHONE

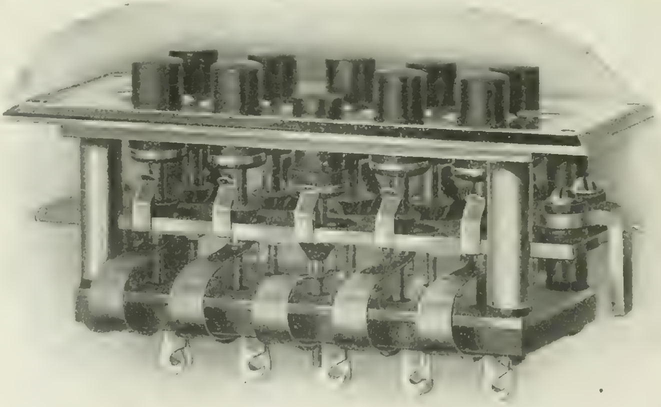


FIG. 2.—SWITCH MECHANISM

Electric Traction Equipment for West Shore Railroad.

Another step in the electrification of leading railroad systems has been taken in the award of contracts for the equipment of the West Shore Railroad from Utica to Syracuse, N. Y. These contracts have been placed with the General Electric Company for motor equipments and sub-station apparatus, including four sub-stations, each to have four 300-kw rotary converters. The engineers are still undecided between third rail and a side-contact system. An overhead trolley was considered undesirable because of the gases arising from steam locomotives, and because of the danger to trainmen on tops of freight cars. The line voltage will be made to conform with that of the Utica & Mohawk Valley, with which the Syracuse-Utica line will be connected. The West Shore between these points is being four-tracked, and two tracks will be equipped for electricity. The West Shore through passenger trains between these points will be diverted to the New York Central tracks; in fact, this is being done very largely at the present time. Freight trains will continue to operate as heretofore.

To fill the gap between Syracuse and Rochester, the Andrews syndicate has acquired the Rochester & Eastern Railway, operating from Rochester to Geneva, 50 miles. The 50 miles from Geneva to Syracuse will be filled either by electrifying that portion of the Auburn branch or building a separate line. Between Rochester and Buffalo the syndicate has no plans that it cares to speak of at present, but the West Shore tracks could be utilized. As outlined this gives a continuous line from Rochester to Little Falls, a distance of about 160 miles, the plan for operation of which has been fully determined upon. The syndicate owns the Schenectady Railway, operating a 14-mile line from Schenectady to Albany, with other lines to Troy and Ballston Spa. From Schenectady westward to Tribes Hill, 22 miles, is the fine double-track line of the Fonda, Johnstown & Gloversville Railway. It is denied that this system has been acquired up to the present time. From Tribes Hill to Little Falls, 35 miles, there is no line at present. For current the Utica & Mohawk Valley leases from the Trenton Falls water power. This service will be abandoned as soon as the 33.000-volt transmission lines from the plants of the Hudson River Power Company, near Lake George, and which are now supplying the Schenectady system, are extended westward to Syracuse, giving a transmission line of about 126 miles. From Syracuse westward the power will be supplied from Niagara Falls, a contract having recently been made with the Ontario Power Company.

The Manufacture of Electric Automobiles.

In some electrical quarters, even those which are likely to consider themselves well informed, there has been prevalent an idea that the electric automobile industry has latterly been in a quiet if not declining condition. As a matter of fact, this is, however, very far from the truth, and it may be doubted whether at any time in recent years this branch of electrical manufacture has been in a more healthy condition than it is to-day. There is no boom, it is true, as there once was, but on the other hand the output appears to be increasing steadily, the demand is improving, prices have a more direct relationship to the rules of demand and supply, and for all purposes save those of a long tour the electric automobile appears to be better able than ever to hold its own. This is particularly true with relation to city commercial and industrial service, and to-day one has but to use one's eyes to note the large and increasing number of electric automobiles of all classes that are circulating the streets, rapidly if of the delivery type and more slowly if of the heavy dray variety, but all doing their work successfully and economically. Moreover, aside from such vehicles, there is a large and growing number of private automobiles replacing vehicles of the horse-drawn type, and in such cities as New York the electric hansoms and broughams certainly show no signs of diminution, but are in the briskest service at all seasons. It is believed, also, that the electric stage or omnibus in some form or another still has its day to come and will soon be in general application.

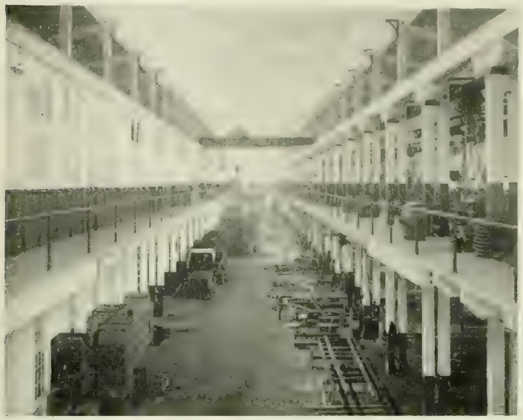


FIG. 1.—VIEW IN MAIN AISLE.

Pertinent application to these remarks may be given by the statement that the Vehicle Equipment Company, of Long Island City, which did not get down to business until about four years ago, has since then built, equipped and put in operation some 800 electric automobiles for 300 different concerns, nearly all of these machines being for industrial purposes, and the great majority of them continuing in operation down to the present moment. Such a record as this should give food for reflection, and be encouraging and stimulating to central station managers who see in the supply of current to such vehicles a large possible field which only needs cultivation and development. Up to the present moment the support given to the electric automobile by central stations has not been particularly marked, but with the lower price of current the vehicle comes most directly within practical range, and local companies everywhere are beginning to give attention to a subject which long ago should have received consideration at their hands. Obviously an enormous business offers here for central station people, supply men and the electrical industries in general, and a few calculations which any one can make would readily show how vast is the market thus to be opened up. It is well known that the cost of storage battery renewal has been the standard and stock argument standing in the way of the more rapid development of the electric wagon business, but to-day there is a mass of data available from which, we do not hesitate to say, it can be easily demonstrated that trackless transportation for freight, material, express, etc., can be more economically developed with storage batteries than with gasoline engines, and that for most of the utilitarian purposes in the city the battery wagon is far superior to its gasoline competitors. There is doubtless an excellent field for gasoline wagons, but it is undeniably true that the scope is small compared with that for electric commercial automobiles in all our great cities.

The Vehicle Equipment Company was organized about January 1, 1901. During the first year it built about fifteen wagons. Since that time the business has steadily grown until this year it is delivering on an average one wagon per day, while the indications are that the increase of business will develop at a greater rate than this. The company began its operations in one corner of a car barn belonging to the Brooklyn Heights Railroad Company, at Thirteenth Avenue and Thirty-seventh Street, Brooklyn, and gradually annexed the entire property. About a year ago, July 5, 1904, the factory was practically wiped out by fire, and steps were immediately taken to secure a larger plant in a better locality. Temporary buildings were erected on the old site, sufficient to carry on a limited business until March of this year, when the business was moved into the new factory erected in Long Island City for the purpose.

The company bought, last summer, five acres of land between Borden Avenue and Newtown Creek, Long Island City, about a mile from the Thirty-fourth Street Ferry. It erected a fine factory-type main building 500 ft. long and 100 ft. wide, two-story gallery construction, and which has been surrounded by minor buildings, such as battery room, lumber store, etc. The heavy materials are handled by a Northern electric crane, and a side track from the adjacent Long Island road enters the building. The factory has been planned so as to bring the various operations in wagon manufacture as closely together as possible. A commodious suite of offices occupies a portion of one of the galleries. Parts of the building are here illustrated.

The company started originally with the intention of developing mechanical vehicles for commercial purposes and was prepared to develop such vehicles propelled by either gasoline or electric power. So far most of the work has been in electric vehicles, and the company believes firmly that electricity can be counted upon for the motive power of a large proportion of the trucks and wagons required in the big cities of the United States. It has, however, built trucks operated by gasoline engines and is prepared to meet any demand for such vehicles in the future.

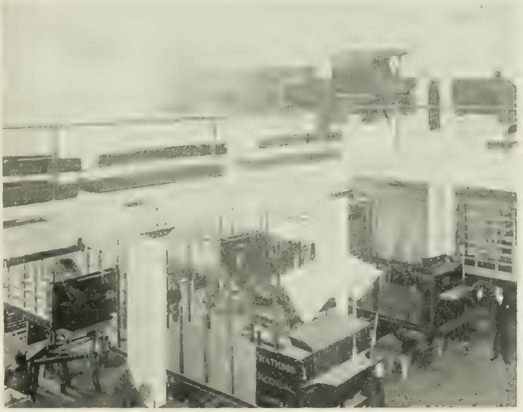


FIG. 2.—A BAY AND GALLERY.

The Vehicle Equipment staff and executive, while adhering to its original plan of developing and pushing the commercial vehicle, has also developed a line of electric pleasure carriages. The company adopted in the beginning a general arrangement of running gear which it has improved from time to time, but from which it has not departed materially, so that its wagons and trucks of all designs and for all purposes can be recognized by the mechanical features of the running gear. The company has believed that it is to great advantage to have one type of running gear and stick to it until it has some good reason to change. It does not build its own electric motors, nor does it limit itself to the use of either spur gear transmission or transmission by chains, but the frame of the vehicle and the axles, brakes, steering gear, etc., have been from the beginning of the same general design. The company has developed a number of types of automobiles which have become common on our streets. It built the first "sight-seeing coaches," since come to great popularity in the United States, and it has developed trucks and wagons for a great many special purposes which have become standard types, such as machinery-hoisting trucks, cable-handling trucks, dumping trucks, beer trucks and various other practical vehicles, which are now used, as noted above, by 300 of the merchants in the United States, some of whom are operating a considerable number of vehicles. The best evidence that they are satisfactory is to be found in the "repeat" orders from firms who were the customers of the company four years ago and have increased their number of wagons each year since.

It is not to be denied that in some cases the purchasers have been disappointed, but when it is taken into consideration that they represent less than 2 per cent of the total number of wagons built by the company it is reasonable to infer that the wagons are doing satisfactory work. The company has naturally profited by the experience of the operation of a great many vehicles in the hands of its customers under various conditions of service, and it has abundant data as to the cost of operating electric wagons as well as other kinds of automobiles and horse vehicles, and with this experience and all these facts in its possession it did not hesitate to build this large new factory and acquire a large reserved acreage of property to meet the business which it expects to get in the near future.

The company's product has become standardized as far as the output of any industrial enterprise can be in this rapidly progressive age of electricity. It is not experimenting, and from the beginning has avoided the waste of time required by contests and competitions in its field. It has, perhaps, been over-conservative in this respect as well as in the matter of giving to the engineering profession the results of its experience. All this has been due to the fact that the management decided to concentrate its entire efforts in producing the goods and selling them.

The Vehicle Equipment Company believes, however, that electrical engineers everywhere should be informed of what has been accomplished, feeling that if they could have the facts they would realize that electricity is a good enough substitute for the horse. The larger use of electric wagons means more consumers of electric current and a larger business for the entire electrical industry with an increased number of openings for electrical engineers. In the City of New York, for example, there are probably not more than 2,000 electric vehicles, while it is said that there are about 400,000 horse vehicles of which 10 per cent are pleasure carriages and the balance trucks and delivery wagons. What an enormous opportunity is here opened up; but it is equalled relatively in every city in the Union, and in every town where central stations exist.

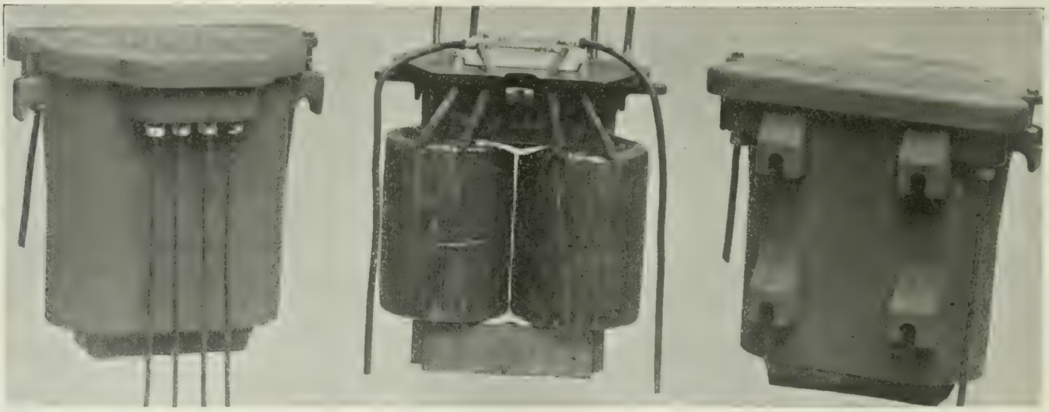
The officers of the Vehicle Equipment Company are Robert McA. Lloyd, president; Hector H. Havemeyer, vice-president and treasurer; Arthur Havemeyer, secretary. The directorate of the corporation includes Charles L. Edgar, president of the Boston Electric Company; Marsden J. Perry, president of the Narragansett Electric Company, of Providence; S. M. Hamill, of the General Electric Company; William R. Willcox, postmaster of New York City, and A. J. Baldwin, of New York.

* * *

Westinghouse Core-Type Transformer.

The Westinghouse Electric & Manufacturing Company has placed upon the market a new line of core-type transformers, which has been designated Type C transformer. This type has operating characteristics closely approximating those of Westinghouse Type O D transformers; their regulation being extremely close, the efficiency high and operating temperatures low, while a high grade of insulation insures long life under severe conditions. They are intended for general distribution service on 60-cycle circuits operating nominally at 1,050 and 2,100 volts, although they will operate successfully on voltages up to 1,200 and 2,400. They are manufactured in sizes from .6 to 50 kw, all wound for the same primary voltages but divided into classes according to the voltages of the secondary. Class 200 may be connected for either 105 or 210 volts, and class 400 for 210 or 420 volts.

The transformer is enclosed in a cast-iron case with felt gaskets under the lid, so as to make the transformer absolutely weatherproof. For sizes above 20 kw, the case is corrugated to increase the radiating surface, but in the smaller sizes a smooth case has surface sufficient to radiate the heat generated. Hanger irons are provided by which any transformer up to and including 30 kw, may be mounted on a pole.



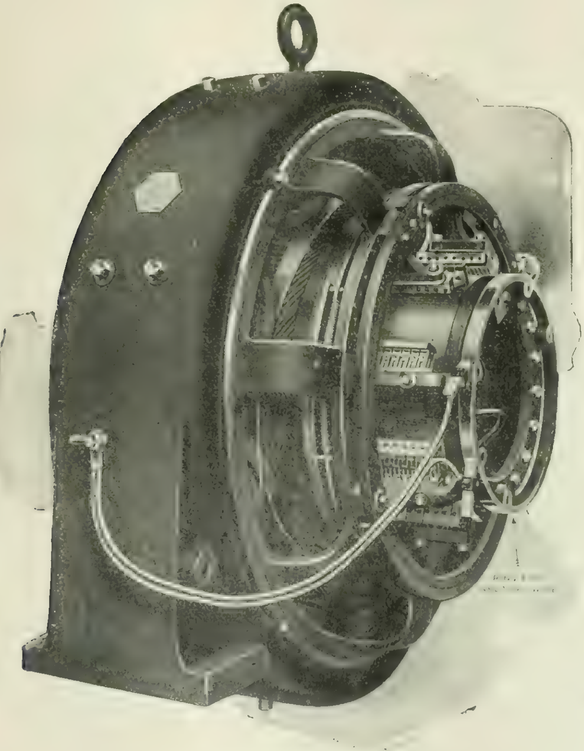
Figs. 1, 2, 3.—Core-Type Transformers.

The core is built up of annealed steel punchings of cruciform shape, and is practically non-ageing. The primary and secondary coils are placed on the long sides of the core, the laminations of which are clamped together at top and bottom by suitable end frames. The low-tension winding is composed of one coil per leg, each coil having two sections so connected that the inner section of one leg is in series with the outer section of the other leg. This arrangement results in a secondary winding of two exactly similar parts both as to resistance and reactance, and insures equal loading of each primary coil irrespective of the method of loading the secondary. A balanced voltage is thus maintained on the two sides of a three-wire distributing system irrespective of the load. The high-tension winding is divided into two coils per leg to reduce the voltage between layers of the winding to a low value.

The core-type construction allows the use of a circular coil, which has many advantages. All insulating parts between layers of the winding and between high and low-tension coils are cylindrical in form, eliminating sharp corners so harmful to insulating material. The windings are so disposed and oil ducts so provided that a free circulation of oil between coils and core is obtained, insuring ready dissipation of the heat and preventing deterioration of the insulation. Careful attention has been paid to the insulation, and liberal allowances made to insure a high factor of safety.

Burke Three-Wire Generator.

The advantages of a three-wire system of distribution have been recognized from the beginning of incandescent lighting. The system was devised by Mr. Edison in the early days of incandescent lighting, and three-wire net works installed at that period in New York, Chicago and other large cities are in satisfactory operation at the present day. In these the voltage between the neutral wire and either of the outside wires is 110 volts and that between the two outside wires 220 volts. Incandescent and arc lamps are connected across the 110-volt lines and motors across the 220-volt lines. Although its many advantages have thus been long recognized, the Edison three-wire system has found very little application except in connection with large central stations, requiring two generators of the same size, which under operating conditions, are considered as one unit. Should either be disabled, it becomes necessary to stop both and disconnect both from the mains. Skillful and competent station attendants are required for this system, which is quite complicated, especially when the units are to be connected in parallel with others operating on the same system. Moreover, the probability of a breakdown is always, of course, greater with two machines than with one.



THREE WIRE GENERATOR.

For small plants the Edison system has not been introduced to any extent for reasons above referred to. The complication of the use of two machines where one should fulfill the requirements has led to a system involving the use of a rotating balancer as a step toward simplicity. This method consists of a single generator which supplies two smaller machines, which are coupled together and are continually in operation. The armatures of these two machines are connected in series, and the neutral wire of the system is connected between the armatures. When the load on the three-wire system is balanced, both machines operate as motors, and no current flows in the neutral wire. If either side of the system is unbalanced, the machine on that side operates as a dynamo and is driven by the machine on the lightly loaded side, which operates as a motor. If these auxiliary machines are not sufficiently large the advantages of the three-wire system are only partially enjoyed, and more complication and greater losses may result than in the system on which it has attempted to improve. The small auxiliary machines consume power continuously while they are running, and make a permanent reduction in the efficiency of the plant. The liability of breakdown is also increased, as there are three machines, any one of which on becoming inoperative will require the load to be transferred to reserve machines, or may cause the entire plant to be shut down if there are no available reserve machines.

To overcome the disadvantage of the above-described methods of operation, a system was devised in which stationary alternating-current transformers replace the rotating balancers for supplying the neutral wire. Although this system was an important step in advance, it is not entirely free from objection as it has introduced the complication of using four collector rings in addition to the regular commutator, and also two balancing transformers. Although the latter possess the advantage of having no revolving parts and are on that account less liable to get out of order, still they increase the first cost of the installation and consume some energy all the time.

The Burke Electric Company, of Erie, Pa., has made an entirely new departure in generators for supplying three-wire systems. The three-wire generators which this company has designed and placed upon the market are entirely self-contained and require no auxiliary apparatus, either rotating or stationary, necessary in the systems already described. By an improved armature winding and arrangement of conductors, the two voltages are generated directly in the armature, a single collector ring being provided for the neutral wire and the current for the outside wires being taken from the commutator in the usual manner. From the accompanying illustration it will be seen that the Burke three-wire generator resembles very closely the standard two-wire generator manufactured by this company, except that a single collector ring has been added. The generators are furnished both in the engine type and belted type, and the same liberal guarantees as to temperature rise, overload capacity and efficiency apply to these three-wire generators as for the standard two-wire generators of the Burke Electric Company.

A 150-kw engine type machine has been in operation in the plant of the Flaccus Glass Company, at Tarentum, Pa., for some months with entire satisfaction, all guarantees having been successfully fulfilled. It may also be interesting to note that for the plant which the City of New York is installing for illuminating the new Williamsburg Bridge across the East River, a contract after proper investigation was awarded to the Burke Electric Company for two 100-kw and one 50-kw, three-wire generators.

Fort Wayne Series Alternating-Current System of Arc Lighting.

Although the many advantages of the alternating-current system for series arc lighting are well known, and although systems of this kind have been in operation throughout the country for some time, the further advantages of a simple system, requiring but slight attention, which is sufficiently flexible to operate in parallel with an incandescent system if desired, will at once be manifest. The Fort Wayne Electric Works has recently developed a complete system along these lines, which is described below.

The system consists, briefly, of a regulator for maintaining a constant current, a specially designed high-tension switchboard, a constant-potential transformer, and a line of arc lamps. In addition, both sides of the line are equipped with lightning arresters peculiarly adapted to circuits of this nature.

Fig. 1 represents the regulator which has been designed for this system. Its operation depends upon the automatic introduction of impedance into the lamp circuit whenever any decrease in the resistance of the latter would tend to cause an excessive current to flow therein. This impedance is introduced by the combined movements of a laminated iron core and impedance coil into such a position as to cause a greater magnetic flux to be cut by the current in the coils. The increase in the amount of flux cut by the line current produces a choking effect, reducing the latter to its normal value. If, for any reason, the line current be decreased, the exact opposite effect takes place within the regulator and the current is automatically increased to its normal value.

The mechanical parts of the regulator are so well counterbalanced that the motion of the heavy core is small as compared with that of the coil. This reduces the inertia and guarantees an immediate and more sensitive adjustment of the current. This design also permits the core and the coils to counterbalance each other, and does away with the use of the counter-weight therebv simplifying the design and reducing the necessary attendance.

The regulator is very compact in form, requiring a floor space of but 22 x 28 in. in the 75-light size, and may be located upon the floor of the power station in any convenient position. No attention is required at the regulator, the starting operation being entirely controlled from the switchboard specially designed for this purpose.

The switchboard furnished with this system consists of a single panel of blue Vermont marble, equipped with ammeter, reactance, fuses, and all necessary switches for the starting and operation of the system. Fig. 2 represents the front of the switchboard ready for use, equipped with a step-up transformer and integrating wattmeter.

By reference to the accompanying diagram, Fig. 3, the peculiar design will be noted by means of which the system may be quickly started from the switchboard without paying any attention to the regulator and without causing any excessive rush of current through either the regulator or the lamps in so doing. The ability to thus start the system without any disturbance upon the line, is one of the great advantages claimed for the Fort Wayne system.

The starting switch, which is located in the center of the panel, should always be closed last. In the closing of this switch, there are three separate stages. At the first stage a reactance which is mounted upon the back of the switchboard, is introduced into the regulator circuit, so that no rush of current will take place when the regulator is thrown upon the line. If it were not for the introduction of this reactance, the regulator, which is in its no-load position and introducing but very little impedance in the circuit, would permit an excessive current to flow. With the introduction of the reactance, however, the current is choked down to its normal value until the regulator comes to its full-load position, in which position it introduces a sufficient impedance of its own to reduce the current to its normal value. In the second stage this reactance is short-circuited, thus throwing the regulator, which has now reached its full-load position, directly across the constant potential bus-bars. During both these stages the line leading to the arc lamps is short-circuited.

When the starting switch is entirely closed the short-circuit across the line which previously existed is removed, thus permitting the line of arc lamps to operate in series with the regulator upon normal current. By thus connecting the lamps into the circuit after normal current has already been maintained, no disturbance is caused in the mechanism of the lamps.

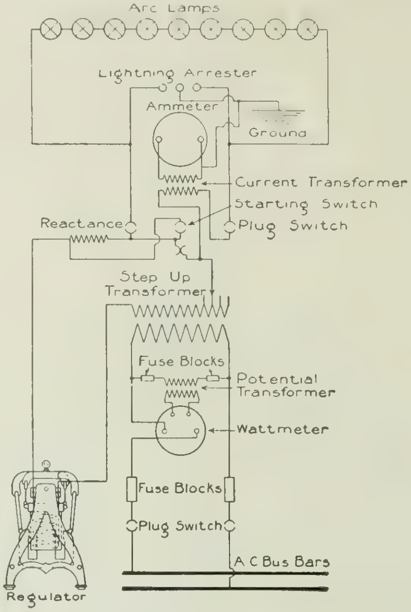


FIG. 3.—DIAGRAM OF CIRCUITS

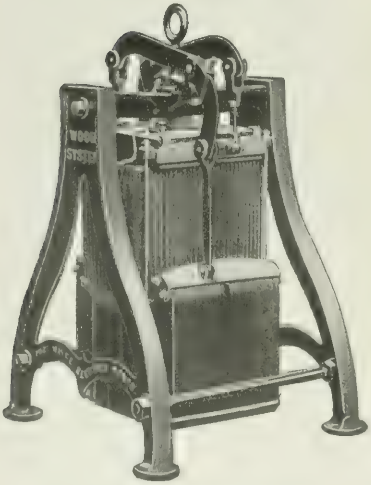


FIG. 1.—FORT WAYNE REGULATOR.

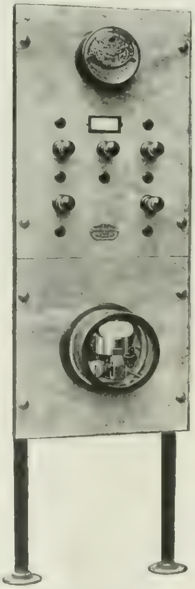


FIG. 2.—SWITCHBOARD.

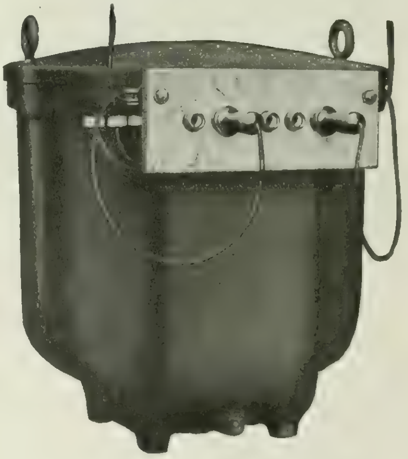


FIG. 4.—CONSTANT-POTENTIAL TRANSFORMER.

Although the systems for 12 and 25 lights will operate satisfactorily without the use of a constant-potential transformer upon circuits of 1,100 and 2,200 volts respectively, it is advisable to use a transformer in all cases, although it may be of a one to one ratio, introduced merely for insulation purposes. This is especially desirable where both arc and incandescent systems are operated from one set of bus-bars, in order to entirely insulate the arc system from that which supplies the incandescent lamps.

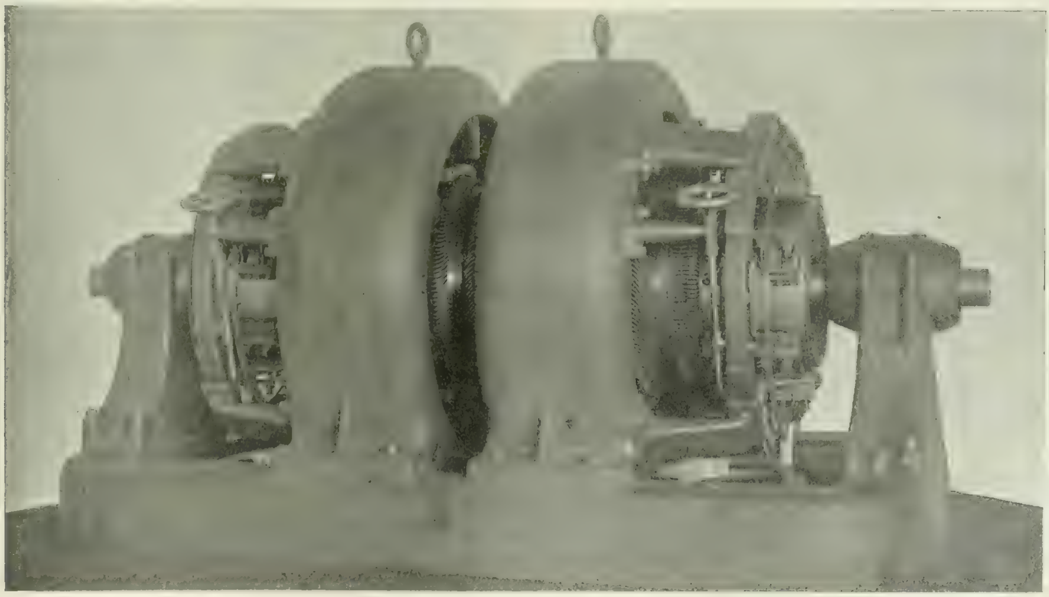
Fig. 4 represents the constant-potential transformer used with this system, which may step-up or step-down the bus-bar voltage, or may maintain the same voltage upon both primary and secondary in cases where it is introduced for insulation purposes only. The secondary of this transformer is provided with a number of taps, by the use of which the output of the station may be varied as more arc lamps are needed upon the circuit, thus maintaining at all times practically full-load efficiency and power factor. The advantage of this will be at once apparent. If a regulator and transformer is selected of sufficient capacity to meet the needs of a growing system, the latter may be connected at first so as to supply only a small portion of its total output, and, as the number of arc lamps increases, the taps upon the transformer may be so connected as to meet this demand with no further cost of installation. This may be done with practically no sacrifice of efficiency when operating the circuits of small capacity.

The alternating-current, series arc lamps which have been designed to operate in connection with this system operate with extremely low temperatures for periods of time up to 125 hours with but one trimming, when adjusted for normal current of 6.6 amperes. Great care has been taken to prevent vibration and the consequent hum which frequently occurs in lamps operated upon alternating current circuits.

The system has been designed for either 60 or 140 cycles, and has been found to operate with entire satisfaction upon each of these frequencies. The 140-cycle lamp has been especially designed for high-frequency service and cannot be operated upon a 60-cycle circuit. Although the use of the 60-cycle system is advised wherever possible, owing to the fact that it is at present the tendency for central stations to reduce the frequency of their systems, central station managers who already have 140-cycle circuits have available a system that will operate with entire satisfaction.

Balancers for Edison Three-Wire System.

The balancer set shown in the cut herewith consists of two standard generator frames mounted on a common base and furnished with two bearings. The generators are shunt wound, for a voltage range from 125 to 250 volts, and the two machines are connected in series across the outside wires of the Edison mains, and are used for the purpose of compensating for any unbalance on either side of the system. Each machine operates as a generator or a motor according as the load on its side is greater or less than that on the other.



Balancer for Three Wire System

These sets were designed to meet the purchaser's specifications. This included temperatures, regulation and sparkless operation under normal conditions, and compactness in design. The sets are so designed that each machine will operate from full load as a motor to full load as a generator, without sparking, the brushes remaining in a fixed position.

The apparatus was planned especially with reference to compactness, so that it would occupy a minimum amount of floor space. Some of these sets have been installed in various stations of the New York Edison Company.

Recent Work with Walrath Gas Engines.

A representative of The Electrical World and Engineer, who recently visited the large factory of the Marinette Gas Engine Company at Chicago Heights, Ill., was somewhat surprised to learn that 80 per cent of the output of this large factory in gas and gasoline engines goes into electric lighting plants. This fact indicates that gas and gasoline engines in sizes of from 10 to 150 horsepower, such as is turned out at this factory, are playing a much more important part in electric lighting business than is generally supposed. Nearly all of these engines are built for direct connection to generators, which indicates that the belt is becoming nearly as extinct in small electric light plants as in central stations. These gas engines for lighting purposes do not all, however, go to isolated electric plants.

For example, the Diamond Electric Light & Power Company, which has a plant in the business district of Pittsburg, has in its engine room ten 85-hp, three-cylinder, direct-connected gas engines of this type. The remarkable thing about this type of engine and one which makes its use permissible where the noise of a gas engine would shut out some types is that it makes practically no more noise with a full load than a good high-speed steam engine. This unusual result is stated to be simply due to proper designing and timing of the valves. The governing is accomplished, not on the hit-and-miss plan, but by throttling. The fuel consumption at full load of these engines can be stated roughly at one pint of gasoline or 18 cu. ft. of common city illuminating gas per hp-hour. On natural gas, the consumption is about 12 cu. feet. By using producer gas, the fuel consumption is about 1¼ pounds of coal or coke per horse-power hour. The company also makes gas producers and has recently shipped some complete gas engines and producer plants to Mexico.

Use of the Nernst Lamp in Yonkers.

The Nernst lamp is a prominent feature to-day in the plans for the decorative illumination of big buildings, but the most significant feature of its recent sales has been its wide introduction by central station companies as a means of attracting business which formerly it had seemed to be difficult or impossible to secure. This business has for the most part occurred where the cost of current consumed to effect a certain lighting result has been the all-important point at issue, and many of the new customers secured through the medium of the Nernst lamp have been small shopkeepers who had been clinging to gas lighting because they believed that incandescent lamp lighting would be too expensive and that arc lamps would not give the form or distribution of light needed. About ninety central station companies have adopted the Nernst lamp for their circuits since the beginning of the year, or more than half as many as the total number of such companies that had previously contracted for its use. One of the most notable instances of its successful employment to win over the shopkeepers of a small city to the cause of electric lighting has been at Yonkers, where the first Nernst lamp was installed in March, 1903. Up to January 1, 1905, the new lamps were installed slowly, but on August 1, 1905, there were 1,836 glower units, or about 800 lamps in all, in service among about 300 customers, the lamps installed being chiefly of the two and three-glower types. Almost all of these lamps have been supplied to former gas customers, and the business of the Yonkers Electric Light and Power Company has grown enormously during this period. At the present time about 200 glower units a month are being installed.

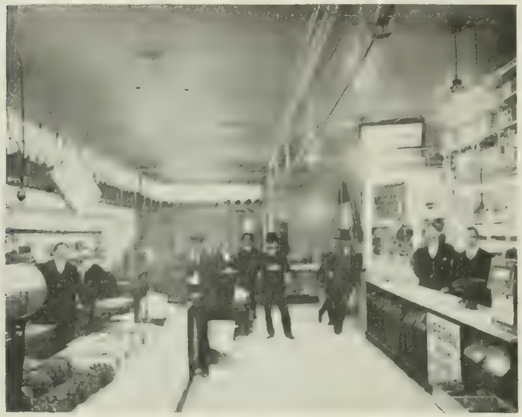


FIG. 1.—INTERIOR STORE ILLUMINATION.

Every barber shop in Yonkers is lighted by Nernst lamps. So is every quick lunch counter and restaurant. So are 8 saloons, 8 shoe stores, 6 butcher shops, 11 grocery stores, 4 candy stores, 2 florist shops, 2 opticians' shops, 4 jewelry stores and 100 or more other establishments within a mile of the New York Central railroad station. The shopping section of Yonkers has been more or less transformed. On Saturdays the Nernst lamp shops are nearly all lighted until midnight, the lighting in many of them being continued for window display advertising after the doors have been closed.

About fifty lamps are hung out of doors for entrance or window illumination, and a good many others are used for interior window lighting, one lamp to a window, so that the general street lighting effect is considerably enhanced. Many of the shops in which the new lamps have been installed are still equipped with old gas mantel fixtures and arc lamps, which are never lighted. The Nernst lamps have been supplied free by the lighting company, and, almost without exception, they are attached directly to the ceiling or hung from a small bronzed rod given with them, so that no expense whatever has been placed upon the customers for fixtures. An important feature also of the argument in favor of the new lamp has been, [illegible] that the expense of wiring has been reduced to a minimum [illegible] that necessary for a satisfactory incandescent installation, the Yonkers shops for the most part being lighted from three or four outlets, two for the salesroom and one for each window.

Shop keepers who could not have used the arc lamp economically have found in the graded units of the Nernst lamp opportunity for a system providing an equally cheap and more effectively distributed maximum illumination, while possessing a flexibility which makes it possible to consume only the actual amount of current needed at any one time. By lighting each dark section of the shop separately, as evening comes on, and by continuing the Nernst lamp illumination of the window display alone, after the shop itself has been closed, the customer is confident that no current is being wasted at any time, and he is encouraged to light his store more brilliantly than he has ever done before. Recognizing the high efficiency of the Nernst lamp with which almost twice as much light is obtained per kilowatt hour as from incandescent lamps, many former incandescent lamp customers have profited by it. The customers have not decreased their bills, but they have secured a more liberal lighting with the Nernst at the old cost of incandescent lighting. Since the introduction of the four-glower lamps, five different sizes of Nernst lamps have been on the market—the single-glower lamp, approximating 60 cp; the two-glower lamp, of 125 cp; the three-glower lamp, of 200 cp; the four glower lamp, of 300 cp; and the six-glower lamp, of 500 cp—the lamp's efficiency increasing as the number of glowers grouped together is increased. The recent advent of the composite type Nernst lamp, which is so constructed that half the glowers may be cut out when desired, thus reducing the current consumption one-half, has still further improved the flexibility of the system.

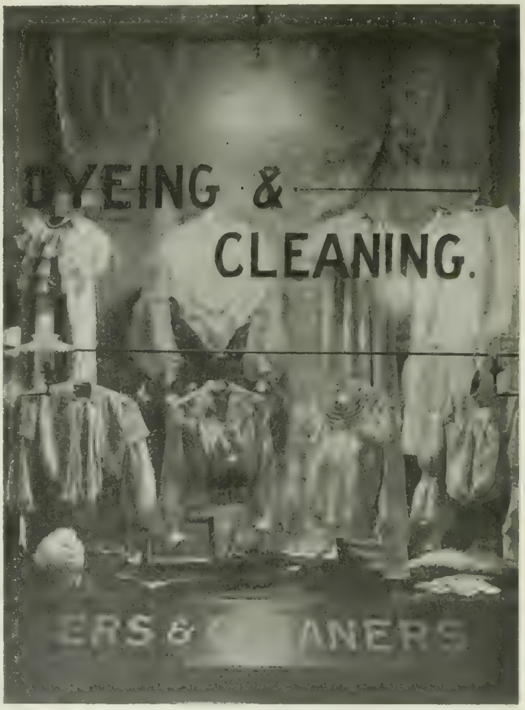


FIG. 2.—EXTERIOR OR WINDOW LIGHTING.

The systems of direct-current distribution still obtaining in most large cities have shut out the Nernst lamp in its present form from several of the most important markets, but its popularity has developed rapidly in hundreds of communities throughout the country where alternating current has been available. Along the alternating-current circuits of the Brooklyn Edison Company, in South Brooklyn and Greenpoint, the lamp has been installed in small shops even more extensively than in Yonkers, in the past year. Transformations similar to that at Yonkers have also been effected in many small cities and villages of the Middle West. Up to July 1, 1905, the Detroit Edison Company had installed 503 three-glower lamps.

In St. Louis, where the lighting company began to furnish Nernst lamps throughout its alternating-current circuits last September, after 1,500 glower units had been successfully used for several months to light the Fine Arts Galleries at the Louisiana Purchase Exposition, 3,330 glower units had been installed up to July 1 of this year. It is stated that 95 per cent of the cases of dissatisfied customers arising on the alternating-current circuits in that ten months' period were retained with the aid of the Nernst lamp, and that 60 per cent of the total Nernst lamp business was secured from former gas consumers.

From the point of view of the central station company, the Nernst lamp has been a valuable "find" not only as an effective weapon with which to meet low gas prices, and as a means of increasing the general demand for electric lighting and of securing former private plant business, but as a solution of many of the problems of current distribution and of load equalization. The acquisition of long-time customers has tended to broaden the load peak, and to build up a profitable after-peak business. Stations have found that the installation of high efficiency lamps minimizes the percentage of unprofitable installations, and that feeder cables laid to accommodate the highest load that might be put upon them, are much more likely to carry a load approximating that maximum with high efficiency lamps than with low efficiency lamps which customers find too expensive for liberal use. Some of them have appreciated, also, the truth of the argument that the investment in a low efficiency lamp does not end in the lamp itself, but means larger boilers, larger engines, larger generators and a more expensive distribution system, necessitating rates sometimes difficult to maintain and sales expenses that are a heavy burden on the balance sheet. The cost of maintenance of the Nernst lamps in small-shop service has been variously reported by central station companies as from 4½ mills to 1 cent a kw-hour The cost of maintenance on the lines of the Allegheny County Lighting Company, of Pittsburg, where the Nernst lamp load is now over 600 kw, has varied only slightly from 5 mils a kw-hour in the past two years.

Electrical Recording Instruments.

A well-developed line of recording instruments which have become widely used throughout Europe on account of their reliability in service is being placed upon the American market by E. H. du Vivier, 14 Church Street, New York, as sole representative in this country for the manufacturer, Jules Richard, of Paris, France.

The electrical instruments are of the true recording type, as distinguished from the indicating and integrating types. In each case the record is made upon a sheet carried by a cylinder which is driven by an accurate French clock mechanism. The clockworks are contained within the cylinder, so that they are well protected and, although requiring but little attention, they will retain their accuracy for a very great length of time. The paper which is placed on the cylinder is graduated in the circumferential direction to accommodate 26 hours, so that each sheet may represent a run of one complete day. For special or testing purposes the speed of the cylinder can be given any value desired. The graduations in the axial direction represent the instantaneous readings, and vary according to the capacity of the instrument. It is worthy of note that the record is equally as legible as though it were plotted to rectangular coordinates. (See Fig. 1.)

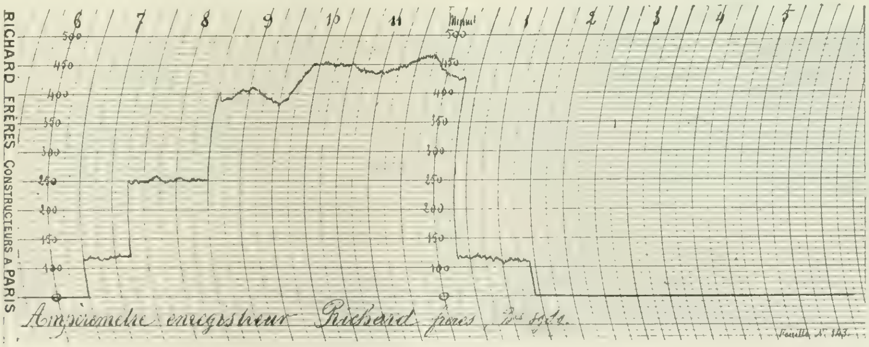


FIG. 1.—CHART OBTAINED FROM A RECORDING AMMETER

The recording device is extremely simple. It consists of a "fountain" pen carried by an aluminum arm whose position is determined by the quantity being measured. In a triangular-shaped cavity in the pen is carried a sufficient quantity of a specially-prepared ink for operation for more than a week. The arm possesses sufficient elasticity to insure uniformity of contact between the pen and the paper in all positions, while a thumb-screw allows the pressure of the pen upon the paper to be varied as desired.

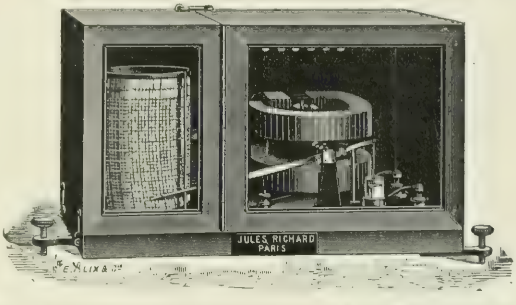


FIG. 2—RECORDING WATTMETER EQUIPPED WITH GLYCERINE DASH POT.

The instruments are of the aperiodic or "dead-beat" type, each being provided with some device to cause the arm quickly to assume its final position without vibrations. Each ammeter or voltmeter which is equipped with permanent magnets is provided with an electromagnetic dampener. This device consists of a short-circuited coil of low conductivity in which eddy currents are produced when it moves through the flux of the permanent magnets so that all rapid motions or vibrations of the arm are thereby prevented. The dynamometer type of instruments are equipped with glycerine dash-pots to deaden the vibrations.

Fig. 2 shows a recording wattmeter of the dynamometer type. The stationary coils carry current proportional to the current in the circuit, while the movable coil carries current varying in value with the voltage of the circuit. The graduations of the chart are uniform over the whole working range of the instrument. In comparison with a so-called integrating wattmeter the instrument possesses the advantage that it not only records the total consumption of energy, but at the same time it shows and records continuously as a function of the time the power used at each instant. The shaft of the moving coil rests on knife edges allowing free movement of the parts, and the oscillations of the pen are dampened by a glycerine dash-pot, as indicated previously.

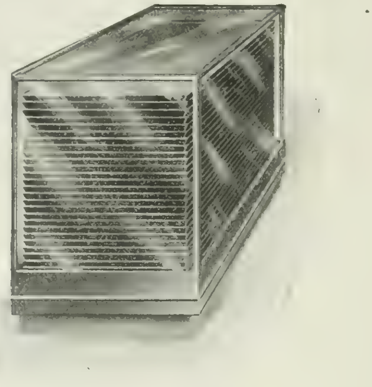
The wattmeters are built for both direct and alternating currents, the latter instruments being of either the single-phase or polyphase type. The voltmeters and ammeters are of the dynamometer, hot-wire or moving vane type for both direct and alternating current work, or are of the permanent-magnet type for direct-current service exclusively. Each of these instruments is equipped with a recording mechanism similar to the one illustrated in Fig. 2. In the design and construction of these instruments special attention has been given to obtaining initial and continued accuracy, and service tests have shown that they fulfill all requirements in these respects.

Alternating and Direct-Current Generators

The R. M. Cornwell Company, of Syracuse, N. Y., has recently added to its line of small machines the "Wonder" alternator, which is claimed to be the only small machine on the market which will furnish either direct or alternating current. With it all kinds of experiments can be performed that require an alternating current. The machine has a laminated armature. All parts are interchangeable, and the arrangement is such that the machine can be easily taken apart to show the general construction throughout, thus being especially adapted for experimental purposes in schools and colleges. It has an output of 12 watts, and is wound for a number of different voltages. When operating as a generator, alternating current can be taken off on one end to run lamps, small transformers, etc., and from the direct-current end motors can be run, thus illustrating the two currents at the same time. It will also operate as a motor on a 110-volt direct-current circuit, by using a lamp in series.

Tray Type of Storage Battery.

A type of battery whose constructional features and operating characteristics are stated to be such as to render it especially fit for stationary service of even the severest kind is shown in the accompanying illustration. The battery is composed of one or more vertical piles of units. Each unit consists of a sheet of chemically pure rolled lead formed into the shape of an ordinary pan or tray with flaring sides. Each tray is subjected to a special electrochemical treatment by means of which the active material, in which the energy is to be stored, is formed upon the two sides of the tray bottom, that on the inside being usually positive and that on the outside negative. Each tray then becomes within itself the negative plate of one cell, the positive plate of the next cell, and a connector between the two; the conducting cross-section of this connector is equal to the entire plate area of the cell instead of being restricted to a narrow strip or lug, as in the usual type.



TRAY STORAGE BATTERY.

The tray units are piled one above another, with separators between, thus providing an open space for electrolyte between successive units. The upper side of the bottom tray, the electrolyte therein and the bottom side of the second tray form the first cell; the top side of the second tray, its electrolyte and the bottom side of the third tray form the second cell, and so on, each additional tray adding one cell and increasing the pressure of the pile by two volts. The whole pile is enclosed in a dust-proof glass case which can be easily opened for inspection, the whole making an exceedingly neat, convenient and attractive structure.

The charge and discharge rates of these batteries are limited only by the rise of temperature which may be caused by an excessive rate too long continued. The rating, however, has been placed on a conservative basis; that is to say, there has been allowed a superficial area of 250 square inches per ampere. It is stated that even a short-circuit will not buckle the plates or loosen the active material, and that if the cell is immediately recharged it will not show any immediate evil results.

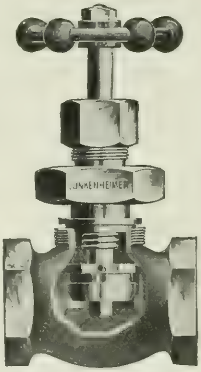
As contributing to both durability and rapid discharge rate, it will be noted that, when the battery is being charged, the current, which enters the lower tray, distributes itself over the entire area and passes upward from cell to cell through the entire pile. When discharging, the action is the same, only the direction of flow is reversed. Every unit of plate area is, therefore, worked at the same rate, and every square inch is doing its full duty. On account of the uniform distribution of current the area of the conducting path is rendered extremely large, and the result is a proportionate reduction of the internal resistance in that part of the circuit.

This battery is the invention of Mr. Malcom O. Smith. It is being placed upon the market by the Smith Storage Battery Company, Zoar, Ohio.

Regrinding Globe Valve.

A globe valve which has recently been the subject of numerous improvements in details is shown in section in the illustration. It will be noticed that the hub which carries the operating stem is secured to the body by a union connection, which, in turn, screws over the shell of the valve body. By means of this construction it is impossible for the hub and the body to become corroded together, as the thread which holds the union ring to the body is protected at all times from the action of the steam, the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body, and tends to make the valve rigid and strong.

The stem is fitted with a very strong, durable and long thread, and the manufacturer states that the valve is very easy to operate, and that there is practically no exertion necessary to close tightly even its largest valves. The reason for this is that the hand wheels are so proportioned in respect to the seat opening that no additional leverage need be applied to the hand wheel to facilitate the operation of the valve.



REGRINDING GLOBE VALVE.

To regrind the valve the bonnet ring is unscrewed, and the trimmings are removed from the body. A wire or nail is placed through the lock-nut and stem, a little powdered sand, or glass and soap, or oil is placed on the disc, and the trimmings are again placed on the valve and reground.

The Lunkenheimer Company, the maker of this valve, in connection with its plant at Cincinnati, Ohio, has a complete physical and chemical laboratory, which enables it to manufacture its products of such composition as is best adapted to withstand the chemical actions, strains, etc., to which the various products are subjected.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Business conditions and trade in general were excellent during the past week, and the cool weather, while it has not materially affected holiday expenditures, has helped to key up industry, so that after Labor Day, a very pronounced briskness is likely to be noted in every direction. The activity in all branches of the electrical industry is well maintained, and the large amount of new building holds out bright hopes for the future. Discussing trade conditions, *Dun's Review* says: "Distribution of autumn merchandise is in progress unusually early this year, and the volume of forward business is so heavy that the last half of 1905 promises to establish a remarkable record of commercial activity. Current retail trade is well maintained, the urgency of orders received by jobbers indicating that dealers' stocks are becoming depleted, and there is little complaint regarding collections. More labor disputes have reached settlement, and no serious controversies are threatened, while in many sections the supply of wage earners is inadequate. Freight blockades and insufficient rolling stock cause delay, despite widely extended facilities as compared with last year, and this trouble will probably increase as the crop-moving season advances. Special reports regarding manufacturing conditions have been received from about forty leading industrial centres, and there is surprising unanimity in the statements. With scarcely an exception, plants are working close to full capacity, with little idle machinery, except where alterations or improvements are in progress, and contracts on hand far exceed those held at this date in 1904. Equally gratifying is the confidence expressed in the future, a prominent feature of most reports." Liabilities of commercial failures thus far reported for August amounted to $4,917,390, of which $2,005,081 were in manufacturing, $2,616,472 in trading, and $295,837 in other commercial lines. Failures last week numbered 190 in the United States against 205 last year, and 27 in Canada compared with 30 a year ago. An evidence of the general confidence is seen in the large orders given by the railroads for new equipment, rails, cars, locomotives, etc. Yet President Gary, of the United States Steel Corporation, says: "One of the most satisfactory features of the present position of the steel trade is that, notwithstanding the enormous demand for steel products of all kinds, there has been no inflation of prices. There is nothing of the character of a 'boom' in the present prosperity of the country's chief industry. Prices are firmly established and at a fair level. Were it not that the present policy of the leading manufacturers is to prevent abnormal movements in the price of steel products, much higher prices than are now being paid could be secured for many products. Consumers would gladly pay more than present prices to have their orders filled at an early date, but it is not possible for the mills to produce material as fast as it is needed by consumers." The upward tendency of the price of copper, now well over 16 cents, is discussed in another item.

THE POSITION OF COPPER has grown to be one of profound and wide-reaching interest, and there is good reason to expect that this will continue without abatement. We have frequently directed attention, says the *Copper Gossip* of the National Conduit & Cable Company, to the enormous increase in the exports of copper, and this feature of the situation may be said to form the sole reason for the marked firmness prevailing during the past 12 months. The exports for the first seven months of 1905 amounted to 332,144,960 pounds, against 299,116,160 pounds for the first seven months in 1904. If the domestic production for the current calendar year is estimated at 875,000,000 pounds, the above rate of export, if maintained throughout the entire year, would represent 65 per cent of the United States' production. Imports into this country for the first half of this year were 98,784,000 pounds, and at this same rate the quantity of imported copper for 1905 would amount to 197,568,000 pounds. Adding imports to production, the new domestic supplies for 1905 aggregate 1,072,568,000 pounds. If the same ratio of exports continues as for the first seven months, the total quantity of copper exported this year will reach the unprecedented amount of 569,391,360 pounds, or 53 per cent of the United States production and imports for the year, as per figures stated. With a foreign demand of such dimensions for the copper produced here and imported into this country for refining, there is no difficulty in explaining why values have risen. Domestic demand is also a large and growing factor to be reckoned with, and with present excellent business conditions the course of the copper market is not to be wondered at.

THE GREEN FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., has just completed the erection of a large shop designed to provide for its rapidly increasing business. This company not only supplies special exhausters with bearings removed from the action of the flue gases for mechanical draft in connection with the Green economizer, but also builds fans, blowers and exhausters for every purpose, having, for instance, recently sold fans for heating, ventilating and humidifying in textile mills, ventilating and drying in paper mills, heating and ventilating in large buildings, etc. It is just now installing the largest mechanical draft exhauster ever built, for a factory in Massachusetts. New designs have been worked out for all types of "Green-Matteawan" fans with the special object of reducing the power required for driving. Fans are often driven by small non-condensing engines or by electric motors using purchased power, so this is quite an important matter. The Green Fuel Economizer Company does not contract for the engineering of plants, or for the installation of heating and ventilating plants in competition with the heating and ventilating contractors, but offers the benefit of its engineering skill and sixty years' experience in the construction and operation of air-moving plants.

PENNSYLVANIA WATER POWER.—Bids will be received until Sept. 1 by Geo. W. Wagenseller, secretary Middlecreek Electric Company, at Middleburg, for constructing a complete water-power electric plant, 100 hp, on Middlecreek and Penns Creek, two miles south of Selinsgrove. The bids will cover the work as a whole, and on portions of the work as follows: Solid concrete dam, 17 to 20 ft. high and about 360 ft. long; to dig a tunnel and waterway 1,225 ft. through a mountain; a power house; 2 units with wheels direct-connected generators; auxiliary engine and boiler, and complete equipment, with 25 or 30 miles of line construction, to furnish light, heat and power to Selinsgrove, Sunbury and Northumberland. The officers are Geo. W. Wagenseller, secretary, and F. W. Darlington, Real Estate Trust Building, Philadelphia, Pa., designing engineer.

THE ATHOS ELECTRIC CHEMICAL COMPANY, a Maine corporation, whose experimental laboratories are in Worcester, and in which some Worcester capitalists are interested, has closed a deal for the erection of a manufacturing establishment in New Jersey on the bank of the North River, opposite Ninety-sixth Street, New York. The company will manufacture a deodorizing and disinfectant compound. James H. Mellen is the treasurer of the company. In addition to Mr. Mellen there are included among the board of directors these Worcester men: Harry V. Prentice, A. C. Johnson and H. H. O'Rourke.

SUPPLIES FOR NAVY YARDS.—Bids will be received until September 12 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Dynamo, electric drills and supplies, insulation of electric lights, etc.; engine, pipe and fittings, steel conduit and fittings, cable, cylinder, copper, sheet bar and tool steel, etc. H. T. B. Harris, Paymaster-General, U. S. N.

ADDITION TO PLATINUM PLANT.—Baker & Company, Inc., refiners and manufacturers of platinum, of Newark, N. J., and New York City, are making extensive additions to their Newark works. The rapidly increasing consumption of platinum in the industrial arts has made this extension necessary, especially in their refining department, which will be enlarged over one hundred per cent. New and larger offices are also being erected, and the entire plant equipped with the most modern appliances for the economical manufacture of their varied and high grade products.

WATER POWER IN PORTO RICO.—Bids will be received until December 2 by the Executive Council of Porto Rico for a franchise for the development of a certain water power known as Comerio Falls, situated on the La Plata River, approximately 17 miles in a direct line from San Juan and at an elevation of about 85 meters above sea level, which falls are estimated to be able to develop about 1,000 hp as a minimum and at times more, depending on local rains. Address chief clerk of the Council.

LA GRANGE PLANT.—The date of opening of bids for furnishing machinery and constructing an electric light plant at La Grange, Fla., has been extended from Sept. 5 to Sept. 15. Address S. H. Truitt, chairman Electric Light Committee. Engineers, Ludwig & Company, 513 Empire Building, Atlanta.

DE LAVAL STEAM TURBINE ORDERS.—Below is a list of the principal orders taken by the De Laval Steam Turbine Company, of Trenton, N. J., dating from July 1, 1905: Lawrence Duck Co., Lawrence, Mass., one 225-hp steam-turbine dynamo; Public Service Corporation of N. J., Paterson, N. J., three 75-hp De Laval-Sirocco blower sets; Semet-Solvay Company, Syracuse, N. Y., two 50-hp, alternating-current, electro-motor pumps, fifteen 10-hp, alternating current and direct-current electro-motor pumps; Springfield Boiler & Manufacturing Company, Springfield, Ill., one 150-hp, steam-turbine centrifugal pump, one 30-hp, 20-kw steam-turbine dynamo, for Mississippi River dredge for government; Armour & Co., Chicago, Ill., one 75-hp, steam-turbine centrifugal pump; Power & Mining Machinery Company, New York City, two 300-hp, 200-kw steam-turbine alternators; Massachusetts Chemical Company, Walpole, Mass., one 300-hp, 200-kw steam-turbine dynamo; Gold Prince Mines, Animas Forks, Col., three 300-hp, 200-kw steam-turbine alternators, two 30-hp, 20-kw steam-turbine driven exciters; Board of Control of State Institutions, Iowa, one 75-hp, 50-kw steam-turbine dynamo; California Gas & Electric Corporation, Oakland, Cal., one 150-hp De Laval-Sirocco turbine-blower set (duplicate order); Indianapolis Gas Company, Indianapolis, Ind., one 75-hp De Laval-Sirocco turbine-blower set; City of Georgetown, S. C., one 55-hp turbine pump; Walter Baker & Co., Ltd., Milton, Mass., two 55-hp turbine dynamos; Atlanta Gas Light Company, Atlanta, Ga., one 55-hp turbine-blower set; Denver Gas & Electric Company, Denver, Col., one 55-hp turbine-exhauster set.

THE PALMER MOUNTAIN TUNNEL property in Washington is now in the hands and under control of Massachusetts people. The executive officers are John Tilley, of Holyoke, Mass., president; F. G. Burnham, vice-president; E. E. Barr, of Springfield, Mass., second vice-president; Samuel Porter, of Florence, Mass., treasurer; Leo. H. Porter, of Northampton, Mass., secretary; John Boyd, manager. They, with F. E. Goolall, of Spokane, comprise the board of directors. The company is having water and electric power plant especially constructed to suit conditions, and expects to have it on the ground early in September. It consists of a 750-hp Escher-Wyss turbine wheel, under construction by the Allis-Chalmers Company, to be operated under a 365 foot head, on Fouts Coulee Creek. Directly connected with it will be a Bullrock alternating current, 750 hp generator. A one-quarter inch steel penstock of 27 inches diameter and nearly 800 feet long is being manufactured at Holyoke. These will be followed by the installation of electric power service for the mines. Next will come a 300-ton stamp and cyaniding mill. C. S. Reitze will have charge of the electrical construction and equipment. L. J. Regali is the local representative for the Palmer Mountain Tunnel & Power Company.

CONTRACTS FOR HAWAII.—The Westinghouse Electric & Manufacturing Company has sent Thomas Anderson to Honolulu to report to the Hawaiian Electric Company, which has the contract for the installation of a water-power electric transmission for the McBryde Plantation Company on the Island of Kauai. The original contract called for two 1,200-kw, 3-phase Westinghouse generators. These are to be directly connected to Pelton impulse wheels. Several wheels of different sizes will be placed on each shaft, so that the amount of power developed can be adapted to the quantity of water available at different seasons. Additional contracts have been closed for a 1,000-hp induction motor and a 500-hp induction motor of Westinghouse manufacture. Current will be transmitted at 33,000 volts for operating irrigation pumps, as well as general power and lighting business.

COOPER-HEWITT LAMP IN JAPAN.—An exhibit was recently given of the Cooper-Hewitt lamp to the Japanese Emperor. The occasion was the graduation ceremony of the Tokio Imperial University, July 11th, this year. The Emperor attended the ceremony as an exceptional case, as he very seldom goes out of his palace. Among the few exhibits which were made, the mercury lamp attracted his attention most. The head professor of electrical engineering, Prof. H. Nakano, a post-graduate of the Cornell University, year 1889, had the honor of explaining the working of the lamp before the Emperor. The lamp was a 48-in. one and was supplied by the Japanese engineering and contracting firm of Takata & Company, 10 Wall Street, who are the agents for the Westinghouse Electric & Manufacturing Company in Japan.

ALABAMA PLANT WANTED.—Bids will be received until Sept. 4 by B. B. Guthrie, town clerk, for a water and light plant, work to include erecting a brick or concrete block power house, furnishing a 100-hp, high-speed automatic engine; two 100-hp boilers and fittings, furnishing 1 compound, 1 duplex and 1 feed pump; furnishing and erecting an 80,000-gal. steel tank and tower; constructing an 80,000-gal. surface reservoir, and furnishing a 60-kw, 60-cycle, single-phase, 2,300-volt alternator, together with exciter, switchboard and station instruments; pole line, transformers and 20 [illegible] 6.6-ampere, series inclosed arc lamps of latest design. Edgar B. Kay, engineer, Tuscaloosa, Ala.

NEW YORK CONSTRUCTION.—Building is not only active in tunnels and new railroad projects in New York, but in offices and homes. The building season, which has been more active than in any preceding year, is drawing to a close. The money involved this season has been tremendous. Since the first of the year permits have been filed for buildings involving an outlay of $155,000,000, while alterations aggregate $13,500,000, a total of $168,500,000. Mortgages, loans and real estate transactions since the first of the year aggregate $625,000,000 in Greater New York. A great deal of electrical work has been involved in isolated plants, wiring, motor drives for factories, etc.

ELECTRIC DREDGERS FOR CALIFORNIA.—The General Electric Company is making deliveries on ten sets of gold-dredge equipments under a contract with the Boston Machine Shop Company, of Oroville, which installs the machinery. Nearly all of the equipment will be placed in dredges operating in the Yuba River at Hammon, near Marysville. The details of a complete equipment include the following induction motors: One digging motor 150 hp, variable speed; two main pumps, one 150 hp and one 40 hp; one winch motor, 20 hp, variable speed; one screen motor, 25 hp; one stacker motor, 15 hp; one small pump motor, 10 hp, and one sand pump, 75 hp. The transformers include three 75-kw, three 25-kw, and one 5-kw for lighting.

THE MORSE CHAIN COMPANY, now located at Trumansburg, N. Y., is building at Ithaca, N. Y., a plant of about five times the present capacity. The company was incorporated in 1898, no change having been made either in the name or personnel since starting, Mr. F. L. Morse being the treasurer and general manager. The plant was originally started for the manufacture of bicycle chains, but in 1901 the concern brought out the present high-speed, silent-running chain, and since that time it has had a rapidly growing business. In the line of power transmission, the Morse Company has in service chains transmitting over 75,000 hp, and is furnishing drives up to 500 hp for a single transmission.

ROBINS CONVEYING BELT.—The Robins Conveying Belt Company, New York, has received contracts for installing coal conveyors and elevators for the Haverhill Electric Company, Haverhill, Mass., for the coal handling machinery for the boiler house of the Arlington Mills Company, Lawrence, Mass., and for belt conveyors for the New Jersey Zinc Company's plant at Palmerton. It is also about to complete several large export shipments for Germany and South Africa.

BIDS FOR BURLINGTON, VT.—The following are the lowest three bids received and opened on Aug. 22 by the supervising architect, Treasury Department, Washington, D. C., for installing a conduit and electric-wiring system for the United States Post Office and Custom House at Burlington: W. W. Gale, New Haven, Conn., $1,994; Plummer Electric Company, Boston, Mass., $1,813, and John Wilkinson Company, Boston, Mass., $2,147.

BAKER AUTOMOBILE PLANT.—The Baker Motor Vehicle Company, of Cleveland, has begun work on a new plant on the West Side adjoining the plant of the American Ball Bearing Company. The plant will have 140,000 square feet of floor space. A power house will be erected and a 400 horse-power generator will be installed. All machinery will be driven by motors. It is said that the investment in the plant will reach $400,000.

POLES FOR TRANSMISSION LINE.—The Iroquois Construction Company has contracted with the Haeberle Lumber Company, Niagara Falls, for 3,000 poles for its power transmission line to Syracuse along the West Shore Railroad. The Iroquois Construction Company is connected with the Niagara, Lockport & Ontario Power Company.

BURLINGTON, WIS., MUNICIPAL PLANT.—John T. Prasel, city clerk, states that bids will be received on September 5 for the construction of a municipal lighting plant to cost about $12,000. The consulting engineer is A. T. Maltby, Fisher Building, Chicago, Ill.

TELEPHONE CABLES WANTED.—Bids will be received until Sept. 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the naval station, Guantanamo Bay, Cuba, a quantity of telephones and telephone cables. H. T. B. Harris, Paymaster-General, U. S. N.

THE WESTINGHOUSE MACHINE COMPANY, of East Pittsburg, Pa., has received the contract for a 2,000-kw turbine generator, together with all necessary equipment, to be installed in the lighting plant at Detroit, at a cost of $61,283. The engine is to be of the Parsons type.

PROPOSALS AT WOODLAND, CAL.—Sealed proposals will be received by Chas. W. Richard, city clerk, until 7.30 P. M., Sept. 18, for a franchise to construct an electric railway, as applied for by J. Reith, Jr. A certified check of 10 per cent required.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market continued to develop strength and breadth, but toward the close of the period was affected somewhat prejudicially by the apparent failure of the peace negotiations between Russia and Japan. As a matter of fact, the American market has shown some tendency on account of its inherent strength and favorable conditions of breaking away from what may be termed the international market. But it is impossible that in these days a general chill of depression in Europe should not make itself felt here, and with the possibility of a resumption of hostilities, prices in America and Europe have shown declines. There were, however, some sharp exceptions, particularly in the steam railroad field, where a corner threatened in Reading, while the buying of Erie has been very pronounced. The market was active during the week, and the dealings in electrical and allied specialties were considerable, although, almost without an exception, electrical securities were on the lower basis common to other stocks. Metropolitan Street Railway was up, however, Securities showing a gain of 1⅛ for the week and the Street Railway 2⅞. Brooklyn Rapid Transit was also up 1½. The demand for steel continues at an enormous rate, and Judge Gary, president of the United States Steel Corporation, says there is every indication of prosperity, not in the shape of a boom but steady and enduring. Such optimism is justified by the government crop report, which shows that it has been a great year for American cereals, the corn crop being estimated at 2,700,000,000 bushels and the wheat crop at over 700,000,000, while the crop of oats is estimated at 950,000,000. Needless to say, the railroads will be busy and almost everybody else. Bank clearings continue unusually large. The gross receipts for the leading railroads for the first half of August show a gain of 6 per cent over 1904, and the business failures for the week ending August 24 were only 176 against 185 in the corresponding week of last year. Following are the closing quotations of stocks after peace was agreed to by Russia and Japan, for August 29:

NEW YORK

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
Allis-Chalmers Co	17⅛	16⅛	Electric Vehicle	19	17
Allis-Chalmers Co. pfd	57	53	Electric Vehicle pfd	..	.3
American Tel. & Cable	90	90	General Electric	182½	182
American Tel. & Tel.	142½	139	Hudson River Tel.	..	..
American Dist. Tel.	30	31	Interborough Rap. Tran.	215¾	213
Brooklyn Rapid Transit	69⅛	70⅝	Metropolitan St. Ry.	129⅜	131¼
Mackay Cos.	41	40½	N. Y. & N. J. Tel.	..	..
Mackay Cos. pfd	74	73½	Marconi Tel	..	..
Electric Boat	30	26	Western Union Tel.	93¾	93¾
Electric Boat pfd.	75	65	Westinghouse com.	159⅞	170
Electric Lead Reduction		..	Westinghouse pfd	..	..

BOSTON

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
American Tel. & Tel	142½	141	Western Tel. & Tel. pfd.	.	97½
Cumberland Telephone	117⅝	118	Mexican Telephone	.	1¼
Edison Elec. Illum.	.	253½	New England Telephone	133⅛	134
General Electric	182¾	181½	Mass. Elec. Ry.	18	18½
Western Tel. & Tel.	.	*18	Mass. Elec. Ry. pfd.	62	61

PHILADELPHIA

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
American Railways	.	53	Phila. Traction	.	101
Elec. Storage Battery	83	87¾	Phila. Electric	8$\frac{13}{16}$	9
Elec. Storage Battery pfd.	.	.	Phila. Rapid Trans.	28½	28⅜
Elec. Co. of America	11⅜	11⅛			

CHICAGO

	Aug. 22	Aug. 29		Aug. 22	Aug. 29
Chicago Subway	.	84½	National Carbon pfd	115	115
Chicago Edison	155	158	Metropolitan Elev. com.	24	26
Chicago City Ry		193	Union Traction	.	
Chicago Tel. Co	.		Union Traction pfd	..	.
National Carbon	63	62			

* Asked.

SOUTHERN NEW ENGLAND TELEPHONE.—The progress of the Southern New England Telephone Company the past four years is shown in the following data from the annual reports of President Tyler:

	1901.	1902.	1903.	1904.
Capital	$2,700,000	$2,000,000	$3,500,000	$4,500,000
Subscribers	17,564	21,110	26,619	33,205
Gain	13%	16.8%	25%	24.7%
Capital per subscriber	$202	$170	$161	$159
Gross to capital	29%	30.7%	31%	28.6%
Expenses to gross	74.6%	75%	76%	77.1%
Total surplus to capital	2.6%	1.8%	2.3%	1.8%
Resources to capital	.5%	.6%	.5%	.6%
Maintenance to gross	30%	32.4%	36%	37.4%
Dividends	6%	6%	6%	6%
Gross earnings per subscriber	$46.20	$43.50	$41.20	$38.70

The constant lowering of the capital investment per subscriber has lowered fixed charges per subscriber and consequently the cost of the service. For instance, the interest charge at 6% on $202, amounting to $12.12 in 1901, has been reduced to $9.44 in 1904. The premium which the stock commands has enabled the company to place such capital as needed and development has been untrammeled. Expenses have shown an increasing ratio largely due to the enlarged maintenance charge, which must be accepted as ample. The amount charged to maintenance last year was over twice the sum available for dividend payments. The usual tendency toward a lower total the public is occasionally admitted, but the increase in value of a income from each subscriber is observed. This decrease in cost to service now nearly double that in 1901 is seldom appreciated.

THE TOPEKA EDISON COMPANY.—A new corporation, the Topeka Edison Company, has been granted a charter by the Kansas State Board. This is the company, backed by the backers of the City Railway Company, which has bought out the Edison Electric Illuminating Company. The capital stock is a million and a quarter dollars, divided up into 12,500 shares of $100 each. The directors and the number of shares held by each are as follows: B. E. Sunny, 1,250; L. E. Myers, 1,250; E. E. Wilson, 1,500; George B. Caldwell, 1,750; George H. Taylor, 1,750; Frank G. Kelly, 5; Albert M. Patten, 5; C. R. Maunsell, 5; Albert H. Priddy, 5. The last four are Topeka people. Three trustees are named who hold 5,480 shares of stock in trust, but are not in the directorate of the new company. They are E. A. Potter, Jr., Theodore P. Bailey and F. R. Fenton, all of Topeka. The State received $500 for the new charter.

CONNECTICUT POWER PLANT.—The Connecticut Railway & Lighting Company has acquired ownership of the New Milford Water Power Company. The property was organized in 1893, and had outstanding capital of $1,000,000, and bonds amounting to $1,000,000. The concern built a large plant near New Milford and drained the Housatonic River near Bull's bridge and other places to supply power. It had a 30-year contract to supply power to the Connecticut Railway & Lighting Company at $130,000 a year. The power is used to operate trolleys near Waterbury and other places. The bonds of the New Milford Water Power Company are now guaranteed by the purchasers. The officers in the New Milford Water Power Company are Winthrop Bushnell, president; Louis E. Stoddard, vice-president, and Samuel C. Morehouse, secretary and treasurer, all of New Haven.

MAHONING & SHENANGO.—The plan of the merger of the Youngstown-Sharon Railway & Light Company and the Pennsylvania & Mahoning Valley Railway Company is made public in a circular issued by Sanderson & Porter, of 32 William Street, managers. The merger, the Mahoning & Shenango Railway & Light Company, is capitalized at $10,000,000, divided into $4,000,000 5 per cent cumulative preferred stock, and $6,000,000 common stock. The new company will provide for an issue of $10,000,000 ten-year 5 per cent gold bonds. Bonds amounting to $3,000,000 will be available for extensions and improvements. An extension of time until September 6 has been allowed for the deposit of certificates with the New York Trust Company. The merger is based upon a valuation of 60 per cent for the Pennsylvania & Mahoning Valley Railway Company and 40 per cent for the properties of the other concern.

TELEPHONIC REORGANIZATION.—At a meeting of the bondholders' committee of the Commercial Telephone Company of Texas, important steps were taken leading to a reorganization of the company. The committee is composed of J. H. Goeke, of Wapokoneta, O.; J. A. Quisenberry, of Danville, Ky., and Fred Bimel, of Portland, Ind., representing stockholders owning nearly $300,000 of bonds in the three States of Ohio, Indiana and Kentucky. Last month at receiver's sale in Travis County, Texas, this committee bought in all the property for $110,000. The company now has bonds outstanding and unredeemed to the amount of $442,000. The present holders have decided to organize a new company with a capital stock of $500,000 and only so much of this stock will be issued as will be necessary to take up the old bonds at par.

CENTRAL PENNSYLVANIA TRACTION.—The directors of the Central Pennsylvania Traction Company, which operates all the electric lines in Harrisburg, have authorized the construction of a new power plant to cost from $200,000 to $250,000. To meet this expense they have further authorized a 10 per cent. assessment of $5 per share on the capital stock of the company, half payments to be made November, 1905, and June, 1906. The new plant is necessitated by the large increase in the business of the company.

DIVIDENDS.—The Kansas City Light Company has declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable September 1. The directors of Whatcom County Railway & Light Company have declared a semi-annual dividend of $3 on the preferred stock, payable September 1. The Columbus, O., Citizens' Telephone Company has declared the regular quarterly dividend of 1 per cent.

IOWA TELEPHONE BONDS.—A trust deed in the amount of fifty thousand dollars has been filed by the New Sharon Electric Company to the Citizens' Bank of New Sharon as trustee, for the purpose of issuing bonds in the sum of $50,000. The property and business of the New Sharon Independent Telephone Company and the New Sharon Light & Power Company is held as security.

FORT MYER SIGNAL POST.—Bids will be received by Captain A. W. Butt, Quartermaster, U. S. A., Washington, D. C., until September 18, for constructing an addition to the electric lighting system at the Signal Corps Post, Fort Myer.

General News of the Week

The Telephone.

LITTLE ROCK, ARK.—The Southwestern Telegraph & Telephone Company is preparing to rebuild its telephone lines between this city and England.

NEWCASTLE, CAL.—An order has been issued authorizing government officials to construct a private telephone line near Tahoe.

SANTA BARBARA, CAL.—The Home Telephone Company is installing a plant for the Coleta Valley, and the cables have ben laid as far as Coleta.

SAN JOSE, CAL.—The Sunset Telephone Company will expend $60,000 next month in improving its system in this city. The central energy system will be put in.

STOCKTON, CAL.—P. Kerr Higgins, a Los Angeles capitalist, has filed an application with the city clerk for a franchise to operate a new telephone company in Stockton.

LOS ANGELES, CAL.—The Pomona Valley Home Telephone Company has issued its call-book, showing 1,000 subscribers. A new switchboard of 3,000 capacity has been ordered.

ONTARIO, CAL.—P. T. Spencer, the representative of the Home Telephone Company, has appeared before the Board of Trustees and asked that a franchise be granted his company.

RIVERSIDE, CAL.—The Corona Home Telephone & Telegraph Company has been incorporated with a capital of $25,000, of which $50 has been subscribed. Directors: A. C. Wood, J. C. Gleason, H. A. Prizer and others.

LOS ANGELES, CAL.—The Alhambra Home Telephone & Telegraph Company has been incorporated with a capital stock of $50,000, of which $5,000 has been subscribed. Directors are P. T. Spencer, G. G. Miller, L. K. Parks, F. E. Williams and E. C. Webster.

NORDHOFF, CAL.—M. W. Phillips, the local manager of the Home Telephone Company, has announced that enough subscribers have been secured to guarantee the instalment of that system in the valley, and that work would begin at once and be pushed to completion in about six weeks.

SAN DIEGO, CAL.—The Home Telephone & Telegraph Company, of San Diego, has made application to the Board of State Harbor Commissioners for the right to place a line of cables over the tide lands and through the waters of the Bay of San Diego, and to maintain the same for a period of 30 years.

SAN FRANCISCO, CAL.—The Home Telephone Company has incorporated branch concerns in Oakland, San Jose, Stockton and Fresno, the papers being filed in San Francisco, which is to be the principal place of business. The capital stock of the Oakland branch is $3,000,000, with $30,000 subscribed; Stockton, $1,500,000 capital stock, $20,000 subscribed; Fresno and San Jose, each $2,000,000 capital stock, and $30,000 subscribed. The directors of the Oakland company are William Thomas, William L. Grestle, Thomas T. Parkhurst, Jr., L. S. Ackerman, J. E. Schoenfeld and L. Webster. The other branches mentioned have the same directors with the exception of Grestle and Webster. The Home Telephone Company applied for a franchise in San Francisco some weeks ago. The formal hearing of the application by the supervisors has been postponed for a short time. Several thousand subscribers have been signed and a demonstration plant placed on exhibition at the company's offices to show the operation of the automatic system.

DANBURY, CONN.—The Rogers Telephone & Electric Company, of Danbury, has been formed with capital stock of $20,000. The incorporators are Arthur J. Baldwin, of New Jersey; N. Burton Rogers, George L. Eastman, C. B. Rogers and Annie R. Davenport, of Danbury, and Frank E. Wiske, of New York.

LOWELL, IND.—The Lowell Telephone Company, Lowell, Lake County, has been formed; capital stock, $9,000.

PENNVILLE, IND.—The Pennville telephone plant, owned by A. D. Parks, has been sub-licensed to the Bell Company.

HOPE, IND.—Application has been made to the Town Board of Hope by Lewis [illegible], who resides near that village, for a franchise for a telephone system.

MARION, IND.—Oscar Barger, manager of the Converse Telephone Company, has asked the Board of Works of Marion for a franchise to operate a line from the south side of the city to Fairmount. He also asked for a franchise from the central part of the city to the west side, this line to extend to Converse.

ALTAMONT, ILL.—The Effingham County Telephone Company has been organized with a capital of $6,000. Incorporated by C. E. Munday and A. Munday.

TREYNOR, IA.—The Independent Telephone Company will locate an exchange at Treynor.

BURLINGTON, IA.—The Mississippi Valley Telephone Company will install a complete new local exchange.

[illegible], IA.—The contract for a new building has been let by [illegible] Company for $[illegible]

KENNEY, IA.—All telephone lines running through Kenney are to be reconstructed with new poles and new copper wire.

LE MARS, IA.—The Plymouth County Telephone Company succeeds the local company and will make extensions and improvements.

CAMERON, TEX.—The Hanover Telephone Company is extending its lines to connect at Midland with the outside world.

ST. CLOUD, MINN.—The Minneapolis-St. Cloud-Fargo toll line of the Northwestern Telephone Company is to be rebuilt.

BROOTEN, MINN.—The Brooten Telephone Company, with a capital of $4,500, has been organized. Officers: T. O. Shelso, W. Stuart and others.

GRANITE FALLS, MINN.—An ordinance has been accepted granting to the Granite Falls Telephone Company the right to erect and maintain its poles and wires in the alleys and public ways of the city.

BISMARCK, MO.—A franchise for a telephone in this city has been granted to Dr. J. L. Eaton and Otto Ramsey.

KANSAS CITY, MO.—The Baldwin Telephone Company has been formed. Capital, $15,000. Incorporated by C. R. Baldwin, R. H. Drake.

AUGUSTA, MONT.—J. C. Furman and others seek a franchise for the construction of a telephone line from Augusta to Sun River.

BILLINGS, MONT.—E. A. Hess, of Lyons, Iowa, has received the contract for a telephone line to Buford, about 70 miles. His contract is $15,932.

GREAT FALLS, MONT.—The line to Portland and Salt Lake City will be rebuilt and two additional lines strung to Lewiston at an expense of $25,000 by the Bell Telephone Company.

NEWARK, N. J.—Still another change has been made by the Board of Works in the limited franchise it is proposed to grant to the New York & New Jersey Telephone Company for the use for a new telephone line of Newark's right of way in the land traversed by the pipe line between the Belleville reservoir and the Macopin intake. An amendment stipulating that the concern must construct for the city a telephone line similar to the one now in use, if the proposed agreement is ever canceled, was approved and incorporated in the franchise.

LANCASTER, N. Y.—The Frontier Telephone Company has applied to the Village Board for a franchise.

OSWEGO, N. Y.—The directors of the Ontario Telephone Company have approved the plans for the new telephone exchange. The plans and specifications have been sent out to prospective bidders.

SYRACUSE, N. Y.—The Independent Telephone Company, of Syracuse, controlled by Rochester capitalists, has started the work of reconstructing and improving the telephone service of the company in that city. Fifteen miles of new subway will be constructed, on which work will begin Monday. The poles and lines of the independent company will be largely extended in all the outlying sections of the city. The switchboard will be built by the Stromberg-Carlson Company. This switchboard, by the way, will, it is said, be the finest and largest ever turned out of the Rochester factory. It is built of mahogany with every new device and will cost complete $150,000. It will have an ultimate capacity service of 12,000 telephones, of which 6,000 will be connected.

NEW YORK, N. Y.—The Atlantic Telephone Company, the new independent corporation which shortly expects to be operating in Greater New York, has filed its plans in the Controller's office and at the first meeting of the Board of Estimate, which will be held on Sept. 15, the officials of the company expect a favorable decision regarding its application for a franchise. The number of exchanges proposed for Manhattan is 18; for Brooklyn 14; for Queens 9; for Richmond 4, and for the Bronx 6, with a further extension to 10 as the number of telephones increase. Where it is possible the wires of the company will be laid underground. The number of miles of wire in the different boroughs will be in Manhattan 30,000 miles; in Brooklyn 15,000 miles; in the Bronx 7,500 miles; in Queens 2,000 miles, and in Richmond 1,500 miles.

MINTO, N. D.—The Northwestern Telephone Company will put in an exchange here with rural connections.

HAMILTON, OHIO.—The bond of the Cincinnati & Suburban Bell Telephone Company in the sum of $5,000 as surety for the grant to construct conduits in the city, with John Kilgore and Volney Elston, of Cincinnati, and M. O. Burns, of Hamilton, as sureties, has been presented and approved.

EL CAMPO, TEX.—The Coast Telephone Company has been formed with a capital of $25,000. Incorporated by T. J. Poole and C. W. Robinson.

WINCHESTER, VA.—The United Telephone & Telegraph Company has been formed with a capital of $5,000. Incorporated by R. G. Park, president; S. R. Caldwell, secretary.

WAUSAU, WIS.—The Wausau Telephone Company has received materials for the construction of a new local exchange.

GRATIOT, WIS.—The Lafayette Telephone Company of this city has been formed, capital $25,000, by H. W. Burmeister and others.

MILWAUKEE, WIS.—Two independent telephone companies—the West Shore Telephone & Telegraph Company and the Milwaukee Home Telephone Company—have made application to the Common Council of Milwaukee for an ordinance permitting them to construct and operate telephone lines in that city.

SPOKANE, WASH.—The Home Telephone Company has been voted a franchise.

MONTEREY, MEX.—The Mexico Telephone Company contemplates improving its lines in Monterey.

Electric Light and Power.

TROY, ALA. A company known as the Pea River Power Company has been incorporated to build an electric railway between Elba and Troy, Ala., and to supply light and power to the adjacent towns. The principal office of the company will be at Troy. Charles Henderson, H. D. Boyd and J. M. Garrett are the officers of the company.

LOS ANGELES, CAL.—The Yuma Electric & Water Company is reported incorporated, with a capital of $100,000 by A. A. Talmage and others.

ANAHEIM, CAL.—Ciem. A. Copeland, of Los Angeles, is stated to have estimated the cost of propsed improvements to the electric light plant at $22,000 and to the water works at $18,250.

SAN FRANCISCO, CAL.—An additional 1,600-k.w. unit has just been installed at the Emeryville power station of the San Francisco, Oakland & San Jose Railway (Key Route). A General Electric direct-current generator is direct-connected to a 2,300-h.p. Hamilton-Corliss engine.

SAN LUIS OBISPO, CAL.—B. F. Thomas, Mgr. San Luis Obispo Gas & Electric Company, states that the C. C. Moore Company, of San Francisco, has secured the contract for constructing a new plant of 270-kw. capacity. A. M. Hunt, of 614 Mission St., San Francisco, is the engineer.

LOS ANGELES, CAL.—The Council has adopted a report of the Lighting Committee in which it is recommended that the city clerk ask bids for municipal lighting under the following terms: 1 year contract not to exceed 2,000 lights, 3 year contract not to exceed 2,500 lights and 5 year not to exceed 3,000 lights.

SAN FRANCISCO, CAL.—The California Gas & Electric Company has completed the installation of two additional 5,000-k.w., 3-phase generating units at its Electra power station. This addition to the three generators already in operation gives the Standard Electric transmission line a large capacity.

SAN FRANCISCO, CAL.—The California Powder Works now has in successful operation at its new general power house at Hercules a 400-kw, three-phase Westinghouse-Parsons turbo-generator. It is the first installation of the kind in this vicinity. A. M. Hunt acted as consulting engineer on the improvements at the powder plant.

SAN FRANCISCO, CAL.—The Eel River Power & Irrigation Company is building the pole line on its 22-mile transmission from Potter Valley to Ukiah. It is probable that a transmission line will be built to San Francisco, a distance of 130 miles, as the market for power near the plant is limited. The machinery ordered includes two 2,000-kw, three-phase generators and two Victor turbine water wheels.

SAN FRANCISCO, CAL.—It is reported that the Tuolumne Electric Company, which is constructing a water-power electric plant near Tuolumne, Cal., has arranged to sell power to operate the projected Kemp, Van Ee electric road from Santa Cruz to Hollister and to the new cement works to be erected in the San Juan Valley. H. Hersey is president and C. W. Quilty manager of the electric power company. The machinery contracted for includes two 600-kw. Bullock, three-phase generators and a 1,200-hp. Platt Iron Works wheel operating under 425-foot head.

NORWICH, CONN.—The Uncas Power Company, of Norwich, has been incorporated with a capital of $1,000,000.

STERLING, CONN.—The Sterling Power Company has been incorporated with a capital of $500,000, and will distribute electric light and power to the towns of Sterling, Plainfield, Brooklyn and Killingly.

NEW HARTFORD, CONN.—The Northern Connecticut Power Company, of New Hartford, has been incorporated to operate in Litchfield, Hartford and Tolland Counties under certain restrictions, and is to develop water power on the Farmington River.

PACKERSVILLE, CONN.—Negotiations are now in progress for the purchase of the Packer power privilege here in behalf, it is understood, of the New York, New Haven & Hartford railroad, which wishes to erect an electric power station for the eastern Connecticut branch of the Consolidated Railway Company and to furnish lighting for Wauregan, Moosup, Plainfield and other nearby towns.

RIDGEFIELD, CONN.—There is every prospect that Ridgefield will have a new electric plant in the immediate future. A meeting of the stockholders of the Ridgefield Electric Company has been held at which the following directors of the company were elected: Henry B. Anderson, John A. Mitchell, George Pratt Ingersoll, George G. Haven, Jr., Dr. R. W. Lowe, Albert H. Wiggins; secretary, Harvey P. Bissell. Mr. Kirk has been made general superintendent and assistant secretary of the Electric Company.

ST. PETERSBURG, FLA.—The St. Petersburg Investment Company, which owns the electric light plant and street railway, contemplates moving the plant and reconstructing it with the addition of a 350-hp. boiler and two 250-hp. engines.

SAVANNAH, GA.—The City Council on Aug. 18 passed the ordinance granting a franchise to the Savannah Lighting Company.

JASONVILLE, IND.—The Jasonville Electric Company will build an electric light plant in that city.

GENEVA, IND.—W. R. Thurston, of Bern, is reported to have petitioned for a franchise to construct a power plant at Geneva.

MICHIGAN CITY, IND.—Estimates are being prepared for remodeling the electric light plant of the Indiana State Prison.

VAN BUREN, IND.—The Huntington Light & Fuel Company, of Huntington, Ind. (F. D. Townsend, Supt.) has petitioned the City Council for a franchise for the erection and operation of an electric light plant in this city.

PEKIN, ILL.—The Tremont electric light and power plant will be rebuilt.

BELLEVILLE, ILL.—The City Council has appointed engineers to prepare estimates of the proposed municipal electric lighting plant.

FREEBURG, ILL.—Chas. Kessler, village clerk, states that the proposed municipal electric light plant will cost about $9,000. No engineer has been selected yet.

BLOOMINGTON, ILL.—A syndicate of Detroit capitalists, headed by Emanuel T. Beyer, has purchased the Union Gas Light & Electric Company for $400,000, the amount of the capital stock.

VANDALIA ILL.—The Vandalia Light & Fuel Company recently sold its electric light plant to the city of Vandalia for $18,000. A number of taxpayers have since filed suit to enjoin the consummation of the sale on the grounds that the city is already indebted beyond the constitutional limit and has no right to engage in the business of selling light.

GENEVA, IND.—The town council has granted W. R. Thurston a franchise for an electric light plant.

MORRISON, IOWA.—The Morrison Electric Light Company has awarded the contract to erect a gas plant in Morrison to Frank S. Moses Company, of Trenton, N. J., at about $50,000.

HERINGTON, KAN.—Chas. F. Custafson, of Topeka, it is stated, has secured a franchise to furnish water, electric light and power to Herrington.

SOMERSET, KY.—W. G. Hunter, of Somerset, has received a franchise for an electric light plant. T. R. Griffin Mayor.

NEWPORT, KY.—An election is to be held Nov. 7th to vote on the proposition to issue $50,000 bonds for an electric light plant. Peter J. Krebs is city clerk.

PITTSFIELD, MASS.—The Eaton-Hurlbut Paper Company is to erect a new power plant in South Church Street. The concern has outgrown the present plant. The new plant will be of brick and will cost about $15,000.

BOSTON, MASS.—An attempt has been recently made by parties in Boston to purchase the controlling interest in the Fall River Electric Light Company. It is understood that offers of over $175 a share have been made for stock of the Fall River Electric Light Company, and the rights to subscribe for the new stock are variously quoted from $10 to $15 a right.

UPTON, MASS.—The Upton Electric Company has sent a letter to the local authorities, declining to accept the conditions whereby the use of Upton's streets could be secured for the carrying on of electric lighting service. The Selectmen gave the company privileges of location provided the company would light Upton town hall free of charge while the contract was in force.

HOLYOKE, MASS.—The contract for the new power plant of the Holyoke Water Power Company has been awarded to Casper Ranger for about $150,000. The contract includes the building, the canal walls of granite, head gates of iron, and it is estimated about 1,000,000 brick will be required in addition to the other material. The house will be located near the Norman paper mill, and the excavations have been made. Mr. Ranger has already begun construction work.

LEOMINSTER, MASS.—Arrangements for the control of the Leominster Electric Light & Power Company by the Massachusetts Electric Companies are completed. All the stock has been subscribed, and the directors have elected E. S. Clarke, of Boston as president and manager. The Leominster Company is to retain its name, and the capitalization of $50,000 is to be the same.

WALTHAM, MASS.—A new power house is in process of construction at Waltham. The building will be of concrete and steel construction, 153 feet in length, 100 feet wide and 35 feet high, with a boiler room at the rear at a lower level. When the building is completed, three generator engines, now being built, will be installed; power will be supplied for electric lighting and for the street car service.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company is preparing to install a steam turbine.

ROSE CITY, MICH.—Jas. Monaghan and Frank G. Bell have secured a franchise to install a commercial lighting plant.

GRASS LAKE, MICH.—The lighting proposition has been carried in this city by 23 majority. Work will be commenced at once on the new plant.

GRAND RAPIDS, MICH.—The Grand Rapids Electric Light Company has been incorporated with a capital of $15,000. Incorporators: Walter C. Winchester, W. C. Miller and E. A. Stowe.

PONTIAC, MICH.—Engineers McKean, Ball & Co., of Chicago, Ill., write that the general contract for constructing the plant of the Clinton River Power Company has already been let, but wire and supplies and arc lamps are yet to be purchased.

FLORENCE, MICH.—A. E. Edmonds and Rhinelander capitalists, it is reported, will construct a power plant to supply the cities of Florence and Crystal Falls with light, and operate an interurban line from Iron Mountain to Spread Eagle Lake.

HART, MICH.—J. N. Cotton, of Hart, Pres. Pere Marquette Light & Power Company, writes that Harry McDaugh, of Dayton, O., has prepared plans and specifications for improvements to this plant, which will be made sometime within a year. The probable cost of the proposed work is $75,000.

CHEBOYGAN, MICH.—Dr. A. M. Gerow is promoting an enterprise to dam Pigeon River. He has the necessary flowage rights. The entire cost of the investment will be $350,000, the current delivered in Cheboygan, the transformer station included. The plant is to generate 8,000 horse-power. The head will be 75 feet.

MOUNT IRON, MINN.—This village is reported to have voted to install an electric light plant.

MINNEAPOLIS, MINN.—Announcement is made of the purchase of the property known as Big Island, in Lake Minnetonka, twenty miles from Minneapolis, by the Twin City Rapid Transit Company. The property will probably be rechristened Coney Island, and the company will construct on a smaller scale an amusement center on the plan of the big New York resort. Steamers will be operated on the lake in connection with the new suburban line of the company now nearing completion.

WAUSAW, MO.—The proposition to issue $6,000 electric light bonds was carried at the recent election.

ST. CHARLES, MO.—The city electric light plant is receiving a complete overhauling. The circuits are also being repaired. The question of moving the plant and consolidating it with the city water work plant is still in deadlock in the Council.

GOLDFIELD, NEV.—The Bishop-Nevada Electric Power & Lighting Company has been incorporated with a capital of $1,000,000, for the purpose of constructing an electric plant on the Owens River, near the town of Bishop, to transmit power to Tonopah, Goldfield, and Bullfrog. D. Jones, of the J. Jones Exploration Company may be able to give further information.

ROCHESTER, N. H.—The Board of Managers of the Alton Bay Campmeeting Association is considering the matter of installing an electric light plant on the campmeeting grounds.

BERLIN, N. H.—E. A. Noyes, of Portland, trustee and treasurer of the Berlin Electric Light Company, has closed a deal with W. K. Aston, of Shelburne, for water power privileges on the Androscoggin at the so-called lead mine bridge. The contract has been given to Ward Brothers, of Berlin, for the construction of a power house and dam estimated to cost from $75,000 to $100,000. There will be a concrete fireproof building 110 feet long and 50 feet wide.

ATLANTIC CITY, N. J.—An ordinance has passed first reading in the City Council granting a franchise to the Atlantic City & Suburban Electric Company.

PERTH AMBOY, N. J.—The City Council has granted a franchise to the Citizens' Electric Light & Power Company. The company will probably begin work on its plant at once. Engineers, Runyan & Carey, 122 Market Street, Newark.

SILVER CITY, N. M.—The City Council has granted a 50-year electric light franchise to Geo. T. Schmelzel and associates.

JARILLA, N. M.—R. G. Mullen represents a company which proposes erecting power plants along the Sacramento River for a mining camp at Jarillo.

SILVER CITY, N. M.—Geo. T. Schmelzel says that the proposed electric light plant will cost $9,000. His address is Hotel Brevoort, Chicago, Ill., for 10 days after Sept. 1st.

ALBUQUERQUE, N. M.—The Union Gas & Traction Company has been incorporated with a capital of $500,000 for the purpose of constructing and operating gas, oil, electric and water works plants and systems; to operate a system of pipe lines, wires, etc., for the transportation of gas, oil, electricity and water; to own and develop clay, sand, cement and other lands and properties, to operate steam, electric and cable street cars or traction lines. Incorporators: C. H. Pattison, Kansas City, Mo.; W. L. Pattison, Gardner, Kan.; J. T. Luthy, Albuquerque, N. M., and others. The principal place of business is to be Albuquerque, N. M.

CAMDEN, N. Y.—The contract for constructing a power house for the municipal electric light plant has been awarded to J. A. Raymond. The building must be ready to receive machinery Oct. 1.

ROCHESTER, N. Y.—The Niagara Falls Electrical Transmission Company, of Niagara Falls, N. Y., has applied to Mayor Cutler for permission to erect poles and wires and to construct conduits in the streets, alleys and public places of the city and to transmit and sell electric power and light.

STILLWATER, N. Y.—Flood & Sherrill, of Sandy Hill, have secured the contract to construct a concrete dam across the Hudson River at Stillwater, at a cost of about $[illegible]. About 600 to 800 cu. yds. of rock will be excavated. The dam is to provide power for the Hudson Valley Ry. and to the mills.

LITTLE FALLS, N. Y.—The J. B. McCaghey Company has been organized by W. J. Berrigan, of Little Falls, J. E. McCaghey, of Sandy Hill, and others. The company has secured contracts from the Paul Smith's Hotel Company to construct two electrical power plants, one at Union Falls, Clinton County, and the other at Franklin Falls, Franklin County.

ROCHESTER, N. Y.—It is stated authoritatively that the Niagara Falls Electrical Transmission Company which has asked for a franchise in Rochester, has no connection with the Niagara, Lockport & Ontario Power Company and that the latter company does not contemplate seeking franchises in Rochester and Syracuse. The Niagara Falls Electric Transmission Company has as its president Mr. Frederick Nicholls, of Toronto. Its vice-president is Frank A. Dudley, of Niagara Falls.

READING, OHIO.—Bids will be received Oct. 15 by G. Hornung, 612 Johnston Building, Cincinnati, for a new electric light plant for Reading, to cost about $30,000.

TOLEDO, OHIO.—The question of holding an election to vote on the issuing of $500,000 bonds for a city lighting plant is under consideration by the City Council.

TOLEDO, O.—Chas. S. Ashley, president of the Central Heating & Lighting Company, has announced that extensive improvements are to be made in the company's lighting plant in the Meredith Building.

TOLEDO, OHIO.—Citizens will be asked to vote, at the fall election, on the installation of a municipal electric light plant. An estimate, prepared by F. J. [illegible], chief engineer of the Board of Public Service, places the cost at about $[illegible].

ZANESVILLE, OHIO.—The H. H. Sturtevant Company has had plans made for a large electric power plant which will in the near future be added to the equipment of its large department store. The contract for the erection of the new power plant has not been let, but all other arrangements and plans have been completed.

TOLEDO, OHIO.—The principal features of the franchise asked by the Central and East Side heating and lighting companies are: Companies to give city bond, Central $25,000, East Side $15,000, to insure good faith and completion of plans in 18 months; rate for lighting to be 9 cents per kw-hour; city has right to use all of either company's poles or conduits without charge; city reserves right to change prices for heating every five years, lighting every 10 years; franchise to run 25 years; the Board of Public Service is vested with authority to compel either company to extend its service to any reasonable location.

MIAMI, OHIO.—The Maumee Valley Electric Company is making preparations for the extension of its operations on both sides of the river between the city line and Maumee and Perrysburg, including the two named towns. The company operates the power plant near Miami, that was originally used to furnish electricity for the Maumee Valley Belt line. It is owned by the Detwilers and George G. Metzger. A franchise will be asked from the councils of Maumee and Perrysburg and an effort made to light every house on both sides of the river between Toledo and the two towns up the Maumee. Wires are now being strung to many summer homes just beyond the city limits.

DRAIN, ORE.—The Skelley Lumber Company is about to apply to the Town Council for a water and light franchise.

NEW CASTLE, PA.—Rights of way have practically all been secured through this county for the new interurban electric railway, to be built from Pittsburg to New Castle by the Pennsylvania Motor Power Company, recently organized by Pittsburg capitalists.

CAMDEN, PA.—The Wyoming Gas & Electric Company has been formed to operate and maintain gas and electric lighting plants; capital $15,000. Incorporators: John A. MacPeak and others.

YORK, PA.—Sanderson & Potter, of New York, N. Y., are reported to have secured the contract for constructing a dam 32 ft. high, to contain about 375,000 cu. yds. concrete masonry, on Susquehanna River, for the McCalls Ferry Power Co.

CONNELLSVILLE, PA.—A deal just completed makes a change in the ownership and management of the Interstate Electric Company of Connellsville. On account of a press of duties as superintendent of transportation of the West Penn Railways Company, J. W. Brown, who organized the company, and Frank Zimmerman, have sold their stock to J. M. Fisher and Charles O. Moser, who were electricians for the company.

MOOSUP, R. I.—The Consolidated Railroad Company is proposing to buy the Packer power privilege at the Quinebaug Bridge, a few miles west of Moosup, with a view to building an electric power plant to furnish light and power for the tramway, and also for the villages of Plainfield, Wauregan, Central Village and Moosup.

PLUMA, S. D.—Phillips & Bartlett, of Deadwood, are stated to have secured the contract for erecting a power house at Pluma for the Consolidated Power & Light Co., probable cost, $20,000.

SIOUX FALLS, S. D.—The Queen City Electric Light & Power Company has been incorporated at Pierre with a capital of $300,000. Incorporators: H. J. Hanford, Chicago, Ill.; P. Curtis, Norwalk, O.; W. G. Mack, of Sioux Falls, and others.

OLIVER SPRINGS, TENN.—Fred. C. Sinckneicht is reported to have decided to construct an electric light plant at this place, and is in the market for an engine.

BRISTOL, TENN.—Following a meeting of the directors of the Bristol Gas & Electric Company, it was announced that the General Electric Company has purchased a large interest in the properties and franchises of the local company which owns all the gas, electric and street railways in this city and Bristol, Va.

VERNAL, UTAH.—The City Council has granted a franchise to G. H. Seth for an electric light, heat and power plant.

RICHFIELD, UTAH.—A. J. Paulson, of Richfield, has filed with the state engineer, at Salt Lake City, an application for a water right on Sevier River. It is proposed to install a power plant capable of developing 450 hp.

OGDEN, UTAH.—L. B. Spencer, of Ogden, has filed with the state engineer, at Salt Lake City, an application for a water right on Ogden River. He intends to construct a power plant to furnish both power and light in Ogden.

SALT LAKE CITY, UTAH.—J. H. Bigger and J. E. Hill have applied for permission to develop power for electrical purposes from American Fork Creek. They propose developing 950 hp for electric lighting and for working machinery in the American Fork mining district.

READSBORO, VT.—Plans are under way for the erection of an electrical power plant on the Deerfield River, north of the east portal of the tunnel. A charter for the new company has been secured from the State of Vermont, under the name of the Deerfield River Power Plant Company. Among those interested in the project are W. S. Morton, of Hartford, Conn.; James H. Roraback, of Canaan, Conn., and Faxon Bowen, of Readsboro, Vt. The plant will be located near Readsboro in Vermont.

RUTLAND, VT.—Receiver Fox of the Rutland Street Railway Company and the Chittenden Power Company, of this city, whose securities were sold by Receiver Douglas Robinson of the Merchants' Trust Company, has explained that the sale was a matter of routine, to clear the local companies involved from their entanglement in the affairs of the Merchants' Trust Company, which held securities aggregating $425,000, given by the Rutland concerns in connection with bond issues. The sale will make no change in the management. It is understood that work on the Chittenden Power Company, which is unfinished, will be pushed.

EVERETT, WASH.—The Mayor has been directed by the City Council to appoint a committee to investigate the possibility of establishing a municipal electric light plant.

ARLINGTON, WASH.—Thos. Moran is reported to have secured a franchise for a light and water system, the power to be developed from the falls of Jim Creek.

TACOMA, WASH.—The City Council Committee on fire and water has recommended that the arc circuit, which in the report of the City Engineer is estimated to cost $5,000, be installed immediately.

SUNNYSIDE, WASH.—The question of constructing water works and an electric light plant is reported under consideration here. The probable cost is $15,000.

REARDAN, WASH.—The Reardan Light & Power Company, it is reported, has been incorporated with a capital of $5,000 to engage in the light and power business. Incorporators: Frank Bradley, John Fields, John Rayman and others.

ALMOND, WIS.—The Almond Milling Company is stated to have asked for a franchise for an electric light plant.

PHILLIPS, WIS.—The Phillips Light, Water, Heat & Power Company petitioned for a franchise.

WESTFIELD, WIS.—The citizens are reported to have voted in favor of establishing an electric light plant.

LITTLE CHUTE, WIS.—The Kaukauha Electric Light Company (W. H. Nelson, secretary) has applied for an electric light franchise here.

BURLINGTON, WIS.—At a special election in this city the proposal to vote $12,000 for a municipal electric lighting plant was carried by a vote of 193 to 188.

MILWAUKEE, WIS.—The County Trustees are stated to have appointed the Milwaukee Engineering Company to prepare estimates for a new electric wiring system at the county hospital; and to be discussing the question of providing for a central heating, lighting and power plant, as well as for extending the city water mains to the Wauwatosa institutions.

PEMBROKE, ONT.—The Pembroke Light, Heat & Power Company has been formed to acquire water power on the Black River, for the purpose of adding to the present electric light system.

NAPANEE, ONT.—W. A. Grange, town clerk, states that plans and specifications have been prepared by R. S. Kelsch, New York Life Bldg., Montreal, Que., for the proposed municipal electric light plant; probable cost, $35,000.

CARACAS, VENEZUELA.—The Caracas Gas & Electric Light Company has been declared bankrupt. The municipal government having sued the Caracas Gas & Electric Light Company for breach of contract, the company replied by sending notice that it would not light the city. The government immediately took possession of the entire plant of the company.

The Electric Railway.

LITTLE ROCK, ARK.—The preliminary survey for the Little Rock & Hot Springs Electric Railroad has been filed. The line will run westerly from Little Rock.

SAN FRANCISCO, CAL.—The Ocean Shore Railway Company, A. D. Bowen, manager, will open bids September 1 for the construction of its standard gauge electric road, 82 miles in length, connecting San Francisco and Santa Cruz. It has been decided to double-track the line for the entire distance.

OAKLAND, CAL.—It is announced that Walter E. Dean, J. Downey Harvey, Burke Corbet and their associates in the Ocean Shore Railway, have decided to make the proposed electric line to Santa Cruz a double-track road instead of a single-track line, as originally planned. This change in the company's plans will involve an increase in the capital stock from $3,000,000 to $5,000,000, and the creation of a bonded indebtedness of $5,000,000.

YREKA, CAL.—An option on a majority of the stock of the Yreka Railroad has been secured by Alex J. Rosborough. The road at present connects Montague on the S. P. R. R., with Yreka, but it is the intention of those now gaining control to extend to Fort Jones and Etna, in Scott's Valley, a distance of about 40 miles. It is reported that the road will be changed to an electric line by the new owners.

SONOMA, CAL.—The Sonoma Valley Company has been incorporated to construct an electric railway from Sonoma to Glen Ellen, a distance of six miles, and to furnish electric light and power for all persons en route. The electric road will touch at El Verano, Eldredge, Agua Caliente Springs and Boyles' Hot Springs. The incorporators are said to have already obtained options on the Sonoma electric lighting plant and on the franchise granted to Weber & Schocken in the city of Sonoma. They expect to apply to the Board of Supervisors at their September meeting for a franchise over the county's domain between the points named. Work is expected to begin in the near future.

WAYCROSS, GA.—A. Sessons, C. M. Sweat, and others, have made application to the City Council for a franchise to operate a street car line, to be known as the Waycross Street & Suburban Railway Company.

FORT WAYNE, IND.—The Fort Wayne & South Bend Traction Company has just completed the survey of its line from South Bend to Fort Wayne, and expects to have a large force on the South Bend end of the line in 30 days.

EAST ST. LOUIS, ILL.—The Ozark Mountain Electric Railway Company is petitioning the City Council of East St. Louis for a franchise to construct, operate and maintain an electric railway on Market Ave., 27th and 4th Sts., to Belleville. The right of way is said to have been secured. E. W. Hartman, of East St. Louis, is president of the company.

EAST ST. LOUIS, ILL.—Articles of incorporation have been filed by the St. Louis, Vandalia, Terre Haute & Eastern Traction Company, with a capital stock of $1,000,000. Its principal office will be in East St. Louis. The object is to construct a trolley line from East St. Louis to Terre Haute, Ind., with branches. The directors are Peter Chase, Decatur; Charles W. Mills, Chicago; Louis Bissell, Effingham; Henry J. Wanner and William P. Baldwin, Chicago.

CLAREMORE, I. T.—A charter for an electric railway has been granted by the Council to T. S. Chambers, of Blackwell, Okla. The proposed electric railway will connect the business and residence portions of Claremore with the radium springs, and extend to the lakes, six miles south of here.

HOPKINSVILLE, KY.—Geo. V. Green, a member of the State Prison Commission, announces that the commission is preparing to construct an electric railway from Eddyville to the branch penitentiary, about a mile and a half from town and the railroad depot. The work of building the road will be commenced and pushed to completion as rapidly as possible.

PARIS, KY.—The Paris-Carlisle-Maysville Traction Company, of which ex-Congressman James N. Kehoe, of Maysville, is president, has been granted a franchise to enter Paris by a route and upon streets to be designated by the City Council. The work of construction is to begin within 18 months and to be finished in three years. The Fiscal Court has granted the company a franchise from Paris to the Nicholas county line. The Traction Company and the county will co-operate in the building of an iron bridge over Stone Creek at the foot of Main St., 60 feet wide.

PARSONS, KAN.—The Pittsburg Electric Railway Company has secured a loan of $600,000 from the Lincoln Trust Company, of New York, for the purpose of financing the extension from Pittsburg to Columbus.

BALTIMORE, MD.—The town council of Takoma Park, Md., has adopted an ordinance granting the right of way to the Baltimore & Washington Transit Company of the State of Maryland to construct and operate a single-track railway.

HAGERSTOWN, MD.—The Hagerstown Street Railway Company has begun work on its extension to Waynecastle. The road will be a little more than nine miles long, four of which are in Pennsylvania. It will run through private lands, the company having purchased rights of way for the entire distance through farms. A substation will be erected at Middleburg.

BALTIMORE, MD.—The Baltimore Terminal Company has been organized as a subsidiary company of the Washington, Baltimore & Annapolis Railway, to construct a terminal in the City of Baltimore to accommodate the cars of the interurban company. An ordinance is already pending before the Council of Baltimore to permit the parent company to operate its interurban cars in the city, having Baltimore Street and Hopkins Place as the site of the terminal, within two blocks of the shopping district. George T. Bishop, president of the company, states that it will spend $5,000,000 in improvements at that point and proposes to start with the work at once. Cars will be equipped with four 125-hp motors capable of 70 m.p.h. The tracks will be laid on private right of way except in the two cities, and the line will be double track.

AUGUSTA, ME.—The articles of association of the Norway & Western Railway Company have been approved by the Railroad Commissioners. The company will build an electric railway through the towns of Norway, Waterford, Stoneham and Albany, with a branch at South Waterford.

KALAMAZOO, MICH.—By the closing of one of the most remarkable railroad deals in the history of the State of Michigan, the Kalamazoo, Lake Shore & Chicago Traction Company has come into possession of the Michigan Central Railroad track and right of way for a distance of 16 miles between Kalamazoo and Mattawan, completing the right of way for a line between Kalamazoo and South Haven. The section of track sold by the Michigan Central was not adapted to the giving of a perfect steam road service. It is winding and the grade is heavy. The work of laying a new line of tracks was begun two years ago and is now completed. With the taking over of this track by the interurban company the prospects are bright for the opening of traffic between Kalamazoo and Lawton this fall. The power house will be located at South Haven. The officers and stockholders of the company are: President, S. J. Dunkley; vice-president, George E. Bardeen; treasurer, W. R. Beebe.

KANSAS CITY, MO.—Jacques A. Haskins, of Haskins City, has been awarded the contract for constructing the Kansas City-Olathe Electric Railway, financed by W. B. Strang. The road will enter the city by way of the Metropolitan's Westport line.

ELIZABETH, N. J.—Work has begun on a trolley line between Elizabeth and Middletown by the New York & Philadelphia Company. The road is being constructed under a railroad charter, and it has a 100-foot wide right of way from Trenton to Elizabeth, N. J. Ninety and 100-pound rails are to be used in the construction, and double tracks will be laid the entire distance. Plans have been made, it is said, for an addition to a power house between New Brunswick and Trenton, which is already constructed. The officers are: W. A. Stearns, president; I. H. Silverman, treasurer, and E. H. Harrington, general manager. Inquiries can be addressed to the company's Elizabeth, N. J., offices.

ALBUQUERQUE, N. M.—The City Council of Las Vegas has granted to

W. A. Buddecke an electric railway and lighting franchise for a term of 50 years. The franchise contains a contract for the lighting of the city.

ALBUQUERQUE, N. M.—The Union Gas & Traction Company has been incorporated with a capital stock of $500,000, to engage in the construction and management of gas, electric light and street railway plants. The incorporators are C. H. Pattison and N. D. Pattison, of Kansas City; W. L. Pattison, of Gardner, Kan.; J. F. Luthy, of Albuquerque.

PORTAGE, N. Y.—The Genesee River Railroad Company has been incorporated under the laws of the State of New York, to build and operate an electric road 30 miles long, from Portage, Livingston County, to Cuba, Allegheny County. The capital is $350,000. Among the directors are F. B. Underwood, Francis L. Stetson, George F. Brownell, Charles Steele and Granville A. Richardson. This will be a cut off of the Erie Railroad.

TOLEDO, OHIO.—The seven interurban railways entering this city, and the Toledo Railways & Light Company have joined hands in a project for a new union depot, to be erected on the local railway company's property.

STEUBENVILLE, OHIO.—The Steubenville, Mingo & Ohio Valley Traction Company has been absorbed by the Steubenville & Wheeling Traction Company, of which A. M. Snyder, of Cleveland, is president, and A. A. McCaslin, of Cleveland, secretary. The new company has filed a mortgage for $650,000 on the property given to the Dollar Savings & Trust Company, of Wheeling. The company will extend the line.

SHAWNEE, OKLA.—The City Council has granted Willis E. Fertig and associates a franchise to build and operate a street railway in this city. It is understood that Fertig is to purchase the Shawnee Traction Company.

PAWNEE, OKLA.—The Interurban Traction Company, of Oklahoma City, is putting an engineering corps in the field to locate an electric railway to Norman. The contract has been let for the grading of the line from the corporated city limits of Oklahoma City to the south border line of Capital Hill.

WILKINSBURG, PA.—The Council of this city has asked $10,000 for a street railway franchise from the Turtle Creek & East Pittsburg Street Railway.

YORK, PA.—A survey will be made this fall for a trolley line from Red Lion to York Furnace, Brogueville and Airville, a distance of over 15 miles. Sheriff S. M. Manifold is in charge of the survey.

SCRANTON, PA.—A charter has been issued to the Scranton & West Side Street Railway Company, with a capital stock of $24,000, to build 3½ miles of road in Scranton. Ezra H. Ripple, is president.

PITTSBURG, PA.—The Pittsburg & Cross Creek Railroad Company has been incorporated with a capital stock of $70,000, to build seven miles of road in Washington County. The president of the new company is N. T. Sanford, Pittsburg.

BROWNVILLE, PA.—The Uniontown, Brownville & West Side Railway, building 16 miles of line to connect Brownsville, Bridgeport, Uniontown and other points, is in the market for cars and overhead material. Mr. J. P. Byrne, of Scottsdale, Pa., is president of the company.

ALLENTOWN, PA.—The directors of the Lehigh Valley Traction Company have made contracts for equipment that will call for an expenditure of $1,100,000. The old power house will be abandoned on both the Lehigh Valley and Philadelphia lines and replaced by a central high-tension plant at Allentown.

PITTSBURG, PA.—Private right of way has practically been secured for the Shenango Street Company, 65 miles long, connecting New Castle, Sharon and other Shenango Valley points with Conneaut Lake, Meadville and Cambridge Springs, and the connecting links, also between Pittsburg and Erie, a distance of 150 miles. This line is independent of the Shenango & Mahoning Valley consolidation and will be built by Cleveland and Pittsburg capital.

PIERRE, S. D.—Articles of incorporation have been filed for the Sioux Falls Interurban Electric Railway Company, to construct a line from Sioux Falls to Salem, a distance of 40 miles. The company is capitalized at $500,000. The incorporators are: R. F. Brown, J. P. Bleeg, Eugene Saenger, G. W. Abbott and Geo. W. Pettigrew, all residents of Sioux Falls.

NASHVILLE, TENN.—The Nashville Interurban Railway Company, which recently purchased the rights and franchises of the Nashville & Columbia Electric Railway Company and the Nashville & Gallatin Electric Railway Company, will at once begin the construction of a line from Nashville to Franklin, a distance of 21 miles. Chas. S. Brown, of Nashville, is consulting engineer for the company.

CORSICANA, TEX.—J. V. Watkins, who is promoting the proposed interurban electric railway from Corsicana to Fairfield, has appeared before the Board of Trade of Palestine with the proposition to extend the line on through Fairfield. The proposition was favorably received.

MORGANTOWN, W. VA.—The Sabraton Railway Company has been granted a franchise for the construction of an electric railway here.

KENOSHA, WIS.—A. C. Frost, president of the Chicago & Milwaukee Electric Railway Company, and Bion J. Arnold, president of the Kenosha Electric Railway Company, were in Kenosha recently completing arrangements for the building of the Chicago & Milwaukee into Kenosha.

TACOMA, WASH.—Articles of incorporation have been filed by the promoters of the electric railway between Tacoma and Puyallup. The new company is to be known as the Puyallup Valley Railway Company. The capital stock is $25[illegible]. Nine trustees will control the affairs of the company and those who will be in charge until the first election, Jan. 3, 1906, are Fred. J. Chamberlain, W. D. Cotter, W. H. [illegible], J. E. Stevenson, John Mills, W. R. Scott, L. A. Chamberlain and Charles Fulmer, all of Puyallup.

THREE RIVERS, QUE.—A special meeting of the City Council was held on Aug. [illegible] for the purpose of considering a grant to the new electric railway to Shawinigan Falls. It was decided to pay $3,000 per mile, making $66,000 to Shawinigan Falls, with an additional $18,000 for continuation to Grand Mere, all [illegible] road is completed.

New Industrial Companies.

THE NORTON RAILWAY SUPPLY COMPANY, of New York, has been formed; capital $600. Directors: Benjamin Norton, T. H. Campion, Troy; J. L. Scott, Saratoga Springs.

THE EXCELLO ARC LAMP COMPANY, of New York, has been formed; capital, $10,000. Directors: R. H. Ludlow, Hermann Olms, R. L. Pritchard, New York.

THE ADJUSTAPHONE COMPANY has been organized under the laws of New Jersey at Camden; capital, $250,000. Incorporators: Robert E. Hill, William S. Pearne, Frank B. Pearne.

THE ELECTRIC CONSTRUCTION & SUPPLY COMPANY, of Oswego, N. Y., has been formed. The incorporators are John C. Knight, John C. Snyder, of this city; W. S. Nichols, E. R. Scott and F. A. Mott, of Syracuse.

THE PENNSYL MANUFACTURING COMPANY, Chicago, has been incorporated to manufacture electrical appliances. Foree Bain, 947 Monadnock Block; George T. May, Jr., and M. F. Allen are the incorporators.

THE PEARSON TYPO-BAR COMPANY has been organzed at Portland, for the purpose of carrying on an electrical and mechanical business, with $10,000 capital stock, of which nothing is paid in. Officers: President, Millard W. Baldwin, of Portland; treasurer, Jas. J. Hernan, of Portland.

Educational.

WESTERN UNIVERSITY OF PENNSYLVANIA.—The University issued recently an illustrated booklet setting forth in an attractive manner the reasons why a young man should be given a college education, why Pittsburg is the natural and ideal home for a great university and why the Western University of Pennsylvania is admirably situated and equipped for carrying on educational work. The University offers four general educational courses: (1) The Classical; (2) the Latin-Scientific; (3) the course in General Science, and (4) the course in Chemistry. There are four Engineering courses: civil, mechanical, electrical and mining. There are also Departments of Law, Medicine, Pharmacy and Dentistry. It is stated that in the near future a new location will be purchased in the eastern part of Pittsburg, on which will be brought together all the departments of the University.

UNIVERSITY OF WISCONSIN.—The University has just issued a bulletin describing the course in Chemical Engineering which will be offered for the first time when the University opens on Sept. 25, 1905. It is the purpose of the chemical engineering course to train students thoroughly in the fundamental principles of both chemistry and engineering. It is held that a chemical engineer should have as thorough a founding in the principles of engineering as a mechanical, civil or electrical engineer should have, and the course is arranged to accord with that belief. In addition to this, he should have an equally thorough founding in the principles of chemistry. To provide satisfactorily for such training within four years seems impossible, and therefore a five-year course is offered. If a student so desires he may at the end of four years receive the degree of Bachelor of Science in this course; if, however, he completes the fifth year, he will receive the degree of Chemical Engineer.

Obituary.

MR. G. C. RUMBOLD.—George C. Rumbold, who, it is said, superintended the construction of the Great Eastern, which laid the Atlantic cable, died on August 20 at East Orange, N. J. He was born in London 82 years ago. He superintended the building of many ships for the British Navy. In 1868, the Civil War having demonstrated the fact that wooden vessels were no longer available for naval warfare, he came to the United States and was engaged by the Lackawanna Railroad to take charge of the cabinet work department in its car shops in Scranton, Pa. He retired 15 years ago.

MR. H. C. ROBINSON.—Heber C. Robinson, sixty-five years old, and one of the best known residents of Camden, N. J., died suddenly at his home from heart disease. Mr. Robinson was an expert electrician and telegrapher, and at the outbreak of the civil war became one of the corps of war operators. After the second battle of Bull Run he telegraphed the first message ever sent from a balloon. He served throughout the war and settled in Philadelphia. He was the manager there of the Western Union Telegraph Company, a member of the select council and active in politics. He moved to Camden about twenty-five years ago and built the first electric light plant in this city, now owned by the Public Service Corporation. He was also largely interested in other lighting plants, and at the time of his death was superintendent of the Egg Harbor City Company's plant. He leaves one son, City Councilman Frank Neall Robinson, and two married daughters.

MR. GUTHRIE GRAY.—The death of Mr. Guthrie Gray, at Muskoka Lake, on August 26th, has cut short at the early age of thirty-one years, the career of one whose future was full of promise. Mr. Gray was graduated from the Lawrence Scientific School of Harvard University in the class of 1896, and was an electrical engineer of more than ordinary ability. After his graduation, he was for a number of years employed in the engineering department of the Buffalo General Electric Company, whose employ he left to accept a position under Mr. Henry Rustin, the superintending engineer in charge of the extensive lighting systems of the Pan American and St. Louis Expositions. For the past two years Mr. Gray was employed in the engineering department of the National Battery Company of Buffalo, N. Y., and in the short time that he had been connected with this company, his energetic work and cheerful disposition gained him the high esteem of the management and his business associates. Mr. Gray was a member of the American Institute of Electrical Engineers.

Personal.

H. F. J. PORTER.

MR. H. F. J. PORTER is the eldest son of the late Gen. Fitz John Porter. He was born in New York City in 1858, and was educated at St. Paul's School and Lehigh University. After graduating at Lehigh as mechanical engineer in 1878, he spent four years in the shops of the Delamater Iron Works, 13th St. and North River, New York City, passing in succession through the pattern shop, foundry, machine shop and draughting room. While in the machine shop he was sent with two other men to John Roach's yard at Chester, Pa., to supervise the installation in a ship built there of the engines which he had helped to erect in the shops. He was two years with Cooper Hewitt & Company as assistant engineer of their rolling mills at Trenton, N. J. He was next called to Columbia College, then removed to its site at 40th Street and Madison Avenue, to install the power plant, together with the lighting, heating and ventilating system. At this time electric lighting was in its infancy, and the lighting plant of two Edison 100-light dynamos was considered a very large installation. After this was finished, the position of superintendent of buildings and grounds was established and Mr. Porter was made the first incumbent. He inaugurated the system which has since been continued and developed of performing all the repairs to the buildings, furniture and fixtures that are required. In this connection, when the electrical engineering department was established he designed the building for housing it and included in it his repair department, consisting of a machine shop and plumbing department, a carpenter shop and paint shop and an upholsterer shop. In 1890 he accepted the position of engineer and superintendent of the steel spring and wire mill of Cary & Moen, in New York City, and here, after a careful study of the methods of cost accounting then evolved by Mr. Chas. R. Towne at the works of the Yale & Towne Manufacturing Company, introduced a system modified to meet the requirements of the situation, and gave to the company its first clear idea of what its product was costing. The following year he was offered by Mr. D. H. Burnham the position of assistant mechanical engineer of the World's Columbian Exposition at Chicago. He designed and installed the power plant which furnished light and power and water for fire protection to the buildings and grounds during the construction period and was then transferred to the machinery department, where, as assistant chief, he had charge of Machinery Hall and the installation of exhibits. After the close of the Exposition, Mr. Porter opened an office as consulting and contracting engineer, and installed several electric lighting and street railway plants in the vicinity of Chicago. At the same time the Bethlehem Iron Company, which had recently completed their new steel plant for the manufacture of armor plate and guns, desiring to enter the commercial field with their high-grade forgings, engaged Mr. Porter to represent their interests in the West. Finding that the market was not prepared to supplant cheap wrought iron with high-priced steel, Mr. Porter inaugurated a campaign of education, em-to technical societies and magazine aricles, which soon brought about a recognition of the merits of his product. This idea of having a practical manufacturer lecture to students regarding his specialty, though new at the time, has since been adopted by many colleges as of great practical benefit in their courses. Mr. Porter introduced hollow-forged steel-engine shafts into power plants, especially large pumping stations and street railway plants, and made possible the large units which now are installed in Chicago, New York, Boston and other principal cities in the country. He also introduced nickel steel in steam-railway work for locomotive forgings, and his work in exploiting this metal succeeded in introducing it in stern-wheel steamer shafts in the rivers of the Middle West and the extreme Northwest, and in such vessels as composed the ore fleets of Rockfeller and others on the Great Lakes. In 1902, when the U. S. Shipbuilding merger, involving the Bethlehem Steel Company, took place, Mr. Porter accepted an invitation by Mr. Westinghouse to take the management of the American branch of the Westinghouse Companies' Publishing Department at Pittsburg. After a year in this department, Mr. Westinghouse made Mr. Porter second vice-president of the Nernst Lamp Company, with the duties of general manager. Within six months after Mr. Porter took hold, he had helped to perfect the details of the lamp and by his methods of marketing, its standing in the lighting field was changed so that to-day it ranks high among electrical illuminants in regard to light efficiency. Mr. Porter's experience has been wide and varied, but constructive and managerial in its nature. His associations have been such that he has had opportunities to observe and put into practice methods which have proved effective in securing results. He has now opened an office in the Metropolitan Building, 1 Madison Avenue, New York, for a consulting industrial engineering practice, installing modern methods of organization and management, leaning towards industrial betterment and including welfare work, which is now recognized as the trend which is taking place in industrial enterprises not only on account of its being morally right, but because it pays in dollars and cents. There are many concerns who desire to treat their employees more like human beings than machines, recognizing the value of taking advantage of the intelligence they possess, but they do not understand just how to go about effecting the change from old methods. There are very few men in the country who have had experience along these lines, and the demand is increasing for experts who can bring about the results desired by the methods which have been proven effective and which are not either sentimental or expensive.

CAPT. HENRY GROVER, of Lynn, Mass., has resigned as superintendent of the Chelsea division of the Lynn & Boston Railroad. Captain Grover's successor is Mr. George H. Gray, hitherto superintendent of the Woburn division of the road.

MR. H. S. RYKERT, dispatcher for the Aurora, Elgin & Chicago Railway Company, has been appointed superintendent of transportation of the Rockford & Interurban Railway Company, of Rockford, Ill. He was for several years connected with the operating department of the Brooklyn Rapid Transit Company.

MR. G. R. FOLDS.—Officials of the Brooklyn Rapid Transit Company gave a dinner on August 29 at the Clarendon Hotel, Brooklyn, to George R. Folds, Assistant General Manager, who has severed his connection with that corporation. Mr. Folds goes to Chicago to become General Manager of the South Side Electric Railroad Company. General Superintendent Dow S. Smith presided at the dinner.

MR. JOHN T. YOUNG has been appointed manager of the Muskegon Lighting & Traction Company to succeed Samuel A. Freshney, who goes to Grand Rapids September 1, to assume the management of the public service department of that city. Mr. Young goes to Muskegon from Akron, Ohio, where he had been in charge of the mechanical and electrical department of the Cleveland Construction Company the past 12 years, during which he has been superintendent of construction work for the company in Ohio, Illinois, Indiana and New York.

MR. J. C. COLLINS has been elected secretary and assistant treasurer of the Rochester Railway Company, of Rochester, N. Y., vice Mr. Geo. G. Morehouse, resigned. Previous to entering the street railway field Mr. Collins was in the employ of the accounting department of the Norfolk & Western Railroad. When E. W. Clark & Company, of Philadelphia, purchased the Chester Traction Company Mr. Collins was appointed to the position of chief clerk and remained in that capacity until just previous to the time of the sale of the road by them. He next filled the position of assistant secretary of the Camden & Suburban Railway Company, with which he remained four years. Entering the employ of E. W. Clark & Company as one of its railway auditors, Mr. Collins remained with the firm until his appointment as chief clerk of the Rochester Railway Company on July 1, 1904.

KING, HODENPYL & CO.—The firm of King, Hodenpyl & Co. was dissolved Sept. 1, Anton G. Hodenpyl retiring. The business will be continued by John C. King, O. E. Babcock, E. Beranek, J. A. Rushton and W. J. Louderback, under the firm name of John C. King & Co., at the Rookery Building, Chicago, Ill., and 7 Wall Street, New York. The firm of Hodenpyl, Walbridge & Co. is largely interested in street railway and lighting properties in Rochester, N. Y.; Springfield, Ill.; Saginaw, Bay City, Kalamazoo, Jackson and Pontiac, Mich., and the dissolution is a simple separation of the two branches of the business, Mr. Hodenpyl retaining his interest in Hodenpyl, Walbridge & Co., and Messrs. King and Babcock withdrawing from that firm. The joint offices will still be maintained at 7 Wall Street, New York, by John C. King & Co. and Hodenpyl, Walbridge & Co.

MR. LEAVENWORTH WHEELER, who has been superintendent of the Worcester & Southbridge Street Railway since its opening, severed his connection with the company Aug. 20, and has assumed new duties in Pittsfield as superintendent of another and larger division of the Consolidated Railway Company, viz., the Berkshire Street Railway. The appointment of Mr. Wheeler to the new position with its added responsibilites was in recognition of his able management of the Worcester & Southbridge property. Mr. Wheeler was considerably surprised to find on entering his office at Pittsfield to take up his duties as superintendent a quartered-oak roll-top desk as a gift from the employes of the Worcester & Southbridge and the Southbridge & Sturbridge Street Railways. Mr. J. B. Potter, of Webster, superintendent of the Worcester & Connecticut Eastern Division of the Consolidated Railway Company, has been appointed Superintendent of these lines.

MR. SAMUEL A. FRESHNEY has resigned as manager of the Muskegon, Mich., Light & Traction Company to accept the position of manager of the Grand Rapids, Mich., public utility service. He will have charge and management of the lighting plant, water works, garbage burner, street and other public works. The position is created by the new city charter and carries a salary of $4,000. On Monday evening, Aug. 21, Mr. Freshney was tendered a banquet by his Muskegon associates. After the last car was in the barns at midnight a special train was made up to run to Lake Michigan Park, on the shores of the lake. Here, in an elaborately lighted pavilion, covers were laid for 96. At the head of the table over Mr. Freshney's head swayed a big bell and a car searchlight threw a beam on the table. At the head of the table with Mr. Freshney were seated the stockholders and officers of the traction company, Mr. John T. Young, his successors, and the others of the company. F. A. Nims was toastmaster and speeches were made by Representative Jerome E. Turner, C. W. Sessions—who presented to Mr. Freshney a silver loving cup—Mr. Freshney, Mr. Young, Superintendent Girdler, Train Dispatcher Percy M. Pett and other employes of the company.

◆

Trade Publications.

SMELTING MACHINERY.—The Allis-Chalmers Company, Milwaukee, Wis., has issued catalogue No. 122, which, in addition to describing smelting furnaces and accessory equipment, deals with the metallurgical processes in an instructive manner, so that the catalogue forms a valuable reference book on smelting.

BENJAMIN CATALOGUE.—A new catalogue will be issued by the Benjamin Electric Manufacturing Company, 42 West Jackson Boulevard, Chicago, Ill., which will be ready about October 1. This will be a new edition and a much larger publication than heretofore. A number of new specialties will be listed and it is expected that the catalogue will meet every requirement of electric lighting work.

ELECTRIC POWER IN FACTORIES.—The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has issued as bulletin No. 144 a reprint of an article by A. W. Henshaw, on "Electric Power in Factories," which appeared in the ELECTRICAL WORLD AND ENGINEER, March 18, 1905. The bulletin is well illustrated, views being given of the various types of S. K. C. apparatus suitable for factory service.

SMALL DIRECT-CURRENT MOTORS.—Bulletin No. 60 of the Crocker-Wheeler Company, Ampere, N. J., is devoted to a line of direct-current motors built to give outputs ranging from one-quarter to three horse-power. These motors are fitted with end shields, which permit their being made dust-proof, and they are adapted for either wall or ceiling suspension. The bulletin shows the constructional features of the machines, and describes the service tests to which they are subjected. Numerous illustrations are given to show the uses to which these motors can be put.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., is about to issue a new catalogue, bulletin No. 19051, covering motor-speed controllers for ventilating fan duty. This bulletin shows cuts, diagrams of all internal connections of these controllers, tables of resistance, capacities, etc. One sheet is devoted exclusively to specifications. These controllers have an interlocking overload circuit breaker, no-voltage release, renewable segments, self-aligning renewable skate-shoe contacts, independent make and quick break device which prevents arcing upon the first contact, etc.

STEAM SPECIALTIES.—The Williams Gauge Company, 543 Fourth Ave., Pittsburg, Pa., is issuing some interesting literature devoted to its steam specialties, including safety feed-water regulators, auxiliary feed-water regulators, high-pressure steam traps, steam-pump governors, safety water columns, chain-lever water gauges and rotating regrinding gauge cocks. Numerous illustrations are given of steam plants where these devices are in use, while a booklet filled with copies of letters from various users serves to show that the specialties have given excellent satisfaction in actual service.

AT THE GATEWAY OF THE MOHAWK.—An attractive pamphlet having the above title has recently been issued by the Schenectady Railway Company, Schenectady, N. Y. The pamphlet is profusely illustrated, and serves to show the beauties of the country traversed by the lines of the company. An interesting group of photographs shows the various stages in the development of the passenger traffic. Views are shown of the old horse car, the small electric street car, the heavy interurban car, the combined direct and alternating-current car and the modern electric locomotive for passenger service.

CRANE MOTORS.—In bulletin No. 223, just issued by the Sprague Electric Company, 527 West 34th Street, New York, are described type N motors, which are direct-current, series-wound machines specially designed for electric crane service. The field frames are rectangular in form without joints of any kind. The ends of the field frame are formed by two bearing shields which support the armature and render the motor dust-proof. The field coils are assembled on the pole pieces on the workmen's benches. After being assembled on the pole pieces, the completed field magnets are installed in the frame and locked into place.

GOULDS PUMPS.—In a well-illustrated catalogue of 192 pages, the Goulds Manufacturing Company, Seneca Falls, N. Y., discusses the constructional features and operating characteristics of the Goulds pumps. It is interesting to observe that most of the pumps are arranged for driving by means of electric motors, several being of the direct-connected type, others of the chain or belt-driven type. A complete line of starters and regulators for the motor-driven pumps is also described. Views are given of the shops where the pumps are made, and numerous illustrations serve to show some of the installations in which the pumps are used.

FUSES.—The H. W. Johns-Manville Company, 100 William Street, New York, has issued a series of three catalogues devoted to a complete line of fuse devices suitable for all voltages. Perhaps the most interesting of these catalogues is the one dealing with fuses for 1,500 to 10,000-volt circuits. The terminal fittings for the 10,000-volt fuses consist of the flat style of contact. The slots in the terminals are at right angles to each other, so that the fuse can be swung out of connection with the contact post. The fuses are of the "Noark" type. The tubes of these fuses are coated with a moisture proofing compound which materially assists in maintaining the tube in a dry condition.

REVERSING CONTROLLERS.—The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has issued Circular No. 1,108, which deals with regulating and reversing controllers for both direct and alternating-current motors. The controllers of the alternating-current type are designed for use with polyphase induction motors and with single-phase commutator motors. The speed of the polyphase motors is varied either by changing the resistance of the secondary circuit or by alternating the voltage impressed upon the primary circuit, while the single-phase motors are controlled in speed by the variation of the resistance in series with the main circuits of the machines.

STEAM ENGINES.—The Ball Engine Company, Erie, Pa., has issued a well-executed booklet, designated as catalogue O, which describes its new line of engines of the side-crank type. The side-crank construction eliminates the necessity for three bearings in engines direct connected to generators. When only two shaft bearings are used, there is no difficulty in preserving the alignment, and it is very easy to test the alignment at any time. The large engines are provided with Corliss valves. It is stated that so perfect is the smoothness of action of these valves that valve gears which have been running for over two years without any adjustments having been made do not make any sound that can be heard five feet away.

HOISTING ENGINES.—In a 78-page catalogue, designated as No. 126, the Allis-Chalmers Company, Milwaukee, Wis., describes numerous styles of hoisting engines and accessories. The hoisting equipments comprise not only the latest and most economical winding plants operated by either steam, electricity, water or air, as local conditions may make desirable, but also single and multi-decked cakes, self-dumping skips for vertical or inclined shafts, timber skips of the latest design, bailing tanks, shaft chairs, cars, buckets, safety detaching hooks, sheave wheels, pneumatically-operated ore gates for loading skips from the shaft pockets according to the latest practice, and everything necessary for the safe and most economical handling of the broken material from the mine to the shipping bins, mill or breaker.

PUMPING ENGINES.—Bulletins Nos. 1600 and 1601 of the Allis-Chalmers Company, Milwaukee, Wis., are devoted to reports of tests of pumping engines. The first of these records the test of one of the 15,000,000-gallon vertical triple-expansion pumping engines installed in the Baden high-service station of the St. Louis, Mo., water works. The mechanical efficiency was found to be 96.84 per cent., and the thermal efficiency 21.0 per cent. The second bulletin reports a test of the 30,000,000-gallon pumping engine installed in the Chestnut Hill high-service station of the Metropolitan Water Works, Boston, Mass. The mechanical efficiency was 93.29 per cent., and the thermal efficiency 21.63 per cent. It is stated that this engine holds the world's record for economy of operation. The test of each engine is described in detail.

THE MOODY PUBLICATIONS.—The Moody Corporation, 35 Nassau Street, New York, has issued a handsome booklet describing its origin, growth and present features. While the only publication issued a few years ago was *Moody's Manual*, the corporation is now issuing no less than four annual reference books, and has also published several other volumes of an economic and financial nature. In addition to the Manual there are issued the Moody's Coupon and Dividend Directory, Moody's Classified Investments and Moody's Municipal Year Book. The last is a new annual volume, now in preparation, the first edition of which will be ready early in 1906. Another annual publication shortly to make its appearance will be Moody's Quotation Record. The organization of the publishing, statistical and printing departments is described in detail.

WAINWRIGHT SPECIALTIES.—Mr. W. R. Billings, Taunton, Mass., has issued the following notice to the trade: "For the past ten years the Wainwright feed-water heaters, Dean reheaters, surface condensers, expansion joints, heat extractors, and air coolers have been made in the shops of the Taunton Locomotive Manufacturing Company, of Taunton, Mass. After an honorable and successful career of nearly sixty years, and while in a thoroughly sound condition, the Taunton company has decided to go into voluntary liquidation. During his term of service as treasurer and general manager, the undersigned was fortunate enough to secure for the Taunton company the Wainwright business, then in its infancy, and for the past ten years he has devoted much time and thought to the development of the possibilities of the Wainwright corrugated tube. The liquidation of the Taunton company has afforded an opportunity, of which the undersigned has gladly availed himself, to purchase from the Wainwright Manufacturing Company, of Massachusetts, the patents, name and good will, and from the Taunton company the drawings, patterns and special tools necessary for a continuation of the Wainwright business. On and after Sept. 1, 1905, the business will be taken up and carried on under the direction of the undersigned, by the Alberger Condenser Company, of New York. Under these circumstances it goes without saying that the high quality of the Wainwright appliances will be maintained. Further announcements concerning the arrangements here referred to will be made in due time by the Alberger Company."

News of the Trade.

VULCAN SOLDERING TOOLS.—F. J. Holmes, of L. P. Brown & Co., 71 West Jackson Boulevard, Chicago, was a visitor to New York last week. The company makes the Vulcan electric soldering tool and Mr. Holmes interviewed one or two people in the East with respect to its merits.

BELT DRIVE.—Recently an erroneous statement was printed in various journals to the effect that suit had been commenced by the "Westinghouse Interests" against the Link-Belt Machinery Company. We are advised that the suit in question was not brought by the Westinghouse interests, but by the Morse Chain Company, of Trumansburg, N. Y., who, on July 27th, filed bill in equity in the United States Circuit Court, Northern District of Illinois, Eastern Division, against the Link-Belt Machinery Company for alleged infringement.

THE STANDARD CHEMICAL COMPANY, of Cincinnati, Ohio, are putting the Imperial soldering paste on the market. This is a preparation that acts quickly and without corrosion, cleaning the parts to be soldered and causing the solder to flow smoothly and evenly. There is nothing in it that is harmful to the clothes or person, so it may be handled with impunity. There is a great demand for good soldering paste, and the manufacturers confidently expect that the user of the Imperial compound will find that it meets every requirement.

THE CHALLENGE MANUFACTURING COMPANY, 365 Market Street, Newark, N. J., are makers of a closed-circuit battery which they have claimed possesses the advantages of maintenance of efficiency throughout its entire life with absolutely no local action or polarization. Besides this the mechanical construction of the cell is such that it permits of renewals in much quicker time. A forceful substantiation of this claim comes from one of the leading railroad companies which has upwards of 20,000 cells on its lines for signal purposes. In a letter written recently to the manufacturer they say that the Challenge battery has been found to be the quickest battery to set up and renew that they have ever used. A testimonial of this sort from one of the largest users of primary batteries gives striking emphasis to the manufacturer's claims.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY call attention to the development of their Standard electro-soldering paste. The discovery of this compound dates back to the early nineties, when the company was awarded the contract for fuses for the World's Columbian Exposition at Chicago. The large quantities required on short notice and the absence of a satisfactory flux caused the copper to corrode and considerable trouble was experienced for a time. The company then secured the services of a noted chemist and a flux was produced which has since played an important part in the manufacture of their well-known "Tested Fuse Links." The vital point so often forgotten in a soldered joint is the necessity of cleaning throughly the entire surface of the parts, especially where full strength or greatest conductivity is required. Mr. Goodman, secretary of the Chicago Fuse Wire & Manufacturing Company, says that many other users have emphasized the need of a really first-class soldering flux, which had no acid base and would not corrode the work, but still would be so quick in its action that the smallest quantity would drive the solder to every part of the joint. These requirements, it is said, are fully realized in Standard electro-soldering paste.

LUBRICANT FOR HOISTING CABLES.—Elevator and other cables used for hoisting purposes, are subject to both internal and external wear; the former is caused by the rubbing of the wires and strands upon one another under pressure in bending over the sheaves, the latter by rubbing and wedging in the grooves of the pulleys. Unless the cables are kept well lubricated they wear and deteriorate rapidly. The Joseph Dixon Crucible Company, Jersey City, N. J., has solved the problem of wire rope lubrication by the use of graphite and now offers to the trade its "Handy Graphite Rope Dressing," concerning which it is now distributing some attractive advertising material in the form of blotters and folders.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY.. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelphia. Next meeting, Bethlehem, Pa., Sept. 18, 19 and 20, 1905.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago. Next convention, Philadelphia, last week in September, 1905. Bellevue-Stratford Hotel and Phila. Com. Museum.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore. Hotel Champlain, Clinton County, N. Y., Sept. 12, 13, 14.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION.. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Next meeting, Glenwood Springs, Col., Sept. 18, 19 and 20, 1905.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA. Secretary, S. J. Fuller, Larimore, N. D.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 16, 1906.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, D. Davis, Litchfield, Ill. Next meeting, Peoria, Oct. 5 and 6, 1905.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

IOWA ELECTRICAL ASSOCIATION. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION.. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Oct. 14 and 15, 1905.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION.. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Oct. 10, 1905.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary Frank S. Leach, Sedalia, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y.

NATIONAL INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in Jan., 1906.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION.. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa. Next meeting, Pittsburg, September, 1905.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. B. Fairchild, jr., 114 Liberty St., New York.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STREET RAILWAY & ELECTRIC ASSOCIATION. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUGUST 22, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

797,561. TELEPHONE HOOK SWITCH; Josephus McKinley Clement, Mineralbluff, Ga. App. filed Mar. 8, 1905.

797,570. MULTIPLEX TELEGRAPH SYSTEM; Tullio Giara, Boston, Mass. App. filed July 5, 1904. A printing telegraph having a plurality of typewriter keyboards at each end of the line, and corresponding receiving apparatus. Employs synchronously rotating contacts.

797,586. TELEPHONE SYSTEM; Edmund Land, Grand Rapids, Mich. App. filed Nov. 2, 1904.

797,589. ELECTRIC CAR OR LOCOMOTIVE; Nils D. Levin, Chicago, Ill. App. filed Apr. 22, 1904. In order to permit the operation of electric trucks at a distance from the regular trolley line, the truck has a spring drum with a flexible cable extending therefrom. In order to increase the radius of action, the spring drum is formed with a series of helical springs arranged in parallel layers.

797,591. ELECTRICAL RAILWAY SIGNALING SYSTEM; Leonidas N. Lyon, Jr., Flatonia, Tex. App. filed Nov. 29, 1904. A pair of conductors are arranged adjacent to the ordinary track rails and depending trolleys upon the train make a circuit therewith. When the train passes over any section, an electro-magnet is energized which completes a talking or telegraph circuit to a neighboring train.

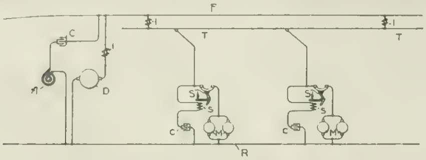
797,593. INCANDESCENT LAMP; Albert W. W. Miller, South Orange, N. J. App. filed Sept. 3, 1903. The lamp is formed with a straight narrow neck portion which may be cut to permit a new filament to be inserted, or the lamp otherwise repaired. The contact sleeve is quite short and has certain special features of construction.

797,612. TELEGRAPH KEY; William H. Schermerhorn, Ree Heights, S. D. App. filed Feb. 24, 1905. In order to insure the usual circuit closing switch of a telegraph key from being left open, the patentee provides an annular button surrounding the usual key which controls the switch. The button is designed to be held depressed by the hand of the operator.

797,628. ELECTROMAGNETIC COMPENSATING DEVICE; Bernard A. Stowe, Cleveland, O. App. filed May 24, 1904. For the purpose of compensating for the decreasing permeability of an electro-magnet when the latter becomes warm under excessive current, the patentee arranges his magnetic circuit so that the latter becomes closed as its temperature rises.

797,629. ELECTRIC ARC LAMP; Bernard A. Stowe, Cleveland, O. App. filed May 25, 1904. In order to avoid the escape of the hot gases from within an enclosed arc chamber under the action of "breathing," the gases are made to pass through a long pipe or duct having an attenuated portion where it enters the arc chamber.

797,669. TROLLEY WIRE REPAIR DEVICE; Hermann Dems, Chicago, Ill. App. filed Nov. 11, 1904. A metal basket has a pair of gripping jaws at each end which may grip the trolley wire sections and draw them together over the basket. The wire is now in position to be conveniently repaired.



797,863. Syntonic Signaling System.

797,678. ELECTRIC RAILWAY SIGNAL; Jake Friedlander, Fargo, N. D. App. filed Dec. 27, 1904. At convenient points along the track a contact plate is located beneath the usual rail in such a way that the weight of the train will establish contact therewith. In this way a telephone or telegraph circuit is completed from the train to the train despatcher's office.

797,679. CIRCUIT CLOSER; Jake Friedlander, Fargo, N. D. App. filed Mar. 20, 1905. A thermostat circuit closer in which a thermometer tube is left open at the top and a metallic plunger located therein is pressed upward to make a contact when the mercury rises. Contact can also be made by a push button.

797,699. INCANDESCENT LAMP SOCKET; Norman Marshall, Newton, Mass. App. filed Jan. 21, 1904. The socket has a cord which may be pulled to throw a switch into either its on or off position. The cord is alternately effective to release a detent and allow a spring to throw the switch, and to positively draw the switch back into engagement with the detent.

797,713. AUTOMATIC FIRE-ALARM; Karl J. Backman, Karlsvik, Forshaga, Sweden. App. filed Feb. 7, 1905. A thermostat cut-out in which spring-pressed contacts are normally separated by a plug of wax or sulphur or other fusible substance which may melt and allow the contacts to approach one another.

797,718. PORTABLE X-RAY APPARATUS; Eugene W. Caldwell, New York, N. Y. App. filed Aug. 18, 1904. The spark gap is formed by a series of buttons supported on metallic rods. The buttons are arranged to be vibrated for the purpose of varying the spark gap.

797,720. TROLLEY; Henry B. Clarke, Chicago, Ill. App. filed Feb. 26, 1904. The trolley wheel has two deep grooves at each side thereof into which the wire falls when the wheel leaves the same. Spiral conducting grooves lead the trolley back onto the central wheel.

797,747. ELECTRIC FURNACE; Henry Noel Potter, New Rochelle, N. Y. App. filed July 23, 1903. (See page 395.)

797,761. COMPOSITE TELEGRAPH AND TELEPHONE SYTEM; Carlo Turchi, Ferrara, Italy. App. filed Nov. 12, 1903.

797,774. SYSTEM OF MOTOR CONTROL; Charles E. Lord, Cincinnati, O. App. filed Apr. 12, 1905. A pair of pneumatic train pipes extend throughout the length of the train and have connections with motor controlling contacts on each car.

797,783. RAILWAY SIGNAL; Vibe K. Spicer, Kenilworth, Ill. App. filed Sept. 12, 1902. The semaphore arm is raised by a mechanical connection extending into the path of projections on an endless belt. The belt is driven from an electric motor and automatically breaks the motor circuit after a pre-determined movement.

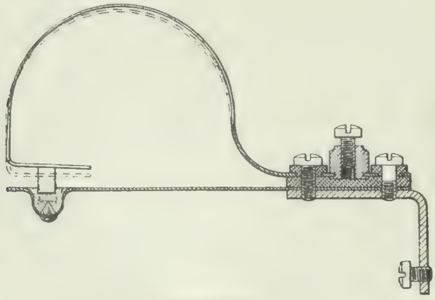
797,787. NEGATIVE ELECTRODE FOR PRIMARY BATTERIES; David L. Winters, Chicago, Ill. App. filed Jan. 30, 1905. (See page 395.)

797,806. ARC LAMP HANGER AND CUT-OUT; Charles E. Harthan, Lynn, Mass. App. filed Apr. 29, 1903. An arc lamp cut-out adapted for high potential circuits. The elements of the cut-out are enclosed within a shell or canopy supported from an insulator above the lamp so as to be protected from the weather. A form of snap switch is used embodying a gear with a certain amount of lost motion.

797,811. WATCH DEMAGNETIZER; Patrick Kerns, Chicago, Ill. App. filed Mar. 9, 1903. A pole changer in which space contacts around the periphery of a drum make alternate connections with a pair of brushes. The current is supplied through a grounded connection and a concentric ring.

797,825. ELECTRIC LAMP SOCKET; Albert P. Seymour, Syracuse, N. Y. App. filed Apr. 27, 1904. In order to secure a more efficient protection against fire, the lamp socket is made of porcelain having two halves with a central cavity. The switch mechanism is located entirely in the central cavity.

797,845. SHEET METAL FOR PERFORATED POCKETS OF STORAGE BATTERIES; Thomas A. Edison, Orange, N. J. App. filed July 21, 1904. (See page 395.)



797,713. Automatic Fire Alarm.

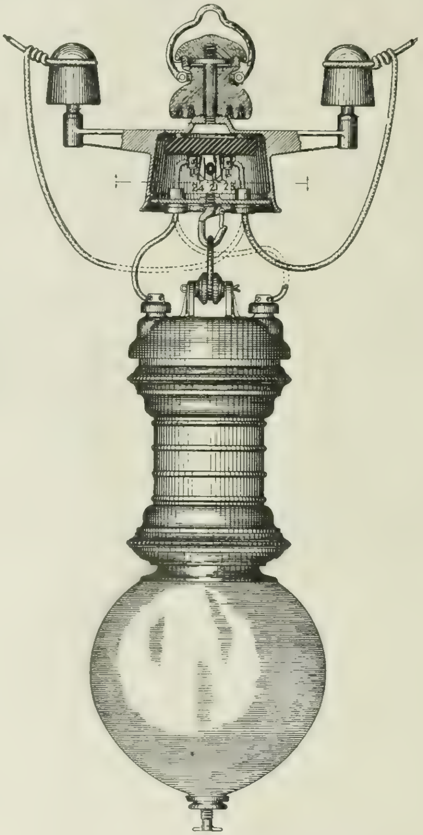
797,859. TRAIN CONTROL SYSTEM; Charles E. Lord, Cincinnati, O. App. filed Jan. 27, 1905. Relates to means of cutting out motor resistances in succession and at the proper rate for efficient starting speed of trains by pneumatic operating arrangement involving two train pipes.

797,860. TRAIN CONTROL SYSTEM; Charles E. Lord, Cincinnati, O. App. filed Jan. 27, 1905. Relates to modifications of the above and particularly to the construction of the controller parts whereby a minimum number of contacts is secured.

797,863. SYNTONIC SIGNALING SYSTEM; Maurice Milch, Schenectady, N. Y. App. filed March 30, 1904. A signaling circuit is arranged in synchronism with a high frequency alternating power circuit, in such a way that when a single car is on a block the circuits are properly in rhythm, but when the second car enters the block, the synchronism is destroyed and a warning signal is given.

797,868. TRANSFORMER; Edwin W. Rice, Jr., Schenectady, N. Y. App. filed Apr. 4, 1904. In order to prevent the destruction of air-cooled transformers by the circulation of air through the ventilating openings during a fire, valves are normally held open by destructible devices and automatically closed in case of fire.

797,889. CONTROLLING ELECTRIC MOTORS; William Geipel, Frederick M. T. Lange, London, and George W. Mascord, Barnes, England. App. filed Nov. 28, 1904. A method of controlling shunt-wound electric motors partially driven by a motor generator. The generator which supplies only a portion of the power, at times assists and at other times opposes the armature windings of the motor.



797,806.—Arc Lamp Hanger and Cut-Out.

797,907. FIRE ALARM SYSTEM; Judson McFell, Chicago, Ill. App. filed May 27, 1904. In order to secure the advantages of a closed circuit fire alarm system in an open circuit, the patentee provides an open circuit apparatus, but in which a test circuit is constantly effective to indicate a break in the signal circuit.

797,917. ELECTRICAL METER; Henry W. Sayles, Peoria, Ill. App. filed March 13, 1905. For the purpose of compensating for the starting inertia of the moving parts in a Watt meter, an auxiliary field coil is provided which is adjustable into various positions with respect to the stationary field coil.

797,979. LIGHTING DEVICE; Thomas S. Sayre, Cape May, N. J. App. filed March 8, 1905. A cigar lighter in which the wick tube is normally closed by a hinged cap. When the cap is swung upward to expose the wick a contact is made for igniting the latter.

797,993. AUTOMATIC REGULATOR FOR ELECTRIC CIRCUITS; Montgomery Waddell, New York, N. Y. App. filed June 28, 1904. The field magnet coils are provided with two separate windings which oppose one another. Each of the windings is in series with a separate resistance which is automatically regulated by a solenoid.

798,008. TELEGRAPH APPARATUS; Henry C. Braun, Barnet, England. App. filed June 20, 1904. A fac-simile telegraph apparatus in which a pair of pendulums at the transmitting and receiving stations swing synchronously by electrical means. When the pendulum at the transmitting station swings over an uninsulated point on the picture, a momentary current is transmitted which depresses the stylus at the receiving station.

798,035. TELEPHONE SYSTEM; Calvin R. Green and David R. Green, Risingsun, Ind. App. filed Dec. 20, 1904.

798,038. APPARATUS FOR ELECTRICAL REGULATION; Albert S. Hubbard, Greenwich, Conn. App. filed June 17, 1904. A system for regulating the voltage of street railway installations involving the use of boosters, storage batteries and regulating resistances.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, SEPTEMBER 9, 1905. No. 11.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.................................1139 Monadnock Block
PHILADELPHIA OFFICE.................................929 Chestnut Street
CLEVELAND OFFICE.................................402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....................Per year, $3.00
Foreign Countries, within the Postal Union.............................$6.00
Great Britain and Ireland.....................................25 shillings
Germany ....25 marks
France ....31 francs
Single copies ....10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **500,000.**

NEW YORK, SATURDAY, SEPTEMBER 9, 1905.

CONTENTS.

Editorial.. 425
Edison Illuminating Association Meeting.............................. 428
Bethlehem Meeting of the American Electrochemical Society.............. 428
The Telegraph Convention in New York City............................ 428
Prof. Darwin on Celestial Evolution.................................. 429
Electricity from Southern Water Powers............................... 429
Chicago Municipal Railway System..................................... 429
Central Station Companies and the Law of Negligence................... 430
Combination and Operation of Small Central Station Plants............. 430
Current News and Notes... 432
Electrical Engineers of the Times. XXVI. G. Wilbur Hubley.............. 434
Waterside Station No. 2 of the New York Edison Company. II. (*Concluded.*).. 435
Hydro-Electric Developments of the Ontario Power Company. III. (*Concluded.*).. 440
Regulation of Electric Rates in Massachusetts. II..................... 442
The Induction Motor Leakage Coefficient.............................. 443
Electric Pumping Plant in Hawaii..................................... 444
Letters to the Editors:
  "Digest" References. By G. Frederick Packard.......................... 444
  The Use of the Third Person in A.I.E.E. Discussions. By B. A. Behrend.. 445
  Alternating Current Nomenclature. By J. Lester Woodbridge.......... 446
Digest of Current Electrical Literature.............................. 446
Adams-Randall High Power Telephone Transmitter Tests. By William Maver, Jr.. 450
The Rateau Steam Regenerator System.................................. 451
The Mabbs Electric Elevator.. 453
A New Type of Motor Starter.. 456
The Westinghouse Exhibit at Portland................................. 457
The Jones Phantoplex... 458
New National Code Fuse Plug.. 458
Industrial and Commercial News....................................... 459
General News of the Week... 462

MEETING OF THE BRITISH ASSOCIATION.

The British Association occasionally meets outside of the British Islands, but this year it takes an unprecedented journey across the equator. It meets in South Africa, at Cape Town and Johannesburg. The inaugural address of the president, Prof. G. H. Darwin, will have been delivered in Cape Town, followed by various papers in different sections. The party was then scheduled to proceed to Johannesburg via Durban, Pietermaritzburg, Colenso and Ladysmith, places that have become famous in the recent war. Other papers were to be read in the section meetings at Johannesburg. After the proceedings, the party is to be taken by train to the Victoria Falls of the Zambesi via Bloemfontein, de Aar, Kimberley and Bulawayo. The Victoria Falls are the African Niagara Falls and are said to outvie Niagara, both in magnitude and splendor. The falls are six hundred feet in height, and the power expended by the falling water is estimated to be nearly twenty millions of kilowatts; or about four times the total estimated power of Niagara Falls. Stringent regulations are said to have been laid on the reservation of the Zambesi Falls in such a manner that the falls shall be preserved aesthetically and shall not be robbed for utilitarian purposes. All electrical engineers are warned that the falls may be looked at but not touched. These are noble sentiments at the present time, when there is no market for electrically transmitted power within a radius of hundreds of miles. It will, however, be difficult to preserve the entity of the aesthetic with such virtuous calm, when future industry shall develop a demand for power on the banks of the Zambesi. Meanwhile, the British Association party is to be congratulated upon its visit to such a magnificent spectacle. There seem to be but few papers on the schedule of electrical interest.

THE LEAKAGE COEFFICIENT OF INDUCTION MOTORS.

While the internal reactions of an induction motor are in themselves so complex that they cannot be represented accurately by any form of mathematical expression on account of the erratic distribution of the flux within the magnetic material, it is found that the complete performance of any specific machine is known sufficiently well for all practical purposes when the exciting current, the "constant" losses, the leakage reactances and resistances of the windings are known. A little study of the mchine soon convinces one that the electrical input characteristics of the motor are largely dependent upon the leakage reactance of the windings and upon the no-load exciting current. When the machine is stationary, the current taken by the primary is determined almost exclusively by the leakage reactance of the coils, so that it may be stated that the input characteristics of the machine are fairly well defined when the starting current and the no-load exciting current are known. Making use of the terms commonly employed with a stationary transformer, the no-load exciting current is referred to as the "open circuit" current, while the starting current is designated as the "short-circuit" current. The ratio of these two currents is sometimes characterized as the "leakage factor," although the true leakage factor, as originally defined by Behrend, has a somewhat different significance.

When the mechanical dimensions of a motor are known, the exciting current for a given magnetic density can be determined with a fair degree of accuracy from the depth of the air-gap and the distribution of the primary coils. It is interesting in this connection to observe that the value of the "quadrature watts" for excitation is dependent almost exclusively upon the magnetic density and the volume of the space separating the rotor from the stator, and is practically independent of the actual dimensions of the air-gap. The study of the leakage reactance, however, is extremely complicated, and no accurate method has as yet been devised for its determination. The leakage flux depends for its value upon the current in the conductors and the permeance of the surrounding magnetic material, which permeance is largely dependent upon the density of the flux. The problem is further complicated by reason of the fact that the path for the leakage flux is partly through iron and partly through air, and the actual path is continually changing with the density of flux and the variation in the opposing magnetomotive forces. The reactance electromotive force due to the cutting of the conductors by the leakage flux depends upon the mechanical position of the conductors with reference to the paths of the flux, and, hence, its value is determined largely by the distribution of the coils. An interesting study of the problems connected with the leakage reactance of the induction motor is outlined on page 443 of this issue by Mr. A. Press, who gives a formula, more or less empirical, for taking into account the influence of the opening of the slots, the length of conductors in iron and in air, and the "zig-zag" dispersion over the heads of the teeth. As stated by the author, the formula differs radically from others which have been proposed previously, but that it may be used to represent the true conditions is shown by the approximate agreement of the calculated with the observed results.

Third Report of the Committee on Current Classification and Nomenclature.

The report of the committee on Current Classification and Nomenclature read before the American Electro-Therapeutic Association last September, has recently been published in pamphlet form. It covers a number of subjects which are of interest to electrophysiologists and electrotherapeutists. A remarkable fact elicited in the experiments upon which the report rests is that the efficiency of good commercial high-tension influence machines is between 40 and 50 per cent. The output of these machines as found on the market is about a dozen watts at the maximum. The current delivered was found to be proportional to the speed of rotation, and reached about one milliampere in some cases. The current strength which may oscillate in a discharging leyden-jar circuit through the resistance of a human body may, however, be much greater than that which a high-tension influence machine can yield directly, even on a very low resistance. The conditions which govern the discharge of a condenser circuit are carefully analyzed. The resistance of the circuit must be kept down, and the capacity must also be kept down relatively to the inductance if the discharge is to be oscillatory. So far as the resistance is concerned its value may be expressed by saying that while the ohmic resistance of the discharging circuit may be equal to the surge resistance for good oscillations, the oscillation will cease and the discharge become aperiodic if the ohmic resistance becomes as great as twice the surge resistance. The surge resistance of a circuit is the square root of the ratio of its henrys to its farads. Hence the greater the resistance included in the circuit, the larger must be the ratio of inductance to capacity for oscillation.

As an illustration of the facility with which aperiodic discharge may be produced, it is shown that a man standing on an insulating platform charged by an influence machine with a 2-inch spark-gap, and in circuit with an inductance of 6 microhenrys, would be subjected to oscillatory discharges if his effective resistance were less than about 600 ohms; but would be only subjected to aperiodic discharges if his effective resistance were over that amount. It is then pointed out that a good large layden jar charged to 130 kilovolts and discharged through a simple spark-gap many develop a discharging current of hundreds of amperes. The discharge will, however, be heavily damped unless the resistance is much lower than is generally supposed. The conclusion to be derived is that the ordinary leyden-jar discharge through a human being is aperiodic unless an unusually large amount of inductance is injected into the circuit. The report is accompanied by curves and mathematical calculations. It is doubtful how far these will be of service to physicians who, with occasional exceptions, receive only non-mathematical training; but the facts elicited are of great interest to electricians and may guide those who make a specialty of designing electrotherapeutic apparatus.

The Small Power-User.

For years the gas engine has been wheezing its way into favor in localities where gas is fairly cheap and electricity fairly dear, but between the objections of the fire underwriters and the high cost of working at light loads it has not been a serious competitor in checking the growth of electric power supply. The cleanliness and safety of the electric motor, its beautiful regulation, and excellent efficiency at low loads have made it a favorite and have enabled it over and over again to push gas and gasoline engines into the scrap heap. In truth the ordinary electrical man has been wonted to look upon such machinery as merely a dynamical freak not to be taken too much in earnest. Now the fact is that not very long ago such was a reasonably accurate estimate of the situation, but at the present time it must be completely revised. The stimulus of automobile development has radically changed the status of the internal combustion engine. So far from being an expensive and troublesome machine it is now singularly reliable, fairly cheap in first cost and pretty nearly as fool proof as the electric motor. If one stops to look into the matter a bit he must recognize the fact that the gasoline engine of to-day must be regarded, with the automobile industry behind it, as a competitor, that while it may be fairly beaten cannot be treated with contempt.

In the first place, the machine has been greatly simplified in its mechanism and much improved in efficiency. The difficulties of lubrication and ignition have ceased to be formidable and with these improvements has come a considerable improvement in the performance at moderate loads. More than this, the large use of such engines for automobiles and launches has started into activity so many makers and has made so familiar the task of construction, that the price has fallen far below the figures of a few years ago. The fact is that to-day a good and reliable gasoline engine can be purchased at about the cost of a first-class electric motor, and so far as the ordinary user is concerned, requires very little more attention. It undoubtedly requires somewhat more cost in repairs and wears out rather faster, but nevertheless is not actually expensive to maintain in view of the comparative simplicity of the repairs and renewals that have to be made. As to efficiency, both the gas and gasoline engines have been brought down to a figure probably 20 to 25 per cent better than it was ten years ago. Moreover, the price of gas has had a downward tendency, and while the increased demand for gasoline has tended to hold up the price, it still can furnish power at a cost quite comparable with that of cheap gas. A good, small modern gas engine on dollar gas should not cost more than 3 cents per brake hp-hour for gas and supplies and less than 4 cents for cost, including repairs and depreciation, assuming that the machine is run at full load, say 3,000 hours per year. The figure for a gasoline engine would be about the same, and even if worked at half load the cost should still run little if at all above 5 or 6 cents per hp-hour.

These are outside figures, and they will grow smaller rather than larger as time goes on.

Now there is really nothing whatever alarming in all this, but it is nevertheless significant. It means that in virtue of improvements the small power user is much less at a disadvantage in cost than he used to be. He is still paying absolutely a large price per horse-power-year, large enough to give electric power a profitable market in serving him, but he is no longer paying an extreme price. The difference in yearly cost per horse-power between a 100-hp engine and a 5-hp engine has been greatly diminished. The central station therefore must bear this change in mind if it wishes to get the great mass of small business which awaits it. There has been in recent years a growing disposition to make rates for the benefit of the large user. The central station uses a scale of discounts which in case of a gas company would scarcely be tolerated, and often arranges so-called service charges or maximum demand charges in a way to still further aggravate the difference between the small and large consumer. The gas company has available the same sort of excuses but it does not use them. And neither ventures to base its charges on the distance of the consumer from the station, a far more logical basis than those usually adopted. The upshot of the matter is that with the improvements in internal combustion engines the central station must either favor the small power user as the gas company does or gradually lose him. The almost flat meter rate of the gas company certainly yields good profits and also meets the needs of the small consumer, both of light and power, far more successfully than the steeply graded rates used by many electric companies. The latter err sometimes, we think, in laying too much stress on the equilibration of somewhat hypothetical engineering charges to fit the supposed cost to the consumer. What would happen to a department store that insisted on entering the time taken to make the sale and a proportionate rent and general expense item in the price of a paper of pins? Perhaps the small consumer may not be desirable, but he exists and will trade in the cheapest market.

CENTRAL STATION RATES.

Judging from the discussions which take place at some of the State electric light organizations, there is considerable misconception among central station men operating the smaller classes of plants as to the real nature of the "readiness-to-serve," and also of the "two rate" method of charging. The effect of these two methods in the long run is likely to be very much the same and they are designed to accomplish similar ends. The readiness-to-serve method of charging is based on the theory that a customer should be equitably charged with every item of expense entering into the cost of the service he receives. Some of these expenses are not proportional to the kw-hours registered by his meter, and therefore the meter reading is only one item to be considered in making up the total charge. Some of the other items, or so-called fixed charges, are nearly equal for all customers, whether large or small, as, for example, office and clerical work and the cost of maintenance of meters. Others are proportional to the maximum demand of any customer, such as interest on the central station plant and distributing system necessary to supply the customer's largest demand for light or power. These charges accounted for, the readiness-to-serve contract gives the customer a low rate per kilowatt-hour as registered by the meter, this rate being based on generating cost alone. The system counds simple enough in theory, but in fact requires, in the first instance, a great amount of careful analysis of capital, administrative, superintendance, maintenance and other charges, in order to make possible a proper determination of the readiness-to-serve charge. Then again in its practical application difficulties are met with in respect to certain details. For example, the question immediately comes up as to what shall be considered a customer's maximum load. The maximum load is not necessarily by any means the maximum number of lights connected. One solution to this is to have the customer elect his maximum demand and then penalize him if this is exceeded without previous arrangement. Furthermore, it is taken into consideration by some managers that certain customers do not require their maximum capacity at the time of the December peak load from the station, and hence should not be made to assume a full share of station and distributing charges. These are only one or two of the things that go to show how difficult it is to fairly adjust the various charges under this system, which is undoubtedly sound and equitable in principle.

The two-rate system accomplishes somewhat similar results in a different way. It charges the customer at one rate until he as used a certain number of kilowatt-hours in a month, and for all consumption above that amount he is accorded a much lower rate. The number of kilowatt-hours charged for at the full rate is quite commonly, for example, the equivalent of thirty hours' use of the customer's maximum demand per month. The maximum demand is determined by some companies by the use of a maximum-demand meter. By other companies the maximum demand is assumed to be the connected load in the case of stores, and a certain proportion of the connected load in the case of residences and other buildings, regular rules being formulated for determining this. The two-rate system thus endeavors roughly to make the customer pay the readiness-to-serve charges under the name of energy consumed until he has paid approximately enough to cover the so-called fixed charges, and then he is given a low rate supposed to be in proportion to the generating cost.

As a matter of fact, the readiness-to-serve system of charging has been adopted by many companies mainly as a means of securing a large amount of business from large customers which they might not otherwise have been able to get. A good example of this was given in an article on "Central Station Work in Denver," in our issue of June 3. It is a system of logically reducing rates to those customers to which the company can afford to give better rates, without letting the bars down to such classes of customers as are unprofitable even at existing rates. A customer who uses all his lights twenty-four hours a day, thus utilizing a portion of the capacity of the plant during hours of light load, is entitled to a better rate than the short hour customer coming on the peak of the load, and the readiness-to-serve form of contract makes it possible to give the former a low rate, thus in cases preventing the installation of an isolated plant or a resort to gas. A readiness-to-serve contract which is useful in getting down-town business may, however, shut out many customers if insisted on through the residence district, if the contract is based on the assumption that the maximum demand will be equal to the connected load, an assumption which does not hold true in residences. If the system is applied to the residence district, it must be modified in its application so that the maximum load is figured on a different basis from what it would be in the down town districts. Where the readiness-to-serve method of charging has been introduced it has usually been optional to the consumer, and is chosen by the larger and more important customers of the company. It is a means of getting large business at profitable rates, and encouraging the use of current many hours a day, rather than a means of a getting more business from the smaller customers. While either system is more equitable to both consumer and central station than a straight meter rate, or, to a less degree, than a meter rate with graded discounts, their application is hampered by conditions arising from the competition with gas, particularly in the cases of small users of light and power. The power situation is treated specifically in another column.

Edison Illuminating Association Meeting.

The twenty-sixth convention of the Association of Edison Illuminating Companies will be held at Hotel Champlain, Bluff Point, Lake Champlain, N. Y., September 12, 13 and 14. As usual, the papers that have been prepared and will be read at the convention, will prove very interesting. The following is a list of the papers: (a) Practical Experiences with Steam Turbines, J. A. Radford, Chicago; (b) Improvements in Steam Turbines, W. LeR. Emmet, Schenectady; Data on Various Manufacturing Requirements, E. W. Lloyd, Chicago; Refrigeration by Means of Electric Motors, G. W. Goddard and H. K. Mohr, of Philadelphia; Experiences with Tests on all Kinds of Lamps for the Past Year, including Nernst Lamps, Dr. C. R. Sharp, New York; The International Electrical Congress at St. Louis, J. W. Lieb, Jr., New York; Magnetic Lamps and Mercury Vapor Arc Lamps and Mercury Arc Rectifiers in Connection with Electric Light and Power Service, Dr. C. P. Steinmetz, Schenectady; (a) Methods of Starting up Large Interconnected Systems Quickly after Partial or Total Shutdown; (b) Instruction and Training of all Operating and Construction Men who Work on High Potential Apparatus and Construction, W. F. Wells, New York; Relative Merits of Discharging Batteries on Edison Systems through Reversible Boosters and through End Cell Switches, Gerhard Goettling, Boston; The Use of Small-sized Carbons in A. C. Arc Lamps, G. N. Eastman, Chicago; Maintenance and Repair of Coal and Ash Handling Machinery, Charles H. Parker, Boston; Practical Operation of the Nernst Lamp, W. T. Morrison, New York; Relative Advantages of 25 and 60 Cycles, Philip Torchio, of New York, and Wm. C. L. Elgin, of Philadelphia. Point Bluff has many attractions, such as bathing, boating, yachting, fishing, tennis and a very fine 18-hole golf course Contests will be arranged for golf, as well as other sports, for which prizes will be offered. The convention closes on the night of Thursday, September 14, and an invitation is extended by the President and Mrs. Jos. B. McCall to those in attendance to be their guests on Friday on a trip to Ausable Chasm, which is within a short distance of the hotel.

◆

Bethlehem Meeting of the American Electrochemical Society.

The eighth general meeting of the American Electrochemical Society will be held at Bethlehem, Pa., and extend over three days, namely, Sept. 18, 19 and 20. The first session, that of Monday, will commence at 3 p. m., while the sessions on Tuesday and Wednesday will open at 9 a. m. The meetings will be held in the lecture-room of the Physical Laboratory of Lehigh University. On Tuesday afternoon a visit will be made to the plant of the Lehigh Zinc Company, and to the Bethlehem Steel Company's works. On Wednesday afternoon members will have the choice of two excursions, one to a large cement works and the other to Mauch Chunk.

The social programme includes a "smoker" on Monday evening, a luncheon by the authorities of Lehigh University in the gymnasium on Tuesday noon, and a subscription dinner at the Eagle Hotel on Tuesday evening. The visiting ladies will be entertained by a ladies' committee, and on Monday evening will be tendered a reception, with their escorts, at the residence of Dr. J. W. Richards. On Tuesday there will be an excursion to Easton and on Wednesday a visit to Nazareth, noted in Moravian history.

The following papers will be presented at the meeting: "A Standard Method of Measuring the Specific Resistance of Electrolytes," by Mr. R. Threlfall; "Notes on the Use of Aluminum as a Reducing Agent," by Mr. Oliver P. Watts; "New Gin Furnace for the Electrical Manufacture of Steel," by M. Gin; "Note on the Electrical Resistivity of Iron and Steels at High Temperature," by M. Gin; "An Electrolytic Process for Refining Silver," and "Notes on the Electrometallurgy of Antimony," by Mr. A. G. Betts; "Report on the Electrochemical Exhibits at the Louisiana Purchase Exposition, 1904," by Prof. C. F. Burgess; "Artificial Willemite," by Prof. Chas. Baskerville; "The Chemistry of Electrochemistry," by Prof. W. D. Bancroft; "Ammeters for Electrolytic Work," by Mr. Lawrence Addicks; "Electrolytic vs. Sulphuric Acid Parting of Bullion," by Mr. F. D. Easterbrooks; "Insulating Paints," by Dr. M. Toch; "The Utilization of Active Oxygen Chemically and Electrically Produced," by Dr. R. von Foregger; "Thermodynamics of the Electric Incandescent Lamp," by Dr. E. F. Roeber; "The Chemical Separation of the Excited Activity of Thorium," and "On the Radioactivity of Some Natural Waters of Missouri," by Prof. H. Schlundt and Mr. R. B. Moore; "Some Observations on the Influence of Arsenic in Pickling Solutions," by Prof. C. F. Burgess; "The Electric Smelting of Zinc," by Prof. O. W. Brown and Mr. W. F. Oesterle.

◆

The Telegraph Convention in New York City.

Note was made in these pages briefly last week of the fact that the Old Time Telegraphers, a historical association, and the U. S. Military Telegraph Corps were holding their annual convention in New York, it being ten years since this city has been visited by these bodies. Under the energetic direction and management of Mr. John C. Barclay, president of the Old Timers, elaborate preparations had been made for the reception and entertainment of the visitors, and during the week at least 1,200 to 1,500 members and ladies participated in the various exercises, which included theatre parties, automobile rides, visits to Coney Island, inspection of the telegraphic and other electrical headquarters, and a great deal of social festivity of a public and private character. The Western Union and the Postal Telegraph companies, Commercial Cable Company and other electrical and manufacturing interests, were generous contributors to the entertainment fund, and money was spent lavishly, but wisely, in providing for the comfort and pleasure of all concerned.

The festivities and entertainment climaxed on Thursday evening, August 31, with a sumptuous banquet at the Waldorf-Astoria, which was so well attended, there being about 700 ladies and gentlemen present, that tables had to be set not only in the big ballroom, but in the adjacent rooms. The galleries were also well occupied, so that about 1,000 persons were present. The ballroom was profusely decorated and the tables were also gay with flowers. Mr. Barclay presided, Mr. Melville E. Stone, of the Associated Press, was toastmaster, and there were seated with them at the speakers' table, Messrs. T. A. Edison, Clarence H. Mackay, R. C. Clowry, U. N. Bethell, W. H. Baker, B. Brooks, E. C. Bradley, T. F. Clark, T. W. Goulding, C. Trippe, W. B. Wilson, W. H. Young and other leaders in the telegraphic field, while Messrs. C. W. Price and T. C. Martin represented the electrical press. A very handsome menu was provided, bearing a portrait of Morse, and the souvenir of the evening was a neat little plaster bronzed bust of "the father of the telegraph." During the dinner a very elaborate musical programme was given, not only by the regular orchestra, but by a special choir which sang original songs set to familiar airs, the composers being Messrs. M. H. Kerner and Thomas E. Fleming, whose admirable verses touched every heart and were received with tremendous applause, the audience joining enthusiastically in the choruses.

The speaking was very interesting and to the point. Mr. Barclay disappointed his friends by indulging in only a brief introductory, but Mr. Stone, as toastmaster, "made good" very felicitously. The toast of "The Old Timers" was responded to by President Clowry, of the Western Union, who was very warmly received, and Mr. U. N. Bethell, of the New York Telephone Company, made a most thoughtful and suggestive speech in response to "The Telephone." Mr. Thomas F. Clark was very happy also in his speech on "The Telegrapher as a Factor in Intellectual Progress." The sentiment of "The Ladies" was never better proposed than it was by Mr. Henry D. Esterbrook, who literally bubbled with fun and anecdote, and whose eloquent praises of the fair sex elicited round after round of applause. The international sentiment of "Our Friends Across the Sea," was responded to by Mr. T. W. Goulding, of England, and with "The U. S. Military Corps" was very appropriately associated the name of Colonel W. B. Wilson. During the speeches an incidental reference to the name of Edison brought the great gathering to its feet cheering and waving napkins and handkerchiefs, and the old telegrapher, while he did not respond to the shouts for a speech, made silent and blushing acknowledgment. The exercises continued until midnight, and thus another great electrical dinner within the hospitable precincts of the Waldorf passed into history. A large number of the members and other visitors stayed in the city until the end of the week, when the executive, entertainment, reception and other committees took a well earned repose. Not alone were the members present men well known and still engaged in telegraphy, but from every part of the country came distinguished politicians, journalists, manufacturers, etc., who once worked the key, as well as many others prominent in telephony, electric lighting and electric traction.

Prof. Darwin on Celestial Evolution.

A special dispatch from Johannesburg, South Africa, contains an interesting report of a lecture delivered before the British Association by Prof. G. H. Darwin on things celestial. Discussing the Nebular Hypothesis as suggested by Kant and restated by Laplace, and considering the influence of tidal oscillations, he said the system might be traced back to a time when the day and the month were identical, both being only about four or five of our present hours. The moon at that time must have been only a few thousand miles from the earth's surface—a great contrast with the present distance of 240,000 miles. It might well be argued from this alone that the moon became separated from the earth more or less as a single portion of matter at a time immediately antecedent to the initial stage to which she had been traced. If at every moment since the birth of the moon, tidal friction had always been at work in such a way as to produce the greatest possible effect, Prof. Darwin said, 60,000,000 years would be consumed in this portion of evolutionary history. The true period must be much greater. Pure geology pointed to some period between 50,000,000 and 1,000,000,000 years, the limit being the more doubtful. Thus the geologists did not find anything which rendered the tidal theory of evolution untenable.

Physicists, from a calculation of the total output of the sun's heat, had regarded it necessary that the whole history of the solar system be comprised within 20,000,000 years. He always had believed that the geologists were more nearly correct. Recent marvelous discoveries in physics showed that concentration of matter was not the only source from which the sun might draw its heat. Radium was a substance which was, perhaps, millions of times more powerful than dynamite.

It has been estimated that an ounce of radium contains enough energy to raise 10,000 tons a mile above the earth's surface. The energy needed to tow a ship of 12,000 tons for 6,000 sea miles at 15 knots was contained in twenty-two ounces of radium.

The earth contains radio-active materials, and it is safe to assume that it forms in some degree a sample of the materials of the solar system. Hence it is almost certain that the sun is radio-active also. This branch of science is yet in its infancy, but already scientists see how unsafe it is to dogmatize on the potentialities of matter.

Prof. Darwin referred to the inconceivably vast multitude of stars and nebulæ revealed by photography. A celestial photograph, he said, looks at first like a dark sheet of paper splashed with whitewash, but further examination shows that there is method in the arrangement of the white spots. It is possible to obtain general ideas as to the succession of events in stellar evolution.

The conviction is forced that the wispy clouds represent the earliest stage of development, the more condensed nebulæ a later stage, and the stars themselves the last stage. Change, obviously, is in progress everywhere, but scientists are unable even to form conjectures as to the tendency of the evolution. In conclusion, Prof. Darwin said:

"We have seen that it is possible to trace the solar system back to a primitive nebula with some degree of confidence and that there is reason to believe that the stars in general have originated in the same manner. But such primitive nebulæ stand in as much need of explanation as their stellar offspring.

"Thus, even if we grant the exact truth of these theories, the advance toward an explanation of the universe remains miserably slight. Man is but a microscopic being, relatively to astronomical space, and he lives on a puny planet circling round a star of inferior rank. Does it not, then, seem as futile to imagine that he can discover the origin and tendency of the universe as to expect a housefly to instruct us as to the theory of the motions of the planets?

"And, yet, so long as he shall last, he will pursue his search, and will, no doubt, discover many wonderful things which are still hidden. We may, indeed, be amazed at all that man has been able to find out, but the immeasurable magnitude of the undiscovered will throughout all time remain to humble his pride. Our children's children will still be gazing and marveling at the starry heavens, but the riddle will never be read."

Electricity from Southern Water Powers.

A recent issue of the *Manufacturers' Record* contains an interesting account of the hydro-electrical developments in the South. It is stated that perhaps at the present time the South leads the entire country in the number of hydro-electrical plants under construction and in contemplation. Some of these are of great magnitude, rivaling in importance the largest electrical power developments in the country, with the exception of Niagara. The aggregate of such developments recently completed in the South, those now under way and others likely to be developed by companies now being formed will total not far from 300,000 to 500,000 hp. By far the largest single water power enterprise in the South is that at Whitney, N. C., which at the initial stage will furnish about 40,000 hp, to be followed later on by an additional development which will carry the total up to 76,000 hp. Exceeding this in the aggregate of power to be developed is the project of the Southern Power Company, recently organized with a capital stock of $7,500,000, which has taken over the Catawba Power Company at Charlotte, N. C., and proposes to continue the development at other sites, all under one control, to an aggregate of 110,000 hp. Another extensive undertaking of this character is that of the Chattanooga & Tennessee River Power Company, which proposes to develop from 30,000 to 40,000 hp on the Tennessee River below Chattanooga.

The Belton Power Company, of Belton, S. C., has completed a dam 32 ft. in height and 600 ft. long across the Saluda River, where 4,000 hp will be utilized. Preliminary surveys have been made for a plant on the Little River, near Blanche, Ala., for the development of 18,000 hp. The Albany Power & Manufacturing Company has in course of construction a 20-ft. dam at Big Shoals, on the Big Muckafoonee River, about one mile from Albany, Ga. This dam will give about 2,500 hp at low water.

The Saluda River Power Company is progressing steadily with its developments on the Saluda River, about five miles from Greenville, S. C. It is expected that 2,000 hp will be utilized. The Winston-Salem Power Company was recently incorporated to develop a total of about 4,000 hp near Winston-Salem, N. C.

A survey of the Great Pee Dee River, about six miles from Rockingham, N. C., showed that about 25,000 hp is available. This property is owned by Hugh McRay & Co., bankers, of Wilmington, N. C., who are considering the development of the power. Near Graystown, Va., about 375 hp is being developed for the purpose of supplying electricity for lighting Christiansburg and other towns. A development is under way at Martinsville, Va., by the municipality. It consists of a stone dam across Smith's River, 15 ft. high, which develops 450 hp under a head of 20 ft. The Knoxville Power Co., Knoxville, Tenn., expects to construct a hydro-electrical plant on the Little River to furnish 40,000 hp for transmission to Knoxville and other cities. It is estimated that the entire plant will cost when fully completed, approximately $3,500,000.

These enterprises show something of the character of the work which is being undertaken in the line of water power development. This phase of Southern progress is likely to commend wide attention, for having been so well begun, hydro-electrical development promises to become one of the most notable features of Southern advancement in the future.

Chicago Municipal Railway System.

We have had occasion frequently to refer to the attempt of Mayor Dunne to introduce the municipal ownership of street railways in Chicago. In a recent issue mention was made of the fact that Mr. A. B. Du Pont, as special traction expert, had submitted to the Mayor a report containing suggestions as to the possibility of acquiring certain lines for which the franchises have expired, and as to the construction of lines along certain streets where no tracks have as yet been laid. The proposed system of municipal street railways would utilize 264 miles of track, the probable cost and earning expenses of which are given in round numbers in the report, an abstract of which is given below.

The system is to be so designed as to be readily extended as the franchises expire on contiguous streets, so as to embrace the entire city. In the operation of these railways the lines running approximately north and south, in the North Side and the South Sides, respectively, and east of Halsted Street, should be connected together and operated as through routes through Wabash Avenue. The diagonal lines running approximately southwest from the central portion of the city should be connected to the diagonal lines, and to lines that are established approximately diagonal, in a generally northwest direction from the central portion of the city, and operated as through routes through Dearborn Street. The lines on the West Side that run east and west should not at present be extended east of Dearborn Street. A full transfer system is recommended.

Temporarily, and until such time as general terminal subways are built, Mr. Du Pont recommends that the overhead trolley system be extended to include the center of the city, thereby saving the excessive waste that would be entailed by the premature construction of the electric conduit system. In case there should be any delay in getting possession of any connection at the time needed, a subway can be constructed to make such connection, and can be so designed as to be a part of a permanent subway system.

The cost of construction of the 264 miles of track above indicated will not exceed $25,000,000. Such a sum, besides constructing the railway complete, will provide ample power and cars to take care of the riding public.

After careful comparison of the earning capacity of the designed system and remaining parts of the Chicago City Railway and the Union Traction Company at 5-cent fares and the transfers above indicated, he is of the opinion that should the designed system be put in operation for the year 1908, its gross earnings will not be less than $12,000,000.

The cost of operation, including maintenance and depreciation, but not including taxes, for the first five years of the designed railway should not exceed 55 per cent of the gross earnings. After that time, owing to the track and equipment becoming older, this cost would probably equal 60 per cent of the gross earnings.

Mr. Du Pont estimates the financial results from the operation of the designed system with 5-cent fares and transfers as indicated, as follows:

FOR THE YEAR 1908.

Gross earnings	$12,000,000.00
Operating expenses, including maintenance and depreciation, but not taxes	6,000,000.00
Net earnings from operation, 45 per cent	5,400,000.00
Interest on cost, 5 per cent. on $25,000,000	1,250,000.00
Surplus	4,150,000.00

FOR THE YEAR 1913.

Gross earnings on annual increase of 5 per cent. of earnings of 1908		15,315,378.75
Operating expenses, including maintenance and depreciation, but not taxes, 60 per cent.		9,189,227.25
Net earnings		6,126,151.50
Interest on first cost, $25,000,000, 5 per cent.	$1,250,000.00	
Interest on $3,000,000 additional cost to provide for increase in traffic at 5 per cent.	150,000.00	
Total charge		1,400,000.00
Total surplus		4,726,151.50

If these streets are available it would add about fourteen miles to the system, as herein set out, and would make a further cost of $1,600,000. This addition of mileage in these streets would increase the earnings $1,000,000 per year, with the same percentage of profits as herein indicated.

Central Station Companies and the Law of Negligence.

Those who read an article which recently appeared in the ELECTRICAL WORLD AND ENGINEER, by Mr. W. Valentine Ball, upon the above subject will be interested to hear that the case of Midwood & Co. vs. the Mayor and Corporation of Manchester, which formed the subject of discussion, has been affirmed by the English Court of Appeal. The action was brought to recover damages for a fire which was caused by the defendant corporation adopting the system of burning out a fault in their electric mains. The fusion of the wires caused the vaporization of the bitumen in which the mains were encased, with the result that the plaintiff's premises were set on fire. The plaintiffs based their cause of action on the grounds (1) that the defendant's system of electric lighting constituted a nuisance, inasmuch as it was a dangerous system by reason of the difficulty of discovering and locating a leakage; and (2) that the defendants were negligent in not detecting and locating the leakage and in not dealing with it promptly after it was discovered. The defendants alleged that as they were empowered to supply electricity, they were entitled to do everything which was reasonable in connection with the supply, and that inasmuch as they were bound to keep up a constant pressure in the mains, they were justified in adopting the system of burning out a fault. The jury found, however, that the corporation had been guilty of negligence, and that they had caused a nuisance.

The Court of Appeal has held that there was evidence upon which the jury might properly come to this conclusion; and the judgment of the court is of interest as it defines the position of an English corporation which supplies electricity. The master of the rolls (who presides in the Court of Appeal) said: "Certain privileges are conferred upon the defendants and for the reasonable protection of the public a clause is inserted in their act which imposes on them the obligation of bearing the consequences if in the exercise of those privileges they cause a nuisance. They are not given *carte blanche* to create a nuisance. If they cause a mischief to third persons by a nuisance in the course of carrying on their undertaking they are made liable by a section in their special act." He also referred to an earlier case where an electric lighting company was sought to be held liable for the nuisance caused by vibration at a generating station. In that case the Lord Chancellor said: "The nuisance being established, it is said, first, that the company is authorized by law to carry on its business, and that, as it has done all that skill and care can effect to prevent any nuisance, it is in the same position as a railway company and entitled to do what it has done under the authority of the legislature. If the analogy were a correct one I should think the defendants had fallen very far short in their proof that they had done all that was possible to prevent a nuisance."

It will be noticed that the decision of the Court of Appeal rested mainly on the fact that the company was expressly made liable for negligence by its special act (i. e., the act of Parliament under which it was authorized to supply electricity). As all other companies and corporations supplying electricity in England are subject to a similar clause, the case of Midwood vs. Mayor, etc., of Manchester, may be taken to have authoritative statement of the law.

Combination and Operation of Small Central Station Plants.

At the recent meeting at Erie, Pa., of the International Association of Municipal Electricians, Mr. Cleon L. Williams received the "Medal of Merit" for a paper presented, entitled, "Erection and Maintenance of Electric Lighting Plants." The data given were gathered from stations of modest capacities employing overhead circuits.

Of the stations reporting, 12.6 per cent. are losing money, the receipts of 10.8 per cent barely cover running expenses and 76.6 per cent are earning from 2 to 51 per cent on the investment. The total average annual depreciation amounts to 8.7 per cent. of the entire cost of the plant, exclusive of real estate, showing that the average station is, or should be, rebuilt or renewed throughout every 12 years. Over 70 per cent. of the reports first received simply gave the operating expenses, with an occasional percentage for repairs or fixed charges. It seems remarkable this item should be so frequently omitted in calculating the maintenance account, and in some cases four reports were necessary to obtain complete data.

Some stations show a profit for the first four years; then, a general overhauling of the boilers, engines, dynamos, lamps and particularly circuits, becomes necessary, due either to inferior and insufficient machinery, incompetent labor, or to the correction of extravagant mistakes in the first construction. Other stations show a continuous expenditure beyond reasonable operating expenses. When this is applied to the extensions necessary to meet the demands of a growing business, it is entered on the construction account, but when applied to patching the plant to keep lights running it is charged to the maintenance account. The result thus deduced shows conclusively that only the use of the very best apparatus and employment of competent labor will yield large returns; also that the employment of a capable consulting engineer, to superintend the erection of the plant, will not only prevent expensive mistakes but frequently effect a saving in operation of many times his commission. Please note the word capable, as applied to the engineer. This is a rare quality which should be proved in stations he has erected before he is given employment.

In the more recently built stations the percentage of depreciation is considerably less, showing that buyers appreciate the value of good construction, and it would seem that unless the purchaser has sufficient means to build his station properly, he had better abandon his intentions of going into the lighting business.

The building is frequently too small, but never too large. A fireproof building with facilities provided for fire protection and small insurance helps to pay larger dividends than a greater fire risk with double the amount of insurance. In most cases of fire in lighting stations it has been hard to adjust the full amount of absolute loss even with fair arbitration, because heat, moisture and dirt greatly impair the apparatus, the injury not being always apparent at the time, but developing later when the plant is again put into daily service. The added loss in revenues through the enforced idleness and the decrease in the number of customers, make it imperative to spend enough money on the building to make it absolutely fire-proof, rather than rely altogether on insurance for protection against loss.

Ventilation is important. The cooler and cleaner the conditions of the dynamos, the more efficient and serviceable is their operation, therefore large windows are not only desirable, but cost less per square foot than the average wall.

In a brick building, a good plan to follow is to build, say, 20-in. brick studs 12 ft. apart, putting two window frames 5 ft. in width, or three 40-in. frames in each panel, except those in which a sliding 6-ft. door or double folding doors are located. This construction requires very little of the 13-in. wall and reduces the cost of building and future enlargements.

A building thus constructed and with a truss roof in sections to correspond, is easily extended at the two ends, and as a steady increase in capacity is the rule in operating, it only becomes necessary to secure a sufficient area of ground which, after building the first section with the unit of machinery decided upon, will permit the extending of the building without wasting money in tearing down and altering the first construction.

Where the size of the building will allow, a truss roof is preferable to supported roofs. Iron truss roofs are made in portable sections for any length of span, and are reasonable in price, usually costing less than a roof made of wood with iron rods and plates.

When the wood trusses are used they are usually covered with a fireproof coating and the roof laid in slate. Unless a cupola is built in the roof it is necessary to provide a wood box casing, say 6 ft. long and 1 ft. wide, in the building wall near the roof, for the easy handling of the wires running from the station. The casing should have a double folding cover so as to permit ready access to the wires, and be painted with an insulating compound. Each wire leaving the station should be covered with flexible tubing, sealed tight with compound, having a drip loop and be protected by a lightning arrester thoroughly grounded. Many dynamos have been burned out simply because of poor ground connection in the lightning arrester.

Frequently the arrester is grounded with No. 6 wire twisted around a gas or water pipe, which is entirely inadequate to carry off excessive charges of lightning even on a perfect working arrester. Three or four strands of No. 6 or one strand of wire of equal carrying capacity, should be first riveted, then soldered, to a large piece of boiler plate or iron pipe, cleanly scraped where soldered, and buried or driven until embedded in damp or wet ground.

In single floor stations, not only the boiler and engine, but each dynamo and all shafting should be placed on a separate foundation laid in the ground, the dynamo base to be thoroughly insulated from the foundation by tar paper or ritrite sheeting and waterproofed. No part of the building should be used for the support of any piece of machinery. In good construction the building is only regarded as a cover for the protection of the plant, every part of which is erected as if the building foundation, or walls, did not exist.

Where the building has more than one floor, the girders and supports are of iron; or if built of wood, the slow burning construction is employed The best floor is that built on the slow burning construction principle, namely, two by four inch, or larger timbers as required, set on edge and nailed solidly together, doing away with the wood girder timbers.

Where this floor is built the dynamos may be fastened thereto, but in no case should the floor touch the building wall, but instead, should have a separate support. The boiler room should have a cement or concrete floor with a sewer drain running from each boiler, pump and heater.

The dynamo foundations should come above the floor line and the floor so laid and drained that it will not only readily dry after scrubbing, but permit of washing down with a half filled hose.

A lifting jack is always necessary. A traveling crane running over each piece of heavy machinery is desirable in case of accident and repairs, but in the smaller stations a fixed support for a chain and tackle will answer. Where the fixed support is not readily applicable, an adjusting tripod of sufficient length or height should be provided and, with its tackle, kept ready for the emergency that always comes.

The boiler room is always shut off absolutely from the dynamo room by a fire wall of required thickness and provided with iron doors.

Upon the completion of a plant, and annually thereafter, a comprehensive test of the efficiency of the boilers, engines, dynamos and circuits will invariably effect a saving of many times the cost of the test, in locating and bringing to light sometimes unexpected wastes which may exist in the per cent of ashes in the fuel, the amount of incrustation in the boiler tubes, the setting of the boiler, the manner of firing the fuel, the method of handling the machinery and quality of supplies.

The average cost of fuel is 30 per cent of the total maintenance account, and is equivalent to a fair quality of free steaming lump coal at $2.70 per ton delivered at the station.

There is no grade of coal that can be taken as a standard, as not only do the different mines vary in the steaming qualities of the coal but the output from any one mine usually varies in the different veins; but for the purpose of enabling the purchaser to estimate the cost of the item of fuel for his particular station, we have deduced the average fuel account of all reports as given in the tables of maintenance hereafter and find its equivalent as stated, its steaming capacity being an evaporation of seven pounds of water to each pound of coal.

With this as a basis, the exact cost of fuel may be readily esti-
at a rate proportionate to the pressure of the steam required.

Apparatus for this purpose can be installed for $8 per horsepower.

mated by adding or subtracting the difference between this average price and the local cost.

Its cost is shown to vary from sawmill refuse, costing nothing, to coal at $14 per ton, the price received for current keeping in close proportion to the price of fuel, which is the most variable of the items entering into the maintenance accounts.

The item of the cost of handling coal and ashes is one which, if properly cared for in the construction, increases the percentage of profit. It seems to be economy to build the station where railway facilities permit handling the coal direct from cars to boiler room, even if the distance necessitates an additional first outlay for circuits.

In the larger stations machinery for taking the coal from the cars and delivering it to the boiler grates is in practical and economical operation. The work is done with a small outlay of power and is automatic in its action, feeding and regulating the supply of fuel at a rate proportionate to the pressure of the steam required. Apparatus for this purpose can be installed for $8 per horse-power.

The price of coal used does not seem to greatly change the total monthly fuel account in stations of about the same capacity, the cheaper the coal, the greater the amount burned. Where the amount used is greater than the average, it is obvious that the boiler setting and grates are not adapted to the kind of coal used. It appears the higher grades of coal are the most economical, except where apparatus especially designed to suit the conditions is employed to burn the cheaper grades.

Wood is burned in 7 per cent of the stations. Hickory, maple, oak, beech, poplar, elm, chestnut and pine vary greatly in weight, but their steaming power per pound is about equal, if air dried, and it requires 2½ pounds of each to equal one pound of average coal. One cord of hickory or hard maple is equivalent to one ton of coal; one cord white oak, 1,700 pounds of coal; one cord beech, red or black oak, 1,500 pounds of coal; one cord poplar, chestnut or elm, 1,000 pounds of coal; one cord pine, 650 pounds of coal.

The labor account averages 36 per cent of the total maintenance account. In the practical operation of a station there should be but one man in authority, who has the entire management as well as the entire responsibility of its successful operation, as there are too many details of too varied a character to divide either the authority or the responsibility.

If an employe, in no matter what capacity, proves by results or lack of results, to be incompetent, no question of sentiment nor expediency should prevent his immediate discharge, because a careless or unskilled man is in a position to injure and disable thousands of dollars' worth of machinery. The average price paid to the various employes in and about a station is as follows:

Managing superintendent, per month, $152.70; electricians in charge apparatus, per month, $84.70; engineers, per month, $82.40; firemen, per month, $49.10; wiremen, per month, $58.18; linesmen, $50.28.

The figures represent the average of wages paid as shown in the station reports, and, while giving the basis of an estimate, should not govern the scale paid in any particular station which naturally depends on local conditions such as size of station, extended duties, cost of living and individual worth.

The labor accounts vary less than the fuel accounts in the stations of different capacities. The plant that is sufficiently large to economize in the station labor requires additional help in the office force and to a considerable extent in the line construction account. Reports showing a small labor account invariably have a correspondingly large fuel, repair or rebate account, and they clearly demonstrate that well-paid labor increases the profits of a lighting station.

Capable expert services are of great value in the prevention of costly mistakes in construction, but the title expert is usually a misnomer, and the employer, too, frequently gets "whipsawed" in the exchange of expert services for cash. As has been often shown, the "expert" experiments with untried theories, or rides an expensive hobby, with the net result of diminishing the station economy in direct ratio to the employer's bank account. The experienced expert, who is a mechanical as well as an electrical engineer, is better equipped to design and construct a station than a college graduate whose only qualifications are a diploma and a distant relationship to some stockholder.

Economy in construction and operation is readily accessible in the employment of the expert who has designed and built at least one station, in which the practical results show an economy in the conversion of fuel into light or power that is above the average station, and whose business relations are such as should make him unbiased in the recommendation of the requisite apparatus and material.

CURRENT NEWS AND NOTES.

A VALUABLE PATENT DIGEST.—Mr. James T. Allen will soon publish in three volumes aggregating more than 1,500 pages, a digest of all U. S. patents issued from 1789 to July, 1905, on air, caloric, gas and oil engines, including patents of all details coming under these heads. A feature of the work will be an index giving the number, name and date of references cited in examination of applications, which data often give a clue to the limitations of a patent. Subscriptions for the Digest may be sent to Mr. Allen, U. S. Patent Office, Washington.

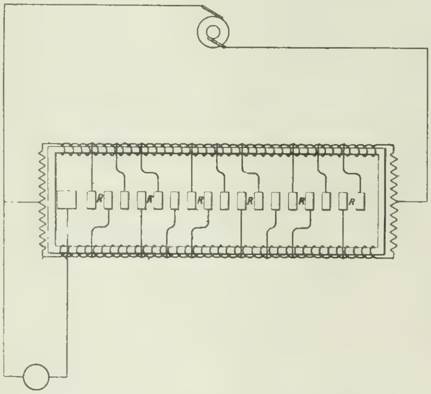
STANDARD ELECTRICAL CONSTRUCTION.—Mr. W. C. L. Eglin, secretary of the National Electric Light Association, informs us that President Blood has appointed the following gentlemen as the committee on standard rules for electrical construction and operation: Mr. Ernest H. Davis, chairman; Captain William Brophy, Louis A. Ferguson, Alex Dow and Samuel Scovil. The chairman, Mr. Davis, is past president of the association and took an active interest in the work of the committee last year. All of the other gentlemen have been in close touch with this question for some time, so the association will be represented by men who are thoroughly conversant with the subject.

COSTLY POLE BREAKAGE.—A curious pole breakage litigation is reported from Bavaria. Frau Senger-Bettaque, the eminent Bavarian vocalist, was traveling in an automobile when a wild boar from some neighboring forest charged into the machine, with fatal results to itself and much damage to the car, which was upset. The lady, who was thrown out, escaped with slight shock and some bruises. Now Frau Senger-Battaque has received a bill for 15 marks from the postal administration for breaking a government telegraph pole in the upset, and another bill for 50 marks from the forest authorities for the dead boar. She has responded by bringing an action for injuries to herself, for an account of a doctor and for cost of repairs to her automobile.

WHO'S GOT THE BUTTON.—An ingenious newspaper writer figures out that more than $50,000 of jewels, sapphires and diamonds are hidden away in New York in electric meters. "Diamonds have been used for only about two years, and until the last six months have been almost prohibitory in price. The diamond cups as they come from the stone cutters cost $2, while the rough diamond would be worth only about 40 cents. The sapphires cost only about 20 cents a cup. The diamond cups are not yet in general use. Only three firms are making them, and it takes one machine an entire day to do so. The length of life of a diamond in use in a mechanical instrument has not yet been determined. The surface of a jewel in a fine chronometer will show a faint haze after a couple of years' use. A diamond in a meter may last from two to four years, depending upon the vibration. Eventually the diamond cups will be used entirely, and jewels in the meters will then represent more money than now."

ELECTROCAPILLARY RELAY.—Five patents were granted to J. T. Armstrong and Axel Orlong, of London, England, on August 29, for apparatus utilizing the electrictrocapillary force exerted at the surfaces in contact of mercury and dilute acid. An inverted V-shaped siphon is filled with mercury. The longer tubular leg is constricted at its lower end so as normally to resist the flow of mercury. The longer leg of the syphon dips into dilute acid, while the shorter dips into a liberal supply of mercury. The device is placed in a circuit, the current in which it is desired to detect. The inventors state that even a current having a strength of a fraction of a milliampere is sufficient to cause the mercury to pass down the capillary tube. The mercury thus moved closes the circuit to a relay which records the presence of a weak current.

CONTROLLER FOR ALTERNATING-CURRENT MOTORS.—An invention patented August 29 by H. L. Van Valkenburg has for its object to provide means for supplying variable voltages to alternating-current motors which will prevent destructive and dangerous arcing between the stationary and movable contact-terminals. The circuits are shown in the accompanying illustration. The opposite terminals of a source of alternating-current are respectively connected to the middle points of non-inductive resistances. The terminals of the separate resistances are joined to the terminals of two autotransformer windings. A movable contact terminal of the motor circuit is arranged to engage with certain pairs of symmetrically placed stationary contact terminals on the autotransformers for each "running" position of the controller. In passing from a running position to the next adjacent one, the movable contact terminal engages with intermediate stationary contact terminals alternately on one and the other autotransformer. It will be seen that the circuit is not opened when passing from one to another running position. The current, due to excess of e.m.f., caused by the difference in the number of turns in the two sections of the auto-transformer windings at each transitional position, is limited by the resistances joining the two transformers, so as to prevent injurious arcing at the contact terminals when changing from one position to another.



WIRELESS IN CHINA.—An imperial edict announces that wireless telegraphs, as well as telephones, are a government monopoly throughout China.

ELECTRIC MOTORS IN ITALY.—In a recent consular report it is stated that the number of electric motors employed in various branches of industry in Italy is 3,622. There are no less than 49,699 water power motors as against 8,150 steam engines. In the Milan district nearly 1,300 electric motors are in use.

CAPE COD TO ST. AUGUSTINE.—The Bureau of Equipment of the navy, in charge of the wireless work, has just been informed that the operators at St. Augustine, Fla., and Cape Cod, Mass., have been enabled to exchange messages. This is a distance of 940 miles, and is believed to be the record distance.

WIRELESS IN CANADA.—It is stated that Mr. J. G. Ridout, of Toronto, Mr. Clarence Thompson, of Montreal, and Mr. Henry Aylen, K. C., of Ottawa, have been appointed by the Dominion Government as arbitrators to meet shortly in Ottawa to ascertain who is the original inventor of the wireless telegraph. This step is the result of rival claims before the Canadian patent office by Sir Oliver Lodge, the English scientist, and Mr. R. A. Fessenden and Dr. De Forest, American inventors. We do not quite understand what such a procedure as this news would indicate.

NAVY WIRELESS TESTS.—News that tests would soon be made to establish direct wireless communication between Washington and the Brooklyn Navy Yard has created considerable interest. The school for training in wireless telegraphy at the Brooklyn Navy Yard is in the Bureau of Equipment Building. Lieut. W. A. Edgar, U. S. N., is executive officer of the electrical and wireless school. Chief Electrician Bean, in charge of the Navy Yard wireless station, is the main instructor, and Chief Electrician Delany is assistant.

ILLUMINATIONS IN BRUSSELS.—In celebrating the seventy-fifth anniversary of Belgium, the capital city of Brussels was brilliantly illuminated on July 21 and following days. No fewer than 60,000 incandescent lamps were used of 5 cp each, over a street area of about three miles. The King's House had 2,000 lights and the City Hall 5,000, of which 3,200 were used in outlining the big tower from which one sees the field of Waterloo. The special illumination cost the city about $38,600. The 5-cp unit was found very satisfactory for this work and for festooning the boulevards.

"PROTECTING NIAGARA."—It is said that hundreds of letters have been received at the state department at Washington from all parts of the United States asking that the President take some action to prevent further destruction of the beauties of Niagara Falls by the vast electrical interests on both sides. The petitioners desire that some arrangement be made with Canada whereby the surroundings of the falls may be turned into an international park. Seeing that there is already an international park on each side, and that Niagara has been destroying herself in steady backward movement for some centuries, it seems that these correspondents might find some better arena for their energies.

LONG ISLAND ELECTRIC TRAINS.—The new electric trains of the Atlantic Avenue division of the Long Island Railroad, now being operated between Flatbush Avenue, Brooklyn, and Jamaica run very smoothly and are giving much satisfaction to the railroad managers and to the commuters. The trip is made in about thirty minutes, but the running time will be greatly reduced upon the inauguration of the new fall time table, September 20. There are twenty-one trains each way on the schedule at present, comprising the suburban service. Through trains will not be put on until more excavation work has been done, so as to give sufficient yard room. This will probably be as late as the last week of October. Meantime, however, residents at such places as Far Rockaway have suffered for their sins, and have been subjected to terrible delays. They look forward to next year for compensation, when the electric system will include that region also.

CABLES TO JAPAN.—Unfortunately at a time when the peace negotiations have been in full swing, according to advices received by the Commercial Cable Company, the "Formosa route to Japan is working slowly." In normal times there are four routes to Japan. Two of them, from Vladivostok to Nagasaki and from the southern extremity of Corea to Japan, have been closed in consequence of the war. A direct cable from Shanghai to Nagasaki has been carrying nearly all the messages since the beginning of hostilities, and there is also a roundabout route by way of Formosa and the Liu Kiu Islands from Foo-Chow, China, to Ohama, Japan. The Shanghai-Nagasaki cable has been recently interrupted by typhoons, and for a time dispatches were received for transmission by steamer from Shanghai to Japan, five hundred miles

AN ELECTRIFIED GRINDELWALD.—Advices from the Grindelwald, Switzerland, say that much interest has been taken in the working of the searchlight just established at the Elgerwand station of the new Jungfrau Railway. It is one of the most powerful lights in the world, being 95,000,000 nominal candle power. Every evening the immense beam is swung about the heavens, and distant peaks are one after another illuminated in the most startling fashion. Occasionally the light is turned down here into the village, and then the hotel gardens stand out as clear in every detail as if in broad sunlight. The device succeeds very well in attracting the attention of all visitors to the railway and the new station just opened up at Eismeer; every day the little electric trains going up in the tunnel are crowded. A form of suspended railway is under construction up the side of the Wetterhorn.

NEW YORK-CHICAGO TROLLEY.—It is stated that continuous trolley rides from Chicago to New York, over two routes, and between Chicago and Cincinnati, are among the transportation possibilities of the near future. William S. Reed, a builder of railroads, has organized a syndicate, which has purchased the Chicago Electric Traction Company, and has organized two other companies to complete the gaps that now prevent a continuous ride on electric roads between the cities named. Mr. Reed claims that these transportation feats will be made possible by next June, and that the traveler may go from Chicago to New York by way of Buffalo, and then through New York State, or may branch off at Cleveland, and travel through Pennsylvania, and so on to the metropolis. The Chicago Electric Traction Company, which is now in the hands of a receiver, is to be taken out of litigation, and will then be absorbed by the Chicago and Southern Traction Company, a new Indiana corporation, which is capitalized for $2,000,000. This will be increased to $4,000,000. A line is to be constructed from Harvey to Kankakee, a distance of thirty-six miles. Other lines will take up the connection, completing the route between Chicago and New York. Such a trip should occupy at best two or three days, but this will not matter to those who have more time than money.

A CHOICE OF DEATH.—A thrilling special dispatch from Chicago, of September 2, says: "Nels Anderson, a motor inspector for the Illinois Steel Company, chose death on a live electric wire to-day rather than fall into a pit full of molten metal at the South Chicago works. Anderson was doing repair work on the arm of a crane about 30 feet above one of the hot metal pits. A slight movement of the crane caused him to lose his equilibrium. The only support within reach was an uninsulated wire which connected the crane with the motor. As he toppled on the crane, workmen who were near by heard Anderson cry out, and saw him struggle to regain his balance. His body swayed in the air and he extended his arms in a frantic effort to right himself and keep from falling in the metal pit. To those who were looking on it seemed that the man struggled an hour in midair, although it was only a second or two. He knew that to touch the wire meant instant death, but he chose that rather than plunge into the boiling metal. Reaching above his head, he caught the wire just as his body shot downward. There was a flash of blue flame as his clothing caught fire. His fellows, as soon as they could recover from the shock of the tragedy, rushed toward him. The current seemed to have welded the man's hand to the wire, and his body hung suspended for several minutes, until the current could be turned off."

ELECTRIC COMMERCIAL WAGONS.—Our Cleveland contemporary, *The Automobile Builder,* estimates that the number of electric commercial wagons now in actual service in this country can be conservatively placed at 4,000.

TROLLEYS IN INDIANA.—According to statistics recently compiled, there are 913 miles of traction lines in operation in Indiana. Of this, the United Gas Improvement Company, of Philadelphia, controls 512 miles. Besides the 913 miles already in operation, 213 miles are building, of which the larger part is probably controlled by the same interests.

HEADING OFF A CYCLINE.—A dispatch from Winona, Minn., says: "A telephone saved the family of F. G. Sanders, consisting of seven persons, from death or injury in a tornado which swept through the county doing considerable damage. The Sanders family were eating dinner when their telephone rang. A neighbor told them that a funnel-shaped cloud was sweeping toward their house. The entire family rushed to a nearby clump of bushes, where they lay face downward. They had scarcely reached their place of safety when their house was lifted from its foundation and dashed to the ground a few feet away with hardly a board unbroken. With the exception of Mrs. Sanders, who had one arm crushed, the family escaped injury.

NOT TAKING CENSUS OF POWER PLANTS.—The Acting Director of the Census stated last week that a number of communications had lately been received by the Census Bureau from companies which supply electric power, concerning a circular purporting to be issued in Washington, but sent out from Chicago, and requesting detailed information concerning water power plants in the United States, Canada and Mexico. The census officials state that no such inquiry is in progress in that bureau, or in any other bureau of the Department of Commerce and Labor, nor is the acting director aware that there is any such branch of the United States Government as that from which the circular purports to emanate. The circular literature is got up in such fashion as to suggest, on superficial examination, that it is a governmental undertaking, and in line with the regular work done by the Bureau of the Census in collecting statistics of electrical manufacturing, street railways, electric lighting, telephony, etc.

HIGH-POTENTIAL SWITCH.—A novel use for an electrolytic condenser is disclosed in a patent issued August 29 to E. S. Halsey. The condenser is composed of a plurality of aluminum plates between which is placed a solution of citric acid. The capacity effect produced by the condenser results from the production of a thin coating of aluminum oxide on the plates, and, although this oxide is extremely thin, it has the power of resisting a comparatively high voltage. The thin film is, however, more or less unstable, so that, when the condenser is first thrown in circuit, there is a considerable leakage of current directly through the condenser before the film has been "formed." The inventor proposes to use such a condenser in series with an air-gap as a shunt circuit to a high-potential switch. When the switch is first opened, the current passes readily across the air-gap and through the low resistance of the condenser. As soon, however, as the film is completely formed, the voltage drop across the condenser is sufficient to extinguish the arc across the air-gap.

TROLLEY DEVELOPMENT IN MEXICO.—The plans for the expansion and improvement of the street railways of Guadalajara are being gradually unfolded. La Electrica, which is the name of the company owning the principal street railway system in the city, and which holds a concession from the Mexican Government to convert its lines into electric transit and to cover many other streets, has just purchased what is known as the Kunhardt street railway system, which operates over about 12 km. of streets of Guadalajara. It is stated that the consideration in the transaction was $500.000, the purchasing company paying $100,000 cash and agreeing to pay the balance in several installments. The Kunhardt system operates on some of the principal streets of the city, and has been doing a paying business for many years. Plans for the improvements and extensions to the combined systems are now being made and will be submitted by the company to Governor Miguel Ahuamada for approval on September 15. It is estimated that at least $2.000.000 will have to be expended to carry out the plans of the company. Included in this sum is $400,000, which the company will have to pay to the State government for its franchise. The construction of the power plant at the Juanacatlan waterfalls will be the first work undertaken. It is stated that the new electric transmission system will consist of twelve independent circuits. Of these ten will be in the city and the other two will connect Guadalajara and the suburban towns of San Pedro and Zapopan.

Electrical Engineers of the Times.—XXVI.

G. WILBUR HUBLEY.

George Wilbur Hubley was born May 9, 1870, at Pittsburg, Pa., and attended the public schools and the high school of that city. In 1889 he entered the auditor's department of the Westinghouse Electric & Mfg. Company, and later took a special course in electrical engineering under a tutor and with the guidance of the late Oliver B. Shallenberger. After more than a year of practical shop work in various departments of the Westinghouse factories, he spent several years in the engineering department, having charge of the erection and construction work. He made a specialty of traction work upon the introduction of the Westinghouse railway system, and was engineer in charge of the construction and equipment of the first Westinghouse railway, that at Terre Haute, Ind., which was installed in 1890. During the same year he went to the Pacific Coast, where some months were spent forwarding the electric railway interests of the Westinghouse Company.

G. WILBUR HUBLEY.

In 1891 Mr. Hubley became electrical superintendent of the Citizens' Traction Company of Pittsburg, during which engagement he constructed the Sharpsburg and Wilkinsburg feeder branches of this system. While engaged in electric traction work Mr. Hubley designed several devices and improvements relating to electric railway apparatus, including removable contacts for electric controllers, a special trolley wheel with aluminum flange and removable contact spool and bushing, and a splicing sleeve connection for large cables. Some of these devices have been largely used in standard practice, and the splicing connector in recent years has been employed as a mechanical connector for aluminum cables. During this period Mr. Hubley also compiled complete data and fundamental statistics relating to electric railway practice of the day. In 1893 he resigned from the Citizens' Traction Company to become electrical engineer of the Louisville, Ky., Electric Light Company, and subsequently was made superintendent of the company, which position he now holds with its successor, the Louisville Lighting Company.

During recent years Mr. Hubley has made a specialty of central station economics, particularly with respect to alternating-current operation and reduction of costs. In 1898 he presented a paper before the National Electric Light Association giving the result of an extended investigation into the subject of transformer iron losses; in this, one of the first contributions to the subject, all factors were thoroughly considered and remedies offered. He has also contributed to the technical press.

Mr. Hubley is a member of the American Institute of Electrical Engineers and the American Association for the Advancement of Science. He was one of the promoters and a director of the Pittsburg Electric Club.

Waterside Station No 2 of the New York Edison Company.—II.

(*Concluded.*)

A GENERAL description was given last week in the first part of this article of the fine new Waterside Station No. 2 of the New York Edison Company. The details then dealt with included the growth of the system, the architectural features of the new building, and the technical features of the new plant as a whole. A number of other details as to the steam plant, electrical control equipment are now discussed.

The boiler arrangement adopted is upon the cross-fire room plan, which has become typical of the more recent large turbine stations in this country. In the majority of cases, however, it has been found preferable to concentrate the firing rooms as much as possible, with the result of a less convenient arrangement of chimneys, whereas in this plant a division of fire rooms was selected which, as may be noted in the accompanying plan, is more advantageous for the flue, chimney and coal bunker arrangements. There are upon each boiler floor three main firing rooms, each having a row of three batteries of two boilers each upon either side, and at either end of the building a half firing room with a single row of six boilers; this arrangement permits of the use of only four chimneys, which will be symmetrical in design, each chimney thus operating twelve boilers upon either floor, or 24 each. The objection that might be offered to this arrangement for a smaller plant resulting in half fire rooms will here not prove serious, as owing to the magnitude of the plant it will be an easy matter at all times to divide the work between boilers to the best advantage for the firemen.

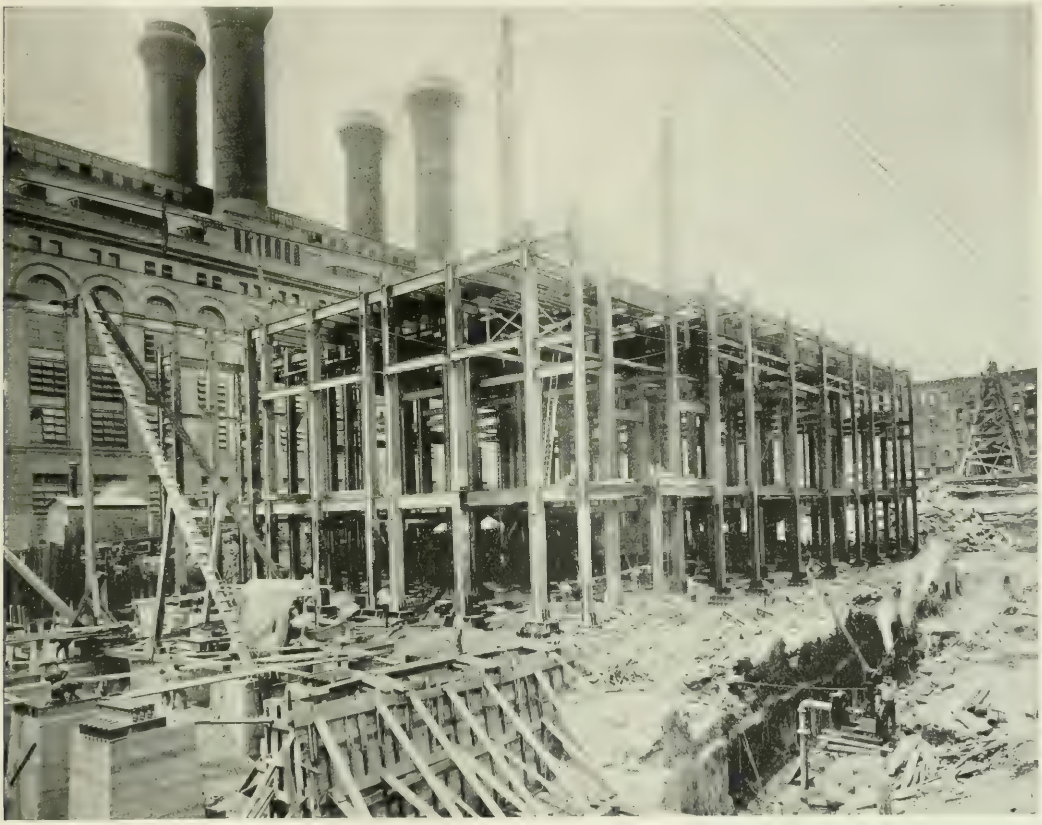


Fig. 8.—View of Waterside Station No. 2, in Course of Construction.

The boilers selected for the new station will be of the well-known inclined water-tube type of the Babcock & Wilcox Company, and will be equipped with the new Babcock & Wilcox single superheaters. Space is provided for 48 boilers upon each boiler floor, or 96 in all. Each boiler unit will be of 650 hp capacity, designed to deliver steam at 200 lb. pressure, and with a superheat of from 100 to 150° F., above saturation temperature. Each boiler consists of three 42-in. steam drums and has 294 tubes, 4 in. in diameter by 18 ft. long, arranged 21 tubes wide and 14 tubes high, thus presenting a total heating surface of about 6,500 sq. ft. The vertical rows of 14 tubes each deliver into a continuous wrought-steel header of a new design, which materially simplifies the construction. The trimmings and fittings for each boiler are of extra-heavy design, for the purpose of securing a maximum of reliability in service. The boilers will all be fitted with flat grates for hand firing.

Both natural and forced draft will be provided, the latter permitting an advantageous flexibility in the burning of low grades of fuel. For the forced draft supply there will be installed two blowers of 90,000 cu. ft. capacity per min., for each row of 6 boilers. These fans, which will be fitted with cases and driving engines by the B. F. Sturtevant Co., Boston, are of the Sirocco type and are to be located upon elevated platforms at the sides of the boiler room from which position the delivery will be through ducts leading down to cross flues beneath the ash pockets. Dampers are to be provided at each opening so that the blast may be regulated at will. Sufficient capacity is provided in each blower to operate the entire six boilers to their maximum if at any time this is found necessary.

The products of combustion are discharged from the boiler furnaces through four large self-supporting steel chimneys which rise to a height of 300 ft. above the first floor level of the boiler room. Each chimney will provide for 24 boilers, consisting of one-quarter of the equipment. Connection is made to each chimney through an interesting design of flue and uptake, which rise in the space between the rear ends of the double row of boilers up into the base of the chimney. This flue structure is built up of ⅜-in. plate and 2½ x 2½ x 5-16-in. angles, having openings 3 ft. 9 in. by 9 ft. in section, at the rear of each of the 24 boilers served. In the main uptake from the first to the second floors, which is 8½x24 ft. in section, there is a baffle plate to prevent interference of draft when one side is idle. At the second boiler floor level the flue opens out to an area of 12½x31 ft., changing section above that to 21 ft. square at the opening beneath the chimney. The entire flue and uptake structure will be enclosed in a non-conducting covering for preventing radiation of heat into the boiler room.

The chimney, which thus commences at the third story level, is 232 ft. high, and has an inside opening varying from 21½ ft. at the base, to 20 ft. at the top. It consists of 31 sections of thicknesses of plate varying from ¾-in. at the base down to ⅜-in. at the top. It is lined with 4-in. hard, common red brick, backed up to the shell with 1-in. of concrete. This lining will be supported by an angle frame work throughout the interior of the chimney with horizontal members at every third plate of the shell; this permits any section to be renewed without disturbing any of the remainder.

While there is no intention of installing economizers at the present, it will, however, be noticed that with the arrangement of uptake and flue adopted, there is ample space provided for economizers for use in connection with boilers toward the sides of the boiler room. Additional connections for such a purpose could easily be made from the boiler setting to the economizer, from which the outlet connection could be joined to the uptake with ease. The middle boilers of each group are inaccessible for such a connection owing to the presence of the main uptake at their rears.

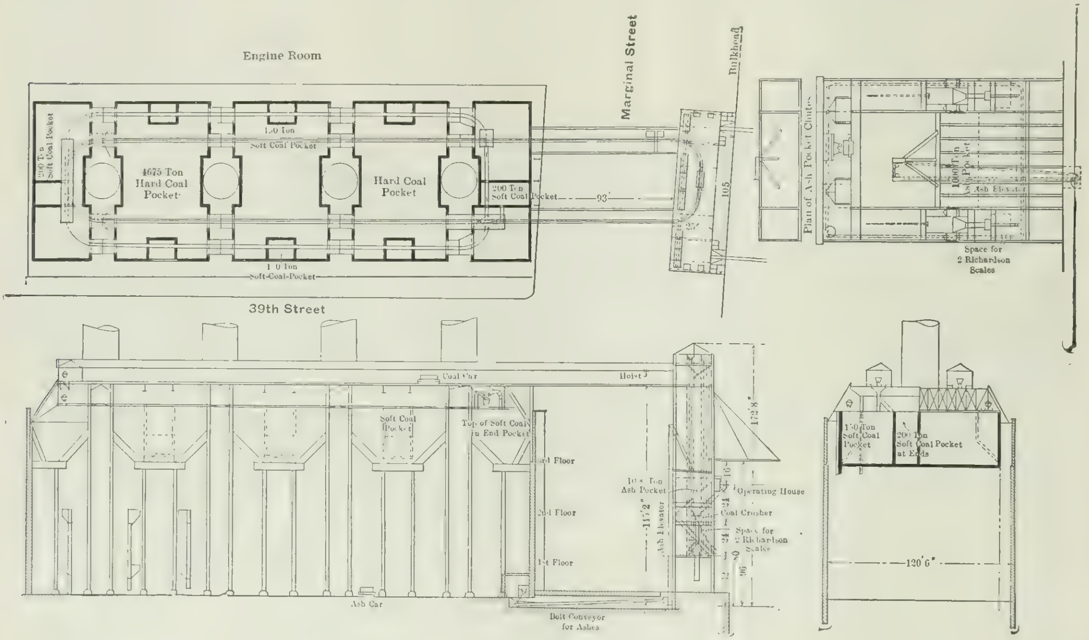


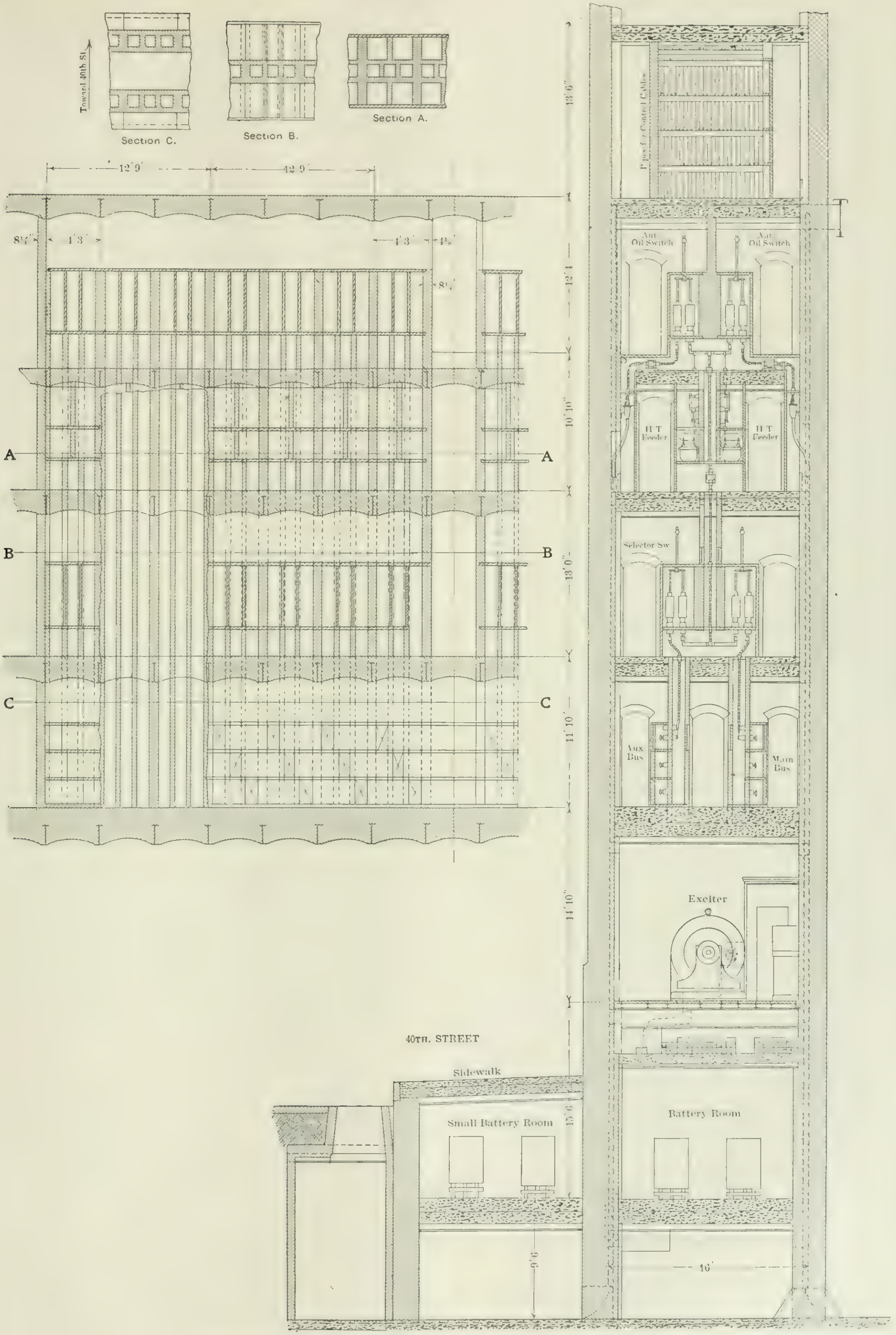
Fig. 9.—Plan of Steam Piping, Coal Distribution, Etc.

A typical piping arrangement for one of the standard groups of twelve boilers is shown in Fig. 9. From the main steam header at the turbine room division wall a branch steam pipe extends up and over the rears of six of the boilers, looping back from thence over the rears of the other six and down to the header again. As the loop is equipped with intercepting gate valves, each battery may thus be seen to have two separate and distinct outlets to the main header. The loop header or branch is located about 5 ft. above the boiler settings, and connections to it from the boilers are made by heavy return bends of 8-in. pipe of 5 ft. 7 in. radius. Each bend has two valves, that next to the boiler a plain gate valve and the other a non-return stop valve.

The main steam header will be of 14-in. pipe, and is to be located in the areaway alongside the division wall on the first floor, where the branch loop connections may easily be made to the boilers upon either floor. The branches to the turbines will be carried from the header through the basement, so that no piping will be visible in the turbine room, although the control of valves will be readily accessible at the machines. All of the high-pressure piping will be of wrought steel with Van Stone joints and sheet-steel gaskets. The flanges used for these joints will be of rolled steel and of a special design with beveled or recessed edges, permitting of easy inspection of the joint at all times. A new schedule of flange sizes will also be used.

A novel feature of the feed-water piping for the new station will be the use of steel pipe with Van Stone joints upon the mains and larger branches using 5 and 6-in. pipe, the 3-in. individual branches to each of the boilers being also of steel. The feed-water piping system will consist of a ring main of the 6-in. steel pipe encircling the entire boiler room, with 6-in. cross headers connected across from the two sides in front of each row of boilers. From the cross headers a branch is carried to each boiler, consisting of a 5-in. branch between each battery connecting through a tee to the 3-in. brass boiler connections. The system will thus, by virtue of the ring main and numerous feed connections thereto, be thoroughly reliable, each boiler having several sources of feed supply and any section of the main being capable of removal from duty without affecting the others. The feed pumps for the new plant have not as yet been selected, and the initial feed system for the first group of boilers will be supplied from the original Waterside station.

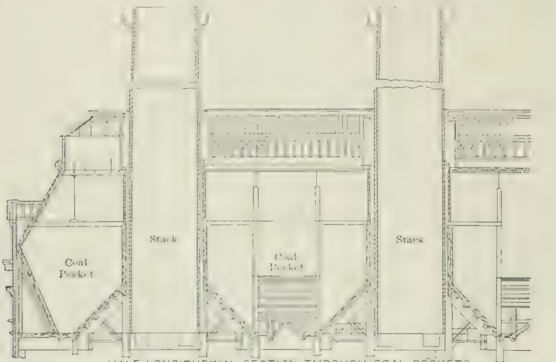
The blow-off piping will consist of a single header of 4-in. pipe at the rear of each row of boilers, into which every boiler will deliver through two 2½-in. brass blow-off connections. The two headers at the rear of boilers in every chimney flue space discharge downward through 6-in. connections to a tee leading to a common 8-in. discharge pipe to the condenser overflow tunnel beneath the turbine room, making thus short, simple and direct outlets for each group of boilers independently. The piping is all of wrought-iron with screw-flange joints, except the branches leading from the boiler mud-drums, which are of extra heavy brass pipe. This pipe system is all fitted with flange joints, the flanges agreeing in design with those upon the high-pressure piping. Each blow-



FIGS. 10 AND 11.—SECTIONAL VIEW OF ELECTRICAL CONTROL EQUIPMENT.

off connection will be provided with two valves for protection from leakage.

For the condensing system a novel arrangement of intake and discharge tunnels has been incorporated in the foundations to bring the circulation supply direct to the condenser pumps. The intake tunnel is 12 ft. wide and nearly square in section, while upon either side of it are two smaller tunnels, about 6x12 ft. in section each, for the overflow, and both extend longitudinally under the turbine room so as to reach every unit. The connections are easily made for the condenser apparatus through openings arranged in the basement floor. The condensing apparatus, however, has not as yet been selected either as to type or make, as is also the case with the boiler feed pumps and feed-water heaters.



HALF LONGITUDINAL SECTION THROUGH COAL POCKETS.

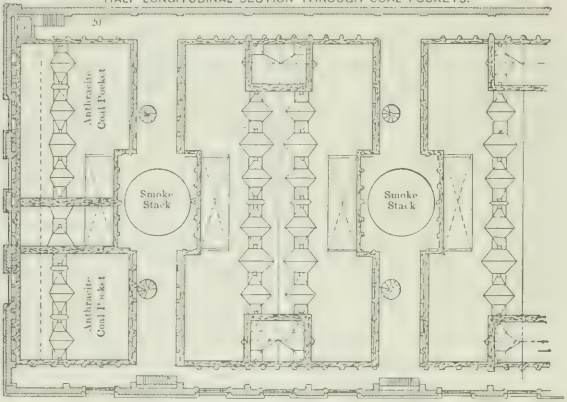


FIG. 12. COAL POCKETS

Coal will be delivered to the new station by barges in the East River, which will be unloaded by a coal tower similar to that of the old station, and from the tower cars upon an elevated cable railway will distribute it into pockets over the boiler room. The tower will consist of a steel structure, 105 ft. long, 25 ft. wide and 172 ft. high, containing the barge unloading apparatus, coal receiving bins, crushers, etc., together with an ash-handling and storage equipment. The unloader hoist jibs, of which there are two, one at either end of the tower, are to be located 96 ft. above high tide level, from which the lift to the receiving bins will be 80 ft. The receiving bins deliver to coal crushers, and from thence the coal is elevated 125 ft. to the top of the tower for delivery to the cable cars. Of the latter there are to be seven of 3 tons capacity each, which will be loaded at a rate of about two per minute, giving thus a total capacity of 357 tons per hour. The cable railway makes a complete circuit of the coal pockets above the boiler room, embracing 835 ft. of track; the cars when in operation will be spaced 133 ft. apart, and will travel 265 ft. per min.

The coal pockets in the boiler house consist of five large bins, as indicated in the plan, with an aggregate capacity of over 18,000 tons. The large bins are intended for anthracite only, while for other classes of fuel eight smaller bins of 150 and 200 tons capacity are incorporated within the large bins, as indicated, so as to deliver to each of the five firing aisles. The large bins are designed to deliver without pocketing to all points of their respective firing aisles, while the small individual bins will deliver at the ends, from which the bituminous or other fuel will have to be distributed in barrows. The small bins will be used for bituminous coal, sometimes used in combination with the anthracite, in proportions of one part to five of the anthracite, during times of heavy peak overloads.

The ashes from the boiler furnaces will be handled from the boiler house basement by a system of small cars operating upon narrow-gauge tracks, to the ash pocket in the coal tower. This ash pocket is of large proportions, holding 1,000 tons, and is elevated so that the outlet spout is 32 ft. above high tide level. Ashes are delivered from the cars to the pocket by an elevating conveyor, and outlet spouts are provided for delivery either to wagons or boats.

The electrical control equipment for the new plant will be very similar to that in the original station, the only features of departure being in minor detail where practice has indicated improvements. The high-tension system, including oil switches and control and switching apparatus, will be controlled the same as in Waterside No. 1, it being intended, in fact, to so tie the two stations together by bus-tie connections that the two plants may be operated as one unit. The oil switches and other high-tension apparatus, instead of being arranged at one end, will be located in the mezzanine galleries, of which there are six extending along the entire 40th St. side of the turbine room. The control boards will, as in the original Waterside, be located on an upper story level (third mezzanine) at the First Ave. end of the room, and will be in the form of an open balcony overlooking the entire turbine section. The control boards are to be arranged in two rows of semi-circular shape in the gallery, the feeder panels at the rear and the generator panels at the front. The equipment of the panels will be in general similar to that of the control panels in the old station, which has been referred to in considerable detail in these columns.

The arrangement of the electrical galleries adopted, as shown in an accompanying section, introduces novelties worthy of note. On the first floor level adjacent to the turbine room will be located the exciter units and associated control apparatus, a booster, compensator and two end cell switches for the storage batteries. On the first mezzanine will be the main and auxiliary buses, encased in cells of brick wall and alberene partition construction; the buses will have wired-glass doors in front and at the rear, where the connecting cables are attached through disconnecting switches. The second mezzanine gallery is to contain the selector oil switches by which the feeders or generator leads are connected to either set of buses as desired. The individual feeder oil switches are, however, located upon the fourth mezzanine, from which the high-tension feeders lead out through series transformers under the floor to the underground mains. The third mezzanine gallery will carry the potential transformer equipment, the connections to which are brought down from the gallery above through disconnecting switches, as shown. In the fifth gallery the greater portion of the space is devoted to racks to carry the control wires to the

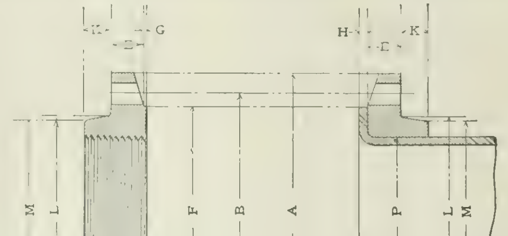


FIG. 13.—DETAILS OF SPECIAL PIPING JOINT FLANGES.

operating boards, this detail alone proving to be one of great magnitude, as well as of importance.

It will be noticed in the above arrangement, however, that each feeder will have only one automatic oil switch in it in addition to the selector or group oil switch, which is similar to the present arrangement in the original Waterside station. The new arrangement also permits of locating the generator oil switches in the same manner as, and alongside of, the feeder oil switches, thus materially simplifying the whole arrangement, and at the same time largely reducing the length of the generator leads. The generators with this arrangement feed directly through the selector switches to the bus-bars, at points opposite their locations. The arrangement of the potential transformers, series transformers, etc., on the third mezzanine by themselves is also a distinct advantage in concentration and simplification of arrangement.

While much of the detail of the electrical equipment is not as yet decided upon, and cannot be definitely referred to, still there are several interesting features which have been definitely determined. Among the latter may be mentioned the exciter system, which will consist of four 150-kw motor-generators, delivering direct-current at from 200 to 280 volts, supplemented by a storage battery. The storage battery will float upon the system constantly, but not so much in the sense of reserve capacity as in security from interruptions, which it is arranged to prevent absolutely. There will be two batteries installed in the basement of this station, one of 140 and the other of 150 cells, one of which will be kept on the exciter system, and the other thus available for the local distribution system. A novel form of direct-current reverse relay, or circuit breaker, will be used in this connection on all the motor-generator leads to prevent a destructive return flow from the battery to a motor-generator in case it becomes inoperative; this relay is designed to open the circuit on any reverse flow from the bus to the machine equal to or above one-half its full-load capacity, although it is entirely inactive when current is flowing properly from the machine to the bus, even at heavy overloads. This interesting device, which is supplied by the General Electric Company, has been in use for some time in the original Waterside station.

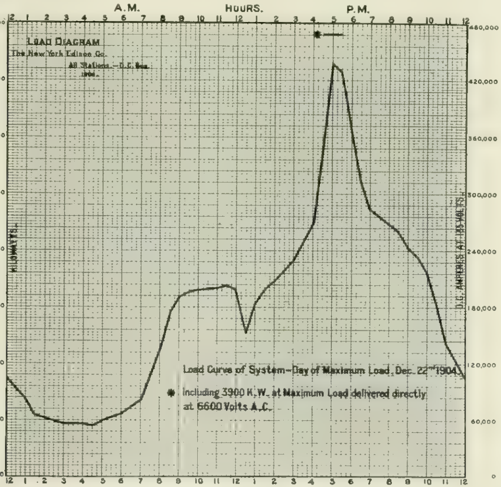


FIG. 14.—LOAD CURVE.

General Electric Company oil switches will probably be used throughout the new station. These will be automatically controlled by the new General Electric diaphragm-type inverse-time-element overload relay, which is designed to open the circuit more quickly in proportion as the overload is heavier or more severe, in contradistinction to the type of overload relay involving a clockwork-operated time element, which is not influenced by the overload.

This type of relay was installed on all feeders in the original Waterside station about two years ago and was the first complete equipment of a large system with this relay.

In this connection data as to the remarkable growth of the Edison lighting system in New York City will be of interest. In the article descriptive of the original Waterside station, in the Electrical World and Engineer for February 1, 1902, a total load curve was presented showing a maximum output of the stations for that winter of 35,000 kw, which occurred at about 5 p. m., December 23, 1901; Fig. 14 gives the curve of maximum load for the past winter of 59,000 kw on the sub-station direct-current bus-bars which occurred at about 5 p.m. on December 22, 1904. This represents an increase in maximum peak load of 24,000 kw in the past three years, and from present indications of the company's output, the maximum peak load for next December will be from 60,000 to 62,000 kw.

There are in all, at present 19 sub-stations from which the low-tension service is distributed, and of these three were installed within the past year or so. Nearly all the others have been added to also, so that the distribution equipment has experienced as radical a change as that under way at the generating station. The accompanying table, showing new rotary converter and battery equipment, added recently, and the present totals, will be of interest. It is to be noted, by way of explanation, that the standard battery of the company consists of 150 cells, 75 on each side of the three-wire distribution system, having a capacity of 2,000 amperes for one hour on each side.

The installation connected to the company's mains on August 1, 1905, was as follows:

Incandescent lamps, 16 c.p. equivalent	1,651,917
Arc lamps	22,093
Storage batteries and heating appliances in kw	2,539
Horse power in motors	99,258
Total installation (16 c.p. equivalent)	3,425,106

The officers of the New York Edison Company and the construction and operating staffs are as follows: President, Anthony N. Brady; vice-president and treasurer, Nicholas F. Brady; second vice-president and general manager, Thomas E. Murray; third vice-president and associate general manager, J. W. Lieb, Jr.; secretary, Lewis B. Gawtry; auditor, H. M. Edwards; assistant treasurer, Joseph Williams; controller, C. S. Shepard; general inspector, Arthur Williams; chief engineer, James D. Andrew; chief electrical engineer, Philip Torchio; acting civil engineer, E. M. Van Norden; superintendent of construction, J. P. Sparrow; superintendent of distribution, Henry Stephenson; chief draughtsman, George A. Orrok; superintendent, first district, W. I. Donshea; superintendent, second district, H. A. Campbell; superintendent, third district, E. A. Harley; acting manager, Bronx district, W. T. Morrison.

Magnetic Double Refraction.

In a recent issue of *Comptes Rendus* A. Cotton and H. Mouton announce some interesting results of their study of magnetic double refraction and rotation in liquids. Very active positively rotating liquids may be obtained by heating colloidal solutions. If a colloidal solution of iron hydroxide recently prepared by dialysis, such as Bravais iron, is sealed up in a tube and exposed to a temperature of 100 deg. for four hours, its double refraction increases to 40 times its original value. It varies with the square of the magnetic field, without inversion. At the same time, the liquid becomes more viscous, more opaque and diffuses the light more. A microscopic examination shows that the thickness of the grains is considerably increased by the heating. There is thus a connection between the size of the grains and the double refraction. If Bredig's method of electrode disintegration is applied to iron, a yellow colloidal solution is obtained, showing ultra-microscopic grains. Such a preparation the authors propose to call Bredig iron. The preparation shows a very peculiar change of refraction with field strength. The curve rises abruptly from the origin, but at a field intensity of about 3,000 units it changes into a slightly rising straight line. If the iron is disintegrated in glycerine, a grey liquid is obtained which gives rise to Majorana's bimagnetic rotation, or rotation independent of the direction of the field. This is due to an unequal absorption of the luminous vibrations parallel and normal to the field respectively. It is further observed that the microscopic particles are oblong, and that they arrange their major axes in the direction of the field. The authors believe that magnetic double refraction is obtained only when the size of the particles lies between certain limits. When they are too small the Brownian movements stimulated by the field prevent the orientation.

Hydro-Electric Developments of the Ontario Power Company.—III.

(Concluded.)

DISTRIBUTION AND CONTROL OF CURRENT

CURRENT from the generator is carried on single conductor cables, isolated and supported on concrete barriers, beneath the floor of the power house, rising through the exciter gallery floor to an automatic oil circuit breaker, passing on the way through series transformers and knife disconnecting switches. From the circuit breaker the current passes out through another set of knife disconnecting switches to cable bells, which are located under the gallery floor and supported on a special brick structure.

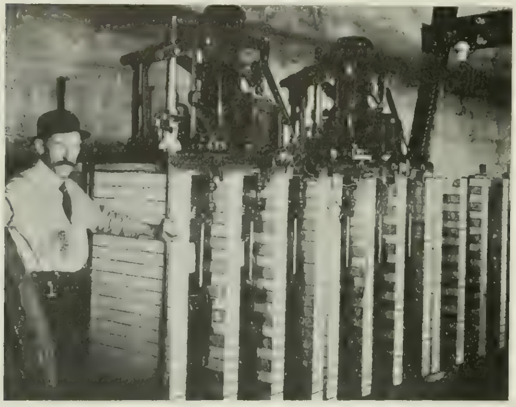


FIG. 14.—OIL SWITCHES IN OFFSET OF GENERATING STATION.

Two triple conductor cables are required to carry the current from the generating station to the distributing station. For about half the distance these cables are carried in a cable tunnel, which lies on a slope of approximately 30 degrees. In order to support the cables on this steep incline, it was necessary to build vitrified clay ducts into the walls of the tunnel, leaving openings 25 feet apart in each duct course, where clamps with wooden bushings are inserted. At the upper end of this tunnel is located a manhole, and cables are carried for the remainder of the distance to the distributing station in an ordinary surface conduit system.

The triple conductor cables employed in carrying the power through the cable tunnel and conduit run are composed of stranded copper conductors of 250,000 c. m. cross section. Each conductor is insulated with a layer of paper, and the three conductors are then spiraled together with a suitable filler of jute to make the cables of a circular cross section. Around this is a layer of paper, a lead sheath, another layer of jute, an armor of spiraled steel ribbon and an outer covering of jute.

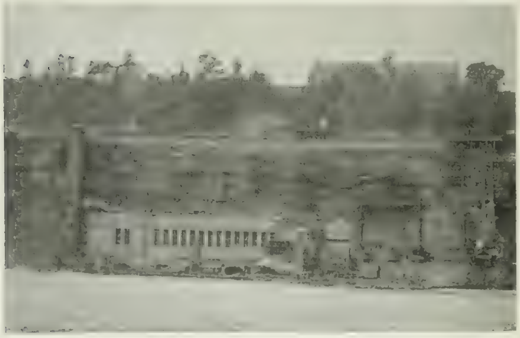


FIG. 15.—GENERATING AND DISTRIBUTING STATIONS FROM GOAT ISLAND.

In the generating station is located the exciter switchboard and a small service switchboard for lighting and local power requirements. The exciter switchboard has panels for the operation of the exciters and the main generator field circuits. An additional panel, located in the center of this board, serves for the distribution of current for lighting and control purposes. Current is taken from this panel to supply the service switchboard above referred to. This service switchboard has panels for lighting and power, including cranes, elevator, etc. This board also has two alternating current panels for the control of the penstock valve motors, which are located in the valve chamber, and which have auxiliary controls at that point. These valve motors are also provided with limit switches, which serve to stop the motors when the valves reach their extreme positions.

DISTRIBUTING STATION.

The distributing station is an artistic structure of brick, located in a commanding position on a bluff above the generating station. (See Fig. 15.) The distance of this station from the power house is some 700 feet, and the height above the base of the cliff about 250 feet. At this station the operation of the power house will be controlled and the output distributed. Some of the power will be sent out to nearby consumers at 12,000 volts, and transformers will be used to step the e.m.f. of the remainder of the power up to 60,000 volts for long-distance transmission. This station is the nerve center of the whole system. All units are governed from the control floor, where indicating and control wires are centered. When the building is completed it will be 525 feet in length, 130 feet wide and 60 feet high. The present building will accommodate eight units. Offices are to be located in the front projection, four stories high. The switch room runs the full length of the river side of the building and the high-tension room occupies a similar position on the opposite side. The control room is located in the center, and to the right and left of it are the transformer pits. The pits are separated from one another by fire walls. (See Fig. 17.) A railroad track runs through both of the transformer rooms and past the central control room along the wall separating them from the switch room.

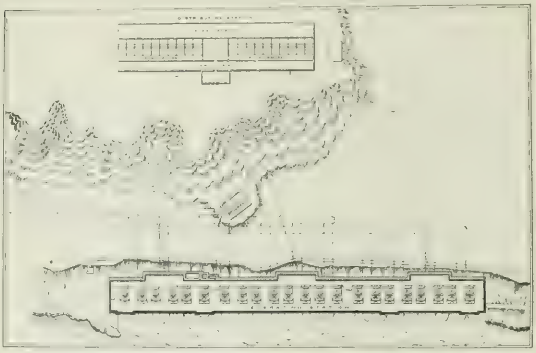


FIG. 16.—PLAN OF GENERATING AND DISTRIBUTING STATIONS.

In the control room there are three floors above the basement; the basement is used for the distribution of wires: on the first or main floor the terminal boards for the control circuits are located; integrating and recording instruments are on the second floor, and on the third or control floor are placed the control pedestals, each with a set of indicating instruments on instrument posts behind and rising above them. The chief operator from this vantage point may view the electrical performance of the whole system and, by personal control or by telephoning to his assistants, may direct the operation of the plant.

After leaving the conduit run the three conductor power cables pass into a system of manholes just outside and in front of the distributing station. In these manholes the three-conductor cables split to single-conductor cables, and pass through the wall of the building to either one of two sets of bus-bars, or through the bus structure without any connection to the bus-bars, as may be desired. The bus structure is located in the basement of the building immediately under the switch room. In the switch room are located the necessary oil circuit breakers for making the various connections to and from the bus-bars. These switches are similar in every respect to those located in the generating station. Their normal capacity is 600 amperes at 12,000 volts, but they are so designed that they will interrupt a very heavy load with entire safety.

After leaving the bus structure the cables pass for a short distance under the floor of the building, in tile conduit, and rise to the 60,000-volt transformers. The transformers are arranged in groups of three, each group serving a main generator, and each transformer will have a capacity of 3,000 kw. They will thus be larger than any that have previously been built. Each transformer will be oil-insulated and water-cooled, and will weigh approximately 50 tons complete. The transformer case will contain about 70 barrels of oil, and about 12 to 14 gallons of water per minute will be required to flow through the coils, immersed in oil for cooling purposes. The transformer cases are designed to withstand an internal pressure of 150 pounds per square inch. Each group of transformers is isolated in a concrete pit, as shown in Fig. 18. A check valve opens from the top of each transformer case to an 8 in. vent pipe into the sewer, thus relieving any excess of internal pressure.

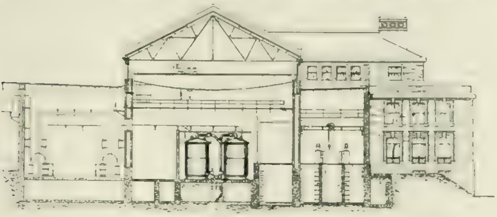


FIG. 17.—CROSS-SECTION OF DISTRIBUTING STATION

Each group of three transformers is connected in delta on the low-tension side and in star on the high-tension side. The transformation is from 12,000 to 36,000 volts, thus obtaining a voltage of approximately 60,000 between wires on the star connection. The high-tension wires pass overhead from the transformers through circular openings 4 ft. in diameter through the wall into the high-tension room. This room contains high-tension bus-bars mounted on line insulators, and the necessary oil circuit breakers for switching from transformers to bus-bars and from bus-bars to the transmission lines. These oil circuit breakers are designed to safely break a load of 40,000 kw at 60,000 volts.

Circular openings 4 ft. in diameter are provided in the rear of the building to bring out the transmission lines. Two plates of glass are set about 8 inches apart in these openings and carry suitable bushings through their centers to support the wires. A suitable hood is built on the outside of the wall to protect the openings from the weather. No strain is imposed upon the glass plates, but insulators will be mounted under the hood to take up any tension from the line.

In the control room the instrument stands and control pedestals will be assembled in an approximate semi-circle. Each instrument stand and control pedestal corresponds to a single unit. On each instrument stand are four ammeters, a voltmeter, frequency indicator, power factor meter, indicating wattmeter and synchroscope. The complete circuit for each unit will be indicated diagrammatically on its control pedestal. Control apparatus included on this pedestal consists of indicating lamps, high-voltage bus switch, transformer switch, selector switch, for low-voltage bus No. 2, synchronizing plugs, water-wheel governor controller, junction switch, selector switch for low-voltage bus No. 1, distributing-station generator switch and field switch controller. Provision has been made for multiple operation of the generators if desired. The power may go directly to the transformers or to the low-voltage transmission line without connection to the main bus-bars, or may feed any bus-bar or any combination in parallel; in fact the circuits are so arranged that they may be adapted to any desired service.

TRANSMISSION.

Upon leaving the distributing station the lines will pass lightning arresters of the horn type, situated on poles between the station and first set of transmission towers. These towers will be of the tripartite type, triangular in form, and built up of wrought-iron with 2.5-in. piping for main supports. This piping is filled with cement, and the base of each tower is secured to concrete piers extending 6 ft. beneath the surface of the ground. The standard tower will be 49 ft. high from the ground to the lowest wire. The distance between towers will be approximately 550 ft. The present intention is to run two sets of lines from the distributing station for a considerable distance along the old Portage road toward Queenston to a point on the Niagara River a little below "Devil's Hole." There the wires will drop from an upright tower 49 ft. high to a cantilever extending out over the cliff and then down to towers located at the water's edge. The river at this point is about 600 ft. wide. A similar type of construction will be followed on the American side. The cables will be of 37 aluminum strands of 820,000 c. m. cross section.

In order to provide for insulation, the conductor cables on each tower will be placed 7 ft. apart at the corners of an equilateral triangle. The insulators will be of special design of the Ontario Power Company, designated as No. 14-0, and made by the Thomas Company. They will be built up of three parts, two petticoats and a hood; the latter, which is the largest, being 14.5 in. in diameter. The whole will be cemented together, and to a steel pin which, in turn, will be bolted to the tower.

The engineering work on this interesting development was begun by the Messrs. P. N. Nunn and L. L. Nunn in February of 1902. Active construction followed in August of the same year. On the 20th of June, 1905, the forebay was filled with water, and in the week previous to the first of July No. 1 unit was run. Voltage was put on the temporary transmission line on July 1st. The present expectation is to have three units with a total capacity of 30,000 hp ready to deliver power before October.

The Niagara Construction Company, which is carrying forward this development for the Ontario Power Company, has officers as follows: Francis V. Greene, president; Edmund Hayes, vice-president; H. E. Nichols, secretary; R. C. Board, treasurer; F. B. H. Paine, general manager; Banker R. Paine, general agent; George Baum and W. N. Ryerson, superintendents of construction.

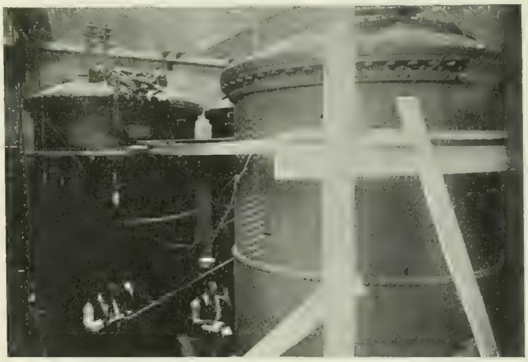


FIG. 18.—GROUP OF TRANSFORMERS FOR UNIT NO. 1.

J. M. Voith, Heidenheim, Germany, is contractor for the main turbines. The exciter turbines are of the Victor type, S. B and S. V. makes. Generators, transformers, switches and electrical accessories were built by the Westinghouse Electric & Manufacturing Company. Water-wheel governors are of the Lombard type. Most of the cables were furnished by the Standard Underground Cable Company. Ransomes & Rapier, of England, supplied the Stoney gates. Pratt & Cady made the 9-ft. penstock valves. The Reinforced Cement Construction Company did a large part of the concrete work at the head works. The Jenckes Machine Company built the steel pipe line. Struthers Wells Company built the penstocks. H. D. Symmes excavated the pipe trench, placed the concrete envelope, backfilled over the conduit and also constructed the helical discharge tunnel from the overflow. Lanquist & Illsley erected the distributing station building. Archbold-Brady Company is erecting the transmission line, and the Tucker Electrical Construction Company is installing the extensive lighting system

For the design and construction of the work, the engineering force is as follows: P. N. Nunn and L. L. Nunn, chief engineers; O. B. Suhr, engineer in charge; V. G. Converse, electrical engineer; C. H. Mitchell, mechanical engineer; J. B. Bailey, field engineer and chief of inspection. Thanks for the facts above noted are due to the entire engineering corps, and also to Mr. J. R. Harsch, who is in charge of the clerical work of the engineers

Regulation of Electric Rates in Massachusetts.—II.

By Alton D. Adams, LL. B.

IN the first part of this article four interesting typical decisions of the Gas and Electric Commission of Massachusetts were given. Some others of equal importance follow below:

6. Mayor vs. Quincy Electric Light & Power Company.

In 1896 the Mayor of the City of Quincy brought a petition before the commissioners concerning the price and quality of the electric street lights supplied by the Quincy Electric Light & Power Company. Before a hearing was had the city and the company reached an agreement and the petition was withdrawn.

7. Selectmen vs. The Electric Light & Power Company, of Abington and Rockland.

The Selectmen of Rockland petitioned the commissioners, in 1897, to fix the rates for electric street lamps supplied by the Abington and Rockland company in their town. During five years after 1892 this company operated arc street lamps of 1,200 nominal cp at $66 and incandescent lamps of 25 cp at $14 each, under contract. During the year ending June 30, 1897, these lamps were operated 1,579 hours: 19 arcs and 208 incandescents, in Rockland. After the expiration of the contract the company raised the price of each arc to $70 and each incandescent lamp to $16 per year, and required the town to make another five-year contract, at these rates. The commissioners fixed the rates at $70 annually for each arc and $16 for each incandescent, as the company had done, but said that the town need not enter into any long-term contract. On the assumption that each arc lamp received 330 watts and each incandescent 88 watts, the rates fixed, on the basis of 1,579 hours of operation per lamp annually, amounted to 13.4 cents for arc lighting and to 10.1 cents for incandescent lighting, per kw-hour.

On June 30, 1897, the capital stock of the Abington and Rockland company was $75,000, and it had notes payable to the amount of $37,500 outstanding. During the year the income of the company from the sale of electric energy was $34,378.69, its operating expenses were $24,299.54, and its net earnings $10,079.15. From this last sum $2,035.20 was paid as interest, leaving $8,043.95, or 10.7 per cent on the capital stock.

In deciding the case the commissioners said that the prices named by the company for street lighting were assumed to be not too low, because no claim was made to that effect. On investigation it appeared to the commissioners that the rates were not too high, and that a certain contract under which the lighting company supplied energy to an electric railway imposed no burden on the town. The commissioners stated their practice to be to fix prices according to conditions at the time of each decision, such prices to continue until new conditions made necessary some further reduction or advance. For this reason the commissioners would not make the rates fixed conditional on a long-term contract, against the wish of the town.

8. Mayor vs. Somerville Electric Light Company.

A petition against the Somerville Electric Light Company, asking for better service and lower rates in street lighting, was presented by the Mayor of Somerville, in 1897. Under this petition the commissioners fixed the maximum rates to be charged for street lighting from October 1, 1897, at $110 for each arc of 1,200 nominal cp, and $25 for each incandescent lamp of 25 cp, operated during 3,831 hours per year. These rates correspond to 8.09 cents per kw-hour in arc lamps and to 7.4 cents per kw-hour in incandescents. During five years from October 1, 1892, the company operated street lamps in Somerville at $120 annually for each arc of 1,200 nominal cp and $25 for each incandescent of 25 cp, under a contract. In the year ending June 30, 1897, each of these lamps operated 3,831 hours, and there were 361 arcs and 211 incandescents in use. When operation began under the contract in 1892 there were 244 arcs and 334 incandescents.

On June 30, 1897, the capital stock of the Somerville company was $200,000 and there were bonds of $33,500 and notes of $105,000 outstanding. During the year the company derived an income of $88,965.85 from sales of electric energy. Its operating expenses were $56,797.45, and the net electric income reached $32,168.40. Of this $8,180.87 was paid as interest, and this left $23,987.53, or 11.99 per cent on the capital stock. In the year just named the electric company at Salem operated 186 arcs of 2,000 nominal cp each and 608 incandescents of 25 cp, on the streets during 3,831 hours, the time of service being the same as in Somerville. The Salem company charged $21.50 per year for each incandescent and 38.4 cents per night for each arc. At these rates and an average of 10.5 hours' operation per night, the cost to the city per kw-hour was 7.60 cents for taking 480 watts each, and with 3,831 hours of operation per year the cost per kw-hour in incandescents taking 105 watts was 5.34 cents.

Before the petition of the mayor was filed, the company offered to continue the operation of the street lamps then in use at the rate of $110 per arc and $25 per incandescent annually, under a new three-years' contract. As these rates were not withdrawn, the commissioners assumed that they were not too low and said that, as the rates offered allowed no more than a fair interest and depreciation charge above the cost of operation, no further reduction at that time could be made. While fixing the same rates that had been named by the company in its offer to the city, the commissioners made them independent of a contract for a definite time. The Somerville company derived about 67 per cent of its income from street lighting in that city and two towns, and though managed with strict economy in the opinion of the commissioners it had contracted a large floating debt so that its stock, bonds and notes represented much more than the probable cost of a new plant with a capacity similar to its own. Stock of the company had all been paid in cash. Excess of the securities and debt of the company over the present cost of a like plant was said to represent that depreciation, due to rapid advance in the art of electric lighting, which it had not been possible thus far to recover out of income. Concerning the proper policy as to such depreciation the commissioners said:

"If the investment of capital in new enterprises which combine substantial advantages to the general public with the probability of great depreciation through the advance of the particular art is to be encouraged, such depreciation must be treated as a proper charge to be made against income. It is as clearly a part of the cost of conducting the business as the expenditure for coal and labor. If in the company's past these considerations have been overlooked, or the charges for light have been too low to cover them, not only the interest of the company, but in the long run, the best interests of the community, require such a management of its affairs and adjustment of its rates as will admit of the gradual recovery of the losses thus sustained. For the successful and proper conduct of enterprises of this sort, and as an inducement for the investment of the necessary money in them, at least two things seem to be essential: a reasonable prospect of a fair dividend on the bona fide capital, and an opportunity to recover out of income such losses as may be inevitable in the progress of the art, and are not in any degree due to carelessness or speculation in the management."

9. Selectmen vs. Andover Electric Company.

This was a petition by the Selectmen of Andover, in 1899, for a reduction in the rates charged by the Andover Electric Company for street lighting in that town. Under this petition the commissioners fixed the rate for arc lamps of 1,200 nominal cp at $83.50 each, and for incandescent lamps of 25 cp at $20.85 each per year, with 1,424 hours of operation, for not less than 31 of such arcs and 74 of the incandescents or their equivalent. During the year ending June 30, 1897, the Andover company had operated the lamps just named for the given number of hours at a total charge of about $4,800. Allowing 330 watts for each arc and 87.5 watts for each incandescent, the lamps of both sorts consume energy at the same rate as 50.6 arcs of 1,200 nominal cp each. On this basis the payment of $4,800 by the town corresponded to $94.80 per arc lamp, or to 20.1 cents per kw-hour for all the energy consumed in the street lamps. The rates fixed by the commissioners corresponded to 17.9 cents for arc lighting and to 16.7 cents for incandescent lighting per kw-hour.

On June 30, 1897, the capital stock of the company stood at $30,000 and its bonds and notes outstanding were $22,000 and $8,960, respectively. The company had an electric income of $11,569.78, its operating expenses reached $8,625.62, and the net income was $2,944.16. From this last sum $1,676.41 was paid in interest, leaving $1,267.75, or 4.22 per cent on the capital stock.

There was a claim at the hearing that the capital of the company was excessive and the commissioners said that the debts alone did not exceed the cost of a plant similar to that of the company; that no more than the interest on the debts and a fair charge for depreciation had been earned, and that the company probably could not earn a dividend with present business and prices.

10. Selectmen vs. Suburban Gas & Electric Company.

In 1897 the Selectmen of Revere and certain consumers in Winthrop petitioned the commissioners for better service and lower prices in electric lighting. During the hearing on the petition the request for lower rates was waived, and the consumers withdrew. Following the hearings the company expended $30,000 on its plant and the commissioners considered no order necessary.

11. Consumers vs. Fitchburg Gas & Electric Light Company.

This was a petition brought by customers of the Fitchburg Gas & Electric Light Company for lower gas and electric rates, in 1900. Acting on that part of the petition which related to electric rates, the commissioners fixed the price for commercial arc lamps of 1,200 nominal cp three nights per week at $6 per month, and of street lamps of the same power operating every night to the extent of 3,903 hours annually at $100 per year. This was a reduction of $1 per month for commercial arcs and $10 in the yearly charge for street arcs, taking effect October 1, 1900.

For the 1,200-cp street arcs consuming 330 watts each, the rate at $100 per year amounted to 7.76 cents per kw-hour. As the hours of operation for commercial arcs were not fixed, the rate for their energy is uncertain. On the day that the petition was filed the Fitchburg company reduced the rate for incandescent lighting by the adoption of a sliding scale of discounts from the maximum meter rate of 20 cents per kw-hour, and the commissioners made no change in this rate. Though fixed for October the rate for street lamps did not go into effect until January 1, 1901, when the contract for them expired.

On June 30, 1900, the company was operating 265 arc and no incandescent street lamps in Fitchburg. At this same date the capital stock of the company was $150,000, and it had out $45,000 in notes. Up to 1889, when it began electrical supply, the capital of the company had been $60,000. After that date the capital was increased to $150,000, and the debt of $45,000 was contracted. The increase of capital was paid in cash and the last $50,000 of stock was issued at 50 per cent above par. Apparently, both the $90,000 increase of capital and the notes, a total of $135,000 face value, were represented in the electric system.

During the year ending June 30, 1900, the company had a gross electric income of $59,749.94, its operating expenses in the electric department were $45,060.22, and the net electric income was $14,689.72. Interest to the amount of $2,033.56 was paid for the year, and this deducted leaves $12,656.16, or 14.06 per cent on the $90,000 of stock represented in the electric system. For the year in question the company paid a dividend of 10 per cent on its entire capital, and this had been the rate since a date prior to 1889. In the year ending June 30, 1901, when the commercial rate fixed by the commissioners had been in force for eight months, and the rate on street lamps for six months, the gross electric earnings of the company were $61,139.87, and its net earnings in this department were $14,783.34, or a trifle more than they had been during the previous year. In giving their decision the commissioners said that the advance in the art of electric lighting had caused a large reduction in the value of the plant as at first constructed, and that the amount expended yearly from income in the effort to maintain an even relation between the plant and the capital had necessarily been large. This maintenance charge and the annual dividends of 10 per cent were said to be the most important factors in the price of current. It was thought that the nearly even relation between the electric plant and its capital justified only a moderate dividend, and that less than had previously been necessary would be required for maintenance. The reduction of $1 per month was extended to all commercial arc lamps.

The Induction Motor Leakage Coefficient.

By A. Press.

In developing the formula for "sigma" given below, it was the intention to abide as close as possible to the accepted values of the self-induction per centimeter length of a turn, both imbedded in iron or practically free in air. It was found, however, that a correcting factor was necessary, and this was ascribed to "zig-zag" leakage effects. For air-gaps beyond 1½ mm. this leakage factor seems to be negligible (see Fig. 1). Apparently one should quite expect, with ordinary sized air-gaps, that the short-circuit current with rotor in or out of place should make very little difference to the magnitude of such current. Furthermore, from the experiments of Dr. Breslauer, it was found that grinding down the rotor teeth had little effect upon the value of σ. This is in full accord with the theory outlined herein. By increasing δ in the manner indicated, the correcting factor for zig-zag leakage was reduced, although the magnetizing current would concomitantly be increased.

Let δ = depth of air-gap in centimeters.
n = number of slots per pole and phase of stator.
n' = number of slots per pole and phase of rotor.
p = number of poles.
t = turn sides per slot.
m = number of phases.
B = average magnetic density in gausses.
i_m = magnetizing current (effective).

Then the magnetizing current is given by

$$i_m = \frac{\pi}{2\sqrt{2}} \cdot \frac{B\delta}{K\,m\,n\,t},$$

where K is a Latour winding coefficient.* The value of the short-circuit current is dependent on the phase volts divided by the reactance of the winding. If λ = self-induction of a complete turn in lines, and i_s = short-circuit current (effective), τ = pole pitch and l = length of core in centimeters,

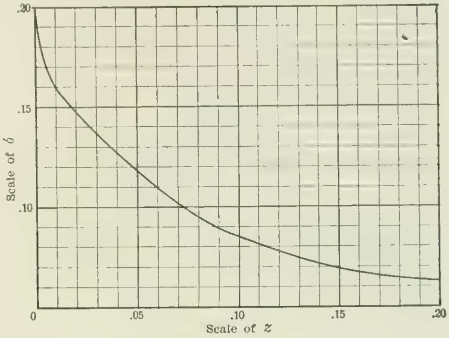


FIG. 1.—EFFECT OF DEPTH OF AIRGAP ON LEAKAGE FACTOR.

$$i_s = \frac{K_1\,\tau\,l\,B}{\sqrt{2}\,\lambda\,t}$$

and
$$\sigma = \frac{i_m}{i_s} = \frac{\pi}{2K\,K_1} \cdot \frac{1}{m\,n} \cdot \frac{\lambda}{l} \cdot \frac{\delta}{\tau}.$$

In this form one readily recognizes the Behrend formula, in which $\frac{\pi}{2} \cdot \frac{1}{K\,K_1} \cdot \frac{1}{mn} \cdot \frac{\lambda}{l}$ is replaced by a limited variable. Mr. Hobart has substituted for this complex expression factors which are functions of $\frac{l}{\tau}$ and $\delta \times mn$. (Here mn is the slots per pole pitch.) If K is taken at .38 and K_1 as .95, $K\,K_1 = .361$ and we have

$$\sigma = \frac{4.35}{mn} \cdot \frac{\lambda}{l} \cdot \frac{\delta}{\tau}.$$

The value of λ—the lines set up per turn per ampere—can be split up into three members: One due to the conductors lying imbedded in iron, equal to $2\,l\,\lambda_i$; another due to the end connections, equal to $2\,e\,\tau\,\lambda_a$, where $e\,\tau$ gives the length of an end connection; and finally $2\,l\,\lambda_z$, where λ_z are the lines set up per ampere length of conductor due to the proximity of the rotor iron. The form of the equation would thus be

---

* See Latour's "Induction Motor," page 87.

$$\sigma = \frac{8.7}{mn}\left\{\lambda i + \lambda z + e\frac{\tau}{l}\lambda a\right\}\frac{\delta}{\tau}.$$

Now λi can be taken as having the value roughly of 4 lines for the imbedded conductors per centimeter, and $e\,\lambda a$ can be taken as 3.25.

Were it now postulated that the zig-zag leakage was of negligible import, the formula just derived should give consistent values. By checking up a number of machines this is found not to be the case. With the condition that the periphery of the rotor were continuous and of negligible reluctance the value of λz would be given by $\lambda z = \frac{.4\pi\tau}{\delta}$. There are, however, disturbing elements such as slits in the rotor, and the questionable permeability of the rotor bridges. For this reason a correcting factor, z, has been introduced, and its value derived from experience.

It will be observed in the above that in estimating the value of δ no allowance was made for the width of opening of slot. Let x be chosen to represent the average ratio of slot opening to slot width for both stator and rotor. Introducing the quantity x into the equation of σ and noting furthermore that the available rotor periphery for zig-zag leakage will depend upon the number of rotor slots, one has finally,

$$\sigma = \frac{17.4}{(2-x)\,mn}\left\{(10-6x)\frac{\delta}{\tau} + .157z\frac{n}{n'}.(1-x)(2-x) + 3.25\frac{\delta}{l}\right\}$$

By making $x = 0$, i. e., for closed slots, it will be seen that the lines per centimeter per ampere of imbedded conductor is taken at 10. The value of λa would in this circumstance not change. For $x = 1$, or wide open slots, it will mean that the zig-zag leakage is taken at zero. A table is given herewith showing the calculation of 20 machines taken from the list furnished by Mr. H. M. Hobart in these pages for April 30, 1904. The formula of Dr. Behn-Eschenberg is radically different from the above and shows no limitation for decreasing δ.

TABLE I.

Reference No.	Calculated value of α.	Observed value of σ.	Disagreement in % of observed value.
1	.0575	.06	— 4
4	.0678	.075	12
7	.0436	.042	+ 4
10	.0551	.046	+17
13	.049	.06	—18
16	.0406	.046	—12
19	.04	.042	— 5
22	.0189	.033	—43
25	.05	.06	—17
28	.0355	.039	— 9
32	.0468	.042	+11
35	.0458	.05	— 9
37	.0448	.052	—14
40	.124	.088	+29
43	.0433	.058	—15
46	.0615	.062	0
48	.129	.129	0
52	.087	.112	—22
55	.0325	.0365	—11
57	.073	.06	+13

◆

Electric Pumping Plant in Hawaii.

An interesting application of water wheels, as applied to irrigation work, is afforded at the pumping plant of the Makee Sugar Company, of Kaleia, Kauai, Territory of Hawaii, now approaching completion. This company controls a large acreage, which has heretofore been barren, owing to the fact of its being situated above the irrigation canals on which the land is dependent for water during the greater part of the year.

The principal irrigation canal on the Island of Kauai, carrying a large volume of water, is situated on the opposite side of a mountain from the ground to be irrigated, and at a considerably lower elevation. There is ample water below this land, but it was unavailable for lack of means to elevate it to the required height. The problem was solved by the application of hydro-electric transmission, using the water from the large canal on one side of the mountain to develop power, which is applied electrically to pumps on the other side.

The water in the main canal is an extremely variable quantity, not only from one season to another, but at different hours of the day; consequently, any transmission scheme must provide means for running the pumps at highest efficiency, taking into account the fluctuations in the initial power, due to varying water supply. It is obvious that to accomplish this it is necessary to vary the speed of the electrically-driven pumps almost in direct proportion to the varying power of the water wheels. This is accomplished by synchronous motors, which, by varying the cycles according to the speed of the generator, are enabled to vary their power output and speed in the same proportion. This, of course, involves a corresponding change of water wheel speed according to the water available, the wheels to run faster during periods of greater water supply and slower as this diminishes. In order to reduce the operating expense to a minimum an operator is in attendance at the generating station only, the resulting operations at the pumping station being automatic.

The Pelton water wheels are six in number, of different diameters, and each fitted with buckets designed for the special conditions of wheel speed and water supply involved, the static head being 390 ft. Each wheel is of such diameter and power capacity as to run the generator at the proper speed to correspond with the pump output, this being maintained at a maximum in accordance with the water used by the wheel. These six Pelton wheels are all mounted on the same shaft, and arranged to run in the same wheel compartment, one at a time, the unit being direct-connected to a single Bullock three-phase electric generator of 500 kw capacity. Thus the largest diameter wheel is to drive the generator at 280 r.p.m. and use five cubic feet of water per second, and the smallest at 450 r.p.m., using eight cubic feet of water per second, the intermediate wheels running at intermediate speeds and using proportionate water quantities. Each wheel is supplied with a single stream of water through a nozzle of proper diameter, and the streams are controlled independently by a hydraulic gate operated through a special three-way valve. If the supply of water is falling off, as indicated to the station operator by gauges, he closes the valve of the operating wheel and opens that of the next slower wheel, and vice versa. These changes may occur several times a day, but it is always possible to deliver irrigating water to the higher levels in direct proportion to the supply of water, thus obtaining a maximum daily efficiency and insuring the highest returns on the investment.

The variation in water wheel efficiency will be extremely slight if working at intermediate speeds between those for which the wheels are specifically calculated. The use of hydraulic gates for controlling the flow of water to each wheel makes the accomplishment extremely simple, and in addition to this method of control there is provided a stream cut-off on each nozzle, operated from a common rock shaft. This, in turn, is controlled by a special device arranged to hold at any speed between 450 and 280 r.p.m., depending on the position at which the connecting belt may be set on the cone pulleys. The current is transmitted six miles over the mountain to the pumping station where the synchronous motors are direct connected to Riedler pumps working against a head of 250 feet.

The electrical and pumping machinery was furnished by the Allis-Chalmers Company, and the complete hydraulic equipment by the Pelton Water Wheel Company, of San Francisco.

◆

LETTERS TO THE EDITORS.

"Digest" References.

To the Editors of Electrical World and Engineer:

SIRS:—Under your heading "Digest of Current Electrical Literature," I frequently find reference to articles on subjects of great interest to me, but often originally written in a language with which I am not familiar. I should like very much to know if you have adopted any plan or arrangement by which your readers may obtain translations into English of any foreign article to which reference is made in your Digest. Possibly such an arrangement is already in practice, but if not, I believe it would be found exceedingly helpful to a large number of readers who would, of course, be willing to pay any reasonable charge for the translation and copy.

Pittsburg, Pa. G. FREDERICK PACKARD.

[We are always glad to assist readers in securing copies of periodicals mentioned in the "Digest," and to put them in communication with reliable translators. The usual rate for the translation of articles from a foreign tongue into English is $3.50 per thousand words.—EDS.]

The Use of the Third Person in A. I. E. E. Discussions.

To the Editors of Electrical World and Engineer:

Sirs:—In reading over the discussions of the papers published in the Transactions of the American Institute of Electrical Engineers, January to December, 1904, Volume XXVIII, I am forcibly impressed with the awkwardness of style introduced into the discussions by the use of the third person, and I respectfully beg permission to trespass upon your valuable space to give expression to my opinion on this subject which, I have no doubt, is indorsed by a large number of engineers who do not belong to that category of scientific prigs, of which I have a sincere horror.

I wish to take at random some statements which the editor of the discussions put into the mouth of Mr. Gano S. Dunn, but which this thoughtful gentleman surely never said. On page 329 we find Mr. Dunn's discussion of a paper on alternating-current generators, and we have to look at the following sentence:

> Mr. Dunn expressed appreciation of Mr. Behrend's views in his book on Induction Motors, and also as given verbally to the meeting, to the effect that engineering and designing of the kind under discussion was not a science, but an art.

In parsing this sentence, it is Mr. Dunn, who, in his book on "Induction Motors," expressed appreciation of Mr. Behrend's views, whereas Mr. Dunn in reality referred to Mr. Behrend's views as expressed by Mr. Behrend in his book on "Induction Motors." The jumble introduced by transposition from the first person into the third person is obvious here.

Let us turn to another page. We read on page 135, as coming from Mr. C. F. Scott:

> The mention of the speaker's name in the paper suggests some reminiscences of early work on this subject.

I suppose that this means that the mention of Mr. Scott's name in the paper suggests to Mr. Scott some reminiscences of his early work, but then why not say so? By completely destroying the individuality of discussions and making them read like the most insipid and uninteresting reading matter imaginable, we deprive oral discussion of its interest, charm and peculiar advantage over common technical publication. The discussion loses flavor and strength and is completely emasculated. Furthermore, if it is pleaded that the third person is introduced into discussions in order to lend to these discussions the cloak of placid philosophical calmness which, in my opinion, would be very much out of place in engineering discussions of the day, there should at least prevail scholastic consistency; but we find Prof. H. J. Ryan, on page 140, saying:

> "Probably you are right, that the constants will be somewhat different for these different metals."

How much more dignified it would have sounded in the editor's opinion if put this way:

> H. J. Ryan:—The speaker then remarked that the former speaker was probably right, and that the constants, etc.——

This would introduce such a large variety of speakers that it might be necessary to use suffixes for the speakers and, perhaps, we may, sooner or later, be presented with a proposition of settling at a future Congress the question of the nomenclature and terminology to be used at the discussions to differentiate between the different speakers! Alas, alas!

The discussion of engineering matters before the engineering societies is of great value in the progress of engineering and, the livelier these discussions can be made, the more benefit there is derived from them. In the discussion of astronomic problems while dealing with the immensities and eternities and with the slowly changing phenomena of the universe, it may be good taste to avoid the introduction of personality or individuality as small and puny in comparison with the great problems under discussion; but while discussing engineering problems which are distinctly the work of man, man's individuality should stand forth and it will give to a discussion a certain flavor of interest which otherwise it never could obtain.

I beg particularly to thank you for publishing these lines, as I know that you disagree with me on the question at issue.

Cincinnati, O. B. A. Behrend.

[As we understand it, the third person was not adopted because the change from the first person was considered to be a grammatical or literary improvement, but because the use of the third person supplies the only practical means of properly condensing discussions. To condense and retain the first person would obviously be as fatal to individuality as the use of the third person, and moreover would convey the impression that electrical engineers were accustomed to express themselves in epigram. The question thus appears to be, on the one hand, that of guarding the individuality of such speakers as exhibit individuality in their remarks, by printing all discussions *in extenso;* or, on the other hand, condensing all discussions from the expansive and tautologous style characteristic of extemporaneous speech, and confining the record to a concise statement of any points brought forth bearing directly on the subject under discussion. If the latter course deprives the discussions of the personal tone, doubtless this loss will not be keenly felt by those who refer to them for technical information, and are enabled to find such information disengaged from its original accompaniment of superfluous words, tautology and digression. We believe that a ballot of the membership would show that for one member who would appreciate the preservation of the individuality of speakers—so far as individuality can be preserved by embalming their remarks *verbatim et literatim* in type—there would be a score who merely care to know what actual contributions—not in words, but in substance—are made to a subject discussed. The Civil Engineers adopted the use of the third person about a decade ago, and while at first there was considerable opposition on the part of those whose remarks were edited, this was not allowed to prevail to the detriment of the great body of membership who merely read discussions. Editing into the third person naturally requires some skill and practice, but if the Electrical Engineers should drop the plan it would by many be construed into a confession of incapacity in dealing with obstacles—literary and personal—which a sister body easily surmounted. Finally, a return to the old and primitive method would involve, through the increased bulk of the Proceedings and Transactions an additional draft on an income scarcely now adequate for carrying out the professional and other work of the Institute.—Editors.]

◆

Alternating-Current Nomenclature.

To the Editors of Electrical World and Engineer:

Sirs:—In the nomenclature generally adopted in dealing with alternating current problems there is one point in which it is quite at variance with the fundamental conventions of mathematics. I refer to the algebraic signs given to angles of lead and lag, the former being regarded as negative and the latter as positive. This is not only confusing to the beginner in this branch of electrical science, but is liable to be disconcerting to anyone who, though familiar with mathematical nomenclature generally, is not working on alternating-current problems so continually as to become hardened to the jolt which this aberration naturally produces.

The difficulty evidently originated in the elementary illustration of a harmonic variable, in which we are told to conceive of a vector rotating about one end with uniform angular velocity and in a *clockwise* direction. The clockwise direction is universally considered as the negative direction of rotation, and there would appear to be no excuse for adopting it in this fundamental conception. If we assume a counter-clockwise or positive rotation in this illustration, which is certainly the only logical assumption, the above difficulty disappears entirely; angles of lead become positive, and angles of lag become negative. The symbol $+j$ will then represent *leading,* or forward rotation through an angle of 90°, and $-j$, lagging, or backward rotation; the expression $a + ja'$ representing a leading vector, and $a - ja'$ a lagging vector referred to the axis of reference. This change involves a change in the signs prefixed to symbols representing reactance and condensance, the former becoming positive and the latter negative. We thus have the impedance of a circuit containing resistance and reactance represented by the expression $r + jx$ instead of the usual $r - jx$, and the current in such circuit, with impressed e.m.f., e becomes $\frac{e}{r+jx} = \frac{e\,(r-jx)}{r^2+x^2}$, the $-j$ in the numerator indicating a lagging component.

Since the above change in nomenclature affects only the statement of a problem and the interpretation of the resulting expressions, and need not be considered in the intermediate transformations, it will be found to involve no appreciable mental effort even where one is thoroughly accustomed to the current notation, and would, I believe, if once introduced, be generally adopted.

Philadelphia, Pa. J. Lester Woodbridge.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Eddy-Current Losses in the Armature Copper of Electric Machines.—Loewenherz and van der Hoop.—An account of an experimental investigation in which the eddy-current loss was determined by temperature measurements. The test was not made with an actual machine, but with a testing arrangement resembling the conditions in practice. The results of the test are given in various diagrams and the following formula, which agrees with the theory, was found: For copper at a temperature of 15° C. the eddy-current loss per cubic centimeter can be expressed as

$$Wc = 1.23\, n^2 f^2 \left(\frac{A}{l}\right)^2 s^{1.6} \times 10^{-10},$$

where n, the number of periods per second, f, the "form factor" of the curve of the e.m.f. induced by the alternating field (slot field), $\frac{A}{l}$, the number of ampere-turns of the teeth, A, per centimeter of the flux path, l, and s the thickness in centimeters for a rectangular cross-section measured in a plane perpendicular to the flux.—*Elek. Zeit.*, August 17.

Single-Phase Motor.—Fleischmann.—An article illustrated by diagrams on the theory of the Winter-Eichberg motor. The essential difference between this motor and the compensated series motor is that there exists in the latter only one flux in one direction, while in the Winter-Eichberg motor there are two fluxes different in phase and amplitude and direction in space. The author gives the diagrams of the Winter-Eichberg motor and develops its fundamental formulas under certain simplified assumptions.—*Elek. Zeit.*, August 17.

Voltage Drop of Alternators.—Rezelman.—The first part of a serial illustrated by diagrams on the general problem of determining by a graphical method the voltage drop in single-phase and polyphase alternators.—*La Revue Elec.*, August 15.

Lights and Lighting.

Street Lighting by Incandescent Lamps.—Howatt.—An illustrated article describing the two main systems of series incandescent lighting in use at the present time.—*Am. Elec.*, August.

Novel System of Emergency Lighting.—A short article with diagram, describing the Hochenegg system of emergency lighting for use in theatres and other places.—*Am. Elec.*, August.

Power.

Stamp Driving by Electricity.—Heathen.—An abstract of a paper read before the South Africa Association of Mining Engineers. The author advocates the employment of a very low frequency for power work, with a separate distributing system at a higher frequency for lighting. With regard to driving stamps, he suggests using a slow-speed motor of about 250 r.p.m. with an overhung pulley at each end to drive either 5 or 10 stamps, i. e., 10 or 20 off each motor. This avoids the necessity of making the cam-shaft pulleys 15 ft. in diameter; ordinary 6-ft. pulleys will do quite well. He admits that the belt thickness will not be quite suitable for a motor pulley of 15 in. diameter. A 1,350-lb. mill takes almost exactly 2.5 hp per stamp, and a 30-hp motor will, therefore, be required for every 10 stamps. By adopting these small motors instead of one or two large ones, the capital expenditure can be reduced by from 20 to 30 per cent. Assuming that there are 22 small motors instead of two large ones, it is considered by some people that motor breakdowns will occur 11 times as often on the small system as on the large one, and as each stoppage on the former involves one-half of the whole mill, and on the latter one-half of the whole mill, there seems no advantage one way or the other. This is, however, an absolute fallacy, since the premises are wrong. One of the premises involved is that it takes exactly the same time to repair or replace a 400-hp motor as it does to do the same for a 30-hp motor; but with one spare 30-hp motor on hand an hour will suffice to get the 10 shut-down stamps restarted. On the other hand, with a 400-hp motor and a line shaft 115 ft. long, 20 to 30 hours will be an average time in which to effect repairs. Complete spares on the large motor system will increase the capital expenditure 50 per cent, and on the small motor system 5 per cent. Up to last year the author had charge of a water power electric plant transmitting power for milling, hoisting, etc., over a distance of about seven miles. After the Boer war, which occasioned a stoppage of three years, there was laid a new pipe line which at first gave a few slight troubles. A fresh start was made in September, 1902, and the plant was shut down on the following Christmas day for 18 hours and 30 minutes, but no repairs were carried out. Twelve months later there was another shutdown lasting 12 hours, but again no repairs were made. Excluding these two stoppages, the running time amounted to 623 days 14 minutes out of 524 days. A number of stoppages turned out to be unnecessary, while some were due to floods. Assuming half the stoppages to be due to the motors and half to the generators, the former accounted for a loss of time of only one-twelfth of one per cent of the total running time. He thinks this record quite justifies his estimate of 5 per cent spares.—Lond. *Elec.*, July 28.

Hydro-Electric Development in Norway.—Ramakers.—An illustrated description of the electric generating station at Glommen, near Kykkelsrud. The provisional power house has a capacity of four turbines of 3,000 hp each, and three smaller ones, namely, two of 300 hp and one of 500 hp. When eventually completed the plant will comprise eight turbines of 5,000 hp in addition to the four turbines already installed, representing an aggregate of 52,000 hp, which is increased to 53,060 hp by the small turbines used for driving the exciters. Of this only 43,060 can be used simultaneously, 10,000 hp being held as reserve. The transmission voltage is 20,000, and the transmission line comprises five distinct lines, four running north and one south. Two pole lines have already been erected to the north for a distance of 39 miles. Each of these is intended for two three-phase transmission circuits, but only one three-phase circuit is carried on each pole line. Seven sub-stations are situated along the route of the transmission line. These are provided with oil-cooled transformers for reducing the 20,000 volts to 5,000 volts. Current at this latter potential is conveyed to the various points of consumption, where the potential is further reduced to 220 volts.—*Am. Elec.*, August.

Electric Power and Bridge Construction.—An illustrated description of the electric installation for contractors' plant on the Brooklyn anchorage for the cables of the new Manhattan suspension bridge over the East River. In order to complete the work in time, electric power is used wherever possible instead of hand labor. An important feature is the absence of any steam plant except a single boiler to operate the high-pressure pump, while electricity is used for all kinds of service, chiefly pile driving, hoisting, traction, concrete mixing, pumping and lighting. The total electric equipment comprises 541 hp, chiefly in 25-hp and 50-hp units. There are employed 21 series motors and 5 shunt motors, using direct current at 240 volts from the Edison three-wire system.—*Eng'ing Record*, August 26.

Steam Jacketing.—Mellanby.—A paper read at the Liege meeting of the British Institution of Mechanical Engineers. Concerning the best mean pressure, it is said that compound engines with a boiler pressure of 150 pounds may be worked with a mean pressure referred to the low-pressure cylinder of about 40 pounds per square inch without any loss of efficiency in terms of the brake horse-power. The jackets have their maximum efficiency when the whole of the high-pressure and the ends of the low-pressure cylinders are jacketed with high-pressure steam. When the jackets are applied to the high-pressure cylinder the total indicated horse-power is slightly reduced, but when applied to the low-pressure cylinder the total indicated horse-power is considerably increased. The jackets have little effect in the high-pressure, but have a considerable effect in the low-pressure cylinder upon initial condensation. The temperature cycle of the cylinder walls next to the steam must be considerably less than that of the steam; first, because the actual "missing quantity" is much less than it would have been had the steam and metal gone through the same temperature changes; and, secondly, because the mean temperature of the metal is higher than that of the steam. To improve the economy of the engine, the aim must be to reduce the "missing quantity." The greater part of the latter must be due to leakage and not to initial condensation.—Lond. *Elec.*, July 28.

Electric Power in Mining and Metallurgy.—Herzog.—A continuation of his illustrated serial. In the present instalment he describes the construction of electric cranes made by various European manufacturers. Detailed drawings are given.—*Elek. Bahnen*, June 14.

Electrically-Released Brakes on Cranes.—Weeks.—A short illustrated article on the care of electrically-released brakes and their magnets for crane and similar work.—*Am. Elec.*, August.

Traction.

Single-Phase Traction in Germany.—Ehnhart.—A profusely-illustrated description of the single-phase railroad from Murnau to Oberammergau. The length is 14 miles. The time of a run from Murnau to Oberammergau is 72 minutes, the time of the return run 65 minutes, including the stops at eight stations. The speed is, therefore, 12 and 13 miles per hour, respectively. The highest speed on level road and down grades is about 24 miles per hour. During winter there are twelve trains and during summer sixteen trains per day. The road was built in 1899 and 1900, and the intention was to operate it with three-phase currents at 5,000 volts, which was to be reduced in transformers along the line so as to get 800 volts at the terminals of the motors. For financial reasons the electric equipment was, however, only partially completed and the road was operated with steam. In 1904 the road was bought by a new company, which decided to introduce electric traction. It was first intended to use the two three-phase machines of the power house which had been installed for a capacity of 375 kw, of which only about one-fourth is utilized for lighting purposes. However, the careful comparison of the three-phase, direct-current and single-phase systems showed that the single-phase traction would be the most economical. It is stated that the average efficiency of the plant from the bus-bars of the power station to the wheels of the cars were calculated to be 66, 62 and 71 per cent for three-phase, direct-current and single-phase current, respectively. On the other hand, the first cost (capital invested in the line and in the car equipment) were in the ratio of 1.16 for three-phase current to 1.25 for direct-current to 1.00 for single-phase current. On account of the lower capital investment, it was decided to install the single-phase system. The line was equipped by the Siemens-Shuckert Company. The hydraulic station of the road contains two 500-hp and two 30-hp turbines. The smaller turbines drives the dynamos for excitation and for lighting the station, while each larger turbine is connected to two generators, namely, one traction generator and one lighting generator. The traction generators have eight poles and produce single-phase alternating-current at 5,500 volts with a power factor of 0.8, the frequency being 16. In order to insure a sparkless collection of the current from the overhead wire under any conditions of weather each car is provided with two trolley poles, but there is only one trolley wire. The motors are series machines designed for 270 volts, with a compensating winding through which the full current passes. They have been tested with 100 hp for one hour without special air ventilation, the temperature of the windings increasing under these circumstances by 65 deg. C. over the temperature of the outside air. It is stated that there are no spark whatever at the commutators. The transformers are placed below the truck. Fig. 1 gives the characteristic curves of the motors used.—*Elek. Bahnen*, July 14 and 24.

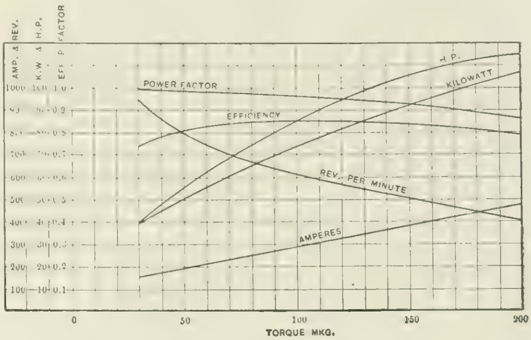


FIG. 1.—CHARACTERISTIC CURVES OF MOTORS.

Single-Phase Traction in Paris.—Montpellier.—A fully illustrated article on single-phase traction on the Malakoff tramway line in Paris, using Latour motors, as was previously mentioned in the Digest.—*L'Elec.*, August 12.

Three-Phase Traction in Italy.—Oserhati.—An article on operating results of the Valtellina Railway on which the three-phase system has been in operation for 2½ years. The total expenses for traction service, including the lubricating and cleaning of material, as well as labor, amounted on an average per year with but partly electrically driven freight trains to 0.62 cent per thousand ton-miles, and for the period with trains fitted exclusively electrically to 0.34 cent per thousand ton-miles. The corresponding expenses on a steam line in Austria, selected for comparison on account of representing conditions similar to the Valtellina as regards curves and grades, although with a 30 per cent denser traffic, amounted to 1.3 cent per thousand ton-miles. The saving effected in operating expenses corresponds in the first case to 3.98 per cent interest on the capital expenditure, and in the second case to 5.53 per cent, besides which the lighting of all stations and motor cars, as well as heating of the latter, is assured. Data are then given on tests concerning current consumption, recuperation of energy, consumption of energy as a function of grades, and the "fly-wheel effect." By the latter is meant that if the speed of the generators should be reduced suddenly by more than 2 per cent, current would be restored to the line by the induction motors of all moving trains; that is to say, the moving trains would act like a huge fly-wheel having the effect of flattening out the momentary peaks. The collector rings are not now placed on the motor shaft between the locomotive frames, but outside of the latter. The author then summarizes the peculiar advantages of three-phase traction as follows: The possibility of recuperating both the energy stored up in the moving trains when the speed is being reduced for stopping and the energy as represented by the train running on down grades; this energy reappears as electric current and is equivalent to the greater part of the original input. This circumstance results in a very low consumption of energy. The possibility of reducing by "fly-wheel effect" the load peaks caused by the starting of trains. The possibility of removing the collectors from the motor axle and thus utilizing the entire space inside of the locomotive frames for the motors. These advantages are obtained, however, only with the use of induction motors. On the other hand, with the same it is not possible to have variable speed. But this is thought not to be a disadvantage. The polyphase alternating-current traction system does not require a thorough training of the personnel, as the speed remains automatically constant after having reached a value peculiar to the system. Indeed, even on lines with a very variable profile, the speed diagrams taken from actual service are almost horizontal lines. Thus individual skill of the staff is nearly eliminated, being restricted to correct starting and stopping.—*St. Ry. Jour.*, August 26.

Swiss Railway.—Somach.—An illustrated description of a narrow-gauge line of six miles length, which connects the important Swiss city of St. Gall with the mountain villages of Speicher and Trogen. An interesting feature resides in the use by the same motors of a 500-volt direct-current within the town limits and a 800-volt direct-current in the country. The section which is supplied with 500-volt current from the local street railway circuit in St. Gall has a length of ½ mile.—*St. Ry. Jour.*, August 26.

French Tramway System.—A fully illustrated description of the power house of the tramway system of Lille. Three-phase currents are generated at 5,500 volts with a frequency of 25 periods per second and transmitted to various sub-stations. In the latter the three-phase currents are changed into 500 to 550-volt direct current by means of transformers and rotary converter. The capacity of the station is 2,500 kw.—*L'Industrie Elec.*, August 10.

Electrolysis of Water Pipes by Tramway Return Currents.—An editorial discussion of the importance of preserving notes on electrolytic damage. Since it seems likely that suits against railroad companies will come in future, the water works superintendent who, of necessity, will be one of the principal witnesses, is urged to cultivate the habit of carefully inspecting his pipes whenever he has an opportunity to do so, and promptly and accurately to record in a suitable notebook everything of value observed, excluding all irrevelant matter. It is also recommended that he make voltmeter measurements and record the difference of potential between pipes and rails, and the drop of potential along the given length of pipe.—*Eng'ing Record*, August 26.

Measurement of Acceleration.—Lanchester.—A description of an instrument for the measurement and recording of starting and stopping efforts in vehicles. He calls it an "accelerometer." The fundamental principle on which the instrument works, is that the effect of the algebraic sum of tractive forces and resistances on the vehicle as a whole is shared proportionately by every portion of its mass, and that consequently the tractive effort on the whole vehicle can be ascertained if that acting on any portion of its mass can be measured. This tractive effort is measured by the deflection of the heavy bob of a very short pendulum, the tangent of the angle of deflection being proportional to the acceleration, and being measured by a pointer prolonging the pendulum upwards and passing over a horizontal scale. The vibrations of the pendulum are damped by a dash-pot. When the gradient varies the instrument no longer measures the acceleration, but it continues to measure the actual tractive effort in every case. Some diagrams taken with the instrument show the sudden stoppage of the retardation when a train is brought to a standstill, giving the familiar impression of a jerk backwards.—Lond. *Elec.*, from *Phil. Mag.*, August.

Portable Sub-Station.—An illustrated description of the equipment of the New Hampshire Traction Company's portable sub-station which is in operation at Seabrook Beach, N. H., an important junction point for three different lines. The sub-station is housed on an ordinary freight car and contains a 250 kw rotary converter.—*St. R'y Jour.*, August 26.

How to Make an Electric Buckboard.—Brocksmith.—The concluding article on the design of an electric buckboard, which has been running for two months. The battery controller and the woodwork are described in the present article.—*Amer. Elec.*, August.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Portland.—Sykes.—A very long and profusely illustrated description of the system of the Portland General Electric Company. It furnishes power for lighting the streets of Portland, Oregon City, St. Johns, etc., and for operating various railway systems and for power purposes in numerous industrial mills. The power is in the form of three-phase, 33-cycles, 10,000-volt current, and can be furnished either from the water-power plant at Oregon City or from the steam plant in Portland. For lighting, the current is transformed into three-phase, 60-cycle, 2,300-volt current, for traction into 550-volt, direct-current. The development of the system and the equipment of various stations and sub-stations is described in detail.—*Jour. Elec., Power and Gas*, August.

Starting Rotary Converters.—Wagner.—A continuation of his serial in which he describes different methods of starting rotary converters. Very full instructions are given together with detailed diagrams of the connections. The first case discussed in this installment is that of two three-phase rotary converters each operating from alternating to two-wire direct-current, the direct-current sides being in parallel. Each machine is started by its own starting motor and synchronizing rheostat. A second case discussed is that of one three-phase rotary converter operating from alternating to three-wire direct-current. The machine is started by a separate starting motor and a synchronizing rheostat. The third case is that of one two-phase rotary converter operating from alternating to three-wire, direct current. The machine is started by a separate starting motor and a synchronizing rheostat. The article is to be concluded.—*Elec. Jour.*, August.

ELECTROPHYSICS AND MAGNETISM.

Specific Inductive Capacity of Metals.—Broca.—Theory and fact are at variance in the calculation of the resistance of wires for direct and for alternating currents of high frequency. The present author shows that the discrepancy can be removed by taking into account the specific inductive capacity of the metal. On doing this he obtains an approximate value for the specific inductive capacity by a new method. Putting it as proportional to the square of the refractive index, he shows that for frequencies between 500,000 and 1,200,000 per second the specific inductive capacity is of the order of 10^{11}. Beyond a frequency of 3,000,000 the specific inductive capacity increases nearly in proportion to the period. Nothing can as yet be said concerning lower frequencies as no data are available.—Lond. *Elec.*, July 28; from *Comptes Rendus*, June 26.

Evolution of Inanimate and Living Nature.—G. H. Darwin.—The first part of his presidential address at a recent South African meeting of the (Brit.) Assoc. for the Advancement of Science. He discusses the parallelism of the ideas of evolution in the problems of life with those in the world of inanimate matter. He refers to the theory of natural selection as the persistence of those types of life which are adapted to their surrounding conditions. The same idea holds good in physics. He compares the species of the naturalist with the stable configurations of the physicist and the states of the politician. The idea of the bottom of all these conceptions is stability. He reviews briefly the researches which have led to the conclusion that atoms are not perpetual. He is led to the conjecture that the several chemical elements represent those different kinds of communities of corpuscles which have proved by their stability to be successful in the struggle for life.—*Science*, August 25.

ELECTROCHEMISTRY AND BATTERIES.

Edison Accumulator.—Schoop.—A long article giving the results of tests of an Edison iron-nickel accumulator. The article is illustrated by many diagrams, and the results of his tests are summarized as follows: The ampere-hour capacity is independent of the rate of discharge under normal conditions of temperature, while the watt-hour capacity depends slightly on the discharge rate, varying between 31 and 35 watt-hours per kg of total weight. It is here assumed that the discharge e.m.f. is carried down to one volt. The Edison accumulator is thoroughly fool-proof and resists even mechanical vibrations very thoroughly. The ratio of the ampere-hours during discharge to those during charge and the ratio of the watt-hours during discharge to those during charge are less favorable than in the lead accumulator and are in the average not more than 75 and 55 per cent respectively. But the author remarks that it is only fair to say that at very high discharge rates which the Edison accumulator stands without any trouble, the efficiencies will be about the same as given above. With lead accumulators the efficiency at such high discharge rates would probably be not much better. Moreover, concerning the efficiency of lead accumulators in actual automobile service there are very few reliable data available, and it is to be assumed that in actual traction service the efficiency of lead accumulators is much poorer than the values determined in the laboratory. For the same capacity the space required by the Edison cell is smaller than for the lead accumulator; the difference will, however, be probably compensated by the fact that in whole batteries the different cells cannot be placed closely together. The Edison cell needs no further attendance than occasional filling up with distilled water.—*Elek. Zeit.*, August 17.

Accumulator for Traction.—Rosset.—The first part of an article in which the author calculates what, under the best possible conditions, may be expected from a storage battery for traction purposes. He calculates the highest possible capacity for one kg of weight of electrodes and of total weight and for one litre of volume. The article is to be continued and the results will be summarized when it is completed.—*Centralblatt f. Accum.*, August 1, 15.

Electrolytic Tin Recovery.—Some notes on the Bergse process for the electrolytic recovery of tin from tinned iron ware.—*Austr. Min. Standard,* July 12.

Calcium Carbide and Acetylene.—MOREHEAD.—A long abstract of a paper on the production of calcium carbide and the manufacture of acetylene.—*Eng'ing News,* August 24.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring an Alternating-Current in Wire Without Cutting It.—MARXEN.—A description of an instrument devised by Dietze which is essentially a small transformer. It is shown in Fig. 2 and resembles a pair of tongs, but is closed under ordinary circumstances by means of a spring while the tongs are opened if the handles are pressed together. The jaws of the tongs are placed around the wire in which the alternating-current is to be measured so as to surround this wire completely. The tongs then form a closed magnetic circuit, and the wire to be tested represents a single turn of a primary winding of a transformer, while around one limb of the magnetic circuit the secondary coil is wound. The induced current in the latter is then measured by a hot-wire instrument or by a telephone if the object is merely to determine whether a current flows in the wire. Fig. 2 shows the larger size of the commercial instrument. It may be used to advantage for the localization of insulation faults, for measuring alternating-currents in line conductors, etc.—*Elek. Bahnen,* August 4.

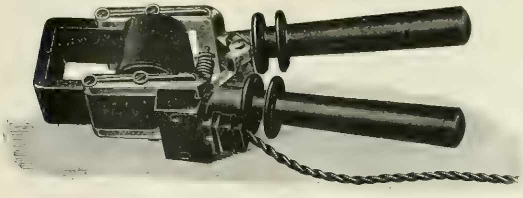


FIG. 2.—VIEW OF TRANSFORMER.

Testing Magnetic Permeability of Iron.—EDLER.—For measuring the permeability of a sample of iron, that is, for determining the magnetization curve, complete accuracy can be obtained only by the well-known ring method with the use of a ballistic galvanometer. The iron to be tested is brought into the form of an annular ring with rectangular cross-section and the primary and secondary windings are wound around it symmetrically and uniformly over the whole surface. In calculating the permeability from such a test, the simplifying assumption is generally made that the magnetic lines of force throughout the ring have the same length, and that the flux density has the same value in all points of the cross-section. The calculation is generally made with such mean values, but this leads to errors. The author calculates how much the error is which is committed by this approximation and shows how to eliminate it by using a correction factor, the numerical values of which are calculated for various conditions.—*Zeit. f. Elek. und Masch.,* August 9.

Electricity Meters.—GERHARDI.—Continuations of his illustrated serial. The Reason, Vulcan and the Watson prepayment meters are described.—Lond. *Elec.,* July 28 and Aug. 11.—In an editorial the advisability of prepayment meters is discussed. In some places they have been found remunerative, in others not. But it seems that the chief trouble is in the prepayment meter itself, as it is usually constructed, consisting of an ordinary watt-hour meter to which is added a coin-fed mechanism. The only way to avoid this complication entirely is to substitute for the meter a simple hour-meter or a lamp-hour meter, both of which are much simpler and cheaper instruments than coin-controlled watt-hour meters.—Lond. *Elec.,* August 11.

Testing Synchronous Motors.—ROWS.—In a continuation of his illustrated serial on alternating-current and laboratory testing, he describes various tests of synchronous motors.—*Jour. Elec., Power and Gas,* August.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Incandescent Lamp for Intermittent Flash Signs.—A description of a method of the Allgem. Elek. Ges. of Berlin for automatically connecting and disconnecting an incandescent lamp with its circuit as used in intermittent flash signs. The principle is shown in Fig. 3. The contact is made and broken at the point *C*. The strip *R* is made of two strips of metals which have very different temperature coefficients of expansion. Such a strip will be bent when heated. The heating effect is produced by the coil *S* and when it has transmitted sufficient heat to *R* the contact at *C* is broken. No current flows through the coil *S*, the strip *R* cools and bends back, and the contact is again closed at *C*, and so on.—*L'Industrie Elec.,* August 10.

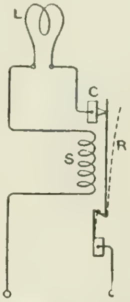


FIG. 3.—ELECTRO-THERMAL FLASHER.

Wireless Transmission of Mechanical Action.—BRANLY.—A description of an apparatus by means of which several different mechanical actions can be produced at will at a distant station without the assistance of anyone stationed there. Thus the impact of electromagnetic waves may be made to start a motor, light a lamp or produce an explosion. The choice of succession of these various actions is regulated by a rotating commutator at the distant station. It has as many discs as there are actions to control. For those actions, each disc would be provided with a sector of larger radius covering 90 deg. While this sector is in contact with a brush, the apparatus reacts upon a spark from the transmitting station and produces the action desired. The operator at the transmitting station is informed of the position of the discs by a constant succession of signals from the receiving station, actuated by the rotating commutator. By introducing a reversing gear, the actions may be started or stopped at will. The commutator itself may be sarted or stopped by electromagnetic waves. The author describes a method by which the operator at the transmitting station can assure himself that the apparatus at the receiving station is working satisfactorily. He has also devised an apparatus for protecting the receiving station from adventitious waves.—Lond *Elec.,* July 28; from *Comptes Rendus,* Mch. 20 and June 26.

Automatic Block Signals.—SCOTT.—The concluding article of the series which has been running for some time, the present article describing the interlocking machine.—*Amer. Elec.,* August.

MISCELLANEOUS.

Cancer and Radium Rays.—REHNS AND SALMON.—An account of two cases of successful treatment of mild cancerous growths, one being an epithelioma of the lower lip, another a nasal growth. Treatment was by application of a radium preparation for 15 to 60 minutes daily for two or three months. The preparation was contained in a box manipulated by the patients themselves. The authors point out the convenience of radium preparations as against Roentgen tubes, and express the hope that they will become more generally available.—Lond. *Elec.,* July 28; from *Comptes Rendus,* June 26.

Presidential Address.—FORSYTH.—His address to the mathematical and physical section of the Brit. Assoc. for the Advancement of Science at the recent South African meeting. He refers to three scientific centenaries in this year. In 1605 Bacon published the Advancement of Learning. In 1705 Halley predicted for 1758 the return of the comet which now bears his name. The year 1805 is "marked by the silent voices of a couple of scientific records." These are Laplace's celestial mechanics and Monge's application of algebra to geometry. Some notes are also given on the development of mathematics within these intervals.—*Science,* August 25.

Megaphone.—LAUDET AND BEAUMONT.—A description of a flame megaphone. The construction is shown in Fig. 4. A mixture of air and acetylene is forced into a chamber and passes into burners through openings periodically closed by the sound vibrations, so that the latter are transmitted into fluctuations of the flames. The apparatus is shown in the diagram, where *A* is the chamber, *B* the supply pipe, *C* a pallet hinged and closed off with rubber at *O*, *DD'* are two nozzles alternately opened and closed by the vibrations of the pallet, *EE'* the pipes leading to the combustion chambers *FF'*; *GG'* are the sound trumpets and *HH'* cooling devices for water circulation. The style at the bottom is run over a gramophone disc, and the flames exaggerate the sounds of the record. Since *D* is closed while *D'* is open, and vice versa, the amount of gas burned is always the same. The loudness depends simply upon the energy given out by the combustion.—Lond. *Elec.*, Aug. 18; from *Comptes Rendus*, July 31.

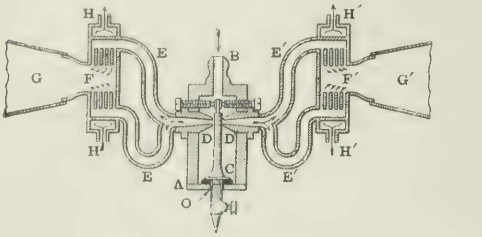


FIG. 4.—FLAME MEGAPHONE.

Electric Welding.—WALLIS JONES.—An account of the development of electric welding and its application for various purposes.—*Austr. Min. Standard*, July 10

India Rubber.—TERRY.—Some notes on the probable sources of the future supply of India rubber.—Lond. *Elec. Rev.*, July 21.

Adams-Randall High-Power Telephone Transmitter Tests.

By WILLIAM MAVER, JR.

For local or short-distance telephony in the present state of the art as exemplified by the first-class companies of this country there is little left to be desired in the way of improvement so far as regards the transmission of speech. The apparatus is capable of transmitting and reproducing speech as clearly and as loudly as may fairly be considered necessary for all practical purposes. If satisfactory speech is not always obtained the cause or causes must be sought for in other directions than in the apparatus.

When we come to consider the question of telephoning over long distances, however, the case is quite different. Here the length of the line enters seriously into the question, inasmuch as the laws that govern the transmission of electric power over conductors for any other purposes also govern the transmission of the minute waves or undulations that produce speech at the receiving end of the line. Indeed, factors such as induction interference from other lines and the diminution and distortion of the waves due to the resistance, leakage and capacity of the line, that have scarcely to be considered in the transmission of power on a large scale, are seriously disturbing factors in long-distance telephony, and in fact frequently render speech inaudible or unintelligible.

In telegraphy, the elder sister art of telephony, there are at least two plans by which the requirements of long-distance transmission may be met without materially affecting the economy or reliability of operation. First, by increasing the electromotive force of the circuit; second, by the introduction of automatic telegraph repeaters in the circuit. There is a distance up to which, with a given size of wire, it is considered good practice to increase the electromotive force of a telegraph circuit, namely, about five hundred miles. Beyond that point it is usual to employ automatic repeaters. These repeaters virtually cut the line into two or more comparatively short circuits of approximately equal length, and by their use telegraph circuits of from one to three thousand miles in length are operated commercially, virtually as though the total distance separating the terminals did not exceed three or four hundred miles.

In telephony, however, the problem is a different one and cannot be solved so economically. Here the electromotive force and current, and hence the electrical energy, are limited to the point at which the ordinary transmitter will carry an increasing current without impairment of speech and without detriment to the apparatus, namely, 4 to 6 volts maximum in the primary circuit of the transmitter. A further difficulty is that as yet no satisfactory telephone repeater has been invented by which the current strength may be reinforced at intermediate stations, as in the case of telegraphy.

There is, of course, available for long-distance telephony the use of copper conductors of low resistance, and this plan has been adopted by the various long-distance telephone companies, but the expense of such conductors prohibits their use for most purposes.

As long ago as 1887 Dr. S. P. Thompson advanced the idea that the true line of improvement in telephony was to find means for strengthening the transmitting apparatus. There was obviously nothing to be gained by increasing the sensitiveness of the telephone receiver, as that would only augment its present great capacity for picking up extraneous currents from neighboring electrical circuits. In the early attempts to produce a more powerful transmitter than the Blake, the Hummings or other forms of carbon electrodes, recourse was had to instruments of the multiple electrode type in which a number of electrodes were arranged in multiple, and through which the current from a common battery was subdivided. In this way it was hoped to obtain the benefits of a large battery together with greater variations of current strength, due to the reduced resistance of the transmitter circuit. A practical difficulty arose, however in the operation of this arrangement of the electrodes, due to the fact that it was not feasible to maintain the resistance of the respective transmitters at a uniform point. The consequence was that when the resistance of any one of the electrodes fell below the normal its circuit received a disproportionate share of the current which not infrequently destroyed the contact point.

To overcome this and other acknowledged defects of the multiple electrode transmitter when employed with a common battery, Mr. C. Adams-Randall several years ago began experiments with solid-back electrodes arranged in multiple, but in which each electrode was provided with a separate battery. By this arrangement it was anticipated that the power of the battery could be accurately determined for the carrying capacity of each electrode without any possibility of an unduly strong current flowing in any one of the transmitter circuits, and practical experiments and tests appear to have confirmed this view. Mr. Randall combines these electrodes on one diaphragm to the extent of 4, 8 or 16 sections, as may be desired or necessary.

After many experiments it has been found that an iron diaphragm gives the best results in practice, probably owing to its greater amplitude of vibration. The diaphragm is supported freely around the edges; it is not clamped to its supports. For a four-section transmitted the diaphragm is 4 inches in diameter and 3/64ths of an inch thick. The diaphragm of a twelve-section transmitter is 5½ inches in diameter and 3/64ths of an inch thick.

During the past six years many successful long-distance tests have been made both in this country and in Europe with the Adams-Randall transmitter, with results that have shown it to possess very powerful transmitting qualities. For instance, Dr. Silvanus P. Thompson, in 1895, subjected this transmitter, as it was then constructed, to a comparative test with the best standard transmitters of that time. In these tests, which included artificial lines on which heavy-induction interference from neighboring lines was introduced, and also lines representing submarine cable equal to sixty miles in length, etc., this transmitter was found by Dr. Thompson to surpass in transmitting qualities all other available transmitters.

A comparative test of this transmitter under actual working conditions was also made at about the same time on the telegraph lines of the London & South Western Railway, from London to Southampton. In these tests it was necessary to reduce the sensitiveness of the receiver to a point at which induction noises from parallel circuits were entirely absent. When the desired degree of non-sensitiveness was reached additional sections were added to the Adams-Randall instrument sufficient to enable it to transmit speech clearly whereas the ordinary standard instruments failed to affect the desensitized receiver.

Since the date of the tests mentioned by Dr. Thompson, the Adams-Randall transmitter has undergone a number of improvements. The electrode is of special construction. Carbon is used as a variable resistance, but it is confined (in a fabric cup) and under pressure in contradistinction to the loose gravity contact of the ordinary transmitter. Any one section of this transmitter is found to be equal in transmitting qualities to the ordinary transmitter now in use, and in actual tests recently made between New York and Albany, to which further reference will shortly be made, four sections of the later type of transmitter gave as loud transmission as sixteen sections of the original form of transmitter.

The electrodes of this transmitter are arranged symmetrically on the diaphragm. The mouthpiece is of the ordinary size and shape, and is placed opposite the center of the diaphragm, a suitable air chamber being provided between the mouthpiece and the diaphragm. The circuit of each electrode has the usual induction coil with primary and secondary wires. The primary wire of each electrode is independent of the other, and, as already stated, each electrode has its own separate battery of four cells. The secondary wires are connected in multiple with one another on the line wires. The resistance and turns of the primary and secondary coils are so chosen as to give the best results. Tests have been made using one secondary wire wound over the four or more primary wires, but on the whole the transmission is not so satisfactory as with four separate secondary wires connected in multiple. The variations of current set up in each primary wire act separately upon the secondary wires and are additive in their effects, as is evidenced by the increasing loudness of the speech as each additional electrode is placed in operation, and this increased intensity of sound is obtained without impairment of the quality of the articulation.

One of the most severe tests to which this transmitter has been put in this country was on a metallic circuit of copper wire, 5.15 ohms to the mile, between Chicago and New Orleans, on the line of the Illinois Central Railway. This circuit was about 1,000 miles in length. These experiments extended over a period of two months in 1904. On a number of occasions speech was transmitted successfully between the points named, by the Adams-Randall transmitter, whereas the transmission of speech was not obtainable with the standard types of transmitters. In addition to its adaptability to long-distance telephony, and to shorter distances to overcome induction interference from parallel circuits, the Adams-Randall transmitter has been found to be well adapted for superposing telephony on grounded telegraph circuits.

It is well known that it is a comparatively easy matter to so graduate the rise and fall of the current impulses of a Morse circuit that, while the diaphragm of a telephone receiver placed directly in the Morse circuit may be deflected by these impulses, no sound will be produced thereby. This smoothing, or rounding out, of the Morse impulses is accomplished by placing inductance coils in the Morse circuit. It is not, however, practicable to place much inductance for this object in quadruplex telegraph circuits owing to the detrimental effect of inductance on the operation of the system. Hence the induction noises heard in the ordinary telephone receiver when placed in a Morse telegraph circuit contiguous to other operating telegraph circuits, are very pronounced and virtually prevent the transmission of speech telephonically with the receiver in its normal condition of sensitiveness. It is therefore essential to desensitize the receiver to a point at which the induction noises will not affect the receiver. This renders the receiver less sensitive to the variations of current due to the telephone transmitter, and renders necessary an increased current output from that instrument.

Quite recently, by request of the Western Union Telegraph Company, a prolonged test of the Adams-Randall telephone system as arranged for simultaneous telegraphy and telephony, was made on one of the circuits of that company between New York and Albany.

The wires on which the tests were carried out consisted of a Morse circuit which was operated telegraphically during the continuation of the tests. The telegraph circuit included about 10 miles of a 19-conductor aerial telegraph cable running along the elevated railroad structure in New York City in close proximity to the third rail of that system, together with about 132 miles of pole line and one mile of subaqueous cables. The insulating material of the telegraph cable is rubber compound. The pole line carries from 30 to 50 telegraph wires in actual operation.

The telegraph circuit was grounded at Albany and New York; the superposed telephone circuit was grounded through condensers at each end of the line. The induction noises from the parallel telegraph circuits were exceedingly loud in an ordinary telephone receiver placed in the circuit and could be heard across the room. An adjustable receiver of a well-known commercial type was desensitized by withdrawing its diaphragm from its magnet a distance of one-quarter of an inch. The induction noises were still too disturbing for the proper transmission of speech, and to eliminate the noises entirely a special shunting device was arranged around the receiver. When this result was effected the current output of the Adams-Randall transmitter was then increased by adding section after section until speech was plainly heard in the desensitized transmitter at the distant station. With the latest type of this transmitter only 16 dry cells in series-parallel were necessary at the New York terminal. At the Albany terminal of the circuit a slightly larger number of cells were required, presumably owing to the neutralizing effects of the cable at the New York end of the circuit. These tests were successfully conducted twice daily for half an hour at a time (during the busy hours of the day) for fifteen days.

One of the most difficult problems that his arisen in connection with the operation of simultaneous telegraph and telephony on commercial and railroad telegraph lines has been to obtain a successful and economical method of calling up the distant stations, the ordinary magnet generator call not being suitable for this purpose. Some of the calling devices hitherto employed entail the use of a closed circuit battery. This plan, while fairly satisfactory, involves so considerable an expense that some railroads have found it more advantageous to erect additional wires to provide needed facilities than to continue the use of the simultaneous system.

To overcome this disadvantage, Mr. Randall has devised a high-frequency vibrator, the battery for which is only in use when calls are going out. The calls set up in this way are heard in a telephone receiver to which is attached a small trumpet or megaphone, the sound from which can be clearly heard at the distant station.

There are a number of other devices which have recently been applied to this system, which combinedly produce the successful results accomplished, but at present it is not deemed expedient to indicate their precise function inasmuch as application for patents covering such devices are now pending.

The writer is mainly indebted to Mr. C. Adams-Randall for the data relative to the foregoing details of the test of his transmitter.

The Rateau Steam Regenerator System.

One of the most interesting applications of steam turbines is in the employment of steam at low pressure, and particularly exhaust steam coming from engines working intermittently. This last class of engine includes hoisting and rolling mill engines, steam hammers, and, in a general way, all engines working under great variations of load. By the nature of their work itself these engines are not able to benefit from the same advantages as engines which work continuously. This is owing to the special difficulties in application to such engines of condensing plant, multiple expansion and superheating. The majority discharge their exhaust freely into the air and the quantity of steam which is thus lost is considerable. To meet these conditions the Rateau steam regenerator system has been developed, its function being to regulate the variable discharges of such engines so that the flux of steam is transformed into a steady flow for utilization in low-pressure turbines.

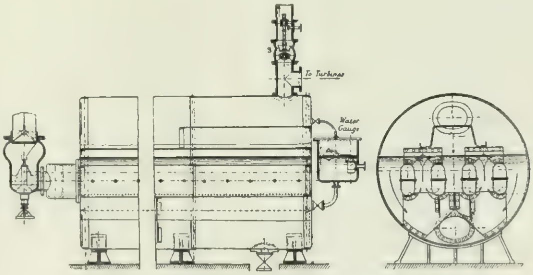


FIG. 1.—RATEAU REGENERATOR.

The process consists essentially in passing the exhaust steam through a vessel containing a heat-retaining medium, which acts as a fly-wheel for heat. The steam collects and is condensed as it arrives in large quantities in the apparatus, and is again vaporized

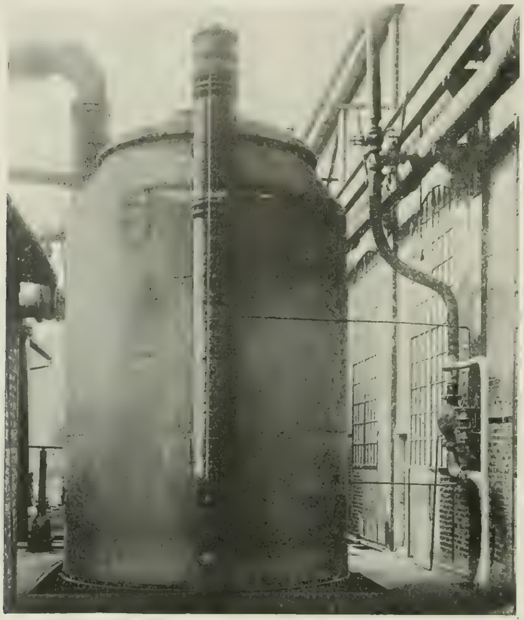


FIG. 2.—RATEAU TRAY REGENERATOR.

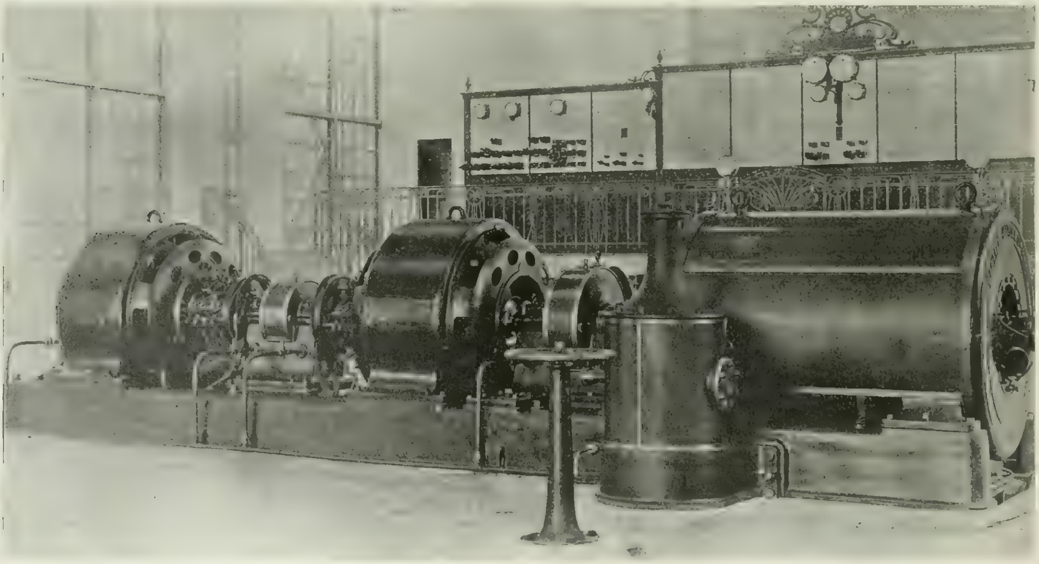


FIG. 4.—HIGH AND LOW-PRESSURE TURBINE.

during the time when the exhaust of the principal engine diminishes or ceases. The necessary variations for condensation and regeneration of the steam correspond to fluctuation in pressure in the regenerator, this pressure rising when the apparatus is being filled, and descending when it is discharging into the turbine. Water, which has a very high calorific capacity, has been used as a heat fly-wheel, but in order to rapidly communicate to a liquid mass a considerable quantity of heat corresponding to the latent heat of steam to be condensed, it becomes necessary, owing to the poor conductivity of water, either to arrange it in thin layers or to cause a rapid circulation in order to increase the surface of contact between the steam and the water itself. The first solution of the problem gave rise to the regenerator with flat cast-iron trays in which water is contained in shallow vessels arranged one above the other; a regenerator of this type is shown in Fig. 2. The second solution of the problem gave rise to the regenerator with water in which a rapid circulation was produced by the injection of steam into the body of the liquid itself; a regenerator of this type is shown in Fig. 1.

A low-pressure turbine working between 17.7 pounds per square inch and a vacuum of 27 in. of mercury can furnish an electrical horse-power, measured at the terminals of the dynamo, for 31 pounds of steam per hour. In a moderate size plant consuming 13,000 pounds of steam per hour, it is, therefore, easy to economize under these conditions 350 electrical horse-power. In steel works where reversible steam rolls are employed, consuming about 45,000 pounds of steam per hour, it will be possible to develop by means of regenerators and turbines an extra output of 1,100 electrical horse-power. The prime movers are in no way affected in their working by the presence of the regenerators and turbines. The back pressure is not raised, but can even be diminished, the turbine working then between less than one atmosphere and the minute back pressure in the vacuum.

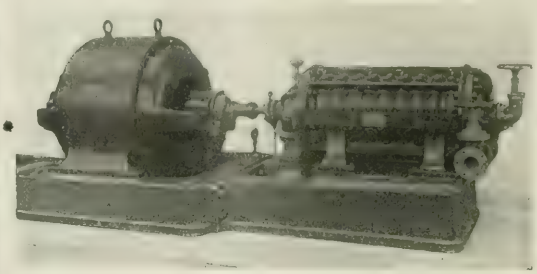


FIG. 3.—LOW-PRESSURE TURBINE.

In order to have the turbine independent of the shutdowns of the main engines a reducing valve allows the live steam of the boilers to be admitted in the low-pressure turbine when there is no call for steam in the primary engines. Another process consists in admitting automatically live steam in a high-pressure turbine having a common shaft with the low-pressure turbine. The idle boilers, instead of blowing off their steam and letting it go to waste, transform it into power. This method was applied for the first time at Bruay, France, and the installation has worked, giving perfect satisfaction, since August, 1902, when it was first put in use. The output of the direct-current turbo-generator in this plant is 300 electrical horsepower. The current produced is employed for lighting purposes, to operate motors for driving fans and cranes.

Fig. 2 shows a regenerator containing pig-iron trays, installed at the Poensgen Steel Works, Dusseldorf, Germany. This regenerator regulates the exhaust of a reversible rolling mill engine and of a power hammer, the total discharge of these engines being approximately 22,000 pounds of steam per hour. This regenerator is 18 feet high and 12 feet in diameter.

Fig. 3 shows a low-pressure turbine driving two direct-current dynamos at 1,400 r.p.m. The turbines receive steam from the regenerator at atmospheric pressure and discharge into a central condenser giving a vacuum of 26 in. This outfit has been running day and night for several months in the Poensgen Steel Works, the normal load being 650 electric horsepower at the brushes. The current is utilized in driving the train of the mill, for lighting purposes and for furnishing power for driving motors in various factories.

A hoisting engine at Firminy, France, has been equipped with the Rateau process and its exhaust steam runs a 250 electric horsepower turbo-generator. The current is sent down into the mine and runs two electrically driven centrifugal pumps.

Fig. 4 shows a Rateau high and low-pressure turbine installed at the Spanish Reunion mines, of 500-kw capacity. The low-pressure steam comes from a Rateau regenerator taking the exhaust of a hoisting engine. Fig. 4 is a type of turbine pump outfit for high lifts.

As shown by these illustrations, an important supply of electrical power can be easily rendered available in mines and in steel works, thus allowing all auxiliary machinery to be electrically driven. In Europe 50,000 hp have already been put in service or are under construction.

Twenty-three plants similar to the one installed at the Poensgen Works at Düsseldorf are now in operation or are being erected in Europe; fifteen are to employ the exhaust from hoisting engines and eight to utilize the exhaust from rolling mill engines.

The Rateau Steam Regenerator Company, 226 La Salle Street, Chicago, is contracting for several important applications in America.

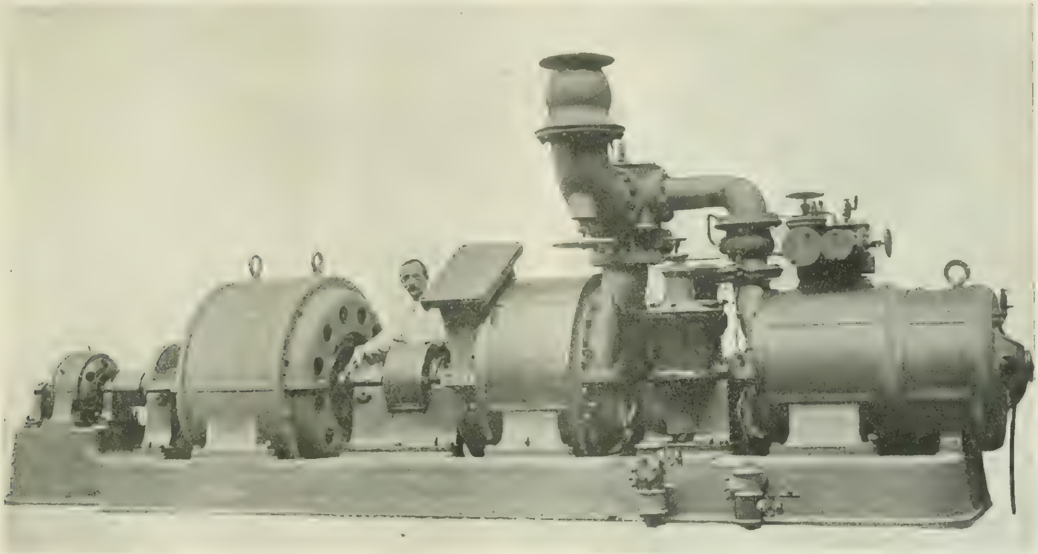


FIG. 5.—TURBINE PUMP FOR HIGH LIFTS.

The Mabbs Electric Elevator.

An electric elevator, which is a radical departure from previous electric elevators, has been the subject of considerable quiet interest on the part of engineers in Chicago where it has been in service in the Board of Trade Building for nearly three years past. The elevator is the invention of John W. Mabbs, chief engineer of the Board of Trade Building. The recent decision of the directors to replace all the other electric elevators in that building with the new Mabbs elevator after considerable investigation lends much interest to the description of the elevator which has not heretofore been published.

The essential feature of the Mabbs elevator is that the motor forms the counter-weight and travels up and down a counter-weight shaft instead of being located permanently in the basement. The motor and other mechanism which form the counter-weight, however, differs from the ordinary counter-weight in that instead of depending on the cable altogether for support, the motors are geared to a vertical rack, so that it has at all times a positive mechanical connection with the sides of the shaft. The counter-weight is, therefore, raised and lowered by means of the motors operating on this rack and pinion. The best general idea of the elevator mechanism can be obtained from Fig. 1.

Figs. 2 and 3 are drawings showing a sectional elevation of the mechanism shown in Fig. 1. The motor, which is of a special design, has a vertical shaft and is geared through a worm gear to two horizontal shafts. Each horizontal shaft has a pinion on each end, making in all four pinions, which engage in four vertical racks. The racks are mounted upon the outer faces of two cast-iron columns. The motor mechanism hangs from a sheave around which the cables pass, as shown in Fig. 1. By this arrangement the elevator car, of course, travels two feet to each foot of motor travel. The motor hatchway, therefore, extends half the height of the building. The motor machine runs in guides on the inner faces of the cast-iron columns. Current is carried to the motor through copper-lined channel irons, mounted on porcelain block insulators situated on the columns between the motor guides and the racks. At the upper and lower ends of the motor hatchway are air buffers which will be described later.

In Fig. 4 is shown a plan and portion of three different horizontal sections of the machine, each quarter of the drawing being of a different section, the location of sections being shown by the lines on the elevations in Figs. 2 and 3. The motor frame is of cast steel, with four poles. The poles are wound with one series and two shunt coils. The series winding is in shunt with the armature starting resistance and is used only in starting. It is cut out entirely when the motor has attained its first speed. After the first speed is attained, to further increase the speed of the motor, one of the shunt field coils is gradually cut out until the elevator is operating entirely on the other shunt coil at a speed of between 900 and 1,000 r.p.m. The motor frame constitutes the mechanical connection between the upper and lower parts of the machine. The armature, *B*, is of the usual laminated core, toothed type. The commutator, *C*, is of unusual size. *D* is a worm of highest grade forged steel, carefully cut and fitted. It is not keyed to the shaft, but is like a sleeve on the shaft, lined with phosphor bronze. Its upper part forms a part of the coupler, *T*, which drives it. The worm gear wheels, *E E*, have phosphor bronze rims and cast-steel hubs and spiders. These gear wheels are pressed and keyed to the horizontal shafts, *F F*. These gear wheels run in phosphor bronze bearings, which are oiled automatically by the rotation of the worm wheels in the gear cases, which are partially filled with oil.

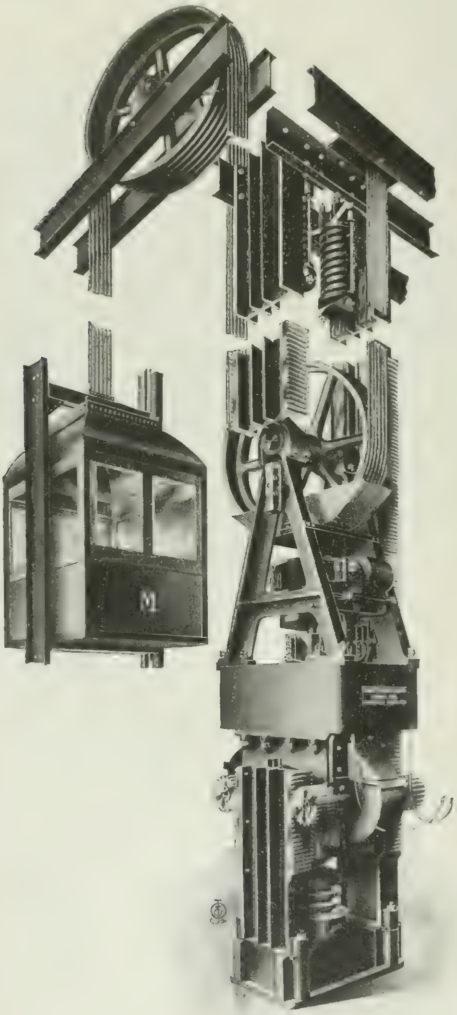
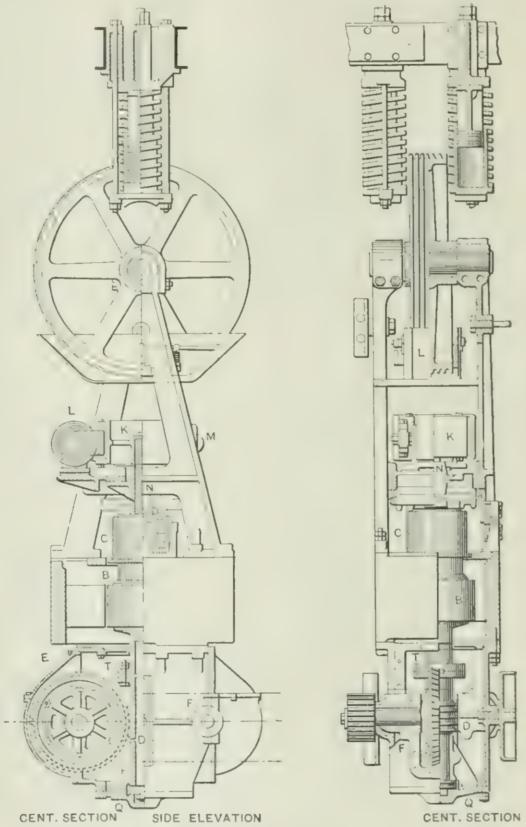


FIG. 1.—GENERAL VIEW OF ELEVATOR MECHANISM.

A brake pulley, *K*, is mounted at the upper end of the armature shaft. This pulley is ribbed to dissipate the heat generated in it by braking. The brake shoes acting against this pulley are held against it by means of a spring, *M*, whenever current is shut off by the operator or by accident. When current is turned on the powerful solenoid, *L*, releases the brake shoes. The upper bearing of the armature shaft, *N*, is babbitt-lined and lubricated by a compression grease cup. The sheave bearings also have compression grease cups and these two bearings are the only ones requiring attention as far as lubrication is concerned. The lower armature bearing, *P*, is babbitt-lined and practically submerged in oil. The thrust of the armature shaft in both directions is taken by a roller thrust bearing, *Q*, designed for a load of about six times the maximum thrust it ever has to carry in this location. The coupling, *T*, is designed to transmit motion from the armature to the worm. The object of a coupling at this point is to make it possible to disconnect the armature shaft, allowing it to revolve freely without operating the machine when sandpapering or turning down the commutator, thus making it unnecessary to remove the armature from the machine. The gear case covers most of the important bearings of the machine. Within it are contained the gears, the four horizontal shaft bearings, the lower armature bearing, the worms and the roller thrust bearings. It is filled with oil to a point just below the horizontal shafts. In the machine at the Board of Trade Building these parts have run over two and one-half years without change of oil. The racks are of cut steel, and are bolted to the outer bases of the column.

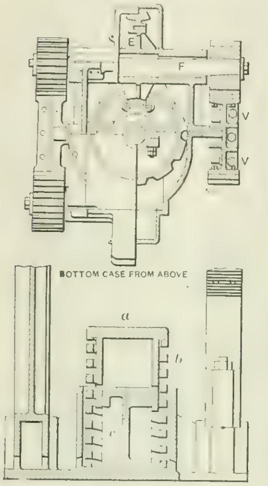


FIGS. 2 AND 3.—SECTIONAL ELEVATIONS OF ELEVATOR MECHANISM.

In Fig. 5 is shown a section through the buffer at the lower end of the motor hatchway. This buffer consists of a steel cylinder marked *a*, fitting over the piston, *c*. The compressing of the air contained in the cylinder forms an elastic cushion sufficient to stop the momentum of the machine traveling at a speed of 600 ft. per minute plus 100 per cent overload of the motor. Outside of the air cylinder is the spring, *b*, which returns the cylinder to normal position and also helps in the retarding.

Fig. 6 is a drawing of the trolley mechanism for collecting current from the copper-lined channels up and down the motor hatchway. On the field frame of the motor is mounted the bracket, *g*, which carries the brush holders. The trolley brush holders are supported by the trunnions, which work in insulated bearings on the trolley bracket. The brush holders thus have free movement sideways and upon their axes. There are eight brushes in each holder, each of over one square inch of contact surface. After three years' service, comprising over 560,000 half trips, there is no burning or pitting of the copper, as the wearing and conducting surfaces are so ample. The trolley conductors, as before indicated, are steel channel bars with a copper bar in the bottom of the channel, all supported on porcelain blocks, *T*. A leather washer is placed between the porcelain and iron to reduce the danger of breakage. A slack cable device is provided to automatically trip the circuit-breaker of the elevator should the cable become slack.

The controller used with this elevator is manufactured by the J. L. Schureman Company, of Chicago, and is operated with pilot control circuits by a small hand switch on the elevator car. The controller is shown in Fig. 7. The field windings by which the three speeds are obtained in acceleration have been already explained. In shutting off current when the operator moves the lever back toward central or off position, the current in the fields of the motor is first increased so as to reduce the speed, and later the main armature circuit is opened and the armature is short-circuited through a resistance. The speed of the motor is thereby reduced, but the car will still move slowly along until the switch is moved to the central or off position. The circuit to the brake solenoid is then opened, thus setting the brake and bringing the car to a stop.



FIGS. 4 AND 5.—PLAN OF MACHINE AND SECTION THROUGH BUFFER.

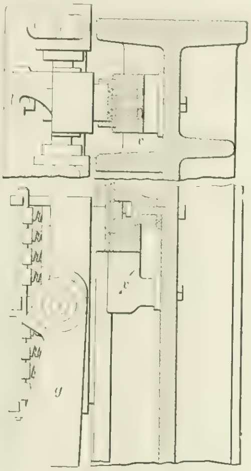


FIG. 6.—TROLLEY MECHANISM.

The stopping and starting of this elevator is remarkably smooth and free from the jerks frequently found on hydraulic elevators, and at the same time there is none of the delay in stopping, starting and reversing that is found in certain types of electric elevators. The controller has magnet switches with vertical contacts, which prevent the accumulation of dust. The main line circuit is made and broken with a double-pole magnet switch having carbon and copper switch contacts with blow-out magnets to prevent arcing. The reversing switch consists of two double-pole interlocking magnet switches controlling the supply of current to the armature. The armature resistance is short-circuited by a set of single-pole magnet switches mounted at the bottom of the controller panel. The construction of these magnet switches can be seen in a general way in Fig. 7, the operating coils being mounted against the board and the switches when open, flying out away from the board.

In connection with this controller there is an overload circuit-breaker which has a tripping solenoid, the circuit of which can be closed by a push button on the elevator car. The operator can, therefore, at any time cut the current off from both the controller and motor. The slack cable device which has been already mentioned also connects with this tripping coil. Switches are provided in the motor hatchway by which the movement of the machine will trip the circuit-breaker just before the motor comes in contact with the buffers in case the operator and the automatic stop fail to stop the car at the upper and lower floors. These automatic switches are also located in the motor hatchway, but connected to the operator's controller in such a way as to perform automatically the same duties as an operator using the car switch.

Although this design of elevator has numerous advantages, the first one urged by its inventor is that of safety. As it has no free moving counter weights, there is no opportunity for the counter weight to jerk the elevator car through the roof of the building, and vice versa, there is no chance for the elevator car to jerk the counter weights out of position so that they can come down and wreck the car. By virtue of absolute mechanical stops at both ends of the motor mechanism travel, which can stop the machine under all conditions, the danger is eliminated of pulling the car into the overhead work and pulling out its cables or shooting the car into the basement and piling the counter weights down on the car. Assuming that the same number of cables are used on this as on other elevators, the factor of safety is claimed to be about one-third greater with this machine because in other elevators about one-third of the cables go to the counter weight. In this machine there is no counter weight but the machine itself. It is claimed that the cables on this machine will last from four to ten times as long as on other elevators because of the fewer number of bends or sheaves around which they must pass, the number of bends determining the life of the cable. The danger of broken cables is, therefore, likely to be much diminished. Friction is reduced to a minimum because of the absence of a lot of multiplying sheaves and intermediate devices. The figures on power consumption in operation given later bear out this statement.

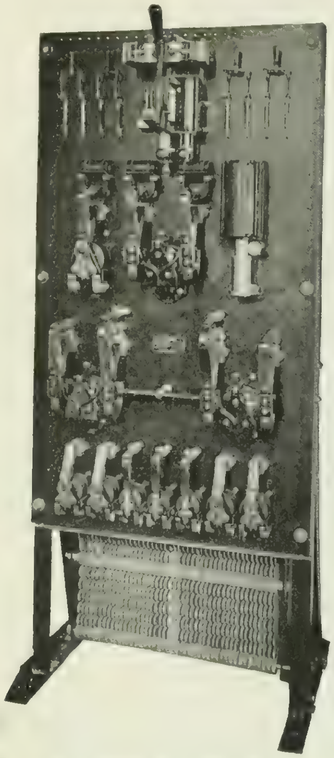


FIG. 7.—VIEW OF CONTROLLER.

The elevator has been in use in express service in the Board of Trade Building, and in this building the service is probably as severe and the requirements of the tenants as exacting as in any building in the country, a large proportion of the passengers being Board of Trade men and employes carrying on Board of Trade business, where time is of first importance.

The average energy required by this elevator for a period of two years is 3.42 kw-hours per car mile. This is in a service calling for stops at five out of nine floors and making a schedule speed of 576 ft. per minute. It is stated that other types of electric elevators running at 175 to 350 ft. per minute take from 5 to 10 kw-hours per car mile.

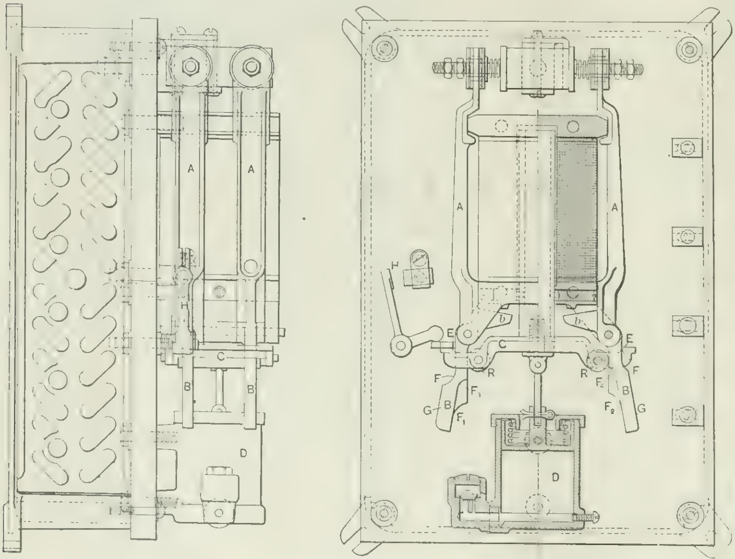
The elevator as already designed is feasible for a building height of 600 ft., and this can be increased. The smooth operation of this elevator in spite of its high speed has been spoken of and deserves special mention again. Reversing at full speed can be accomplished promptly and yet without any disagreeable shock, which is something made possible by the use of the motor machine as a counter weight and the absence of numerous multiplying sheaves. It seems to have virtually put the electric elevator on the same footing as regards satisfactory service as the best hydraulic elevators. The elevator is extremely popular with the occupants of the building, as shown by their written testimonials.

◆

A New Type of Motor-Starter.

The frailties of the old-style dial-type of motor-starting switch, comprising a row of contact plates over which a contact brush travels, were brought into uncomfortable prominence as soon as motors began to be built in large sizes, and recognition of the limitations of this type of switch resulted in the multiple-switch starter now extensively employed in conjunction with motors of 50 horse-power and upward. The difficulties incident to hand operation of sliding contacts carrying heavy currents become serious, if not prohibitive handicaps when such contacts are operated by automatic means, such as an electromagnet or an air cylinder and piston, of ordinary power; consequently, the multiple-switch idea has been extended to the field of semi-automatic distant control in the shape of butt contacts each actuated by an individual electromagnet.

A motor controller comprising four to six electromagnetic switches is an extremely expensive piece of apparatus, and several attempts have been made to operate all the contacts by means of one magnet, with varying success. One of the most promising forms of this general class of motor starter has been developed by the Sundh Electric Company, of New York, and is illustrated by Figs. 1 and 2 herewith. It consists broadly of a solenoid, a cam frame carried by the lower end of the solenoid plunger, and two or more pivoted contact arms or levers adapted to cut out the starting resistance section by section and having extensions engaging with the cam frame so that the latter partially closes and then releases the levers when it is drawn upward and knocks them open with a snap action when it falls.



FIGS. 1 AND 2.—SIDE AND FRONT ELEVATIONS OF MOTOR STARTER.

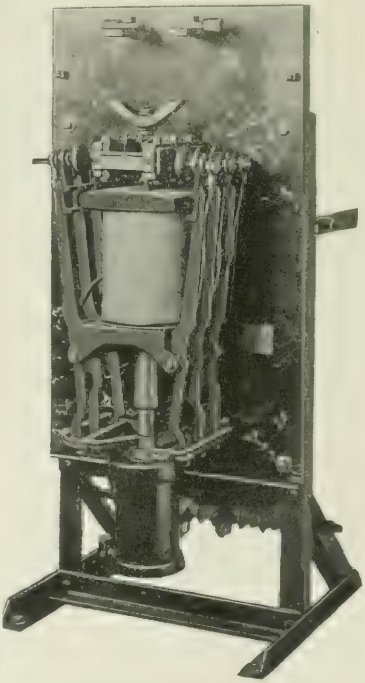


FIG. 3.—GENERAL VIEW OF MOTOR STARTER.

Referring to Fig. 1, the contact levers (four are shown), *A*, are pivoted to lugs extending from the lower "pole-plate" of the solenoid, and their extensions, *B*, project through the cam frame, *C*, which is bolted to the lower end of the solenoid plunger. The piston of the dash-pot, *D*, is also attached to the plunger, but pivotally so as to allow it freedom to keep in alignment with the pot irrespective of the alignment between the pot and the solenoid. The drawing shows the plunger drawn up, and the contacts closed; the contact faces being located at the upper ends of the arms. When the exciting circuit of the solenoid is opened, the plunger drops and the cam frame edges, *E*, *E*, strike the outer curved faces, *F*, of the lever extensions, throwing the extensions inward and thereby opening the contacts at the upper ends. This motion is practically instantaneous, the dash-pot being provided with a check valve which opens outward and relieves the pressure under the piston.

With the contacts open and the plunger at the bottom of its travel, excitation of the solenoid causes the plunger to be drawn upward, of course, and its motion in that direction is retarded by the dash-pot. As the cam frame, *C*, moves slowly upward, the rollers, *R*, carried by it impinge against the inner faces, $F1$, $F2$, $F3$ and $F4$, of the lever extensions, one after another, and move them gradually outward until the edges, *E*, of the frame have cleared the outer plane faces, *G*, of the lever extensions; then the upper ends of the levers are within magnetic reach of the upper pole-plate of the solenoid, and the levers (which are of soft iron) are drawn "home" with a quick movement, which absolutely prevents anything like sneaking an arc. Of course, this action takes place with one lever at a time, the lower extensions being so designed that none of the levers can close out of its proper order. The inner faces, F_1, F_2, F_3 and F_4, are numbered in the order in which the contacts close, this sequence being obtained by locating each face curve at the proper point in the travel of the rollers. The contact levers, *A*, also have short projections, *b*, which limit their movement away from the stationary contact block after the cam frame drops below the point at which the rollers begin to engage the curved faces, F_1, F_2, etc.

This arrangement has the decided advantage that the levers cannot be closed by hand or by accidental jarring or blows as long as the cam frame which surrounds the extensions is down. It also has the advantage that the sequence in which the contacts are closed is positively determined by purely mechanical means, no reliance being placed upon the gradation of magnetic attraction or of retractile means, such as weights or springs, which often get out of adjustment at critical times; and the contacts are opened by a hammer blow independent of the rate of magnetic de-energizing of the solenoid plunger and polar plates—when the plunger once lets go of the upper pole-plate, it goes all the way down with a rush. The switch action is positive in both directions and the contacts close and open with a quick motion comparable to that of the familiar "snap" switch.

In the four-lever switch shown by Fig. 1, the fourth contact, which cuts out the last section of starting resistance, is metallic, so that the resistance coils are cut out with a low-resistance short-circuit; the other contacts are made against a carbon block common to all of the lever faces. In the larger types, however, one of which is illustrated by Fig. 3, a separate laminated copper brush is attached to the upper end of the solenoid plunger and arranged to short-circuit the carbon contacts after they have all closed; upon opening, this copper contact opens just before the carbons, so that there is no arcing at its faces. It will be noticed that the contacts on the ends of the levers are spring-mounted, so that there is no rebound due to the vigorous closing. The stem of each contact piece passes through an insulating bushing in the lever end and a flexible cable is secured to it by means of the nuts shown; this cable is carried down the outer edge of the lever to a point near the pivot, whence it is led off to stationary terminal blocks.

A small auxiliary switch is opened by a projection on the cam frame when the plunger reaches its upper limit of travel; this inserts in series with the solenoid winding a resistance coil, which is at other times short-circuited by the switch.

The solenoid and switch mechanism are mounted on a slab of slate which is bolted to the resistance frame, so that the apparatus is self-contained. The resistance conductor in starters, built for 40 amperes or less, consists of Adovane or Ia Ia wire wound on lava tubes. The tubes are mounted between the side walls of the rheostat box, and these sides can be removed, bringing the tubes with them, without dissecting the structure of the box. In sizes above 40 amperes, the resistance conductor is made in the form of a grid, the proper number of grids being assembled between the removal sides of the box as in the case of the wire-wound lava tubes.

◆

The Westinghouse Exhibit at Portland.

The evolution of apparatus for the generation, distribution, control and application of electrical power has been so rapid that engineers, station managers, power users and the engineering public in general have been compelled to keep constantly in touch with the electrical developments in order to remain abreast of the times. The latest and most improvd products in every line of industry may always be seen at expositions and fairs, which are, therefore, great educational factors.

At the Lewis and Clarke Exposition, Portland, Oregon, in the building devoted to machinery, electricity and transportation, the Westinghouse Electric & Manufacturing Company occupies 1,500 square feet of floor space. This section is devoted to the display of many kinds of generators, motors, controllers and instruments of every description. At the main entrance to the exhibit is located the most prominent and most interesting feature of the display—a 400-kw Westinghouse-Parsons turbo-generator unit. This outfit represents the most efficient and most economical type of apparatus which has ever been produced for transforming the energy of steam into that of the electric current. To the left is a showcase containing all the standard types of portable instruments, and just behind this is an electrically-operated, distant-control automatic oil circuit breaker, designed to interrupt a current of 200 ampere at 33,000 volts.

Along the aisle are placed a 50-hp, direct-current and a 75-hp alternating-current, single-phase, series railway motors and a switch group of the multiple-control system. To the right is a group of type S motors, including a vertical type machine, a 25-kw rotary converter, and a 2-kw type S generator direct-connected to an Ohmen high-speed engine, manufactured by the Ohmen Engine Works, of San Francisco, Cal. Across the aisle is a motor generator set, consisting of a 150-hp induction motor and a 100-kw direct-current engine-type generator, and in immediate succession are a group of type R, direct-current motors, 1/6 to 1 hp; a 120-kw revolving-field self-contained alternating-current generator, and a 100-hp, type HF, induction motor. At the extreme rear the Sanitary Devices Manufacturing Company displays in conjunction with this exhibit an automatic dust removing plant driven by a type S motor.

In the rear section are also some distinctive types of Westinghouse transformers, including a 110-kw air-blast transformer, a number of type OD and type N transformers of the manhole type. Five OD transformers, ranging from 7½ to 25 kw, are mounted on the wall. On the left toward the main entrance may be seen a group of induction motors, types H and CCL for constant-speed work and types F and C for variable-speed service. A line of special motors, both alternating and direct current, for crane service is also shown. Standard switchboard instruments, comprising voltmeters, wattmeters, ammeters, power factor meters, etc., are arranged on display boards against the wall. In the controller section are found an oil-immersed auto-starter for use with the CCL motors, a rheostatic controller for the type HF motor, an elevator controller used with type F motors, an automatic pump controller, and finally a three-wire, double-voltage controller for use with direct-current motor in machine tool drive. Near the centre of the exhibit is a rope hoist manufactured by the Denver Electric Company, to which is connected a type F induction motor. Various classes of fuses artistically arranged on a board, a double-throw oil switch, a static interrupter, choke coil and lightning arresters complete the display.

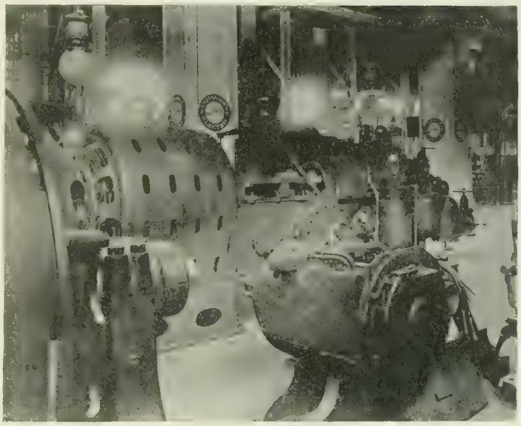


FIG. 1.—WESTINGHOUSE EXHIBIT.

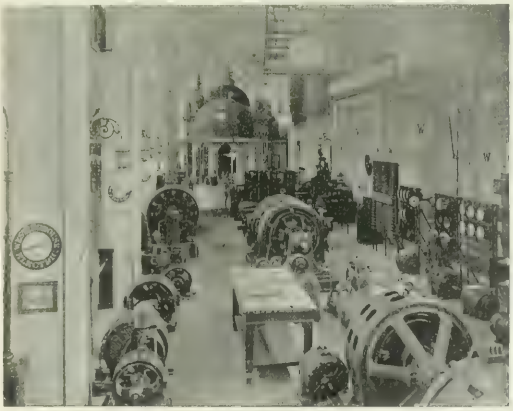


FIG. 2.—GENERAL VIEW OF WESTINGHOUSE EXHIBIT.

The exhibit is illuminated by two large "Westinghouse" display signs and by series-multiple arc lamps suspended from artistic gooseneck posts. It might be mentioned in this connection that the entire building is lighted by Westinghouse lamps of similar pattern.

The Jones Phantoplex.

It has long been well known by telegraph managers in the United States that it was entirely due to the introduction of the duplex and quadruplex systems that telegraph message tolls have been maintained, and in many cases lowered, since 1872, to the figures that have since prevailed. The large increase in the cost of erecting and maintaining telegraph lines, the almost insurmountable difficulties in securing new right of way, the high taxes and obstructions that are met with in every city, town, village and hamlet throughout the country, besides the increased cost of labor, rents, apparatus, heat, light, etc., have been so great as to have made it impossible to earn enough by the use of single wires alone to meet expenses.

The latest addition to the apparatus which enables these unfavorable conditions to be met without increased expense to the public, is an invention of Mr. Francis W. Jones, Electrical Engineer of the Postal Telegraph Cable Company, who has been a prolific worker in the direction of expanding telegraphic wire facilities. This consists of the "Phantoplex," on which has been granted five patents, and several circuits of which are in daily use on the wires of the Postal Telegraph Cable Company, where the results have been extremely successful.

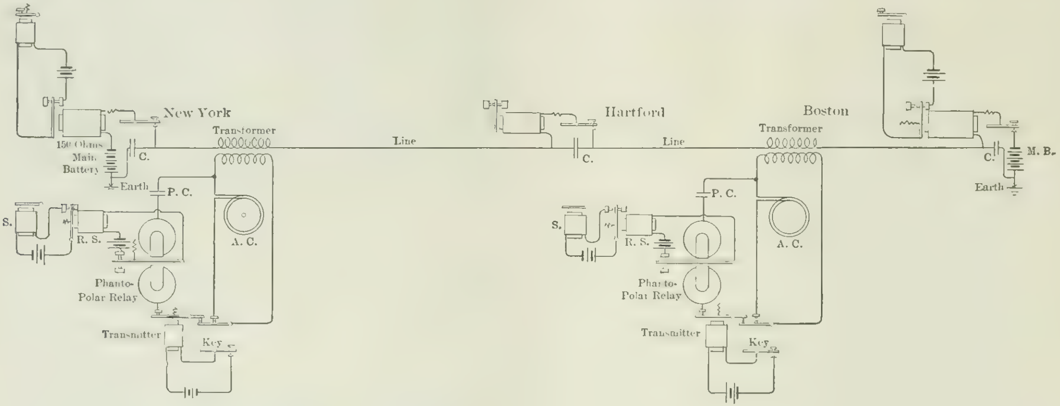


DIAGRAM OF PANTOPLEX CIRCUITS.

The accompanying diagram shows the instruments and connections for a Phantoplex circuit superposed upon a Morse way wire, between New York and Boston, with one Morse intermediate office at Hartford. The Morse circuit is easily traced from earth at New York through the main battery, Morse relay, 150 ohms via key, through the secondary coil of a transformer, via line to Boston, via Morse relay at Hartford, via secondary coil of transformer in Boston, and via Morse relay and key, through main battery to earth. Around each Morse relay, and around the batteries, condensers, *C*, are connected as shown. One terminal of the primary coil of the transformer at either station is connected to one brush of an alternating current generator, *A. C*, also to one side of a condenser, *PC*, the other side of which is connected to one terminal of the coils of a specially constructed polarized relay, *PPR*, the other terminal of the relay coils being connected to the top connecting point of the transmitter. The other terminal of the transformer primary coil is connected to the supplemental lever of the transmitter, *TR*, and the line connecting point of this is connected to the other brush of the generator, *AC*. *PPR* is locally connected to a repeating relay, *RS*, and sounder, *S*, in a well-known way. The Morse circuit is entirely independent and established as usual via the keys, relays and line wire. The condensers, *C*, are opaque to the Morse currents. When the transmitter at either end is closed, the alternating currents set up in the primary of the transformer are inductively transmitted over the line wire, via the condensers, *C*, which are transparent to said currents, but they do not pass via the Morse relays, which are opaque to such currents. These currents act inductively upon the secondary of the transformer at the distant station where the transmitter, *TR*, is open, and set the armature of the polarized relay in corresponding vibration, the circuit for these alternating currents being established through the supplemental and main levers of the transmitter, *TR*, via the top contact of the main lever and condenser, *PC*. The repeating relay, *RS*, which is normally closed, is opened by the vibrations of the relay, and by contact at its back stop closes the reading sounder, *S*, so that Morse signals made by the key at the sending station are perfectly recorded upon the sounder at the receiving station. This system may be worked equally as well by having the secondary of the transformer cut into a line wire that is being operated either duplex or quadruplex. The only precaution to be taken is to have the artificial circuits of the duplex or quadruplex sets carefully arranged and balanced to imitate as nearly as possible the new conditions introduced upon a line circuit, both as to resistance, inductance and capacity.

The system lends itself very readily to an interchange of signals, through simple automatic arrangements, either with other "Phantoplex" circuits, or with Morse working wires, and also to being "legged on" to a quadruplex or duplex.

New National Code Fuse Plug.

An all-porcelain Edison fuse plug has been designed by the Peru Electric Mfg. Co. of Peru, Ind. This plug embodies new features, and is so constructed that no spark or molten metal is thrown when the fuse blows. On account of this special factor of safety, and the fact that the fuse has gravity action insuring the circuit to open at the proper time, this device is designated as the "National Code Standard."

Openings in the cover enable one to see when the fuse is blown. The rating of the plug in volts and amperes is placed in the center of the cover, making it plainly visible when the plug is installed. A feature of special merit is found in the plastic material holding the base and cover securely together, and which in addition serves as a cushion, reducing breakage to a minimum even when the plug is dropped or thrown on the floor. The engraving shows the inside construction of the plug. This device takes an extra long fuse, which assures perfect action. The fuse lies across knife-edge projections in the porcelain, allowing gravity to pull on the fuse in the molten state, and opening the circuit exactly in accordance with the new code rating. The fuse wire is soldered to a square lug, which is held in a deep countersink by the counter screw. The other end of the fuse wire is soldered to a terminal connecting with the contact shell.

FUSE PLUG.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The reports from all parts of the country as to trade and finance, as the fall season opens, are very encouraging. Not only are the crops large and in good condition, but prices for produce of all kinds are excellent. In fact, it would be strange if with food so abundant, the price level should remain at its present high point. In the iron and steel industry, all the conditions are those of stability and strength. The demand for the finished material is enormous. There has, however, been a notable weakness during the past week as to copper, which was said to be selling around 17 cents but went off very sharply, on, it is supposed, to the obviously lessened demand due to the declaration of peace in the Far East. The bank clearings for the week were 31 per cent in excess of last year, and exchanges outside city totaled 11 per cent over last year. *Bradstreet's* reported 161 failures in the United States for the week, against 176 for the previous week, and 189, 162, 133 and 169 for the corresponding week of 1904 to 1901. About 85 per cent of the total number of concerns failing had capital of $5,000 or less, and 10 per cent had from $5,000 to $20,000 capital.

THE WESTINGHOUSE COMPANY has closed contracts with the Northern Electric Company, for sub-station equipment, including three 400-kw motor generator sets. Seven car equipments were also ordered. Deliveries are to be made in three months. Henry A. Butters is interested in the new road which is in course of construction from Chico to Oroville, Cal. Electric power can be obtained from the transmission lines of the California Gas & Electric Corporation. Henry A. Butters, of the Butters' Syndicate, which is interested in electric roals in South Africa, Mexico and elsewhere, has options on electric railway franchises in Colusa and Glenn counties, held by W. T. Forsman and others. He disclaimed personal knowledge of a reported project for a merger of a number of electric roads projected in Northern California. There has been talk of an electric railway project extending from Redding to tidewater through Colusa and Glenn counties. It was suggested that there would be branches to Chico and Oroville, and one to Marysville connecting there with the John Martin line from Auburn and Grass Valley.

THE PELTON WATER WHEEL COMPANY has closed a contract with the Siskiyou Electric Power Company of Yreka, Cal., for a 2,000 hp water wheel for direct connection to a 1,000 kw engine type generator running at 360 r.p.m., the effective head being 700 feet. This makes the second order from this company, which installed a duplicate of this wheel a couple of years ago. Ephraim City, Utah, has installed a 500 hp Pelton wheel under 640 foot head for running a generator for lighting their municipality. The plant recently furnished the Hawaiian Electric Company on the Island of Kauai, is about ready to be installed. This consists of a double Pelton unit of the overhung type, operating under a head of 550 feet and direct connected to a 1,200 kw generator running at 375 r.p.m., the water wheel having a maximum capacity of 2,500 hp. Power is transmitted electrically a considerable distance, and is used in connection with pumping for irrigation, which is attracting much attention of late. Westinghouse generators will be used.

EQUIPMENT FOR BROOKLYN FACTORY.—A six-story factory building is being constructed of reinforced concrete by the Turner Construction Company on the south side of Fifth Street, between Bedford Avenue and Berry Street, for the Fred Gretsch Manufacturing Company, manufacturers of musical instruments and trimmings, 104-108 South Fourth Street, Brooklyn. The main building on South Fifth Street is 72 by 77 feet, with an L 74 feet 6 inches by 44 feet; Mr. Benjamin Finkensieper, 134 Broadway, Brooklyn, is the architect, and Percival Robert Moses, electrical engineer, 320 Fifth Avenue, New York, has been retained as consulting engineer. There will be a complete heat, light and power equipment, consisting of two boilers of 80 hp capacity each, one simple automatic high-speed horizontal 16 by 16 in. engine, direct-connected to an 80 kw. 220 volt direct-current generator operating at about 280 r.p.m. There will also be numerous motors and extensive shafting equipment.

JACKSONVILLE, FLA., MUNICIPAL PLANT.—Bids will be received until October 4 by the trustees of the Water Works and Improvement Bonds for furnishing and setting in place on foundation furnished by the board at the electric light station two 500 kw. steam turbo-generators, a steam-driven exciter set and switch panels; turbines to be run condensing, steam pressure at boilers 150 lbs., no superheat, 27 in. of vacuum; generators to be of the revolving field type, three-phase, 60 cycles, 2,300 volts. Blue prints and specifications are to be furnished with bids. Mr. R. N. Ellis is the superintendent.

ALLIS-CHALMERS CONTRACTS.—The American Graphophone Company, Bridgeport, Conn., has ordered a 600 hp Allis-Chalmers engine, direct-connected with a Bullock generator, to furnish power for the several additions to the plant. The Nevada Copper Consolidated Copper Company with offices in the Schmiedell Building, San Francisco, has closed contracts with the Allis-Chalmers Co. for a complete electric transmission and mining plant, costing about $250,000. There are two generating units, each consisting of a Bullock 1000 k.w., 2200-volt, 3-phase generator direct-connected to a Reynolds-Corliss engine. The location is near Ely, Nevada. The reduction plant includes smelting furnaces, six McDougall roasters, Anaconda rolls, etc.

NORTH TELEPHONE CONTRACT.—The Texas Consolidated Long Distance Telephone Company, which was recently given a franchise granting the privilege of installing and operating a toll telephone exchange in Dallas, Tex., is progressing rapidly with its work. The contract for the entire apparatus, including full central energy lamp signal switchboard, main distributing and fuse board, power equipment and telephones, was placed with the North Electric Company of Cleveland, Ohio. It is announced that the line is completed more than half the distance. It is built of thirty-foot Idaho cedar poles. Three circuits of No. 10 copper wire and one of No. 10 iron will be placed in service at the beginning.

TONOPAH TRANSMISSION ORDER.—The Nevada Power Mining & Milling Company, C. M. Hobbs, manager, has contracted with the Allis-Chalmers Company for a Bullock 1,500 kw three-phase generator for use on its Tonopah transmission system. The original installation is well advanced, two 750-kw National Electric three-phase generators having been ordered some time ago. The prospects for business have increased. Power will be transmitted nearly 100 miles.

STANLEY CONTRACTS.—The Stanley Electric Manufacturing Company, of Pittsfield, Mass., it is reported, has closed a contract with the Bodwell Water Power Company, of Bangor, Me., for eight 1,000 kw generators and necessary switchboards, the cost to be about $75,000. It is also stated that a contract has been secured by the Stanley Company to furnish arc lamps for Seaside Park in Chicago to cost $20,000.

THE BEST MANUFACTURING COMPANY, of Pittsburg, Pa., has secured the contract for furnishing all the high and low pressure valves to be used in the New York Central & Hudson River R. R.'s electric power plants at Port Morris and Yonkers. The "Best" patented gate valves have become well known in the electrical field, and are in use in many of the largest lighting and power plants.

THE OREGON WATER POWER & RAILWAY CO. has given the Stanley Electric Manufacturing Co. a second order calling for six 850-kw transformers, the first order being for nine transformers. All of the equipment at the company's power house on the Clackawas river will be of Stanley manufacture except the generators, which are to be supplied by the Allis-Chalmers Co.

DANA, IND., MUNICIPAL PLANT.—Bids will be received until September 9 for the construction of a municipal electric light plant and power plant at Dana, Ind. Bids will be received for both direct current and alternating current, and will be received on the plant as a whole or on separate items. G. W. Sturm is town clerk.

BALTIMORE CUSTOM HOUSE.—Bids will be received by Jas. Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until September 27, for the installation complete of the conduit and electric wiring system for the United States Custom House at Baltimore.

PHILADELPHIA SUBWAY.—The contract for the construction of the Market Street Subway of Philadelphia around the City Hall and eastward to Juniper Street has been awarded to the E. E. Smith Contracting Company, the cost being estimated at about $3,000,000.

PLANT FOR FORT SNELLING.—Bids will be received until September 8 by R. M. Schofield, Constructing Quartermaster, U. S. A., St. Paul, for constructing an addition to the electric system at Fort Snelling.

THE STANLEY ELECTRIC MFG. CO. has sold a carload of lighting transformers to the city of Seattle for use in connection with the municipal lighting plant.

THE LAMP POOL IN MISSOURI.—According to the St. Louis *Star Chronicle* of August 29, some pretty strong language has been used in the Missouri courts as to the workings of the incandescent lamp pool or association. The Missouri "anti-trust" laws are severe to a degree, and the Missouri American Electric Company, manufacturer of the Miller lamp, is putting up a big fight for their enforcement. The *Chronicle* says: "Methods of gigantic corporations were scored by Judge Smith McPherson in the Federal Court Tuesday morning, when he denounced the attitude of the complainant in the suit of the General Electric Company, of New York, vs. the Missouri American Electric Company, a local concern. 'There are many big concerns in this country,' he said, 'that believe the patent laws were made for their exclusive use. They use them to bully and browbeat smaller manufacturers, and seek by these methods to force them out of business. Fully 75 per cent of these suits are not bona fide,' he continued, 'but are brought for the purpose of advertisement, and with the hope that the minor companies will be forced to quit business because of expensive litigation.' Evidence had been submitted on both side in the suit, which was brought on a complaint of infringement of patent. Both sides had submitted cases, but the complainant company asked for more time to present evidence in rebuttal. Attorney F. R. Cornwall objected on the grounds that several continuances had been granted before, but declared that he would acquiesce if his company's customers would be guaranteed freedom from threatening letters during the interval. He produced letters from the local concern and stated that they were received by customers of the Missouri Electric Company and warning them against using certain brands of goods. Judge McPherson announced himself as displeased with these methods, but granted the continuance after specifically stating that a clause be inserted giving the defendant the right to enjoin the complainant from further annoyance during the time that the suit is pending adjudication."

GENERAL ELECTRIC SALES.—In addition to the very large orders for General Electric apparatus noted recently, the following sales may be noted: 194 railway motors aggregating 8,060 hp for the Illinois Steel Company; 26 induction motors aggregating 650 hp for Griffin Wheel Works, Chicago, Ill.; 11 induction motors aggregating 1,325 hp for Brandon Mills, Columbia, S. C.; two 600 hp induction motors for Montana Ore Purchasing Company, Butte, Mont.; two 25-ton, 150 hp electric locomotives for the Cement Solvay Company, Syracuse, N. Y.; one 750 kw, 2,300-volt revolving field three-phase generator, and three water-cooled 250 kw. transformers stepping up from 2,300 to 45,000 volts for the Gold Mill Mining Company, Gold Hill, Ore.; two motor generator sets, each consisting of one three-phase revolving field 1,000 kw. 4,150 volts, 60-cycle generator driven by a three-phase 1,060 hp, 9,000 volt, 25-cycle synchronous motor for the Commonwealth Electric Company, Chicago, Ill.; two two-phase, 500 kw. 2,300 volt, 60 cycle Curtis steam turbine alternators, one for Portsmouth, N. H., and the other for Chester, Pa.; one three-phase, 500 kw. 4,000 volt, four-wire, 60 cycle Curtis steam turbine alternator for the North Shore Electric Company, Chicago, Il.; one motor generator set consisting of a two-phase revolving field, 400 kw, 2,200 volt, 62½-cycle alternator, driven by a three-phase, 25 cycle, 425 kw. 2,200 volt synchronous motor; one six-phase 500 kw. 280 volt, 25 cycle rotary converter; one six-phase motor operated, 25 cycle potential regulator; three 185 kw. air-blast transformers with voltages of 186 and 11,000, and one 600 kw. three-phase, 25 cycle rotary converter for the Buffalo General Electric Company, Buffalo, N. Y.

WARING-WHITE IN LONDON.—The Waring-White Company, of which J. G. White is one of the principals, is the contractor for the gigantic Hotel Ritz, which is being erected in Piccadily, overlooking the Green Park, London. This building is expected to be one of the wonders of the European hotel world. It will cost upward of $5,000,000. The steel superstructure alone will cost almost a million dollars. The company is also constructing the big offices of the International Mercantile Marine Company, off Trafalgar Square, which building is one of the most conspicuous in the English capital. It is now finished. Other London contracts include the erection of a large hotel to be called the Waldorf, built and equipped mainly on the lines of the Waldorf-Astoria. Contracts have also been undertaken for the construction of two large apartment houses, one to be named Harley House, to be in the northwest residential district, while the other building is to be adjacent to the French Embassy, facing Hyde Park. The Waring-White people have also secured the contract for the new Liverpool Cotton Exchange. These buildings will be the first to be erected in England on the American method of self-supporting steel frame construction. As already noted in these columns, J. G. White & Company, of London, are busy with new electric traction work for the London County Council, involving $800,000.

THE INDEPENDENT CARBON COMPANY is the new name of the United States Carbon Company, with headquarters at Cleveland. The capital stock of the new company is $500,000. The incorporators are Gustav Von den Steinen, G. W. Cottrell, John P. Dempsey, H. E. French and W. E. Stewart. The men interested in the company include M. B. Daly, general manager of the East Ohio Gas Company, who recently purchased the United States Carbon Company, and several men who have large interests in the Standard Oil Company. Plans for improving the old plant of the United States Carbon Company were announced some time ago. It was stated that about $100,000 would be spent for improvements at once. It was also intimated that when the volume of business warranted it, other plants would be built, in Ohio, for the most part.

THE DIESEL ENGINE.—An American Diesel gas engine of 225 horse-power is to be installed in the central station of the Pittsfield, Mass., Electric Company's station about November 1. The engine will cost about $12,000. If the tests are as successful as anticipated the old steam engines in the plant will be replaced. Several months ago W. A. Whittlesey had plans prepared for a large light and power plant in which gas engines were to be used for motive power for dynamos. The plant was to have been located near Goodrich Pond in the east part of the city, and was to be operated and conducted independent of the Pittsfield Electric Company. It is possible that a stock company may be organized in the near future and the scheme carried out as originally planned.

EQUIPMENT FOR SUGAR MILL.—A large sugar mill is under construction in Jatibonico, Cuba, by Hugh Kelly & Company, 79-85 Wall Street, general constructors for the Cuba Company, owner. Percival Robert Moses, electrical engineer, of 320 Fifth Avenue, has been retained as consulting electrical engineer. The mill house will be 60 ft. x 325 ft. with machine shop 30 ft. x 90 ft. The electrical equipment consists of two 270 kw, 500 volt, direct-current dynamos, two 250 hp shunt-wound motors for driving vertical centrifugal pumps, switchboard, pump motor panel and wiring material and arc lamps. The entire electrical equipment will be furnished by the Westinghouse Electric & Manufacturing Company.

THE NEW HAVEN WATER & POWER COMPANY will place a force of men at work next week to construct the poles for the line by which it will transmit electric power to Middletown, Harrisburg,, Pa., and other points in Dauphin and Lancaster counties. Agents of the company are still engaged in securing rights of way for the construction of the proposed line, and it is said that the corporation will soon have all of the necessary rights so that it can dispose of its power across the river. Preliminary work is now being done for the laying of the cable beneath the Susquehanna River from the York Haven plant to a point on the Lancaster County shore, where a terminal station will be built.

LONG ISLAND TROLLEYS.—The *New York Herald* says that the announcement to the effect that the Central Long Island Electric Light & Railway Company has prepared an application for a two-tracked trolley line from the Manhattan terminal of Blackwell's Island bridge to Little Neck, in Queens, for submission to the Board of Estimate, indicates that the Metropolitan intends to push its fight for new traction lines into the Belmont field in Queens Borough. It further says that the same company made application to the Nassau County authorities some time ago for a franchise to extend this line from Little Neck to Oyster Bay through Great Neck, Port Washington, Roslyn and Glen Cove.

GLASS FACTORY FOR FOSTORIA.—The Fostoria Glass Specialty Company will start work at once on a two-story brick building, the dimensions of which will be 100 x 80, for use as a finishing department. The building with its equipment will cost approximately $15,000, and will furnish employment for nearly 150 men and boys. While in itself a good thing for Fostoria, the new improvement is better for what it promises for the future. The National Electric Lamp Company, Cleveland, owns the two glass factories and the Incandescent Lamp Company, of Fostoria, and the erection of the finishing plant is understood to mean that much more may be expected.

BALTIMORE PRINTING PLANT.—The plant of the new Baltimore *American* Building consists of two 150-kw Curtis turbo-generating units and about 50 electric motors of various sizes. The two boilers are of the marine type, of 150 horse-power each. An air compressor for supplying air hoists for the transfer of the large rolls of paper to the printing presses is driven by chain from a 30 hp power motor. This compressor also forces ink to the presses and energizes a pneumatic tube system. The two Hoe presses, motor-driven, have each an hourly capacity of 200,000 12-page papers.

ELECTRICAL SUPPLIES FOR CHICAGO.—Bids will be received until September 8 by William Carroll, city electrician, for furnishing to the Department of Electricity the following supplies: 1,500 or more cedar poles, 6-in. tops; 1,500 cross arms; 3,000 cross arm braces; 3,000 locust pins; 5,000 lag bolts; 5,000 washers; 10,000 pole steps; 10,000 triple petticoat glass insulators, and 100 miles of No. 6 triple braid weatherproof electric light wire.

PLANT FOR CARTHAGE, MO.—The city of Carthage, Mo., will purchase shortly two 60-cycle, 2,200-volt, 2-phase alternators of the belted type; also a condenser to handle the present steam plant. Mr. W. H. Stout is chairman of the Light Committee and Mr. A. P. Knowles is superintendent of the plant.

Financial Intelligence.

THE WEEK IN WALL STREET was in many respects a surprising one. The stock market had come to follow in its rise and fall the prospects of peace between Russia and Japan, and it had been assumed by many that if the negotiations were successful, all prices would soar. As a matter of fact, just the exact opposite happened, and when the thing was settled the whole market went to pieces. Perhaps the news had been discounted, but that was not enough to account for the break, which may have been due to the financial difficulties in Paris, the call for money to move the crops and the fear that both the exhausted Powers might want heavy loans, which would make deep inroads on available capital otherwise invested in stocks. There was a partial rally toward the end of the week, quite natural in view of the continuing strength of every good condition, but it was not sufficient to wipe out the declines. General Electric closed at 180 last Saturday, or a decline of 2½. Westinghouse Electric was off 3½ to 166½, Allis-Chalmers preferred 3⅛ to 53. The tractions were also weak, Brooklyn Rapid Transit going off 2⅜ to 68¾, Manhattan Elevated 1½ to 165, Metropolitan Street Railway 3¼ to 128⅞. Western Union Telegraph, however, held firm at 94⅛, a rise of ⅛, and Electric Storage Battery was steady at 85½, a gain of ½. Quotations are given below of leading stocks on September 5:

NEW YORK

	Aug. 29	Sept. 5		Aug. 29	Sept. 5
Allis-Chalmers Co.	16⅛	15½	Electric Vehicle	17	17
Allis-Chalmers Co. pfd.	53	54	Electric Vehicle pfd.	23	21
American Tel. & Cable	90	90	General Electric	182	180⅛
American Tel. & Tel.	139	138	Hudson River Tel.	..	..
American Dist. Tel.	31	30	Interborough Rap. Tran.	213	219
Brooklyn Rapid Transit	70⅝	69¼	Metropolitan St. Ry.	131¼	129⅛
Mackay Cos.	40⅛	40¾	N. Y. & N. J. Tel.	..	..
Mackay Cos. pfd.	73½	73¾	Marconi Tel.	..	..
Electric Boat	26	30	Western Union Tel.	93¾	94⅛
Electric Boat pfd.	65	65	Westinghouse com.	170	166
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..

BOSTON

	Aug. 29	Sept. 5		Aug. 29	Sept. 5
American Tel. & Tel.	141	141⅛	Western Tel. & Tel. pfd.	97½	98½
Cumberland Telephone	118	118	Mexican Telephone	1¼	1⅛
Edison Elec. Illum.	253⅛	253	New England Telephone	134	134
General Electric	181½	180	Mass. Elec. Ry.	18½	17
Western Tel. & Tel.	*18	*18	Mass. Elec. Ry. pfd.	61	60

PHILADELPHIA

	Aug. 29	Sept. 5		Aug. 29	Sept. 5
American Railways	53	53½	Phila. Traction	101	101
Elec. Storage Battery	87¼	86	Phila. Electric	9	8¾
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	28⅜	28¼
Elec. Co. of America	11⅛	11			

CHICAGO

	Aug. 29	Sept. 5		Aug. 29	Sept. 5
Chicago Subway	84⅛	83¼	National Carbon pfd.	115	115⅛
Chicago Edison	158	..	Metropolitan Elev. com.	26	24½
Chicago City Ry.	182	..	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	62	61			

* Asked.

REPORT OF ALLIS-CHALMERS.—The consolidated general balance sheet of the Allis-Chalmers Company as of June 30, 1905, as compared with April 30, 1904, is as follows:

Assets—	1905.	1904.	Changes.
Real estate, plants, good will, etc.	$30,535,770	$30,246,085	Inc. $289,685
Bonds and shares	165,000	...	Inc. 165,000
Bills and accounts receivable	3,628,778	3,437,520	Inc. 191,258
Mdse., stocks, etc.	3,478,725	2,914,878	Inc. 563,847
Cash	516,483	1,060,113	Dec. 543,630
Bullock Co., etc.	...	463,000	Dec. 463,000
Totals	$38,324,756	$38,121,596	Inc. $203,160
Liabilities —			
Preferred stock	$16,150,000	$16,150,000	...
Common stock	19,820,000	19,820,000	...
Bullock Elec. Co., payable Mar. 1, 1929	110,128	...	Inc. $110,128
Accounts payable	1,080,951	1,014,396	Inc. 66,555
Mortgage Norwood Foundry	...	34,000	Dec. 34,000
Dep'n reserves	815,388	478,365	Inc. 337,023
Surplus	348,289	624,835	Dec. 276,546
Totals	$38,324,756	$38,121,596	Inc. $203,160

The fiscal year of the company has been changed to end on June 30 instead of April 30. The net profits of the fiscal period ended June 30, 1905, after deducting all expense of manufacturing and selling, and after making provision for the depreciation of business and machinery, and for possible bad debts, amounted to $68,982. For the fiscal year ended April 30, 1904, the net profits were $952,624, out of which dividends of $853,125 were paid on the preferred stock, leaving a surplus for the year of $99,499. President Warren in his annual report says: "The contraction in general business referred to in the last annual report, as then justifying the postponement of dividends, continued during the first half of the last fiscal period, with particular manifestation in the steam engine department of this company. This was due largely to the introduction of steam turbines, especially those of large capacity, for which certain manufacturers had been preparing for several years. Our engineers have been engaged during the last year in improving our established standard lines of apparatus and machinery, and in reducing its cost. Particular attention and effort have been devoted to developing and perfecting a line of steam turbines, gas engines, centrifugal pumps, hydraulic turbines, steam turbo-generators, hydraulic turbo-generators, induction motors, street railway motors and controlling devices therefor, transformers, steam and hydraulic dredges and steam shovels. Soon after the beginning of this calendar year an improvement was manifested in the general business of the company, the orders increasing in April to the normal volume and since then exceeding in extent the previous record of the organization; but the results of these orders will be realized only upon their execution and the delivery of the work. This increase pertained more particularly to the older branches of the business of the company."

VALUE OF CHICAGO SUBWAY.—Mr. H. Allaway, in the special financial column of the *New York Tribune*, says: "The extraordinary appreciation of New York's Interborough Subway seems sure to be duplicated, the Chicago property being a carrier of freight in contrast with the exclusive passenger traffic of the New York company. Against the New York Interborough Company's $35,000,000 capital have been issued $35,000,000 city bonds, and it is understood they have issued $10,000,000 notes for equipment. They own the Subway and a lease of the Manhattan Railroad Company on a 7 per cent guarantee. The Interborough Rapid Transit Company was formed with a capital of $25,000,000 to complete and operate the Subway, so that in round numbers they have $35,000,000 bonds, $35,000,000 Interborough stock and $35,000,000 Interborough Rapid Transit Company stock—a total of $95,000,000—and Interborough Rapid Transit stock is quoted at 215 per share. Upon the other hand, the stock of the Chicago Subway is $40,000,000, and this is a holding company, having issued about $17,000,000 bonds (out of $30,000,000 authorized), and has thirty-three miles of tunnel completed, connecting with all the depots, wholesale houses, hotels and shipping docks of Chicago. Comparing receipts, the New York company carries passengers at five cents each, down in the morning and back in the afternoon (six to ten miles), and does comparatively little at night, while Chicago Subway handles freight, and the lowest revenue it receives is sixty cents per ton for hauling a distance of one mile—and the system will be in use 24 hours a day. Now, any railroad will haul soft coal 200 miles at three mills per ton per mile, or sixty cents per ton for 200 miles, and consider it profitable. There is no city in the world where business is so congested in a mile square as in Chicago."

LOS ANGELES LIGHTING.—It is stated that the Edison Electric Company, of Los Angeles, is in negotiations for the purchase of the Redlands Gas Company and that it has already acquired the plants of the Riverside Light & Fuel Company, Pomona & Ontario Light & Fuel Company, and Whittier Light & Fuel Company. The purchase price is said to approximate $500,000, the buyers assuming bonded indebtedness of about half that sum, and paying the remainder for stock of the three companies. The Edison Company already supplies gas and electricity in Santa Barbara, Long Beach, Ocean Park, Santa Monica, San Pedro and Santa Ana. It has light and power plants at Pomona and Whittier, and it is engaged in the lighting and power business at Redlands, whence it may extend power lines to Riverside. The cities in which the Edison Company operates electric, but not gas, plants are Los Angeles, Pasadena, Redlands, Colton, Orange, Fullerton, Redondo and Monrovia.

FAILURE OF ENGLISH MAXIM CONCERNS.—A lot of concerns are being wound up in England that have gathered under the Sir Hiram Maxim Electrical & Engineering Company, Limited, and have in some way or other had the name of Maxim in their titles. These companies were interested in lamps, flying machines, etc., etc., and their affairs appear to have become pretty badly entangled, owing chiefly to operations in each other's stock, and little real business on the whole seems to have been done since the first of these Maxim companies was formed six years ago.

TROLLEY MERGER IN TEXAS.—A special dispatch from Dallas, of September 5, says: "A report has reached Dallas that a big company is being formed by Eastern and Western capitalists for the purpose of taking over all the street car lines in Fort Worth, Dallas, Houston, Galveston and several other Texas cities and merging them into one corporation. It is said that a meeting is to be held during the current week in St. Louis to further the plan."

DIVIDENDS.—The quarterly rental of 1¾ per cent on Metropolitan Street Railway stock will be paid on October 15. The directors of the South Side Elevated Railroad of Chicago have declared the regular quarterly dividend of 1 per cent, payable September 30.

General News of the Week

The Telephone.

MOBILE, ALA.—The Home Telephone Company, of Mobile, Ala., an independent corporation, has notified the Secretary of State of an increase in its capital stock from $40,000 to $350,000.

LITTLE ROCK, ARK.—M. H. Patterson, owner of the Augusta, McCrory and Clarendon telephone exchanges, is arranging to extend the long-distance lines of the Augusta exchange to Memphis.

MORGAN HILL, CAL.—The Sunset Telephone Company will in the near future install a telephone system here.

HANFORD, CAL.—P. Kerr Riggins, of Los Angeles, has applied for a franchise for a telephone system in this city.

COMPTON, CAL.—The Compton Telephone Company contemplates erecting a new building for its own use. A new switchboard will go in and many improvements be made.

SAN BERNARDINO, CAL.—A franchise for a pole line for electricity, petitioned for by Lytle Creek Power Company, promoted by Judge John L. Campbell, will be advertised for sale.

GOLD RIDGE, CAL.—The Gold Ridge Improvement Company has been incorporated by C. M. Weeks, A. B. Swain and others. Capital, $11,500. The company has been formed for the purpose of owning and operating telephone and telegraph lines at Sebastopol.

ALAMEDA, CAL.—The Home Telephone Company, of Alameda County, has been incorporated with a capital stock of $3,000,000, the directors being William Thomas; Thomas S. Parkhurst, Jr., L. S. Ackerman, J. E. Schoenfeld, J. Robinson, William L. Gerstle and L. Webster. This is one of several branch companies incorporated by the main concern.

SAN FRANCISCO, CAL.—The main switchboard for the Pacific States Telephone & Telegraph Company's new main telephone exchange on Bush St., near Grant Ave., has been completed by the Western Electric Company, at Chicago, and shipped. This board will have a capacity of 25,000 subscribers. The company's new brick buildings are approaching completion and the new central energy system will be extended throughout the city as rapidly as possible.

OAKLAND, CAL.—Application has been made to the City Council by William Thomas for the Home Telephone Company of Alameda County for a franchise to establish an automatic telephone service. Judge John G. North, who presented the petition, stated that the company would file a bond of $100,000 for the faithful performance of a contract, would begin work within three months, and would expend at least $850,000 within three years to complete the work. The city would be furnished with twenty-five telephones free.

COLORADO SPRINGS, COLO.—The telephones, switchboard and electric appliances of the El Paso Telephone Company, operating in Colorado City, have been sold under chattel mortgage held by the Chicago Telephon Supply Company, for $4,648.43. Attorneys Spurgeon and Cassidy, representing the creditors, bid the stock in for $4,250. The sale of the poles and wires, under a chattel mortgage in favor of R. A. and R. M. Handy, of this city, has been postponed.

WILMINGTON, DEL.—By order of the court the Burke County Trust Company, trustee under the mortgage, has sold to R. D. Brown all the property and franchises of the Standard Telephone & Telegraph Company. The price was $50,000. This company, which went into the hands of a receiver a few months ago, has been operating less than four years. It was not able to meet its current operating expenses or to lay aside a fund to offset the depreciation of its plant.

WASHINGTON, D. C.—E. A. Hess, of Lyons, Ia., has been given the contract for building a telephone line from opposite Glendive, Mont., to Buford, N. D., for the Government Reclamation Service, at $15,932.

LUTHER, IND.—The Luther Telephone Company has been organized. Capital, $1,500. Incorporated by Henry Wilson, president; William O. Stall, secretary.

PAOLI, IND.—The Lost River Telephone Company has been organized at this place for the purpose of operating in Orange County. Directors have not been chosen. Capital stock, $325.

ANGOLA, IND.—At a recent meeting of the directors and stockholders of the Steuben County Electric Telephone Company, L. Taylor, president; E. A. Wilder, secretary, the capital stock was increased from $50,000 to $100,000.

MARION, IND.—The Converse Telephone Company, an independent concern, which has recently established a toll service between Marion and Converse, now desires to run a line south of Marion for both telephone and telegraph purposes.

TERRE HAUTE, IND.—The owners of the independent telephone systems in this city, Dana, Sandaford and Libertyville, also certain towns in Illinois, have organized the Citizens' Mutual Telephone Company, with a capital stock of $50,000. The organization aims to obtain franchises for central office in Paris, Ill.

FRANKFORT, IND.—The council has granted the New Long Distance Telephone Company, of Indianapolis, the franchise the company sought, but the terms of the franchise forbid the company establishing a local exchange in the city, and it is to be used only for toll service. The rate to Indianapolis is 25 cents and in the county, 15 cents. The franchise runs for 25 years.

FRANKFORT, IND.—The Frankfort City Council has granted a franchise to the New Long Distance Telephone Company, giving it the right to construct and operate a telephone system in Frankfort for 25 years. The Central Energy Telephone Company of Frankfort was recently bought by the Central Union Telephone Company, thus giving the Bell Company a monopoly of the telephone business in Frankfort.

ALBION, ILL.—The Edwards County Mutual Telephone Company has increased its capital from $4,048 to $25,000.

DECATUR, ILL.—The Long Distance Telephone & Telegraph Company has increased its capital stock from $500,000 to $1,000,000.

ATHENS, ILL.—The Independent Telephone Company is busy putting in new telephones and doing a good deal of wiring.

GALESBURG, ILL.—Architect William Wolf, of this city, has been employed to furnish plans for the Union Telephone Company's new building here, to cost $40,000.

JOLIET, ILL.—The Interstate Telephone Company has a force of men at work constructing a line to Beecher, where an exchange office will be established. Lines are to be extended in every direction in eastern Will County.

GALESBURG, ILL.—F. C. Woods, manager of the Galesburg Union Telephone Company has returned from Lafayette, Ind., where he practically closed the deal for $20,000 worth of new Sterling equipment for the exchange building which the company is to erect in this city.

COUNCIL BLUFFS, IA.—The Independent Telephone Company will install a manual system.

SIOUX CITY, IA.—The Sioux City Telephone Company has inaugurated its automatic telephone service in Sioux City.

DELMAR, IA.—The Clinton County Telephone Company has been incorporated. Capital, $15,000. C. C. Davis, president.

DES MOINES, IA.—The Sherman Telephone Company has been formed. Capital, $2,000. Incorporated by J. C. Emery and others.

MUSCATINE, IA.—The Mississippi Valley Telephone Company's loss to exchange office, wires, etc., from a fire, was $1,500; small insurance.

SIOUX CITY, IA.—The Sioux City Telephone Company is now inaugurating its automatic telephone service in Sioux City. The construction of the plant and installation of the system was begun about a year ago, and is now nearly completed.

ARDMORE, I. T.—J. D. Templeman, of Lafayette, Ind., has been investigating the possibilities in a new telephone system for this city.

DANVILLE, KY.—The Danville Home Telephone Company, with a capital of $5,000, has been incorporated by Saml. Menifee, editor; G. W. Welsh, cashier, Farmers' National Bank, Danville; Capt. Wm. Herndon, attorney; W. Ross Bastin, electrician and H. V. Bastin, electrical engineer, Lancaster, for the purpose of putting in a copper line from Danville to Harradsburg, ten miles, to connect with the Louisville long-distance lines and to put in 30 toll telephones in Danville. This company will take the Bastin line from Lancaster into their switchboard. The Bastin lines connect with southeastern Kentucky.

HAVRE DE GRACE, MD.—The American Telephone & Telegraph Company has reached Havre de Grace with the erection of poles for the long-distance lines, and now has a large force of linemen engaged in putting up poles on the right of way through the city, which was recently granted them by the Mayor and City Council.

CAMBRIDGE, MASS.—A new telephone company has been organized and is now constructing a line from Cambridge over the old Birmingham road to Odell. The organization is known as the North Eastern Telephone Company. The officers are J. T. Beggs, president; Reuben Banker, vice-president; J. M. Willis, secretary; W. F. Geary, treasurer. Directors: D. E. Braden, David Milligan and T. D. Ferbrache.

OWATONNA, MINN.—The Northwestern Telephone Company is expending $40,000 in local improvements, including new switchboards.

MINNEAPOLIS, MINN.—A new exchange board will probably be installed in the courthouse by the Northwestern Telephone Exchange Company.

ADA, MINN.—The Norman County Telephone Company has completed a deal whereby it becomes owner of the entire system of telephones in the county.

SPRINGFIELD, MINN.—The Springfield Farmers' and Citizens' Mutual Telephone Company intends to build two more rural lines before the cold weather puts a stop to the work of construction.

OKOLONA, MISS.—The city of Okolona has granted Dr. J. E. Givham, of the Okolona Telephone Company, valuable concessions in the construction of his system here. Dr. Givham has one of the best local and long distance telephone systems in the State of Mississippi. It will be known as the Okolona Telephone Company.

MAGNOLIA, MISS.—The Home Telephone Company is transferring all of its holdings in this county to the Cumberland Telephone Company, the two-year lease of the lines held by the Home Company having expired August 1. Two years ago the two companies were operating in competition, and by an agreement the Home Telephone Company was to have the use of all the lines of the Cumberland, in Pike County, for a term of two years; at the expiration of that time all the property was to go to the Cumberland. The new management has sent H. B. Walthall here to take charge of affairs here and at Osyka.

PURCELL, MO.—Work is being pushed very rapidly on the new Home Telephone system and quite a number of telephones have been installed. The work will be completed in a few days.

GLASGOW, MO.—George Dice has been extending his telephone lines, building into Pattonsburg and Mabel. They will soon be connected with Hamilton and Winston.

GLENDIVE, MONT.—A telephone line is projected to Wibaux, 35 miles east. The Hughes Electric Company is planning it.

MILES CITY, MONT.—A stock company is being formed to build a telephone line from Miles City to Ekalaka. A. Laney is interested.

CAMDEN, N. Y.—The Camden Home Telephone Company has been formed; capital, $25,000. Directors: J. F. Sorekweel, Oswego; B. D. Stone, A. C. Woodruff, Camden.

NEW YORK, N. Y.—The Auto Telegraph Company has been incorporated; capital, $100,000. Directors: H. M. Angle, E. V. Fleming, Brooklyn; G. S. Jacob, Ocean Grove, N. J.

ROME, N. Y.—The new home of the Clinton Home Telephone Company is nearly completed. The whole equipment is first class and built for permanency. The wires through the business portion of the town are laid in a subway capable of carrying wires enough to serve a city of 10,000 inhabitants.

CLARENCE, N. Y.—Incorporation papers of the Pioneer Telephone Company, which proposes to construct a line serving all the towns of Erie County, have been filed. The capital stock is $10,000. The directors are: C. D. Cramer, O. A. Martin, William Bald, E. Weinanger, H. C. Britting, F. C. Goold and F. W. Schaad. Headquarters will be at Clarence.

LEXINGTON, N. C.—P. W. Siebert, of Lexington, N. C., has secured the right to install an interurban telephone system between a number of towns in the State.

GRAND FORKS, N. D.—The property of the North Dakota Telephone Company, or enough of it to pay a judgment of $7,599.20 in favor of Edwards-Wood & Co., has been sold by the sheriffs of Grand Forks, Traill, Nelson and Ramsey Counties.

TIFFIN, OHIO.—Mr. James T. Carbin has transferred to the Farmers' Telephone Company, of Fireside, the Bloomville telephone exchange and about 65 miles of toll line.

SALEM, OHIO.—Manager W. S. Holloway, of the Columbiana County Telephone Company, is supervising at the local office of the company the preparation of a fine, new and modernly equipped Kellogg switchboard, which it is intended to install at the Sebring exchange.

CLEVELAND, O.—It has been decided that the Federal Telephone Company will not be liquidated this fall. In fact, it is thought that the telephone company will be held together for two or three years. The syndicate decided last summer that it would be advisable to liquidate the Federal and divide up its securities among its creditors, but lately they have come to the conclusion that such a course would not be advisable.

TIFFIN, OHIO.—James T. Carbin has transferred to the Farmers' Telephone Company, of Fireside, the Bloomville telephone exchange and about 65 miles of toll lines, embracing circuits extending from Bloomville to Tiffin, Bucyrus, Shelby, Republic and intermediate points. The consideration was about $15,000. Mr. Carbin a few months since transferred to the same company the telephone exchange at Republic for $6,000, and in a short time previous sold to other parties his toll line to Nevada, Chicago Junction, and several small towns in Crawford County.

BAKER CITY, ORE.—The Independent Telephone Company, of Boise, will soon establish a system of telephones in this city.

SALEM, ORE.—The Home Telephone Company, which has secured a franchise for a new telephone system in Portland, and which is seeking a franchise in Eugene, will apply for permission to establish a system in Salem, where there is a good field.

PORTLAND, ORE.—Chas. E. Sumner has purchased property on Burnside Street for the Automatic Telephone Company, at a cost of $30,000. It is understood that this will be used as site for headquarters for the new telephone company.

BEAVER FALLS, PA.—The Central District and Printing Telephone Company will erect an exchange in this city, to cost $15,000. Plans are about completed by Architects Alden & Harlow.

CLAYSVILLE, PA.—The Chartiers Telephone Company, which formerly connected with the Claysville Telephone Company through the Federal Company's lines, is arranging for the construction of a new line from Buffalo village to Taylorstown, where connections will be made with the Claysville Telephone Company's lines. The same company is also arranging for the construction of a new toll line between Canonsburg and McDonald.

MILANO, TEX.—A company of Hanover and Milano citizens has organized what is known as the H. R. F. Telephone Company, which is constructing a line from Milano to Hanover. This line will be in operation by September 1. The contract for building the line was let to Mr. Tom Iglehart, of Cameron.

VIRGINIA BEACH, VA.—The Princess Anne & Virginia Beach Telephone Company has been formed with a capital of $5,000. Incorporated by J. Woodhouse, president; John S. Woodward, secretary, both of Norfolk.

CHEHALIC, WASH.—The City Council has directed that an ordinance be prepared granting a franchise to the Sunset Telephone Company.

FERNDALE, WASH.—A mass meeting has been held for the purpose of ascertaining feeling in the matter of installing a new telephone system from this place to Bellingham. The majority favored the move.

MONTEREY, MEX.—Mr. Juan Woessener, owner of the Telephone system, has begun the construction of a long-distance line between this city and San Pedro.

STOUFFVILLE, ONT.—With a capital stock of $40,000 and head offices at Stouffville, Ont., the Bethesda & Stouffville Telephone Company has received articles of incorporation from the Ontario Government. This new company is to carry on a general independent telephone business in the County of York and in the townships of Pickering and Uxbridge adjoining.

Electric Light and Power.

STANISLAUS, CAL.—The Stanislaus Water & Power Company, for which Sanderson & Porter acted as engineers, is doing preliminary work under the direction of Beach Thompson, the promoter. An available head of 1,500 feet will be secured by taking water from the Stanislaus River. San Francisco is the objective point of the new system.

SAN FRANCISCO, CAL.—The Oroville Water, Light & Power Company, of Oroville, Cal., has issued specifications calling for the equipment of its new water power electric transmission plant. Two 750-kw, three-phase generators, 2,000 to 2,300 volts with alternative of two 1000-kw generators are included. There will also be required raising and lowering transformers, switchboard and sub-station equipment. Cory, Meredith & Allen are the engineers.

WASHINGTON, D. C.—The District Commissioners have decided to have one lighting and heating plant constructed to supply both the new municipal almshouse and the industrial home school.

QUINCY, FLA.—The citizens have voted to issue $5,000 bonds for improving the water works and electric light plant.

JACKSONVILLE, FLA.—The Florida Electric Company announces to the public that hereafter its business will be conducted on the open-shop basis—that is, the employment of union and non-union men without discrimination.

SALT LAKE CITY, UTAH.—J. H. Bigger and J. E. Hill, of this city, are arranging to establish a 950-hp electric lighting and power plant in the American Fork mining district.

ATLANTA, GA.—Comptroller General William A. Wright has assessed the franchise of the Atlanta Water & Electric Power Company at $424,000, after the company had returned its franchise value under protest at $100. This company owns the $1,000,000 plant at Bull Sluice Shoals, on the Chattahoochie River, and is sending the current into Atlanta. The company, when directed by the comptroller general to make a return of its franchise, replied through President Forrest Adair that it had no taxable franchise and nothing in that line, therefore, upon which to make a return.

BLACKFORD, IDAHO.—E. W. Wade, of Ogden, and Christian Just, of Blackfoot, are interested in the construction of a plant on Blackfoot River, to supply Idaho Falls, Blackfoot and other cities with electric light and power. The probable cost of the plant is $100,000.

CLINTON, IND.—The Clinton Electric Light Company has purchased and will install two Westinghouse dynamos and one 150-hp Hamilton-Corliss engine. A new dynamo room is being built.

SPRINGFIELD, ILL.—The City Council has authorized the Mayor to take over the properties and plant of the Springfield Electric Light & Power Company.

PORTLAND, ME.—Citizens' Water & Light Company has been formed. Capital, $230,000. President, C. E. McGlauflin; treasurer, H. L. Cram. Directors, as above and A. F. Pine, all of Portland.

BIDDEFORD, ME.—The Pepperell Manufacturing Company, of Biddeford, Me., is to install an electric light plant to light both the Pepperell and Laconia division by electricity, instead of by gas, as at present. The plant will be installed this fall and be in working order for the winter days.

AUGUSTA, ME.—The Kennebec Light & Heat Company has recently purchased a new three-phase generator. The new machine will be used for the purpose of generating the power that is to be used at East Winthrop, and for the Tayntor Co., at Hallowell, and probably the State House will also be lighted from this machine.

HYATTSVILLE, MD.—The Town Council is considering the question of constructing a municipal electric light plant.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has advertised in the local papers the notable fact that since the great fire it has doubled its business in 16-c.p. lamp equivalents, and has tripled its power service in horse-power of motors connected. Mr. D. Barnett, formerly of New York, is the energetic manager of the system.

ELKRIDGE, MD.—A delegation from the First, or Elkridge, district of Howard County has been before the county commissioners to protest against any change in the method of lighting the village of Elkridge. The delegation brought a numerously signed petition. About a month ago a five-year contract was awarded to the Patapsco Electric Lignting Company, of Grays, Baltimore county, calling for 1,800-cp lights, the wiring to be completed and service begun October 1. The system now in use, supplied by the United Electric Company of Baltimore, furnishes arc lights of 2,000 cp. The petition claims that the same amount of money is required for fewer lights under the new contract.

LOWELL, MASS.—The present contract with the Welsbach Company expires on Sept. 15. There are two propositions, first to light the streets by electricity at $22.75 a lamp, and, second, to light the streets by the Welsbach system of gas lighting at $28.50. The demonstrations of the Nernst lamp have emphasized the great difference in the two propositions in favor of the Nernst.

HOLYOKE, MASS.—Manager Snow of the municipal gas and electric department, announced to-day the annual report of the department required by the State lighting commission. In spite of reductions in the price of gas and tar, the returns of the gas department show a profit, although it is about $19,000 less than last year. The electric department receipts show a profit of $14,767.00. While this report shows a working period of a year, yet it is not the annual report made to the mayor. The profits of the department for the year were $18,485.52.

GRAND RAPIDS, MICH.—The Grand Rapids & Muskegon Water Electric Power Company, owning flowage rights on the Muskegon River and the biggest power dam in western Michigan, located near Big Rapids, has entered Grand Rapids for the purpose of supplying light and power for commercial purposes. The Muskegon Company already has the contract for furnishing power to the Grand Rapids & Muskegon interurban, and it has been reported that the new deal involves the furnishing of power, also, to the Grand Rapids & Holland interurban.

FRANKLIN, N. H.—Work is now under way on the new reservoir, to be used in connection with the city water system. Electric power will be used for pumping.

PORTSMOUTH, N. H.—The contract for the electric power plant at Freeman's Point has been awarded by the Publishers' Paper Company to the General Electric Company. Work will begin at once. This contract involves an outlay of more than $100,000.

LACONIA, N. H.—The Laconia Electric Light Company has begun furnishing power for the street railway. The lighting company has secured control of the Meredith plant, and wires will be run from The Weirs to that place before winter sets in. It is the intention of the new owners to use the Meredith plant as a reserve power, to be used as occasion demands. The latest acquistion to the plant is a 225-hp engine.

SHELBURNE, N. H.—An important deal has been consummated for a new water power plant. The contract has been let to Ward Brothers, of Berlin, for the construction of a dam across the Androscoggin, which at this point is 350 feet wide, and a power-house 110 x 50 feet, the total cost being estimated at between $75,000 and $100,000. It is the purpose of the Berlin Electric Light Company to transmit electric power to Berlin and it is expected that at least 1,200 hp will be available from this new source. The power-house will be of concrete and will be fireproof.

PORTSMOUTH, N. H.—The Rockingham County Light & Power Company, of this city, which furnishes power for the light of the New Hampshire Company all over the southern part of the State and also lights this city, has served notice through its counsel, Judge Samuel W. Emery, on Mayor Marvin and City Clerk Underhill that it has brought suit against the city of Portsmouth for unjust taxation of the company's plant in this city. The company was assessed on an appraisal of $451,250, which it claims is over-valued to the amount of $277,818.

UTICA, N. Y.—Work has been started on the pump house of the Hudson River Electric Power Company, north of the new power plant on the river bank. The first of the permanent turbines will arrive and will be put in position about October 1. Those now in use are only temporary and their combined capacity is 2,000 kw. The first of the permanent generators to be erected will supply this power alone and as it will be placed on an extra base in the plant the work of establishing it will not interfere with the operation of the other turbines.

STATESVILLE, N. C., at a recent election, voted $20,000 for water and for improving the electric lighting system of the town.

GREENSBORO, N. C.—The Greensboro (N. C.) Electric Company has installed four 300-hp boilers, thereby doubling the capacity of its plant in the city.

GENEVA, OHIO.—A new engine for the Geneva Illuminating Company has arrived. The engine was made by the Erie City Iron Works and is a 200 hp.

GALION, OHIO.—The Crawford County Gas & Electric Company has been granted an ordinance which gives it the right to use the streets, alleys, and public grounds of the city of Galion, Ohio, for the purpose of erecting and maintaining an electric power plant. The Crawford Company will erect a plant to be completed and in practical operation within one year from the date of the passage of the ordinance.

WILLIAMSPORT, PA.—The Lycoming Electric Co. has taken out a permit to erect a new power house, to cost about $75,000.

SINKING SPRING, PA.—The Cumru Township Electric Light & Power Company has been formed, with Wm. F. Krick, of Sinking Spring, as president, to furnish electric light in Sinking Spring and Shillington. Capital, $5,000.

GREAT CATAWBA FALLS, S. C.—Three hundred men are already at work on the immense water power development of the Southern Power Company at Great Catawba Falls in upper South Carolina. The entire developments along the Catawba will represent an outlay of perhaps two million dollars.

CLINTON, TENN.—The City Council has passed on first reading the ordinance granting Wm. B. Crawford, of Oliver Springs, a franchise for water works and an electric light plant.

GREAT FALLS, TENN.—The Great Falls Power Company, proposing a big water power development near Nashville, Tenn., has asked for an etension of time limit of the franchise and will likely be favored. Already sufficient money has been promised, it is said, for the construction of the electric plant which the company proposes to build, and from which power will be furnished to Nashville.

BAY CITY, TEX.—By order of the court the Bay City Ice, Light & Power Company's plant will be offered for sale to the highest bidder by Special Commissioner Judge W. C. Carpenter early in September. This plant is very finely equipped, having cost in the neighborhood of $40,000. It would no doubt have been a money-making institution from the start, but through overexpenditure on buildings and fine machinery it became deeply involved and was forced into the hands of a receiver. During the past few months it has been showing nice profits and as the town grows and as new territory is opened up by the Brownsville road now building it will prove to be a profitable investment.

The Electric Railway.

SAN FRANCISCO, CAL.—Among the electric railway companies that will soon be on the market for electric equipment is the Ocean Shore Railway Company, which is constructing an 82-mile double track road from Santa Cruz to San Francisco. Sidney Sprout is electrical engineer. A large power house will be built. The Central California Traction Company, A. M. Hunt, engineer, will also require a good deal of machinery and equipment for its electric road at Stockton, Cal.

WAYCROSS, GA.—The Waycross, Ga., Street & Suburban Railway Company has applied to the town of Waycross for a charter to operate an electric railway there. A. Sessoms, C. M. Sweat and several others are among the applicants for the right.

PORTLAND, IND.—Construction work is about to begin on the power house of the Muncie & Portland Traction Company, about two miles southwest of here.

HUNTINGTON, IND.—The Fort Wayne & Wabash Valley Traction Company will erect a large supply house in connection with its power house and plant in Huntington.

HUNTINGTON, IND.—Stock is being subscribed to extend the Huntington, Columbia City & Northwestern Traction Company's line from Huntington southwest through Marion, Elwood, Noblesville and Malott Park to Indianapolis.

TERRE HAUTE, IND.—O. L. Brown, an attorney, has asked the Vigo County Commissioners for a franchise for the Wabash & Southeastern Traction Company, which proposes to build an electric railway southeast from here to Columbus, Ind.

INDIANAPOLIS, IND.—The Louisville, New Albany, West Baden & French Lick Company proposes to build an electric railway from New Albany to French Lick. Thomas Taggart is one of the incorporators and directors. The line will be about fifty miles long. The principal office of the company will be in New Albany.

INDIANAPOLIS, IND.—Electric railway connection between Indianapolis and Cincinnati is planned by the management of the Cincinnati, Lawrenceburg & Aurora Traction Company, which proposes to construct an extension from Harrison, near Cincinnati, to Batesville, Ind., a distance of about 30 miles. The line would connect at Batesville with the Shelbyville division of the Indianapolis & Cincinnati Traction Company.

INDIANAPOLIS, IND.—The Indianapolis Suburban Belt & Terminal Railway Company, capitalized at $100,000, is composed of stockholders in the Indianapolis, Newcastle & Toledo Electric Railway Company. The company purposes to construct an electric belt railway around the city on the Newcastle Company's right of way, thence north, west, south, east and north around the city, into or near Millersville, Malcott Park, Flackville, Popular Grove and Irvington. The directors are: David M. Parry, W. E. Stevenson, Charles S. Hernly, Eli Marvin and E. H. Bundy.

DAVIS, I. T.—The City Council of Davis has granted a franchise through the streets to the Oklahoma City, Lexington and Sulphur Springs Electric Railway Company.

MONETT, MO.—The City Council has passed an ordinance granting a franchise to C. W. Copeland and others for the purpose of constructing and operating an electric railway over the principal streets of Monett. The line is to be extended to Pierce City, a distance of five miles. The work is to be completed within twelve months. The franchise is for thirty-three years.

ELMIRA, N. Y.—Papers of incorporation of the Corning, Elmira & Waverly Traction Company to build an electric railway between Corning and Waverly are being filed with the Secretary of State in Albany. The capitalization will be $2,500,000. This company will represent the opposition to the Chemung Valley Traction Company. Among the incorporators are Senator Tully and Mr. Orcutt, of Corning; Joseph A. Powers and Thomas O'Connor, of Troy; Hon. George McCann and A. Lee Smith, of Elmira; Fritz E. Hawkes and Mr. Watrous, of Waverly; Thomas Rogers, of Binghamton; Messrs. Wade and Broadhead, of Jamestown, and others of Troy.

WAYNESBORO, N. C.—Bryan Lawrence is interested in getting northern capital to invest in a scheme to build an electric railway from Waynesboro to Augusta, Ga.

SPENCER, N. C., has contracted with the Salisbury-Spencer Electric Railway Company for electricity to light the streets of the first named town, the equipment having already been installed.

HENDERSON, N. C.—Polk County, N. C., is expected to vote about $100,000 bonds toward the construction of the Appalachian Interurban Electric Railway to connect Henderson, Spartanburg and other points.

PORTLAND, ORE.—Specifications are in hand for work on the construction of the new line of the Portland Construction Railway Company from the north end of Union Avenue to a point a few hundred feet west of the east end of Shaw's Island, where the new ferry landing for the Oregon side of the Columbia River is to be constructed. When completed a 30-minute service to Vancouver can be maintained.

PHILADELPHIA, PA.—Preliminary plans for the construction of the Market Street Subway around City Hall, recently filed with the Survey Bureau, have been transmitted by Director of Public Works Acker to the Department of Public Safety as they show that if they were followed the coal vaults on the southwest corner of City Hall would be cut away in part. The plans are those approved by Chief Engineer Twining, of the Rapid Transit Company, on August 17.

NASHVILLE, TENN.—The Nashville (Tenn.) Interurban Electric Railway is fast becoming a reality and at a recent meeting held in that city a considerable sum was subscribed to the enterprise which is backed by northern and New York capital.

SEATTLE, WASH.—A franchise has been granted to the Seattle Electric Company for the use of Tenth Avenue, north, Harvard Avenue and Roanoke Street for street railway purposes.

CLOVERDALE, CAL.—F. J. Kilpatrick, of New York, is reported to be back of an electric railway project north from this city to Anderson Valley, Boonville and the big timber belt along Rancheria, Albion, Navarro, Garcia and Indian Creeks.

NEW BRITAIN, CONN.—The city has filed papers in a suit against the New York, New Haven & Hartford Railroad Company to compel the road to protect the electrically charged third rail which runs through the city or forego its use.

SAN FRANCISCO, CAL.—Plans and specifications are now being prepared for the conversion of the present Geary Street cable railway in San Francisco into an underground conduit road, from Market Street along Geary Street to Point Lobos Avenue, and along Point Lobos Avenue to Fifth Avenue, a distance of 3.33 miles; also for the construction of a new electric underground conduit road from Fifth Avenue along Point Lobos Avenue to Tenth Avenue, and along Tenth Avenue to Fulton Street at Golden Gate Park. The cost has been estimated at $304,705, which has been appropriated and is now available. Bids will be received for the present work in about three months. Thomas P. Woodward, city engineer of San Francisco, is in charge of construction details.

CHICAGO, ILL.—W. S. Reed, First National Bank building, Chicago, formerly of the firm of Townsend Reed & Company, has secured control of the Chicago Traction Company and will use it to secure an entrance to Chicago for the Chicago & Southern Traction Company, which he is promoting between Chicago and Kankakee.

EAST ST. LOUIS, ILL.—Articles of incorporation for the Illinois & Indiana Electric Railroad Company have been filed. The company is capitalized at $2,500, and the incorporators are E. J. Kurrus, J. J. Kane, B. F. Keshner, Horace Eggman and James Ramsey. The head offices of the company are to be in this city. The company contemplates building an electric railway from East St. Louis to Centralia, Ill.

FAIRFIELD, IA.—Cason & Barrett, Dwight Building, Kansas City, Mo., have begun the preliminary survey for an Interurban Electric Road between Fairfield, Birmingham and Keosaqua, Iowa, a distance of 22 miles, August 28th. Their civil engineer, Mr. Henry S. Hackbusch, will have charge of the field party. Mr. E. B. Smith (attorney at law, Fairfield) states that the road will be financed by local capitalists and that a large part of the $500,000 to be raised is already subscribed.

NORWAY, ME.—The Norway & Western Railroad Company, having obtained its charter, is about to commence construction work, and is in the market for equipment for the entire line.

LANSING, MICH.—Extensive improvements are being made on the lines of the Lansing & Suburban Traction Company. The company is laying 60 and 62 pound steel rails and white oak ties. New cars are being added to the rolling stock. Portions of the city lines are being double-tracked.

KALAMAZOO, MICH.—The estimating department of the Westinghouse Electric & Manufacturing Company is getting out plans, specifications and estimates for complete electric equipment for the newly organized West Michigan Railway Company. The road will be built between Benton Harbor and Kalamazoo. W. M. Coler & Company, of New York, are reported to be interested in the project.

GRAND RAPIDS, MICH.—Municipal ownership for the local street railway is recommended by Mayor Sweet. The new city charter, which became operative Friday, September 1, gets around the constructional restriction upon municipal street cars in Michigan by permitting the municipal ownership of street railway tracks. Mayor Sweet believes that if the city could purchase the railway at a price near the assessed valuation, $2,000,000, the city could give three-cent fares.

ST. JOSEPH, MO.—Interest in the proposed St. Joseph-Maryville Electric Railway has been revived in St. Joseph. A mass meeting was held August 30, when the project was discussed by Judge J. W. Thompson, of Maryville, chairman of the board of directors; Charles N. Nelson, of Indianapolis, president of the American Engineering Company, and others. A plan was adopted for raising funds with which to prosecute the preliminary work.

CORTLAND, N. Y.—There is a proposition on foot for the construction of an electric railway from South Otselic to Georgetown, on the Chenango Valley branch of the West Shore Railroad. An outlet for the agricultural products of that region is greatly needed.

ELMIRA, N. Y.—The Elmira, Corning and Waverly Railway has been formed to operate a street surface electric road 37 miles long from Waverly to Corning; capital, $2,500,000. Directors: A. N. Broadhead, A. C. Wade, Jamestown; Joseph A. Powers, J. H. Caldwell, Troy; Thomas O'Connor, Stratford; W. J. Sully, Corning.

GLEN COVE, N. Y.—The state railroad commission has granted the application of the Glen Cove Railroad Company for a certificate of franchise for a road from the steamboat landing at Glen Cove to the railroad depot at that place, thence by private right of way to Sea Cliff. The Long Island Railroad Company is behind the enterprise.

WHITE PLAINS, N. Y.—The board of trustees of White Plains are considering an application from the Bronx, Yonkers & White Plains Railroad Company for a franchise to construct and operate a double track electric railway from Yonkers to White Plains. It is understood that the company intends eventually to extend the road to Tarrytown. As there was so little opposition shown, it is believed that the trustees will grant the franchise. They have referred the application to corporation counsel.

PORT CHESTER, N. Y.—The New York, New Haven and Hartford Railroad Company, which recently purchased the New York and Stamford trolley system, is negotiating for right of way for a trolley extension from Port Chester to White Plains. When completed this line will shorten the time between Port Chester, Rye Beach and the county seat at White Plains nearly an hour. It is proposed to construct a double-track road, which will allow a high-speed schedule. The extension will be about seven miles in length, and will connect with the "Huckleberry" Road at White Plains for Tarrytown and the Hudson River towns, also giving them a quick route to Rye Beach. A large part of the route will be over private right of way.

MOUNT VERNON, N. Y.—The Mount Vernon aldermen have voted unanimously to give a franchise to the New York, Westchester & Boston Railroad. It proposes to build a rapid transit line in Westchester County to connect with the Subway at Bronx Park. It holds a franchise in New York City. Under the franchise Mount Vernon will have a five-cent fare to the point where the proposed connection with the Subway is to be made. The city will regulate the minimum number of trains to be run so that there will be enough at all times to give everyone a seat. The company has put up a $20,000 bond to begin construction within sixty days. It promises to spend $100,000 the first year and have the line completed within four years.

ABERDEEN, S. D.—A company has been formed here for the construction of a street railway system. It will be capitalized at $10,000, and the parties behind the deal are S. H. Jumper, Willliam Wallace, A. C. Witte, J. L. W. Zwitlow, C. F. Easton, F. J. McArthur and C. N. Herreid.

SARATOGA, WYO.—The Saratoga & Denver Electric Railway will soon be incorporated, with a capital stock of $500,000, to build an electric railway from Saratoga to Denver.

New Industrial Companies.

THE MERIDEN ELECTRIC SUPPLY COMPANY, of Meriden, Conn., has been organized. C. J. Diel is manager.

THE SOUTHERN STATES ELECTRIC COMPANY, of Atlanta, Ga., has been incorporated. The organizers are Joe W. Little, Charles M. Coyen and E. Gillespie. The company proposes to conduct a general electrical business, with a nominal capital stock of $20,000.

THE CITIZENS' WATER & LIGHT COMPANY has been organized at Portland, Me., for the purpose of manufacturing gas and electricity and machinery of various kinds, with $230,000 capital stock, of which $300 is paid in. Officers: President, C. E. Glauflin, of Portland; treasurer, H. L. Cram, of Portland.

Legal.

POLE LINE RIGHTS.—In the appeal of the complainant against an adverse decree, the Supreme Court of Alabama has sustained the lower court in the action of the Montgomery Light & Water Company against the Citizens' Light, Heat & Power Company. The points involved are: 1. The fact that defendant electric company's franchise from a city provided that its poles and wires should be so erected as not to interfere with those of complainant electric company does not change the rule that complainant, seeking an injunction against the erection of poles and wires by defendant, must by its bill show the necessity for it by the statement of facts, and not by the mere statement that complainant will be irreparably injured; the only difference being that in the case of such a provision in defendant's franchise the allegations of the bill must be of facts showing a violation thereof, while in the absence of such provision the allegations must show facts from which the law will infer actionable injury. 2. Under the State Constitution, a city may not grant any exclusive privilege in its streets to any corporation, so as to prevent its granting like privileges to another, though in granting the privileges to a second company it may provide regulations to prevent injury to the property and interference with the discharge of the duties of the first occupant. 3. The resolution of a city council, allowing an electric company to maintain for 20 days its wires, then strung on a certain street, on condition of its obligating itself at the end of such time to replace the wires in accordance with ordinances and regulations of the City Code as should then be in force, is of a "temporary" character, and not required to be passed according to the requirements for resolutions of a "permanent" character. 4. A preliminary injunction should be dissolved, when the sworn answer denies the allegations of the bill on which the relief is sought.

DUTY OF INSPECTING WIRES.—In an appeal by the defendant in the suit of Brunelle vs. the Lowell Electric Light Co., the Supreme Judicial Court of Massachusetts, Middlesex, has sustained the court below in favor of defendant on exceptions. The points are as follows: 1. Where an electric light company agreed to connect its electric system with plaintiff's store, and furnish electric current for lighting, and plaintiff agreed that no change should be made in the number or candle power of the lamps or the wiring of the premises without defendant's written consent; that all appliances furnished by defendant should remain its property, and that all wires of the customer to which defendant's service wires were connected should be so installed that the company could carry out its contract, and that plaintiff should allow defendant and its agents to enter the premises to keep its property in repair and for the purpose of inspecting the wires or apparatus—defendant did not owe to plaintiff the duty of inspecting the wires and apparatus belonging to him. 2. Where an electric light company contracted in writing to furnish electricity for lighting plaintiff's premises, the construction of the contract was for the court, and it was error to submit to the jury whether plaintiff was entitled to assume that defendant undertook, by the contract, the inspection of the premises, and to describe the degree of care which would be required under such assumption. 3. Where a city ordinance provided that no extension of electric wires should be made without the written permission of the inspector of wires, and that whoever violated such provisions should suffer a specified penalty, plaintiff's act in attaching a wire extension to the electric light wires in his building, to furnish light in his cellar by means of a socket and bulb attached to a flexible cord, without permission of the wire inspector, which act contributed to plaintiff's injury, constituted evidence of negligence on his part.

Educational.

MICHIGAN COLLEGE OF MINES. The year book of the College for 1904-5 contains two maps showing the mineral district of Northern Michigan around Houghton, where the college is located, in the heart of the great copper mining region of Lake Superior. Within a radius of eleven miles from the college are some twenty active copper mines. Several of the largest, most extensively equipped and most successful metal mines in the world are among them. It is stated that the aggregate horse-power of the engines employed by but two of these great mines exceeds the grand total of all the engines used in the gold and silver mines in the United States. This location, together with the practical methods of training employed, account for the remarkable fact that, of 283 men graduated up to this time, only four have left engineering for other pursuits. Accompanying the catalogue is a book of views which are intended to make more evident the methods pursued at the institution, and also to show to some extent the facilities for practical instruction afforded by the immediate surroundings of the college.

Personal.

F. E. VALENTINE.

MR. F. E. VALENTINE, the newly elected president of the Ohio Electric Light Association, whose annual convention has just been repoprted in these pages, is secretary and manager of the Miami Light, Heat and Power Company, of Piqua, Ohio, one of the progressive concerns of that State. His election to the office of president of the association for the current year is in recognition of the active part he has taken in furthering its interests in every way. He has always taken a prominent part in discussions at conventions, and has been active in committee work between conventions. At the last convention he headed the written discussion on meter and billing records.

MR. GEORGE WESTINGHOUSE has returned from Europe this week by the "Kaiser Wilhelm."

MR. FRANK J. SPRAGUE, who has been in Europe some months for recreation and electric railway affairs, returned home to New York last week.

MR. ANDREW CARNEGIE, when installed as Lord Rector of St. Andrews University, Scotland, on October 17, is to receive the honorary degree of doctor of law.

MR. RALPH D. MERSHON is the author of an article entitled "Electric Transmission," which appears in the Engineering Supplement of the London *Times*, dated August 23.

MR. L. GRIFFITH has been appointed manager of the Union Telephone Company, of New Castle, Pa., succeeding Mr. W. B. Thomas. He has been active in the independent field for some six years.

PEPPER & BOWIE is the name of a new firm of engineers and general contractors, with offices in the Land Title and Trust Building, Philadelphia. The members of the firm are David Pepper, Jr., and John B. Bowie.

MR. ARTHUR WILLIAMS, of the New York Edison Company, returned from Europe this week, after a holiday and tour of several weeks. While abroad he devoted time to a study of the municipal ownership situation in the electrical field.

A. L. REGISTER & CO. is the successor to the electrical engineering and contracting firm of Pepper & Register, of Philadelphia, which has been in business for some years. The new firm will continue at the former address, 112 North Broad Street.

MR. PUTNAM A. BATES, of 42 Broadway, New York, has taken over the engineering business of Bates & Neilson, from which Mr. John Neilson, who has been in poor health for the past six months, has retired. Mr. Bates has a large amount of electrical work in hand.

MR. B. H. WARREN, who retired from the presidency of the Allis-Chalmers Company, on September 1, will, it is said, become the head of a new engineering and contracting company which is to be established in New York, and which has several powerful interests associated with it.

MR. ARTHUR N. DUTTON has been promoted from assistant superintendent of elevated lines of the Brooklyn Rapid Transit Company to the position of assistant to the general manager, succeeding Mr. George R. Folds, who recently went to the South Chicago City Railway as general manager.

MR. J. DON ALEXANDER, Keokuk, Ia., is about to engage in the electrical contracting and supply business, and intends to put in a large stock. He would therefore appreciate receiving from all manufacturers and dealers in electrical supplies and appliances their catalogues, literature, etc., together with discount prices.

MR. H. M. DAVIS, manager advertising department of the Sprague Electric Company, has gone up into the Catskill Mountains to recuperate. He has been under the physician's care for three or four weeks, being treated daily with electricity and gas, and he says that by the time that both have "set in" he ought to be pretty bright.

MR. HERBERT CLARK has severed his relations as electrician for Charles Warner Company, Diamond Ice Company, Diamond Stone Brick Company, all of Wilmington, Del.; Cedar Hollow Company, Cedar Hollow, Pa.; Whiteland Lime Company, Devault, Pa.; McCoy Line Company, Bridgeport, Pa. Pending the appointment of a new electrician, Mr. Irving Warner, engineer for the above companies, will be in charge.

MR. O. T. CROSBY.—Mr. Oscar Terry Crosby has just returned from Paris and is reading the proofs of his book, "Thibet and Turkestan," in which he describes adventures, people he saw, their religions, the effects of the climate upon them, etc., in his journey from the Caspian Sea, through Turkestan and Northwest Thibet, to Kashmir. It will be remembered that Mr. Crosby gave a brilliant lecture on Thibet last year before the New York Electrical Society.

SIR CHARLES EUAN-SMITH, K. C. B., of London, is here with Lady Smith, en route from Mexico to England. He is chairman of the board of directors of the Compania Limitada de Tranvias Electricos de Mexico, and has been visiting the city of Mexico, after participation in the recent International Railway Congress in Washington. Sir Charles is interested in four or five other trolley system in various parts of the world, and is chairman of the board of directors of the Marconi Wireless Telegraph Company of London.

MR. EDWARD R. KNOWLES, consulting engineer, 120 Liberty Street, New York City, has been appointed by the Brooklyn Masonic Guild, its consulting engineer for the light and power installations to be made in the new Masonic Temple, about to be erected in the Borough of Brooklyn. Mr. Knowles is a thirty-third degree Mason, and is widely known as an expert in this line of work. He proposes to make this installation as complete and up to date as possible and one which will be eminently suited for the work it is intended.

MR. WILLIAM RANDOLPH STRICKLAND has resigned from the New York Central Railroad and is now associated with J. G. White & Company as assistant to the secretary at New York headquarters. He is a graduate of the Massachusetts Institute of Technology and during the Spanish War served at the Mare Island Navy Yard as assistant engineer. He was also on the United States Steamship "Bennington." After the war, Mr. Strickland was employed by the Blake Pump Company and Buckeye Engine Company as draftsman, and also in designing special electric cranes and controllers for the Case Manufacturing Company in the capacity of assistant and also as chief engineer. Mr. Strickland made the hydraulic calculations for the North Fork Power House scheme at Denver, Col., in 1900. After he had completed this work he joined the staff of the Colorado Fuel & Iron Company as engineer of location on a standard gauge line over M'Clure Pass. He also located several electric and steam narrow gauge lines in Colorado. In 1902 he was appointed designing engineer for the Lannius Machine Company. In 1903 he was appointed location engineer on the New York Central Railroad and supervised the extension from Cherry Tree to Possum Glory as well as several of their double-tracking and grade revision schemes. For the past year Mr. Strickland has been assistant engineer in the Maintenance of Way Department, handling correspondence from all divisions in regard to the repair and construction of bridges and buildings.

Trade Publications.

RESISTANCE MEASURING INSTRUMENTS.—Queen & Company, Inc., 1010 Chestnut St., Philadelphia, Pa., have issued, as a well-illustrated folder, circular No. 605, devoted to new testing instruments for measuring resistance. The list of instruments includes portable testing sets, current indicators, resistance boxes, mica condensers, slide-wire bridges and detector galvanometers.

BRASS VALVES. Advance circular No. 4SDV of the Crane Company, Chicago, deals with the Crane renewable spring-disc brass valves, which are suitable for working pressure up to 150 pounds per square inch. The most novel feature of these valves resides in the peculiar shape of the disc, which tends to give them a springy, resilient action that fully compensates for the contraction and expansion of the valve parts.

CONCRETE MEASURING AND MIXING MACHINE.—The Link Belt Engineering Company, Philadelphia, has just issued booklet No. 55, which is devoted to the Trump concrete measuring and mixing machine, and which analyzes the manufacture of concrete from a scientific point of view, and shows the advantageous features of the Trump mixer. Booklet No. 56, of the same company, describes and illustrates the machine as used for measuring and mixing materials for the manufacture of sand brick and artificial stone.

EXHAUST RELIEF VALVES.—Circular No. 8AERV, of the Crane Company, Chicago, Ill., describes automatic exhaust relief valves suitable for reciprocating or turbine engines which operate condensing. These valves are designed to provide a means of promptly relieving a condenser in the event of the vacuum being lost. When the vacuum is lost, the steam pressure will lift the disc of the valve, and the engine will exhaust into the atmosphere until the vacuum is restored, when the valve will close automatically.

ELECTRIC TRAVELING HOISTS.—The economy of handling heavy material by electric traveling cranes is now so universally accepted as to be beyond question, but for the moving from place to place of loads weighing between one-half and five tons the ordinary type of crane is sometimes considered too expensive. To meet the demands of this class of service, the Miles-Bement-Pond Company, 111 Broadway, New York, has designed a line of electric traveling trolleys which are described fully in an atractive catalogue just issued.

STORAGE BATTERIES FOR VOLTAGE REGULATION.—The National Battery Company, Buffalo, N. Y., has issued bulletin No. 2, which describes the installation of "Unit Accumulators" for the Syracuse & Suburban R. R. Co., of Syracuse, N. Y. This equipment furnishes a striking example of a storage battery auxiliary in connection with electric railways for maintaining the voltage at a great distance from the power house. The power for the railway is obtained from a hydro-electric station at Edwards Falls, 14 miles from Syracuse. The electric railway circuit is fed with direct current at a potential of 650 volts. As the system was formerly operated, the pressure at the end of the line frequently dropped to 2[illegible]0 volts. In order to remedy this defect a storage battery was installed at Orville about nine miles from the power station. The battery acts as a balancing governor to the generating equipment. A chart from a recording voltmeter serves to show the valuable service that is rendered by the battery.

LIGHT DIFFUSERS.—The American Metal Stamping Company, Germantown, Philadelphia, Pa., has issued an architect's edition of its bulletin on the subject of the new light-balancing selective diffuser ceilings. These ceilings are made of steel, and in the surface are impressed designs such as to give an excellent diffusion of light. In addition to increasing the effectiveness of the lighting, the diffuser ceiling, when used in connection with arc lamps, produces an æsthetic improvement by concealing the lamps. Below the lamp is placed a reflector which insures that all rays which reach the eyes of the observer must be reflected from the ceiling. The light in the immediate vicinity of the lamp is greatly softened, and the intensity at points midway between the lamps is increased, while dark shadows are dispersed, and the general effect is an even intensity of light in all parts of the area illuminated. The bulletin contains numerous photographs, taken at night under the light furnished exclusively by the diffuser ceiling system, which serve to show the exceptional detail and the absence of strong shadows.

News of the Trade.

J. H. BUNNELL & CO., of 20 Park Place, New York, distributed at the great telegraph dinner at the Waldorf last week splendid little facsimile Bunnell keys, perfect in every detail, and small enough for a watch chain. They were greatly admired and appreciated by everybody.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., will increase its capital stock from $500,000 to $800,000. A meeting of the stockholders has been called for October 4, to vote on the proposition. The company last January resumed payment of dividends, which had been suspended since 1900. The first payment was at the rate of 7 per cent. annually, which was stated would be maintained for the year.

THE DUPLEX COIL COMPANY, Fond du Lac, Wis., organized last year, to manufacture an electric spark coil for use on gasoline engines in automobiles and boats, is to move into a new factory building by September 1. The inventor is Herman G. Mueller. The officers of the company are as follows: President, W. O. Zehring, Dayton, O.; vice-president, G. M. Huber; secretary-treasurer, O. J. Huber; superintendent, H. G. Mueller, the last three of Fond du Lac, Wisconsin.

PHILADELPHIA MEETING.—The firm of J. G. White & Co. will be represented at the convention of the American Street Railway Association, to be held in Philadelphia, September 25-30, by Mr. W. E. Harrington, operating manager of the Operating Department; Mr. W. E. Goldsborough, business manager Engineering Department, and Mr. William Petsell, assistant mechanical engineer, in charge of matters relating to rolling stock and equipment of the Street Railway and Engineering Department of this company.

HERCULES GAS ENGINE WORKS, San Francisco, Cal., on August 13, suffered the loss by fire of its factory, at Nos. [illegible] to 231 Bay Street. So far as the stock in process of manufacture, patterns and tools are concerned, the destruction is almost complete. The organization, however, has been held together. A temporary shop has been secured, and permanent buildings and equipment will be installed as rapidly as circumstances will permit. With the latest improved tools, labor-saving appliances and special facilities for manufacturing, a full line of gas, gasoline and oil engines will be placed on the market at an early date. The company states that it has in its Mission Street store and in its various agencies, a stock of engines from which to fill current orders.

THE ELECTRICAL EQUIPMENT & SUPPLY CO., Pittsburg, states that it has reorganized its order system on a basis which provides for an increase of more than double its stock of electrical specialties and supplies. The office force required to handle its orders has also been increased and practically all orders received for standard material are shipped the same day as received. A new feature of the business is the forwarding of standard packages of lamps by prepaid express as soon as received. The vigor and aggressiveness of the company are shown by the manner in which it takes care of its mailing orders and with increased facilities and unusual efforts that are making for prompt delivery, the company is very confident of continuing to attract and hold a large amount of customers.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 29, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

798,039. APPARATUS FOR ELECTRICAL REGULATION; Albert S. Hubbard, Greenwich, Conn. App. filed Feb. 25, 1905. Relates to the control of dynamos. A plurality of dynamos are used, different machines being interposed at different portions of the working circuit and having different relations to the storage cells and regulating resistances.

798,043. AUTOMATIC LISTENING APPARATUS FOR TELEPHONE-OPERATOR'S CORD-CIRCUITS; Jacob W. Lattig, Wyncote, and Charles Lane Goodrum, Philadelphia, Pa. App. filed June 6, 1903.

12,383. TELEPHONE SELECTIVE SYSTEM; Noble S. McKinsey and Anton R. Nelson, Susanville, Cal. App. filed Aug. 16, 1904.

798,082. AUTOMATIC CONTROLLER FOR ELECTRIC CIRCUITS; August Sundh, Yonkers, N. Y. App. filed Feb. 7, 1903. A main circuit switch for elevators in which a knife blade lever swings into engagement with oppositely disposed copper plates. The lever is swung back and forth by a short double-bell crank lever moved alternately by two solenoids.

798,097. TROLLEY STAND; Boniface A. Grasberger, Richmond, Va. App. filed Dec. 12, 1904. A trolley retriever in which a pneumatic cylinder is normally effective to press the pole against the wire. When the trolley leaves the wire suddenly, the movement of the parts is so rapid that a "governor cylinder" does not have time to release its air, and operates certain tappet rods to lower the pole.

798,123. TELEPHONE-SWITCHBOARD; Joseph L. Wright, Cleveland, O. App. filed July 28, 1904.

798,124. AUTOMATIC SAFETY CUT-OFF FOR ELEVATORS; Leon J. Adams, Providence, R. I. App. filed May 20, 1903. A door switch for elevators in which the usual latch has an extension extending into the door jamb which trips a detent and allows the switch contacts to separate by gravity. The contacts are positively closed by the reverse movement of the latch extension.

798,152. GALVANOSCOPE; James T. Armstrong and Axel Orling, London, England. App. filed May 19, 1902. (See Current News and Notes.)

798,153. APPARATUS FOR WIRELESS TELEGRAPHY AND TRANSMISSIONS ACROSS SPACE. Alessandro Artom, Turi, Italy. App. filed Apr. 19, 1904. Designed to produce "circularly or eliptically polarized electromagnetic waves for transmitting and receiving telegraph signals." The spark gap and the induction coil are located in a portion of a divided circuit which includes two high tension transformers. The antenna are connected to the separate transformers.

798,156. COOLING APPARATUS FOR ELECTRIC GENERATORS; Benson Bidwell, Chicago, Ill. App. filed Nov. 25, 1904. A complete cooling system for electric generators involving a cooling coil and a system of piping extending through the hollow shaft of the generator into the armature cores. Additional pipes extend into the field magnet cores.

798,160. CONTROL SYSTEM; Eugene R. Carichoff, East Orange, N. J. App. filed Nov. 4, 1903. A controller for electric car and similar motor installations in which a magnet is effective to simultaneously place all the switches under strain tending to close the same, and additional means automatically regulates their closure in succession.

798,161. CONTROLLER FOR ELECTRIC CIRCUITS; Eugene R. Carichoff, East Orange, N. J. App. filed June 30, 1904. Relates to modifications of the above and includes a single solenoid having a plurality of cores which are simultaneously attracted. The cores are permitted to move only successively, however, into the solenoid by a cam controlled by a dash pot.

798,162. CONTROL SYSTEM; Eugene R. Carichoff, East Orange, N. J. App. filed June 30, 1904. Relates to modifications of the above and particularly to the means in which the switches are placed under initial strain. In this case the solenoid is very long and adapted to attract all the switch blades which are allowed to move successively by a cam shaft which is steped around by a pawl and ratchet.

798,171. CIRCUIT BREAKER; Harry P. Davis, Pittsburg, Pa. App. filed Dec. 26, 1901. In order to avoid the arcing which might injure the terminals when the fuse wire blows, the fuse wire is enclosed in a hardwood tube which projects from the panel board and makes connection with a swinging arm. When the fuse wire melts the tube serves as a blow-out device. The arm may be actuated at any time by the operator and serves as a circuit breaker.

798,190. CONTROLLER FOR ELECTRIC MOTORS George Laird and John P. Todd, Manchester, England. App. filed July 22, 1904. A controller for electro-motors in which the motor is at times used as a generator for a braking effect. Only a single lever is employed and connections are such as to properly connect the motor windings for the braking effect under either forward or reverse conditions, by movement of the lever in a single direction.

798,196. CONDUIT FOR ELECTRIC WIRES; Robert W. Lyle, New York, N. Y. App. filed Feb. 24, 1903. The usual tile conduits have grooves upon their lateral faces in which metallic keys are placed so as to lock adjacent tubes into a unitary structure. Cement is also packed into the grooves to additionally hold the parts together.

798,197. FIRE ALARM; Henry A. Marshman, Albany, N. Y. App. filed Apr. 22, 1905. A thermostat fire alarm in which a dash pot is normally closed by a soldered plug which melts in case of fire. The movement of the piston makes successive contacts which punch a strip and ring an alarm gong at the central station.

798,222. VENTILATING DEVICE FOR CORES OF ELECTRICAL MACHINES; Robert Siegfried, Pittsburg, Pa. App. filed Jan. 3, 1905. In order to more efficiently ventilate an armature core the lamanations are separated at intervals and U-shaped wings are slipped over laterally projecting clips upon certain lamanations, so as to form a centrifugal fan.

798,235. INSULATOR; William R. Twiggs, Sandusky, O. App. filed May 9, 1904. The insulator is formed with a groove in the top constituting a saddle, and has wedge faces which co-operate with balls to clamp the wire firmly within the saddle.

798,236. ELECTRIC ANNUNCIATOR; Hans Usener, Kiel, Germany. App. filed Jan. 4, 1905. A dial enunciator in which currents of varying intensity are transmitted through a three-wire circuit by manipulating a resistance arm. The receiving dial has four magnets in the three-wire circuit which move an armature to varying positions corresponding to those of the transmitting arm.

798,237. CONTROLLER FOR ALTERNATING-CURRENT MOTORS; Hermon L. Van Valkenburg, Pitsburg, Pa. App. filed Sept. 2, 1904. (See Current News and Notes.)

798,252. ANTIHUMMER FOR TELEPHONE WIRES; Benjamin P. Bartlett, Norway, Kan. App. filed Oct. 19, 1904.

798,258. METALLURGICAL FURNACE; George Hillard Benjamin, New York, N. Y. App. filed April 25, 1903.

798,270. PRESSURE OPERATED ELECTRIC SWITCH; Edward H. Dewson, Edgewood, Park, Pa. App. filed Nov. 2, 1901. Is particularly designed for brake motors and comprises a diaphragm operated slide valve and a piston controlled thereby which moves a compound lever to oscillate the switch blades into and out of contact with the terminals.

798,279. BRUSH OR COLLECTOR FOR DYNAMO ELECTRIC MACHINERY; Josef H. Hallberg, Cincinnati, O. App. filed Feb. 15, 1904. In order to make a more efficient connection between the carbon and the spring holder of a generator brush, the carbon block is recessed and the metallic holder provided with an expanding plug which enters the recess and makes electrical connection therewith.

798,280. ELECTRICALLY ACTUATED RECIPROCATING TOOL; Alonzo W. McArthur, Lynn, Mass., and John G. Crawford, Chicago, Ill. App. filed Aug. 26, 1901. An electric hammer in which the plunger is acted on by two solenoids. The power of the blow can be regulated by cutting out coils of the lower solenoid. Connections are made by a simple make and break contact, the arcing at which is blown out by the air moved by the plunger.

798,300. ELECTRICAL WATER HEATER; Eli E. Sager, Vancouver, Canada. App. filed Feb. 14, 1905. An electric water heater having a lava core with a spiral groove in its periphery upon which the resistance wire is wound. The coil is placed in the chamber through which the water circulates.

798,314. ELECTRODE OF ELECTROLYTIC APPARATUS; George Jones Atkins, Tottenham, England. App. filed Nov. 22, 1904.

798,319. ELECTRICAL BINDING SCREW OR TERMINAL; Maurice Bouchet, Paris, France. App. filed Aug. 9, 1904. A conical hole is provided in the block into which the wire may be conveniently directed. The clamp nut is arranged to screw against the wire with its smooth annular end face and efficiently clamp the same.

798,326. FIELD COIL PROTECTOR; Herbert E. Dubois, Springfield, Mass. App. filed Dec. 23, 1904. In order to avoid the injury to motor field coils which ordinarily occurs by reason of the water which collects within the motor casing, the patentee provides a sheet-metal jacket for the lower field coil, which protects it under all circumstances.

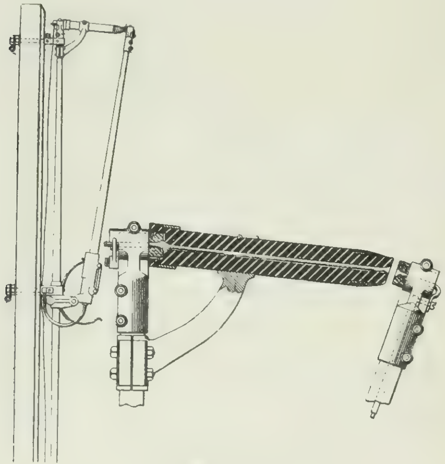
798,335. SYSTEM OF GUN CONTROL; John L. Hall, Schenectady, N. Y. App. filed Nov. 28, 1904. Is designed to operate heavy ordnance from a distant station and includes a pair of three-wire circuits, one of which controls the elevation and the other the direction. A firing circuit is also provided.

798,336. HIGH-POTENTIAL SWITCH; Edward S. Halsey, Palmetto, Fla. App. filed Nov. 30, 1904. (See Current News and Notes.)

798,337. TOY; Oscar Hammarlund, New York, N. Y. App. filed Oct. 25, 1904. An illusion contrivance in which four blocks having numbers may be arranged in any way within a box. The prestidigitator ascertains the arrangement of the blocks by a small compass which is controlled by magnets differently arranged within the separate blocks.

798,339. ELECTRIC VIBRATOR; Henry J. Heeney, Boston, Mass. App. filed Nov. 22, 1904. An electric gong in which a hammer vibrates through a considerable amplitude between two bells. The hammer has a short arm which is connected to a second lever moving through a small amplitude under the influence of the operating magnets.

798,342. SYSTEM OF MOTOR CONTROL; George H. Hill, Schenectady, N. Y. App. filed Sept. 30, 1903. A combined checking and overload relay adapted to prevent progression of the contacts in case of too great current in the motor circuit, and to open the circuit in case of overload.



798,171.—Circuit Breaker.

798,368. THIRD RAIL CONTACT SHOE; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed May 5, 1904. The shoe is supported by the usual diagonal links, but instead of being loosely mounted each includes a compression spring which is effective to press the shoe more firmly against the rail.

798,374. ELECTRIC SWITCH; Harold E. White, Schenectady, N. Y. App. filed Mar. 22, 1904. Includes a switch arranged to permit independent rotary and reciprocating movements and a second switch having a handle on control its movement and certain of the movement of the first switch. The first switch is also capable of movement under the influence of independent means.

798,375. CONTROLLER; Harold E. White, Schenectady, N. Y. App. filed Apr. 7, 1904. Relates to modifications of the above and employs a special system of cams and contact segments adapted to give a wide range of control with a small motor.

798,383. VACUUM TUBE; William S. Andrews, Schenectady, N. Y. App. filed May 10, 1900. In order to avoid the lowering of the density of the air in X-ray tubes to an undue extent, a shunt circuit spark gap is provided which operates when the resistance of the tube becomes too high. When current passes through this shunt circuit, a chemical action is produced in a material which liberates a certain amount of air.

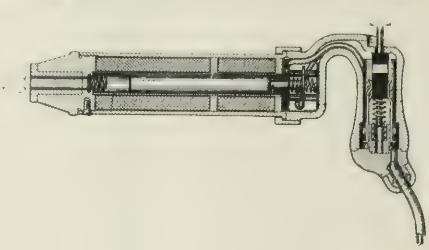
798,389. REEL FOR MINE LOCOMOTIVES; Harris Booker, California, Pa. App. filed Apr. 4, 1905. The operating cable reel is unwound by connection from the locomotive wheels, so that the cable is unwound when the locomotive leaves its base of supply, and again wound up when the locomotive returns.

798,391. MOTOR DRIVEN MACHINE TOOL; Harold H. Clark, Lynn, Mass. App. filed Apr. 9, 1903. A connection is made from the controller to the usual tool carriage, so that the movements thereof are effective to vary the speed and torque of the motor to accord with the diameter of the work.

798,394. TROLLEY; Frederic C. Cottrell, Taunton, Mass. App. filed Apr. 26, 1905. The trolley harp has a pair of vertical rollers, each having a rib on its peripheral face. When the wheel engages the wire, or when a hanger is passed, the rollers separate under spring pressure.

798,396. CONTROL OF SELF-PROPELLED VEHICLES; Albert G. Davis, Schenectady, N. Y. App. filed Feb. 10, 1905. A plurality of magnetic clutches are successively operated so as to give a soft and gradual starting action. The clutch can be entirely disconnected independently of the controller.

798,397. SERVICE SWITCH; Frank C. DeReamer, Schenectady, N. Y. App. filed Dec. 19, 1904. Relates to mechanical details of a service switch having contact clips, and a fuse, enclosed within a box having a cover.



798,280.—Electrically Actuated Reciprocating Tool.

798,410. CONTROLLER; George H. Hill, Schenectady, N. Y. App. filed May 2, 1904. In order to provide a cheaper construction of controller for small motors, the blow-out magnet is carried directly by the controller arm.

798,413. THERMOSTATIC BAR; Charles D. Howard, Syracuse, N. Y. App. filed Sept. 17, 1904. A metallic plate is punched so as to provide a toothed or ribbed face and a rubber slab is vulcanized thereto.

798,414. SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed June 24, 1903. Relates to improvements in distribution system involving the use of a storage battery and booster and regulating apparatus for the booster. Has automatic means for cutting a resistance into circuit with the field winding upon increasing the current therein.

798,427. CONTROLLER ATTACHMENT FOR SUPPLEMENTARY CIRCUITS; William Lintern, Westpark, O. App. filed Nov. 7, 1904. A supplemental switch upon the usual controller arm which makes a contact for ringing the gong or other purpose at the axis of the arm in whatever position such arm occupies.

798,439. TROLLEY WIRE FINDER; Peter McDonald, Harrison, N. J. App. filed Oct. 8, 1903. A pair of rollers adjacent to the trolley wheel have spiral grooves thereon and are turned to replace the trolley wire whenever it leaves the wheel.

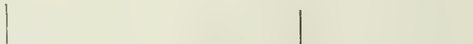
798,452. ELECTRICAL SIGNALING SYSTEM; Joseph P. Sauer, Wheaton, and Samuel E. Johnson, Lombard, Ill. App. filed Sept. 19, 1904. A semaphore arm is operated by a solenoid magnet controlled by a tappet adjacent to the usual track rail. The device is arranged for use with a turn-out switch.

798,457. SELF GALVANIC MASSAGE APPARATUS; Sven R. E. Schmidt, St. George, Staten Island. App. filed Jan. 7, 1905. A massage roller in which a plurality of zinc and copper strips are alternately disposed around the periphery of a felt disk so as to constitute a galvanic pile.

798,466. SIGNALING DEVICE FOR USE IN CASE OF FIRE OR ACCIDENT; Emil Stoll, Hanover, Germany. App. filed Apr. 4, 1905. A fire alarm door is normally held closed by a bolt, but may be also closed by a latch which operates a signal circuit. The hatch is normally held inoperative by the bolt, but when a person enters the alarm circuit cannot be completed unless the latch is engaged.

798,481. ELECTROCAPILLARY APPARATUS; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 2, 1904. (See Current News and Notes.)

798,483. ELECTROCAPILLARY APPARATUS; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 2, 1904. (See Current News and Notes.)



798,383.—Vacuum Tube.

798,484. METHOD OF ACTUATING ELECTROCAPILLARY APPARATUS; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 2, 1904. (See Current News and Notes.)

798,511. APPARATUS FOR ELECTROLYZING AIR; August Johnson, Moline, Ill. App. filed Jan. 5, 1905.

798,546. ELECTRICAL SIGNAL CIRCUIT; Eugeue W. Vogel, Chicago, Ill. App. filed July 10, 1901. Relates to a railroad signal system in which the side track has an insulated section which causes the signals to be given only when the train is passing on the main line.

798,555. SWITCH OR CUT-OUT FOR TELEPHONES AND CIRCUITS; Charles Adams-Randall, New York, N. Y. App. filed Sept. 17, 1904.

798,561. COMMON BATTERY LOCK-OUT TELEPHONE; Mark P. Boone, Peru, Ind. App. filed April 11, 1905.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, SEPTEMBER 16, 1905. NO. 12.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..........................1139 Monadnock Block
PHILADELPHIA OFFICE..........................929 Chestnut Street
CLEVELAND OFFICE..........................402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **513,000.**

NEW YORK, SATURDAY, SEPTEMBER 16, 1905.

CONTENTS.

Editorial 469
Twenty-Sixth Edison Illuminating Convention, at Bluff Point, N. Y.... 472
Reorganization of the American Street Railway Association.......... 473
Brooklyn Rapid Transit Annual Report.......... 474
Accident on the New York Elevated Railway.......... 474
Trolley and Finances 475
The French Cable in Venezuela.......... 475
American Patents in Germany 475
Value of Membership in the American Street Railway Association...... 476
Current News and Notes 476
Electrical Engineers of the Times.—XXVII. John Stone Stone........ 478
Along the Niagara-Toronto Transmission Line.......... 479
Motor-Rating Diagrams. By C. P. Nachod.......... 481
The Bellinzona (Italy) Hydro-Electric Station. By S. Herzog.......... 482
Regulation of Electric Rates in Massachusetts.—III. By Alton D. Adams 484
The Power Plant of the Post-Office Square Building, Boston.......... 486
Erecting a Large Motor. By William Burns.......... 487
Electrically-Operated Aeirial Ferry.......... 488
New Telephone Patents 489
LETTERS TO THE EDITORS:
  Coal and Power in South Africa. By J. W. Kirkland.......... 489
  A Prize for a Prophet. By F. R. Fast.......... 489
  Electricity in Agriculture. By E. W. Baker.......... 489
Digest of Current Electrical Literature 490
Atlanta-Marietta Single-Phase Railway 494
Magnetic Switch Controllers for Automatic Ore Unloaders.......... 495
Electrically-Operated Bulkhead Doors 496
Improvements of Savannah (Ga.) Central Station.......... 497
Electric Walking Jib-Crane 497
Newer Methods of Street Lighting.......... 498
A New Desk Telephone 498
New Wireless Telegraph Station at South Boston.......... 499
Three-Wire Panel Board 499
Industrial and Commercial News 500
General News of the Week.......... 503

RADIUM AND THE ORIGIN OF LIFE.

Mr. John Butler Burke, of the Cavendish Laboratory, Cambridge University, contributes to a recent issue of *Harper's Weekly*, a long article giving an account of his researches in certain radioactive phenomena. It is these researches which several weeks ago furnished the occasion of some sensational cablegrams, noted at the time in these columns, to the effect that the Cambridge experimenter had succeeded by means of radium in creating life. The article is polemical in tone, the author predicating possible objections to his conclusions and theories and then proceeding merrily to whack the presumptive (in both senses of the word) critics over the head. The nature of the experiments can be very briefly described. When a radium salt was introduced into highly sterilized bouillon specific nuclei developed after six or seven days, which later ceased to grow and then began to divide and multiply. The growth as pictured in illustrations is gradually from a single nucleus to a two or four-branched body, the several branches finally separating. The article discusses at length the probability of the growth being a form of crystallization or the result of imperfect sterilization, and the conclusion is finally presented that it is "entitled to be classed among living things in the sense in which we use the term." Until Mr. Burke can bring forth the results of experiments which require less argumentation in their interpretation, we fear that most people will remain unconvinced that, with a few milligrammes of radium salt, the great mystery of the origin of life has finally been fathomed.

MODERN IDEAS IN LINE WORK.

The Niagara-Toronto line of which we give a brief description elsewhere, is a capital example of recent principles of line construction. Its performance should go far to settle some of the moot points of design. Of late there have been developed two distinct parties in high-voltage line work. One of these, which we may style the "radical," pins its faith (with steel pins, of course) to the insulator alone, and the chief plank in its platform declares all wooden construction anathema. The other, or "conservative," holds that insulators are desperately wicked and deceitful above all things, and that bringing the full earth potential squarely up into the interior of the insulator is simply inciting it to crime. As happens in larger politics, either party can cite campaign documents without number, and yet when it comes down to business either can put up a safe and successful administration. The line here under consideration is built on the tenets of the radical platform, yet we have no reason to indulge in any gloomy forebodings concerning its success, any more than if it had been constructed on the most rigid Tory principles, albeit it is much easier to criticise a good line than to build one.

The steel tower construction has many good points, especially in the reduction of the number of points at which the high-tension conductor has to be insulated. But it secures these advantages at the cost of absolute dependence on the insulators, which are fairly grounded in the interior all the time. Any failure of an insulator means putting the circuit out of business right then and there. In the Niagara-Toronto line there are two complete circuits carried on the towers, but how cheerful a task it will be to work on a tower with one circuit alive at 60,000 volts is not altogether obvious, even though the tower is grounded. However, in working at 60,000 volts in the present state of the art one is pretty consistently between the devil and the deep sea anyhow, and must take chances somewhere.

We are particularly glad to have a thoroughly first-class example of tower construction put up in a severe climate for work at 60,000 volts. It will go further toward trying out the merits of the system than a dozen such lines in Mexico or Southern California. We note, too, that the line is a copper line in spite of the theoretical advantages of aluminum—perhaps a concession to climatic conditions, since as a rule aluminum can be had at a slight advantage in price. A temperature ranging from say 50° in winter to 125° or so in the summer sun is quite a different proposition from the comparative uniformity of many southern localities, and the danger from snow, sleet and high winds is of course far greater in Canada than five hundred miles further south.

The precautions taken against lightning are most interesting and look decidedly businesslike. Nobody knows exactly what lightning will do to a line carried on towers. In case of a wooden line it may splinter poles and even cross-arms without a shutdown. Whether it will go harmlessly down a tower without causing the line current to kick over the insulators remains to be seen. The broad principle of the protection, i. e., taking relatively few precautions and those exceedingly thorough, is certainly right. We should much like to see a veracious list of all the shutdowns which have been caused on high-voltage lines by failure of the lightning arresters, not to arrest the lightning, but to hold the line insulation intact. It would be a long and variegated one. Certainly if a grounded wire strung above the line is to be anywhere effective it should be with such a construction as this—a sturdy stranded cable carried seven feet above the tower wires and thoroughly grounded. The arrangement of division houses is exceedingly good, and should have been adopted on many lines that are without it. The convenience of being able to cut out a section of one conductor without disturbing the others is at times most valuable and the value of such a house as a center of observation in caring for the line is very great. The lightning arresters, too, can thus be properly cared for and quickly repaired in case of damage, which is quite impossible when they are scattered promiscuously along the line. We shall be greatly interested in watching the performance of this fine line when it is put to the test of continuous service. It is in a situation where this test will be of unusual severity in nearly every particular, and success will mean the establishment of some very valuable precedents.

COMPRESSED GAS AS AN INSULATOR.

Last year Prof. Ryan read a paper before the American Institute of Electrical Engineers upon the voltage required to produce the electric corona around wires in air. In that paper it was shown, as indeed the researches of several laboratories had already indicated, that the rupturing voltage of a given gas layer increased with the pressure of the gas. In later measurements upon the breaking voltage of air under high pressures, using an air-gap of a few millimetres between needle points, it appeared that the breaking voltage increased steadily with the pressure until in the nighborhood of twelve atmospheres, when the curve of voltages with respect to pressure bent out of shape in a most erratic way. This peculiarity manifested itself not only with air, but also with other gases. The source of the discrepancy was finally traced to the spark-gap structure, which was not sufficiently large and remote from the electrodes to leave the course of the dielectric stress undisturbed. When the structure was altered with this phenomenon in view, and thin aluminum rods with rounded ends substituted for needle-points, uniform results were obtained, giving smooth platted curves. A report of the later investigations of Prof. Ryan is contained in a recent issue of *The Electric Journal,* as has been mentioned in these columns.

With an air-gap of approximately 2.5 millimetres or 0.1 inch, the rupturing voltage was about 12.5 kilovolts at normal pressure, or 1 atmosphere, and 70 kilovolts at 14 atmospheres, following a straight-line law between these two conditions. Above 14 atmospheres the effect of increasing pressure becomes markedly reduced, causing the curve to flatten, until at 50 atmospheres it would appear that the rupturing voltage of 111 kilovolts became substantially constant, or was not susceptible of being further increased by increase of pressure. Whether this flattening of the curve is again due to local disturbance in electric flux, or whether it represents a physical limit, it is at present impossible to say with certainty. The results show, however, that the dielectric strength of the particular air-gap used was increased nearly six times by increasing the air-pressure fourteen times. At normal pressure, or 1 atmosphere, the rupturing electric intensity was apparently 5 kilovolts per millimetre, and at 14 atmospheres it increased to 28 kilovolts per millimetre. Consequently the apparent electric strength of the air was raised to that of the strongest rubber insulator, by increasing the air-pressure to 14 atmospheres. There does not seem to be much difference between the dielectric strengths of oxygen, air, nitrogen, or carbonic acid at high pressures, although they are stated to increase by about 18 per cent in all, in the order named. Hydrogen, however, is distinctly weaker. It is hardly likely, therefore, that any of these gases would be substituted for air in attempting to secure high insulation. The advantage to be gained by the substitution would hardly warrant the trouble of the chemical apparatus.

It is hardly likely that compressed air will compete with oil for insulating purposes in connection with high-pressure machinery. It is true that the dielectric strength of oil is only about 6 kilovolts per millimetre; but oil tends to obliterate an arc, and is very conveniently applied to the parts to be protected. On the other hand, compressed air requires a very strong containing chamber for the apparatus, and makes the introduction of the conducting leads difficult. Inspection and repair are also hampered thereby. It would be very interesting to ascertain how liquid air behaves in regard to dielectric strength, by comparison with gaseous air under high pressure. It is not, of course, likely that any important practical use could be made of liquid air for the permanent insulation of apparatus. High-pressure air acts as a high insulator, but it is well known that low-pressure air acts as a very poor insulator. The earliest Edison steam-dynamos, for generating pressures in the neighborhood of 120 volts, had armatures in which the copper bar conductors were insulated by air, over the greater part of their length. When driven at speed, however, these armatures were found to short-circuit internally through the air, probably owing to the low air-pressure or partial vacuum produced in the immediate neighborhood of the armature structure by the rapid rotation. Thereafter it became necessary to insulate the conductors with oiled paper. One direction in which it has been proposed to utilize the increased dielectric strength of high-pressure air is for increasing the potential, and oscillation energy of wireless telegraph antennae. The voltage at the spark-gap determines the energy of discharge, and this can be artificially increased by compressing the air between the spark electrodes.

SOME PROPERTIES OF ALPHA RAYS FROM RADIUM.

Professor Rutherford has published, in the July number of the *Philosophical Magazine,* a very attractive paper containing the results of some recent researches on alpha rays. Radium salts emit very complex radiations. Not only are they distinct in character, as α, β and γ rays; but the rays of each of these classes also differ in intensity and in penetrating power. It is pointed out that in order to study α rays separately, and under uniform conditions, a very thin film of radioactive material is necessary as the source, because otherwise the rays emitted by the deeper layers become more or less absorbed or attenuated by traversing the superincumbent layers. In order to study the α rays under favorable conditions, a wire made radioactive by exposure to radium emanation was used as the source. A short, thin wire was immersed in a solution containing the emanation from about 20 milligrams of radium bromide and kept negatively electrified. After a time, the wire became intensely radioactive. It was then laid in a support beneath a thin slit in a metallic shield so as to throw a narrow beam of α rays upwards through the slit upon a photographic plate. By placing the apparatus in an exhausted chamber between the poles of an electromagnet, and reversing these poles at intervals, the beam of rays was magnetically deflected from the rectilinear path first to one side and then to the other. With a field of nearly 9.5 kilogausses, the two bands photographed on the plate were found to be dispersed 4.7 mm when the distance from slit to plate was 40 mm. Concordant dispersions were obtained at other distances. From these dispersion measurements, and from the independently observed heating effect of radium, the velocity of emission deduced for the α rays was 0.26×10^{10} cms. per second, or nearly 9 per cent of the velocity of light.

A remarkable fact brought out by the experiments was that the penetrative effect of the α rays ceases very abruptly; that is to says, the rays were found to produce a distinct photographic impression after traversing twelve thicknesses of aluminum foil each 0.0031 mm in thickness, but to be incapable of producing a photographic impression after passing through thirteen thicknesses. That is, the photographic effect was lost between 0.037 mm and 0.040 mm. Yet it is pointed out that the velocity remaining in the α rays at the stage where they ceased to produce the photographic effect was nearly two-thirds of the original velocity of emission. It was also found that the ionising power of the rays, upon gas, ceased at substantially the same range as the photographic power. It was also found that the phosphorescing power of the rays ceased at substantially the same range as the ionising power. From this the deduction follows that the photographic phosphorescing and ionizing power of α rays cease when their velocity has fallen to about 60 per cent of the initial velocity. When, therefore, an α particle falls in velocity to below 0.13×10^{10} cms. per second, or 5 per cent of light-speed; although it still possesses 40 per cent of its initial energy and 60 per cent of its initial velocity, it cannot make its effects visible to the senses either by photographic action, or by phosphorescent action, or by ionising a gas and indirect electric action thereby. An α particle, on the average, is stated to generate about 100,000 ions in gas before it is absorbed, so that the indirect electrical effects produced by the ionization are about 100,000 times as great as by the α particle itself.

Several noteworthy suggestions are offered as flowing from the above experimental results. One is that perhaps the phenomena of phosphorescence and of photographic action due to α rays may be ionisation phenomena. If the alpha-rays fail to phosphoresce as soon as they fail to ionise free molecules in a gas, may it not be that in the fluorescent screen the visible rays emitted are due to ionisation? It is suggested that they may be emitted in the process of recombination after ionic disruption. This is another theory of the modus operandi of the spinthariscope. It is generally supposed that the continual fluorescent lustre observed in this little instrument is due to the rays emitted by the particles of the bombarded substance on the screen when these are subjected to cleavage by the blows of the alpha-ray projectiles. In this paper, however, it is suggested that the cleavage is within the molecule, and that the ions struck out of the molecules may give out heat and light in recombination. Again, if alpha-rays cease to generate perceptible effects when their velocity is still one-twentieth that of light, it is suggested that other substances may also be undergoing slow spontaneous molecular disruption, like radium, and yet we may be entirely unable to recognize the fact, owing to the velocity of the emitted rays being below nine thousand miles per second, so that they are unable to produce any of the recognizable effects of radioactivity. This suggestion opens a wide field for speculation. It is now a widespread doctrine that all matter is of the same fundamental character. In other words, all atoms are aggregations of protyle, the mother substance, and some opine that this protyle is nothing else than electricity. If so, all matter is ultimately composed of electric charges. The forces within each atom that keep its particular atomic structure complete are presumably dynamic forces, just as the forces which keeps our solar system of sun and planets complete are dynamic forces. Each atom is thus a solar system on a liliputian scale. These dynamic forces are evidently stable, or the material forms around us would not be permanent. Yet they may be constantly in fluctuation, just as the earth's distance from the sun in its annual orbit is constantly varying. Conditions are conceivable in a planetary system like ours, when, by a coalition of unusual conditions, a marked perturbation would take place, such as a collision between planets, or a sudden increase in the velocity of one planet which might throw it out of its system, and thus disrupt the same. By the laws of probability such a set of cooperative conditions might occur only once, say, in a trillion planet-years, or planet-orbits. But in a universe containing a trillion such planetary systems, a disruption of this character would be due every year, and yet each system would certainly be stable.

If atoms are microsmic planetary systems of ions, the ion-year must be an exceedingly minute fraction of a second, so that a disruption which might happen in a trillion ion-years would not be so infrequent an accident as human beings measure time. Some consider that radium atoms are liable to occasional disruption, in this way, with the explosive release energy in α, β and γ rays, the subsequent condition of the atom being no longer that of radium; but of some other substance of smaller atomic weight, perhaps helium. The possibility now opens up, as an unverified speculation, that not only radium, but also other atoms, are liable to rare atomic instability, whereby they may disrupt with an explosion of energy and a degradation into atoms of lesser complexity, energy and atomic weight. If the velocity of the projectiled ions is under about nine thousand miles per second, we would be at present unable to perceive the explosions, and we might have to wait for thousands or even millions of years in order to verify the change in physical and chemical constitution. Of these possibilities we seem to have no available evidence. We know that substances seem very slowly to disappear. Metallic objects of great antiquity, as preserved in museums, often seem to have suffered loss of substance, but it is always supposed that simple oxidation or some kind of superficial chemical action would account for the erosion. According to ordinary chemical and physical observations, matter is permanent and does not appear to waste away. It might become possible, however, to add artificially to the velocity of the ions in such cases and thus enable them to attain the critical speed of ionising. Some of the experiments with the ionising properties of very highly heated substances may possibly bear on this point.

Twenty-Sixth Edison Illuminating Convention, at Bluff Point, N. Y.

The twenty-sixth convention of the Association of Edison Illuminating Companies was held this week at Bluff Point, Lake Champlain, N. Y., and was still in session when this issue of Electrical World and Engineer went to press. The meeting was well attended by delegates from all parts of the country. It is well understood of course that the very nature of the association constituted originally and virtually also to-day of "Edison licensees," forbids that the body should grow at the same rate or attain the same magnitude as the National Electric Light Association, which has 3,500 local companies to draw upon for its members. For this reason a very large attendance for the Edison Association would be a quite small one for the National Electric Light Association, but aside from mere numbers the objects, topics and discussions of the two organizations have become very much alike. Most of the men at Bluff Point, whatever the early limitations of their company, as to nature of service, have to deal with all branches of power supply and illumination; and nearly all of these Edison companies moreover have absorbed or been absorbed by other local companies started merely to do arc lighting, or for alternating-current supply. Now and again the presidents of the two bodies fill both chairs at once, so to speak, and it is rather significant of the close relationships now enjoyed between the two associations that in order to avail of the opportunity presented by the gatherings at Bluff Point of so many of its officials, an executive committee meeting was called there of the N. E. L. A. during the week.

In one respect there is a difference in practice, and that is as to the time of meeting. The N. E. L. A. with its wide scope of membership finds it very convenient to have its annual gathering just at the end of the lighting season, when the winter business is over, and results can be summed up. The Edison body, on the other hand, waits until the fall season of activity has begun, and as one of its members remarked this week, it "usually goes to some nice out-of-the-way hotel whose season is over and helps close it up." But in view of the constitutional limiting conditions it may be doubted whether any much larger gathering could be brought together by a change of date than was actually assembled this week on the beautiful banks of Lake Champlain. A great many of those in attendance arrived some days before the opening of the convention, or else visited the General Electric works at Schenectady en route.

Following its usual practice, the association which began business of Tuesday, held two sessions daily—morning and evening. The meeting was held in one of the large parlors of the hotel and was called to order by President Joseph B. McCall, of Philadelphia, who made some brief appropriate remarks. The rule of the association in sitting with closed doors was adhered to, the wonted care being taken with credentials. Through the operation of this rule a large amount of valuable material and data is in a sense lost each year to the electrical community, but the tradition of the body in this respect seems hard to kill, and a committee was appointed to take the proceedings in hand and see what could be divulged without serious harm to any interest at stake.

On Tuesday morning the reports of the executive committee and the treasurer were presented, showing stable prosperity, and the following reports were also listed by the committees named for presentation and discussion: Meter committee, Alex. Dow, chairman; J. W. Cowles, G. R. Green, A. H. Ackerman, O. J. Bushnell, J. W. Lieb, Jr. Storage battery committee, L. A. Ferguson, Chairman; W. C. L. Eglin, J. W. Lieb, Jr., G. Göttling and W. F. Wells. Lamp committee, J. W. Lieb, Jr., chairman; C. L. Edgar and S. Insull. National Code committee, W. C. L. Eglin, chairman; L. A. Ferguson, T. E. Murray. Steam turbine committee, W. C. L. Eglin, F. Sargent, J. D. Andrews, C. H. Parker, W. H. Norris. Electric heating committee, J. F. Gilchrist, chairman; J. D. Israel, A. A. Pope, C. H. Herrick, W. W. Freeman. These various reports embodied some highly important matters and recommendations, particularly with regard to such points as the new low-watt lamps, the status of the National Code and relations with the underwriters, etc. A paper was read on "The Practical Operation of the Nernst Lamp," by W. T. Morrison, of New York, embodying some of the striking results that have been obtained in the year at such places as Yonkers, Brooklyn, etc.

Tuesday afternoon was given up to the men's handicap at golf and work was resumed at 8 p.m. when the following was the programme: Paper on "The Use of Small-Sized Carbons in Alternating-Current Arc Lamps," by G. N. Eastman, of Chicago. Paper on "A New Rotative Test Meter," by W. J. Mowbray, of Brooklyn. Paper on "Experiences with Tests on All Kinds of Lamps for the Past Year, Including Nernst Lamps," by Dr. C. H. Sharp, of the Electrical Testing Laboratories, of New York, an institution which is under direct control of the Edison Companies. The particular point in mentioning Nernst lamps is not known, but it is understood that the paper touched on many other types, notably tantalum, not only with alternating but direct current, and at high and low frequencies—these conditions apparently explaining some of the inconsistent reports as to the life and behavior of such lamps.

The programme for Wednesday morning embraced the following items: Papers by J. A. Radford, of Chicago, on "Practical Experience with Steam Turbines," giving the Chicago data of operation and by W. L. R. Emmet, of Schenectady, on "Improvements in Steam Turbines," giving the latest results from the standpoint of the manufacturer, the General Electric Company having not only pushed forward the four-stage, large type, etc., but introduced the smaller horizontal sizes. Two papers of a related nature were also presented by Mr. W. F. Wells, of New York, who has lately been made chief engineer of the Brooklyn Edison system. The topics were "Methods of Starting up Large Interconnected Systems Quickly After Partial or Total Shutdown," and "Instruction and Training of All Operating and Construction Men Who Work on High-Potential Apparatus and Connections." A paper was also presented in the joint names of Messrs. Philip Torchio, of New York, and W. C. L. Eglin, of Philadelphia, on "Relative Advantages of 25 and 60 Cycles, Seen from the Standpoint of the Central Station Rather than the Power Transmission System, Pure and Simple."

Wednesday afternoon was given up to entertainment, but in the evening two important items occupied attention. One of these was a paper by Dr. C. P. Steinmetz, of Schenectady, entitled "Magnetite Lamps and Mercury Vapor Arc Lamps and Mercury Arc Rectifiers in Connection with Electric Light." Dr. Steinmetz has of late concentrated a good deal of his work and attention upon what may be termed the elimination and abolition of the time-honored arc light dynamo by the mercury arc system of constant-current transformation and the paper is understood to embody his views as to the fact that all such arc lighters as are now left "must go." The other parts of his paper as to vapor lamps and magnetite lamps were equally interesting, several circuits of both types having been installed. Mr. J. W. Lieb, Jr., the retiring president of the American Institute of Electrical Engineers, whose brilliant work did so much last year to make the "circular tour," the visit of European friends and the St. Louis exercises a success, read an admirable summary or paper on "The International Electrical Congress at St. Louis," in one part of which he gave special prominence to the papers and discussions relative to lighting and other central station problems.

But one—a morning session—was listed for Thursday, when to the long string of useful papers, etc., already presented, the following were added: Paper on "Coal Handling and Storage of the Edison Electric Illuminating Company, at the South Boston Station." It will be remembered that the general plant has been fully described in these columns. Paper on "Notes on Sales of Electric Power," by E. W. Lloyd, of Chicago; paper on "The Relation of the Central Station to the Motor-Driven Refrigerating Machine," by G. W. Goddard, of Philadelphia. Paper on "The Relative Merits of Discharging Batteries in Edison Systems Through Reversible Boosters and Through End Cell Switches," by Gerhard Göttling, of Boston.

The officers of the association for the current year 1904-5 are: President, J. B. McCall; vice-president, D. L. Huntington; treasurer, Alex. Dow; secretary, E. A. Leslie (deceased), and H. C. Lucas, assistant secretary. Mr. Lucas had his office established as an annex to the meeting room for the convenience of members and visitors and thanks are due him for many courtesies extended.

It is the exception rather than the rule for any exhibits to be made at an Edison convention, but one was made this year by the General Electric Company in the basement of the hotel of its two types of electric heating apparatus, the Lynn and Schenectady; the newer forms having the heat wire embedded in a quartz substance. The company was well represented and as usual extended many courtesies to the delegates, including a tally-ho ride for the ladies on Tuesday afternoon. The company's officials on the spot were Gen.

Eugene Griffin, first vice-president; Mr. E. W. Rice, Jr., third vice-president; Mr. J. R. Lovejoy, general manager of the lighting department; Dr. C. P. Steinmetz, chief engineer; Mr. J. R. McKee, manager power and mining department; Mr. B. E. Sunny, western manager, and Messrs. W. L. R. Emmet, G. E. Gilbert, C. D. Haskins, F. H. Gale, H. W. Hillman and P. D. Wagoner, of Schenectady; C. B. Davis and F. M. Kimball, of Boston; T. Beran and F. C. Bates, of New York; John W. Howell, F. R. Willcox and G. H. Morrison, of Harrison, N. J.

Among others participating in the convention were Mr. Wilson S. Howell, of the Electrical Testing Laboratories; Mr. Chas. Blizard, sales manager of the Electric Storage Battery Company; Mr. B. H. Scranton, president American Electric Heater Company; Mr. Max Loewenthal, Prometheus Electric Heating Company; Mr. T. C. Martin, Electrical World and Engineer, and Mr. Converse D. Marsh, conductor of the "campaign of publicity" for the Chicago and Boston Edison Companies.

The entertainment programme included on Wednesday afternoon a special trip of the whole covention to the Clinton County Fair at the adjoining town of Plattsburg. A special excursion was given by Mr. and Mrs. Joseph McCall on Thursday to the famous scenic resort, Ausable Chasm, with which the meeting may be said to have terminated.

The total attendance of delegates at the convention reached a figure before its close of probably 150. Among the member companies represented were the New York Edison by Messrs. Murray, Lieb, Pope, Littlefield, Ackerman, Morrison; the Boston Edison by Messrs. Herrick, Hale, Marsh, Göttling; the Chicago Edison by Messrs. Ferguson, Holmes, Gilchrist, Lunn, Junkersfeld, the Philadelphia Edison by Messrs. McCall, Johnson, Eglin, Lucas, Israel; the Brooklyn Edison by Messrs. Freeman and Wells; E. H. Davis, Williamsport, Pa.; J. H. Perkins, Wilkesbarre, Pa.; N. V. N. Powelson, St. Louis; Capt. Wm. Brophy, Boston; Harry Bottomley, Fall River, Mass., and G. W. Brine, Atlanta, Ga. Other well-known representatives were Messrs. Dow, Stetson, Price, Post, E. B. Greene, Kielholtz. The absence of Messrs. Insull and Edgar, who have been abroad for some months was much regretted.

Reorganization of the American Street Railway Association.

The following embodies the contents of an important circular just issued to the members of the American Street Railway Association by President W. Caryl Ely:

The proposed constitution for the new body provides that its name shall be the American Street and Interurban Railway Association, with headquarters in New York City. Its objects will be those which have characterized the association in days gone by, but are set forth somewhat more explicitly. The membership is to consist of two classes, active members, which are to be American street and interurban railway companies or lessees or individual owners. Each member is entitled to one vote cast by a properly accredited delegate. The second class consists of associate members, including individuals who are or have been at some time actively identified with street and interurban railway interests, and other persons who, in the opinion of the executive committee, have had experience rendering them desirable for membership. Such associate members will have the general privileges, but will not be entitled to vote nor to speak unless expressly permitted. The fees for associate members are annual dues of $5. The fees for active members are based upon gross receipts, and an admission fee of $10. The scale of gross receipts runs from $25 for under $100,000 up to $600 for gross receipts of over $10,000,000 there being eight different groups. The officers are to consist of a president, vice-presidents, equal in number to the number of affiliated associations, a treasurer and a secretary, all of these being elected at the annual meeting by ballot and by a majority of the votes of all present, excepting the secretary, who is to be the appointee of the executive committee, and is to be paid a salary.

The meetings are to be held annually between September 15 and December 15, and a committee on subjects is to be appointed each year to organize a programme. All papers read must relate to the objects of the association and have the approval of the executive committee.

A special section, devoted to affiliated associations, is as follows:

XII. This association shall do all in its power to promote the welfare of other associations organized with its approval to investigate technical matters connected with street and interurban railway construction and operation. To this end it will, in the following way, and in others which may be determined by the executive committee, assist in the work of such affiliated associations:

(a) By granting charters to and approving the constitutions of such associations.

(b) By admitting to the executive committee a member from each of such associations.

(c) By granting financial assistance to such associations for specific purposes.

(d) By editing, printing and binding the reports of the proceedings of such associations.

(e) Through its secretary and committee it will assist in arranging for conventions, suggesting suitable subjects for investigation; it will file information for reference and distribution and in every way endeavor to stimulate interest in all of the affiliated associations.

It will be remembered that the last annual convention at St. Louis devoted considerable time to the consideration of questions relating to a more complete and perfect organization of this association and the various associations affiliated with it in street and interurban railway work, and that all matters and things concerned in bringing about said objects were committed to your executive committee with power to act. Pursuant to such action your executive committee entered upon the work so delegated to it, and, as you have been heretofore advised, held a meeting at the Holland House in New York City upon the third and fourth days of February, 1905. At such meeting there were present representatives of all affiliated organizations, and a committee to prepare a plan of reorganization was appointed, consisting of the undersigned, as chairman, and the following members: For the American Street Railway Association, E. C. Foster, New Orleans; Richard McCulloch, St. Louis; C. G. Goodrich, St. Paul; W. E. Harrington, Camden, N. J. For the Accountants' Association, W. G. Ross, Montreal, and Frank R. Henry, St. Louis, alternate. For the Mechanical Association, H. H. Adams, Baltimore, and E. W. Olds, Milwaukee, alternate. For the Claim Agents' Association, W. A. Dibbs, New York, with W. H. Renaud, New Orleans, alternate. For the Manufacturers' Association, W. H. Heulings, Jr., Philadelphia, and William Wharton, Jr., Philadelphia, alternate.

The committee determined to have a thorough examination and study made of the scope, plans and methods of work of the more prominent organizations of similar character throughout the country. Professor Henry H. Norris, of the Department of Electrical Engineering at Cornell University, was selected for that part of the work, and he at once entered upon it. He made a most complete and thorough investigation and a comprehensive and admirable report. Professor Norris' report was based upon a careful study of practically all of the similar organizations in the United States and Canada, and embraced an extensive digest of the constitutions and methods of work of the following: 1. American Street Railway Association; 3. American Railway Mechanical and Electrical Association; 3. American Association of Street Railway Claim Agents; 4. Street Railway Accountants' Association; 5. New York State Railway Association; 6, American Railway Association; 7. American Railway Engineering and Maintenance of Way Association; 8. Master Car Builders' Association; 9. American Railway Master Mechanics' Association; 10. International Tramways and Light Railways' Association; 11. American Association for the Advancement of Science; 12. National Electric Light Association; 13. American Bankers' Association; 14. New York State Bankers' Association.

In analyzing the methods of procedure of the various associations their work was divided into the following sections: (a) Object, (b) means of attaining same, (c) members, (d) privileges of same; (e) officers, (f) meetings, (g) lines of work undertaken, (h) dues.

Professor Norris' report was voluminous, embracing nearly 150 printed and typewritten pages. A very complete digest of the same was made and printed. The report was considered at a joint meeting of representatives of the affiliated associations held at the Hotel Bellevue-Stratford, Philadelphia, Pa., on the 12th and 13th of June, 1905, at which meeting there were present the following members of the joint committee: For the American Street Railway Association, President Ely, Mr. John J. Stanley (in place of Mr. E. C. Foster), Mr. John I. Beggs (in place of Mr. Richard McCulloch), Mr. C. G. Goodrich and Mr. W. E. Harrington. For the Accountants' Association, Mr. W. G. Ross. For the Mechanical Association, Mr. H. H. Adams. For the Claim Agents' Association, Mr. W. H. Renaud. For the Manufacturers' Association, Mr. Wm. Wharton, Jr. There were also present the following named gentlemen: Messrs. John B. Parsons, John Grant, C. C. Pierce, James H. McGraw, E. H. Baker, D. M. Brady, H. W. Blake, Samuel Curwen, H. J. Kenfield, E. M. Williams, George Keegan, Newcomb Carlton and Professor H. H. Norris, of Cornell University.

The report and the draft of form of proposed constitution and by-laws accompanying the same were carefully gone into and discussed at great length, and finally read section by section, and freely amended.

The constitution and by-laws were adopted as amended and recommitted to a sub-committee for revision, and have been by it carefully revised, submitted to counsel, and finally approved and printed, and are herewith submitted to each member of the association.

They have been issued to the technical press to insure the widest publication to all interested in street and interurban railway work, and through the membership committee, of which Mr. H. H. Vreeland is chairman, a copy will be sent to every non-member company, together with a letter setting forth the increased advantages of membership which will be afforded by the reorganized association and its affiliated organizations. They will be brought up for final action at the coming convention to be held at Philadelphia on the 27th and 28th of September, 1905.

Concerning the writer's views it may not be inappropriate at the present time to quote from the President's annual address delivered at the last convention. He said in part: "A careful inspection of the proceedings of the conventions of the last few years reveals the fact that most of the time of each convention has been occupied with the reading and discussion of papers embracing subjects which, for the most part, relate to the small technicalities of the business, and nearly all of which might have been profitably committed to proper auxiliary and subsidiary organizations. Broad fields of cooperative effort in the most important lines of our work have remained almost untouched. It becomes immediately apparent upon investigation and discussion of the situation that we might profitably enter upon the discussion of the greater questions affecting our welfare. The confusion of laws throughout the country affecting our corporations is a matter to which we might well devote attention. There are also such great questions as taxation; municipal ownership of street railways; franchise rights and obligations; statutory laws affecting our class of companies; municipal laws and ordinances, and other questions of importance to which your minds will readily refer. The collection and preservation of data tending to throw light upon the problems of great importance that confront us is also a matter deserving of attention, and in this regard it would seem that through the medium of the secretary's office and of appropriate standing committees an invaluable collection of data could be made and permanently preserved in such form as to be conveniently accessible to any member of the association upon merely making request of the secretary. If the work of the secretary's office should be made continuous there would thus grow up in time a vast repository of valuable statistical and historical information, readily available as a matter of right to every member. This branch of the work alone, if properly prosecuted, would render membership in this association so valuable that it is difficult to understand how any street railway corporation would feel justified in remaining outside of this association."

Some of the more important advantages to accrue from the proposed reorganization, as stated by Professor Norris, are: (1) The Information Bureau.—The function of this bureau will be to supply such information as follows: (a) Statistics regarding electric railway construction, maintenance and operation; (b) general information regarding various electric railway properties; (c) information regarding statutes affecting electric railway construction and operation in various localities; (d) advice as to the practicability of new appliances, looking toward the establishment of a testing bureau, if such be found desirable; (e) scientific information along lines allied to electric railway work. (2) The investigation of general problems affecting the relations of electric railways and the public, e. g., municipal ownership at home and abroad, franchises, taxes, etc. (3) The investigation of technical problems, such as the utility of new fuels, new prime movers, new motors, new sytsems of transmissions, new signal systems, etc. (4) The distribution of important information among the members by means of regular and special bulletins. (5) The arranging, binding and distributing of the volumes of proceedings of the association, including the indexing and general supervision of printing, proofreading, etc. (6) The arranging of the details of conventions. This will relieve the president and executive committee of much detail work, and will enable the association to do a large amount of investigation by means of special and standing committees.

Brooklyn Rapid Transit Annual Report.

The report of the Brooklyn Rapid Transit Company for the fiscal year ending June 30, 1905, has just been made public. It reviews briefly the general condition of the property, and notes additions and improvements that have been made during the past year. The latter extend to all departments of the company. Of particular interest is the statement that there have been added to the equipment 100 new elevated motor cars and 87 convertible surface cars, and that a further addition of 100 elevated and 114 convertible surface cars are to be received within a few months. Still another item of interest is the reference to the new Williamsburg power station building, which really is an extension of the company's eastern district station on Kent Avenue. This station is designed for the ultimate capacity of 100,000 kw. There is now being installed in the station one 7,500-kw turbo-unit and one 5,500-kw turbo-unit. These, it is expected, will be ready for operation by the end of the year. A third unit of 7,500 kw capacity will be installed during the summer of 1906. The power equipment has been further augmented by an increase in the equipment of the Tompkins Avenue, Brooklyn Bridge, Essex, Coney Island and Parkville sub-stations, and a new substation has been erected on Myrtle Avenue near Broadway.

The operating statement shows that the gross receipts were $16,333,444. Charging off against this operating expenses of $9,803,870, there is left as net earnings from operation $6,529,574. Income from other sources, of $252,135, brings the total income up to $6,781,709. As taxes and fixed charges amounted to $5,178,491, the net income is $1,603,218. Out of this sum was taken for betterments and additions to property $453,284. This leaves the surplus for the year $1,149,933. Adding to this the surplus of June 30, 1904, of $1,594,189, the surplus to June 30, 1905, is $2,744,123. Charged off against this is the sum of $1,795,400 for adjustment of supply accounts and for discount on bond sales. This makes the balance surplus as of June 30, 1905, $984,723.

Accident on New York Elevated Railway.

Twelve persons were killed and 42 injured a few minutes after 7 o'clock Monday morning, September 11, by the fall of a car of a southbound Ninth Avenue train from the elevated railroad structure at the curve at Fifty-third Street and Ninth Avenue, New York. The train, running at high speed, took the switch at Fifty-third Street, which it seems was set by mistake for a Sixth Avenue train. The first car cleared the curve, but the second slewed around and was torn off its trucks, falling into the street. As the car fell it turned completely over, and its forward platform struck the sidewalk with a crash. The rear platform remained suspended against the framework of the elevated road. The trucks of the third car were hurled from the track through the bottom of the second car and the first and third cars came together with a crash. The car which had been thrown from the structure remained suspended at an angle of 45°, and the passengers in it were hurled to the forward end, some being killed instantly and the others injured more or less seriously. The third car of the train, pushed forward by the weight of those behind it, was shoved over the elevated structure and its forward end was forced through the window of a dwelling on the corner. This car finally settled, its forward end, held by the sill of the window and the fire escape, hanging suspended like a bridge across the intervening space.

An examination was made by the officials of the company soon after the disaster, and it was found that on the first car of the train the signals were set for Ninth Avenue. On the other hand, the switchman claims the car signals were those of a Sixth Avenue train, and he set the switch accordingly. The Coroner and the officials of the road are said to agree that Motorman Kelly should in any event have seen that the tower signals were set for Sixth Avenue, and as he was running a Ninth Avenue train should have stopped until he got the proper signals to proceed down Ninth Avenue.

This is the first accident which has occurred on the New York Elevated road causing loss of life to passengers through no negligence of the latter.

Trolleys and Finances

The continuous and striking development of trolley systems, etc., and the need for new money in their development is thus noted by the *Wall Street Journal*:

Fourteen corporations either operating street railways or connected therewith directly have taken from the Wall street market in the four months ending September 1, nearly $48,000,000 of cash. The total does not include the dozens of small railways in various districts which have come to the New York underwriters for small amounts of cash for extensions, etc.

The list is bigger than for the four months ending May 1. While the steam railways have checked their financing, the street railway industry seems to have taken a new lease of life. There was but one item of importance in the street railway underwriting of the first third of the year, while the second third brought four items of $5,000,000 or over. The list is as follows:

Brooklyn Rapid Transit	$1,000,000
Consolidated Railways of Connecticut	1,000,000
Detroit United	6,585,000
Havana Electric	5,000,000
Interborough	10,000,000
International Traction	1,000,000
Indianapolis & Southeastern	1,000,000
Philadelphia & Western	1,600,000
St. Louis Transit	1,000,000
Street Car Consolidation	11,000,000
South Side Elevated	2,500,000
Toledo & Western	2,500,000
United Railways of Baltimore	1,000,000
West Penn	2,500,000
Total of street railways	$47,685,000

It will be noted that the biggest item is the $11,000,000 for the organization of the Street Car Trust. This is but part of a bigger capitalization in stock. The underwriters have supplied the cash to combine practically all the big manufacturers of street cars, along the lines followed by the steam railroad equipment consolidations in 1900-1903. This is an important development, with its principal bearing, so far as Wall street is concerned, in the fact that the street car business is now regarded by financiers as so far assured that it warrants a combination of this kind. It is but a few years since the electric street railway industry in this country was experimental.

Brooklyn Rapid Transit is credited unofficially with an additional $2,000,000 of bonds. The item listed is official. In the first quarter the company issued nearly $6,000,000 of its refunding bonds to the $1,000,000 in the second period. The Interborough kept up the reputation of New York city tractions for spending money by the issue and sale of the $10,000,000 of notes to pay for extensions. The big issue of Detroit United bonds was largely in the nature of refunding.

The French Cable in Venezuela.

Confirming previous advices, the State Department at Washington has been informed by Minister Russell, the American diplomatic representative to Venezuela, that the Venezuelan Government has closed the French Cable Company's offices at Caracas and at all other points in Venezuelan territory. Accordingly it has become necessary to send telegrams from Caracas to La Guaira over the Government cable line. At La Guaira they can be sent to another cable line for the transmission of a message between Caracas and La Guaira, a distance of but twelve miles. The Venezuelan Government has established a rate of 20 cents per word Government officers here are inclined to think the rate exorbitant, and that the Government of Venezuela, having an exclusive line, is playing a hold-up game.

As soon as the news that the French company's offices have been closed and the property seized reaches Paris it is thought here that France will make representations to Castro. The case of the French Cable Company is similar to that of the New York & Bermudez Asphalt Company. The Government maintained that the cable company was guilty of non-fulfillment of contract by failing to construct certain lines. The case was taken to the courts. It quickly passed through one and was appealed to another. Up it went to the highest court of the country, and at the end the concession of the company was canceled.

When the first decision annulling the concession was made France was considerably stirred up. At that time the French Minister made forcible representations to the Venezuelan Foreign Office. President Castro had withdrawn to the mountains and refused to receive any diplomats. French warships were sent to Caribbean waters to be close at hand. The two cruisers were placed at the disposal of the French Minister at Caracas and France was fully ready to take action against Venezuela.

French property has now been actually seized by the Venezuelan Government, and in view of the French belief that the company has been unjustly dealt with, action is likely to be forthcoming soon. President Castro has been preparing for trouble. Recent reports from Venezuela indicate that he has made large purchases of arms and ammunition, coast defense and mountain guns. If the French Government desires to use force in making Venezuela return the property of the cable company it is not likely that the American Government will protest or interfere.

Since the above was written, a cable dispatch has been received from Caracas of September 7 as follows: The following Governmental decree was issued to-day: "Whereas M. Brun, manager of the French Cable Company, has protested before the national Government against the decree closing the overland and coast offices of the company, and whereas this action shows that M. Brun is ignorant of the laws of the republic, the president decrees that the said M. Brun be expelled from the territory of the republic." M. Brun has left.

American Patents in Germany,

In a letter to Consul-General Mason, of Berlin, Mr. Robert Grimshaw dwells upon the importance to Americans of taking out German patents on inventions which some time may form part of manufactures exported to Germany. In the first place, patenting in Germany prevents the foreigner from doing what he has otherwise every legal right to do at any time that he sees that a foreign invention is meeting with success—and possibly success at his expense, in that it is being sold in his territory and supplanting his own products, viz.: make and use it.

Of perhaps great importance is the assistance rendered to the selling agent. A prospective customer does not want to buy a lawsuit with a machine or other purchase. In case the article to be sold is not patented in the country in which it is offered for sale there is the danger that it has already been patented by another, and that the patentee will very justly bring against the purchaser an action for infringement of his chartered rights. In this danger the resident agent—the missionary—participates. It is useless to assure the customer that the manufacturer is one of the largest concerns in his native country, and will protect the purchaser against any possible suits for infringement. In the first place the customer has no means of verifying the statement about the financial weight of the manufacturer, and in the second he does not care; he does not wish to be annoyed by any suits, no matter how heavily he may be backed up. In the third place, if he knows any thing about German patent law, and the case is a German one, he will quietly remind the missionary that in that country the infringement of a patent is not merely a civil but a criminal offense; and no manufacturer in America, however influential in financial circles, can get around that part of the difficulty. Section 20 of the German patent law of April 7, 1891, says: "Whoever knowingly uses an invention contrary to the ordinances in sections 4 and 5 will be punished with a fine of 5,000 marks or with imprisonment not to exceed one year." The quoted sections 4 and 5 are those which secure to the inventor the sole rights of the invention which he patents.

Further, there are many manufacturers who seek to convey to their agents and to the customers the impression that the matter is patented in the country of sale, not by directly saying so but by implication. Sometimes this implication is only one of silence; but for all that the attempt, whether unlawful or not, is dangerous in most countries, and especially in Germany. For section 40 of the law, already quoted, says distinctly that whoever marks objects or their packages with any sign calculated to impress one falsely with the idea that the object is patented according to the German law shall pay a fine of 1,000 marks.

◆

Value of Membership in the American Street Railway Association.

In a recent circular sent to the street railways of the United States not now on the roll of the American Street Railway Association, Mr. H. H. Vreeland, chairman of the membership committee of that body, points out the value to even the smallest roads of the association as recently broadened in scope.

The change to electricity as a motive power for street railways, in conjunction with other improvements in the industry and with the general progress of the times, has, it is stated, resulted in a wide expansion of traction facilities in cities and a vast extension of suburban and interurban lines. This has in turn resulted in a readjustment of the attending conditions, with an ever-increasing demand for information relating to the methods used and results obtained in conducting departmental work, and for statistics concerning investigations made in the interests of electric railway companies. Among the new features of importance introduced into the association is a Central Bureau of Information, for the collection of valuable data relating to various phases of the industry, and for the circulation of this information among members.

While the companies of greater mileage, for years past, have been accumulating information of such value along specific lines, the bureau will promote a more general interchange of such data between these companies than has been practicable up to the present time. It is also proposd to engage in active investigations of such questions as taxation, franchise rights, municipal ownership, accident claims and statutory and municipal laws affecting electric railway companies. The accumulation of data regarding these problems will be immediately available to all members of the association. The companies with greater mileage will thus be relieved of the constant inquiries by the companies with lesser mileage, and the information thus received, through the secretary's office, will be of the highest value to the latter. While the companies with lesser mileage can least afford to make experiments, they also can least afford to make mistakes. Although they may not be as vitally interested in municipal ownership, statutory laws, taxation and accident claims as are the companies with greater mileage, there will be available to them a large fund of information resulting from the long practical experience of such companies.

◆

CURRENT NEWS AND NOTES.

MUNICIPAL ELECTRIC LIGHTING.—By a blunder of the printer of the advance copies of the papers read before the recent meeting of the International Association of Municipal Electricians, a paper by Mr. A. S. Hatch, of Detroit, on "Municipal Ownership" was made to appear as a continuation of a paper by Mr. Louis Gascoigne on "Underground Construction." In our abstract of the proceedings of the meeting this error led to the omission of the name of Mr. Hatch, credit being given to Mr. Gascoigne for treatment of both subjects.

ELECTRICALLY-DRIVEN FIRE ENGINES.—It is announced in the *Zeitschrift für Elektrotechnik* that two fire engines and a car for carrying accessory appliances, all electrically driven, have recently been put into service by the Vienna fire brigade. The accumulators, which, it is said, are sufficient to propel the car for some 28 miles at a speed of 12½ miles per hour, are placed in a compartment in front of the driver's seat over the front wheels. India rubber tires 125 mm. (4.9 in.) thick, are fitted to the wheels, which are 850 mm. (2 ft. 9½ in.) in diameter. Each of the front wheels is provided with a 35-hp Lohner-Porsche hub motor. The controller provides for the following speeds: 5.6, 6.8, 12.5, 17.4 and 22.4 miles per hour.

AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION.—The third annual convention of the American Railway Mechanical and Electrical Association will be held at Philadelphia September 25 [illegible] 26, in conjunction with the convention of the American Street Railway Association. Following is a list of the papers and reports that will be presented at the sessions: "Power Distribution," by C. H. Hile, Boston, Mass.; "The Power Station Load Factor as a Factor in the Cost of Operation," by L. P. Crecelius, St. Louis, Mo.; report of the committee on Controlling Apparatus, chairman J. S. Doyle, New York, N. Y.; report of the committee on Welding of Rail Joints, chairman F. G. Simmons, Milwaukee, Wis.; report of the committee on Maintenance and Inspection of Electrical Equipment, chairman William Pestell, New York, N. Y.; "The Power House," by Fred N. Bushnell, Providence, R. I.; "The Track Brake," by F. F. Bodler, master mechanic, the United Railroads, of San Francisco, Cal.

AMERICAN MACHINERY IN RUSSIA.—The Czar of Russia has ordered the discontinuance of the special levying of extra duties on American products. The customs duties referred to grew out of the imposition early in 1901 by the American government of a differential duty on Russian sugar imported into the United States. Following this action an order of the Russian Minister of Finance imposed maximum duties on certain American articles, the increases ranging from 20 to 30 per cent. Generally stated, these articles were cast-iron wares, manufactures of iron and steel, iron and steel boilers, tanks, bridges, pipes, etc., machinery, sewing machines, meters, dynamos, electric motors, portable engines, locomotives and locomotive cars, automobiles and fire engines. The retaliatory duties on American goods in Russia have been heavily felt by American manufacturers, especially those making agricultural implements and machinery. The high duties on these American products have had the effect of giving German and English manufacturers an uncontested market in Russia. The change will be decidedly advantageous to this country.

LIGHT AND THE DRAMA.—Mr. Augustus Thomas, the playwright, in a recent interesting interview, spoke of the "greater disposition to naturalness" in modern plays, and when asked to what he attributed this, said: "To the improvement in the playhouse itself, and very noticeably to the introduction of electrical lighting. In the olden days when the theatres were lighted by candles the facial expression of the actor must have been more difficult to see, and his meaning had necessarily to be bolstered by additional speeches, by a greater prolixity. There was a gradual diminution of this prolixity as in their turn oil and gas and electricity secured a greater illumination. Facial expression became more evident and verbal expression correspondingly abridged." "Has this resulted only in the abridgement of the lines?" "No, I think that there has been an introduction of more delicate shades of meaning in the lines of the ordinary comedy. It is quite possible for a dramatist to write a speech which he shall intend the facial play of the actor to absolutely contradict. The modern comedy has become more delicate, more intimate and more insinuating."

BUZZERS AND RIBBONS.—A visitor from Massachusetts to Manhattan is described by the New York *Sun* as denouncing the use of the "buzzer" in windows for calling attention thereto, and as saying: "In Springfield you will notice in many of the stores on Main Street a device for attracting the attention of passersby to the stock displayed in the windows in a pleasing manner that is calculated to draw purchasers, not repel them, as these window buzzers do. To the center of an electric fan long streamers of ribbon are fastened, sometimes all white, sometimes in tasteful combinations of colors. When the fan revolves these streamers float out over the goods in the window, fluttering in the swift currents of air and waving in graceful, ever-changing hues. The effect is one of coolness, and stopping a moment to enjoy it on a hot day, one is much more likely to feel drawn to enter and buy than if a wicked little buzzer mocked at his tired nerves. It is especially effective in a wndow filled with nice candies and backed by a cool fountain of summer drinks." The streaming ribbons are a very old device, too, in New York City, and were probably seen in its store windows in the earliest days of the fan motor.

FRENCH CABLE IN VENEZUELA.—At Caracas, on September 5, pursuant to the judgment dissolving the contract of the French Cable Company, a presidential decree closed the coast and overland offices of the company, which remains in charge only of the La Guayra office for dispatches relating to foreign business.

ANOTHER ATLANTIC CABLE.—The Commercial Cable Company's new cable from Canso, Nova Scotia, to Port Au Basques, Newfoundland, has been completed and was opened for business September 11. This gives the Commercial Cable and Postal Telegraph system connection with all points in Newfoundland by direct communication.

SERIOUS LIGHTNING EFFECT.—Special dispatches from Richfield, Utah, state that one man was killed outright, one fatally injured, and a score of others seriously injured by a bolt of lightning which struck in the centre of a crowd of 1,200 persons who were watching the horse races at the Richfield Fair. More than 200 persons were thrown to the ground, and most of them were insensible for several seconds.

FIRE AT NIAGARA FALLS.—A fire which started on the night of September 9 in the wire tower of the Niagara Falls Hydraulic Power Company left half the city in darkness, owing to destruction of the power conduits. The plant of the Pittsburg Reduction Company was damaged to the extent of about $10,000. The damage to the power company's plant will be heavy. Owing to the position of the buildings on the edge of Niagara River, down in the gorge, the firemen were unable to fight the flames effectively for some time.

GOLD DREDGES IN ALASKA.—For the electrical operation of gold dredging boats on Alaskan rivers a power house, which will be located at Dawson City will be equipped with a 400-kw generator, operated by a 600-hp steam turbine. Lines for transmitting this power, says the *Iron Age,* will be strung from the station to wherever the dredges may be operating on the Yukon and its tributaries. On the boats will be installed induction motors of an aggregate of about 500-hp, in sizes ranging from 7 to 100-hp each.

LONDON MUNICIPAL TROLLEYS.—A cable dispatch from London of September 9 says: "The London County Council has just concluded a deal by which it takes over the North Metropolitan Tramways Company for a total payment of $2,000,000, including right of way and rolling stock. The surrender of the lines will take place next March. The lines to be transferred from the North Metropolitan Company are 48¼ miles in length, and, together with the southern system of 46 miles at present worked by the Council, will give that body a combined tramway mileage of 94¼ miles. The present transaction will make the Council master of virtually all the tramways in the county area."

ELECTRIC SHELL HOISTS.—Bucket dredger shell hoists in the ammunition passages are a novelty that has been fitted to the English battle ship King Edward VII, reports the *Iron Age.* These hoists are operated by electric motors, upon the same mechanical principles as marine dredges. The difference in detail is that the bucket is halved, and consists of a bisected steel cylinder, slightly larger in diameter than the shell. A pedestal is fitted on the ammunition passage flat, which is geared to the electric motor, and the base is exactly fitted to receive the bottom of the shell. Directly the shell is placed in position steel clips attached to the half buckets retain it there, and by means of an endless chain and recurring buckets a constant supply is delivered to the gun crews. Hand gear is provided, for use in case the electric gear should become disabled.

DUNNE A JELLYFISH.—The "municipalites" of Chicago have agreed to differ among themselves, and war is on. A special telegram from Chicago of September 9 says: "The storm in the Municipal Ownership League broke over Mayor Dunne's head to-day, when T. P. Quinn, president of the organization, declared that his honor had abandoned municipal ownership. Mr. Quinn calls on all real friends of the movement to defeat Mayor Dunne's latest plan. The league will hold a referendum on the plan next week, and those who favor straight municipal ownership, as against granting a franchise to a corporation, will endeavor to defeat the Mayor and his advisors. Mr. Quinn flayed the Mayor for being recreant to the voters in not carrying out his ante-election pledges. In describing the man he helped to elect, Mr. Quinn referred to him as a "jellyfish," a man without nerve, and declared that he had proved his incapacity by his failure to push real municipal ownership of the street railways, instead of compromising on a plan which practically continued private control of the traction lines."

ENGLISH MUNICIPALISM.—An item in the *London Daily Mail* gives an insight into the feelings of the taxpayers about the results of municipal ownership, in the following item: "A conference of 140 delegates from ratepayers' committees and associations in all parts of London met in the Peckham Town Hall last night to decide on united action in regard to municipal extravagance. The speakers had a monotonous story to tell of distress through high rates and of unbusinesslike management of local affairs. Some were in favor of petitioning the Government to limit the rates. 'It's our own fault as ratepayers,' others said. 'We elected the spendthrifts. We must bear with them until we turn them out.' Organization in the boroughs and a revision of the methods of keeping borough accounts were agreed on as lines of action. 'We want nothing to do with politics. We want our boroughs run as business concerns,' emphasized one delegate, and his declaration was cheered vigorously." Another *Mail* item states that the year's profits of the large tramway system of the Cardiff Corporation were $100

THE TALE OF THE TICKER.—According to the *Wall Street* Journal people everywhere are more interested to know the state of the stock market than to be informed as to the weather outlook. "The tape rolls from the stock ticker continually into the waste paper basket, that receptacle which, more than anything else on earth, is symbolic of utter worthlessness. Yet this narrow ribbon of paper on which a few cabalistic characters are printed may almost be said to rule the business world during its brief journey from ticker to basket. Its life is short measured by time, but long measured by the standard of achievement. It only records by a system of shorthand, all its own, the transactions of the stock exchange, and these transactions do not all represent actualities. Taking one month with another, a third of the sales recorded by the tape are probably manipulation, a third are the exchanges of the room traders, leaving only one-third as the sum of the buying and selling that stands for real transfers of securities. But even so, the expert Wall street man can often read in the abbreviations on the tape not only the history of the day's speculation, the play of force against force, the plot of the manipulator, the hopes of the bulls, the fears of the bears, the folly of the lambs, but even more than that the history of the times, the profits of commerce, the yield of crops, the ambitions of kings, the fate of cabinets, and the chances of battles."

TROLLEYS FOR LONG ISLAND.—The Long Island Railroad Company has been erecting poles all along the lines of its right of way between Jamaica and Mineola and up the Oyster Bay line to Glen Cove for the support of the feed wires which will transmit electricity from the power house in Long Island City for the short electric line owned by the company at Sea Cliff and for the new line being built at Glen Cove from the landing to the station. There will be a sub-station built at Mineola, and in the near future the third rail will be extended from Belmont Park, five miles beyond, to Mineola, and from there to the north, the entire length of the Oyster Bay branch to the south over the Norwood division, through West Hempstead and Hempstead Garden, to Valley Stream, to which point the electric line is being extended from Far Rockaway. Many rumors have been going the rounds, one of which is that the control of the Nassau Light & Power Company will, within the next few days, pass into the hands of a new corporation allied with the interests which, it is said, are to build an electric railroad along the north side of Long Island, from Blackwell's Island Bridge to Northport, in the town of Huntington. From Long Island City to Port Jefferson is 58 miles. Running the trolley lines sinuously along the northern shore, so as to take in every little hamlet, as well as the larger villages, will add many miles to the length of the trolley. There are at certain points, such as Sea Cliff, Huntington and Northport, local trolley lines operated by the Long Island Railroad and used by the road as feeders for the steam railroad. These will work in with the proposed new lines, and in no way interfere with the main railroad.

ENGINEERING CLUB IN SAN FRANCISCO.—An engineering club will be formed in San Francisco. The electrical trades will be well represented. Electrical, gas, hydraulic, mechanical and civil engineers are included in the list of prospective members. The committee of electrical men to secure names included L. E. Sperry, George P. Low, J. E. Bibbins, Charges Wiggins and E. B. Parsons.

WIRELESS ON SABLE ISLAND.—The new Marconi wireless telegraph station on Sable Island was opened for business on Sept. 7. The first message received by the station was from Capt. Cueppers of the eastbound North German Lloyd liner Kaiser Wilhelm der Grosse, who said: "Congratulations. First message through Sable Island; 600 miles from New York." The island is 90 miles southeast of Cape Canso, Nova Scotia.

SOCIAL BETTERMENT WORK.—For its attention to the comfort of its women employees, the New York Telephone Company has received an award at the International Exposition at Liege, Belgium, according to a cablegram received at the office of the company. The exhibit of the New York Telephone Company included illustrations of its social betterment work, relative to the care of the telephone girls, in offices where they are provided with comfortable sitting rooms, when off duty, with plenty of current literature to read, dining rooms in care of matrons, where tea, coffee and milk are served free of cost.

LIGHTNING STROKES.—A correspondent of *Fire and Water Engineering* asks: "How is it that more barn fires are due to lightning than to any other cause? I ask this question, because I see that the president of the Home Insurance Company, supported by the testimony of the Iowa Farm Mutuals, claims that such is the fact. He makes the statement that, after having investigated 622 barn fires, he finds that 343 were the result of lightning—over 50 per cent.—and 131 were set by incendiaries. If this is so, the further question arises: Why should farmers' barns and not farmhouses be such targets for lightning. It would seem that lightning conductors are not able to avert the lightning stroke."

A FUNNY TROLLEY PICNIC.—The Dobbs Ferry Improvement Society held its first annual picnic and lawn fete on September 17. The proceeds were to enrich its campaign fund next spring for a trolley ticket which will favor a trolley on Broadway. Opposed to it are Edwin Gould, Miss Helen Gould, John D. Archbold, Oswald Villard, O. G. Smith, the Ardsley Club, and other wealthy residents of Broadway. The sentiment for a trolley on Broadway is strong. It took a combination Democratic and Republican ticket to beat it last spring, and then it lost by only five votes. The trolley advocates hope to win out next spring. They will endeavor to have the Burns law repealed which prohibits forever the building of a trolley line on Broadway. The wealthy residents would favor a trolley by any other route. One of the banners at the picnic read: "Broadway for autos and carriages, but it is too nice for trolleys." The situation is developing many humorous features.

Electrical Engineers of the Times.—XXVII.

JOHN STONE STONE.

Mr. John Stone Stone was born in Dover, Virginia, in 1869. He is the son of the late General Charles P. Stone, a graduate of West Point and veteran of the Mexican and Civil wars.

In 1870, General Stone was called to Egypt to reorganize the Egyptian army, where he remained thirteen years, or until 1883, as General Aide-de-Camp to the Khedive and Chief of the Staff of the army. His son, who accompanied him abroad and remained with him during those years, spent his boyhood in Europe and Egypt. On his return to this country in 1883, he prepared for college at the Columbia Grammar School, New York City, and entered the School of Mines of Columbia University in 1886. At Columbia University he studied civil engineering for two years, but having a strong predilection for the study of electricity and physics he left that institution in 1888 and in the same year entered the course in electrical engineering at Johns Hopkins University, where he pursued studies in mathematics, physics and electricity under Dr. Louis Duncan, who was at that time director of the course in electrical engineering at that university. During the summer vacation of the year 1889 Mr. Stone took charge of the American Bell Telephone Company's exhibit at the Paris Exposition. He completed his studies at Johns Hopkins University in 1890, and joined the staff of experimentalists of the American Bell Telephone Company until the year 1899. From 1899 until 1902 Mr. Stone was general consulting engineer, with offices in Boston, and in the latter year became chief engineer of the Stone Telegraph and Telephone Company, a corporation organized for the development of the system of selective wireless telegraphy invented by him.

While with the American Bell Telephone Company, Mr. Stone made a number of important inventions. He was the first American telephone engineer to point out the fallacy of the so-called *K R* law as applied to telephony, and to insist upon the important role played by distributed inductance in telephone circuits. His work on this subject culminated in an invention patented in the United States March 2, 1897. In this patent the losses due to the reflection of energy which takes place at the junction of a cable with an air line in telephone transmission was first pointed out and the first practicable means of increasing the natural inductance of the lines and of preventing the reflection of energy at such junction was shown.

JOHN STONE STONE.

Mr. Stone also invented and patented the centralized energy or common battery system now known as the Stone common battery system, which has been widely used in this country and abroad. He also was one of the first to realize the practical application of resonant circuits to selective signaling and multiple telegraphy, and demonstrated over the lines of the American Telephone & Telegraph Company the possibility of sending two or more messages simultaneously by this means. After leaving the employ of the American Bell Telephone Company, Mr. Stone applied the same principles which he had successfully used in multiple telegraphy over wires to the production of a system of selective or multiple wireless telegraphy. His work for the past five years has been almost entirely in this direction, and the Stone wireless telegraph system is now in use commercially.

For a number of years Mr. Stone was special lecturer at the Massachusetts Institute of Technology upon the subject of electrical oscillations and resonance. Since 1890 he has taken out in the United States nearly 100 patents, largely upon inventions relating to applications of electrical resonance. These inventions have also been extensively patented in foreign countries.

For his work in the application of electrical resonance Mr. Stone was elected a Fellow of the American Academy of Arts and Sciences. He is also a member of the American Association for the Advancement of Science. His most important publications relate to wireless telegraphy and include a paper on "The Theory of Wireless Telegraphy," read before the International Electrical Congress at St. Louis, in 1904, and a paper on "Interference in Wireless Telegraphy," read before the Electrical Section of the Canadian Society of Civil Engineers at Montreal, in 1905.

Along the Niagara-Toronto Transmission Line.

SIX hand drawn copper cables, each of 190,000 circular mils cross section, now stretch over a line of steel towers 75 miles long between a terminal station at Niagara Falls and another at Toronto. In a few weeks the two circuits formed by these cables will be delivering energy generated by Niagara water to the electric lighting, power and street car systems of the second city of Canada.

A general description has been given in these columns of the design and construction of this transmission line, which, by reason of its length, the voltage employed, the amount of power to be delivered, and its steel towers, is one of the most notable in the world. Now it is possible to add some details as to the completed line work. Each of the two groups of three conductors on the steel towers forms a three-phase circuit, which is designed to receive current at 60,000 volts from Niagara Falls, and to deliver 12,000 horse-power in Toronto with a loss of 10 per cent in voltage. A loss of 20 per cent in voltage on the line will be incurred at times, and under these conditions the two circuits will deliver about 43,000 horse-power, with a 100 per cent. power factor.

In its 75-mile course the transmission line of steel and copper takes an outline like the string of a well drawn bow, with the ends at Niagara Falls and Toronto, and the center near the western end of Lake Ontario, which is known as Burlington Bay. Along almost its entire length the line traverses the watershed of the lake approximately parallel with its shore, and thus crosses the numerous creeks that flow into it between the Welland Canal and Toronto. The streams of which these creeks are now only feeble remnants, have in past ages cut wide and deep gorges in the high lands that run back from the lake, and in several instances extra long spans have been necessary at such crossings. About seven miles from Niagara Falls the line crosses the Welland Canal on towers that carry the conductors 150 feet above the water, and on these high towers lightning rods are used. Ten miles from the Niagara terminal station the line begins to verge toward the shore of the lake, and reaches the brow of the escarpment after a run of 29.6 miles, at a point a little beyond Grimsby. From this point to the 35th mile the line carries a galvanized steel cable above the copper conductors as a lightning guard wire. This cable is secured at the top of a central extension of the steel tower which holds it seven feet above the nearest copper conductors. Though resting on the steel work of the towers, the guard cable is more effectively grounded at intervals.

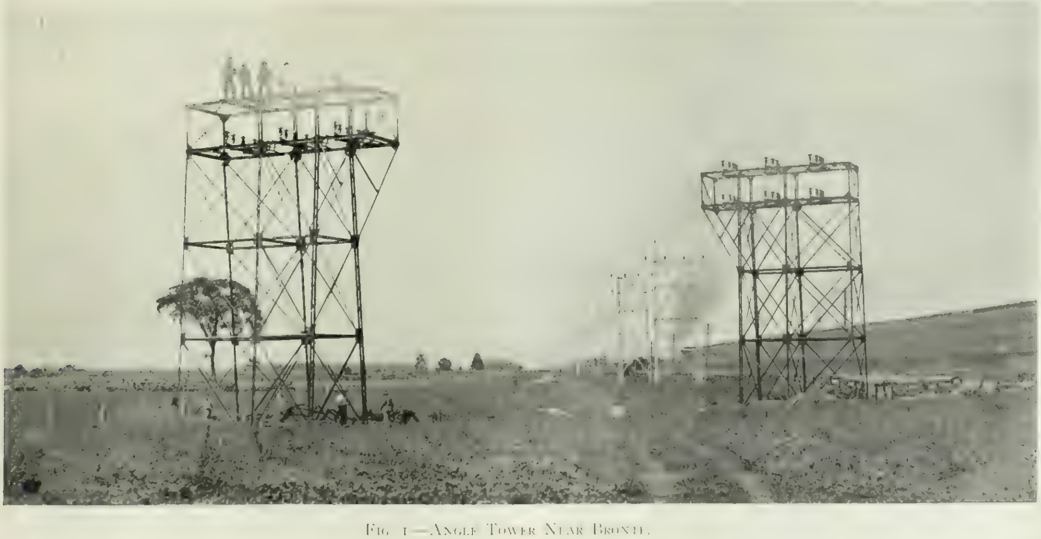


Fig. 1—Angle Tower Near Bronte.

By following the narrow neck of land known as Burlington Beach, which separates Burlington Bay from the main body of the lake, the line avoids a course around its extreme west end, and thus saves several miles in length. For purposes of navigation to the city of Hamilton, near the head of the lake, a canal cuts Burlington Beach, and the circuits cross this canal high above the water. On the north shore of Lake Ontario, near Bronte, the line crosses the gorge of Twelve Mile Creek with a span 630 ft. long. The steel towers at the ends of this span are of extra heavy construction, and each tower carries three insulators in line for the support of each copper cable.

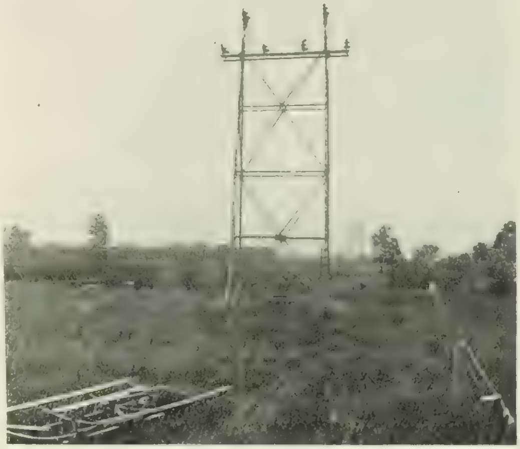
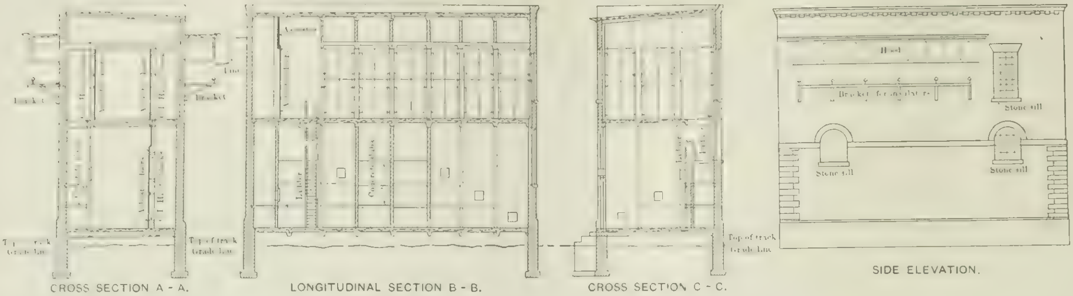
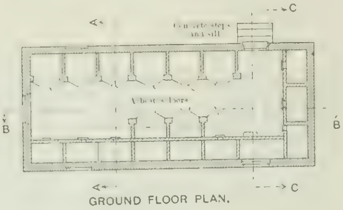


FIG. 2. LONG SPAN NEAR BRONTE.

About two miles west of Bronte comes the crossing of the transmission line over the Great Western Railway, and at either end of the crossing over Twelve Mile Creek a pair of angle towers is used to increase the distance between the conductors and the railway. From the fiftieth to the sixtieth mile of its length from the Niagara Falls end, the transmission line runs over a right of way that adjoins that of the railway, and in this section are the crossings of both Twelve Mile and Sixteen Mile Creek. At 63.8 miles from the Niagara terminal is the crossing of River Credit



CROSS SECTION A - A. LONGITUDINAL SECTION B - B. CROSS SECTION C - C. SIDE ELEVATION.



GROUND FLOOR PLAN.

Fig 3.—Sections and Plans, Toronto Terminal Station.

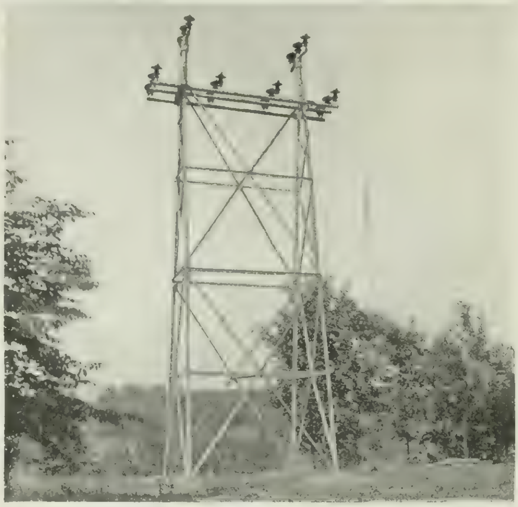


FIG. 4. HEAVY TOWER AT CREDIT RIVER.

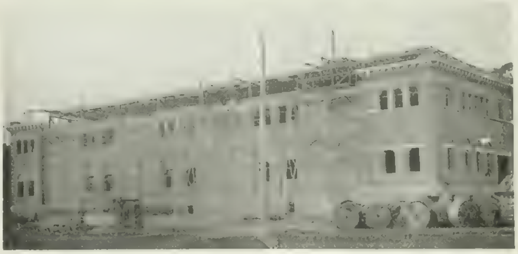


FIG. 5.—TORONTO TERMINAL STATION AND ANCHOR TOWERS.

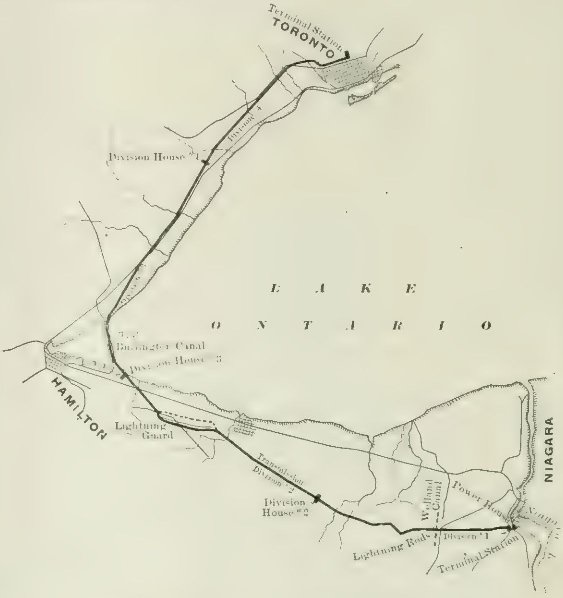


FIG. 6.—MAP OF ROUTE OF TRANSMISSION LINE.

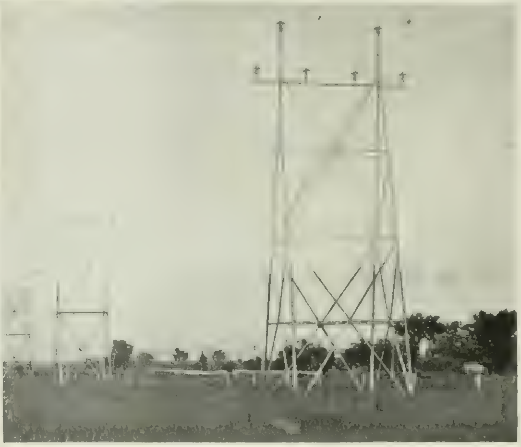


FIG. 7.—TRANSPOSITION TOWER (SECOND TOWER).

ALONG THE NIAGARA-TORONTO TRANSMISSION LINE.

where the span between towers is 766 ft. The tower at each end of this span, like those at Twelve Mile Creek, is of extra heavy construction, carries three crossarms in the same plane, and has three insulators in line for each copper cable.

As it nears Toronto the transmission line swings away from the lake shore, and reaches its terminal station on the northern boundary of the city, which is the side farthest from the the harbor. Close to this terminal station are the two anchor towers, one for each three-phase circuit, which take the strain of the line before it reaches the entrance hood.

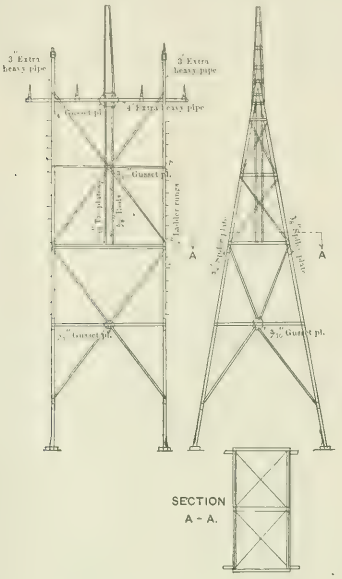


FIG. 8.—ELEVATIONS AND PLAN OF TOWER.

The way in which transpositions of the conductors are carried out along the line is illustrated in Fig. 7, where it may be seen that the transposition tower, the second one in view, has two cross arms instead of one like the standard towers, and carries two wires of each circuit above the third. From the fiftieth to the sixtieth mile, approximately, of the transmission line, where it runs close to and parallel with the railway, the transpositions of the conductors is more frequent than elsewhere, and there are four complete spirals in that section. Three division houses are so located along the line as to cut it into four nearly equal sections. One of these division houses is about 19 miles, another about 40 miles, and the third about 61 miles from the Niagara end of the line.

Through each division house pass the two three-phase circuits, and the switches there make it possible to connect any conductor in the section of the line on one side of the house with any conductor on the other side. Each conductor in a division house is connected with a lightning arrester made for 60,000 volts by the General Electric Company. This lightning arrester contains 240 air-gaps between brass cylinders, and 60 carborundum rods, all in series from the line cable to the earth. A complete lightning arrester as just described is mounted on porcelain line insulators, is 25½ in. wide and 19 ft. long.

Each tower has a good ground connection and it will probably act to some extent to protect the line against an actual stroke of lightning. It is evident, however, that the towers cannot be depended upon as a protection against static and inductive influences, and the lightning arresters are just as necessary on steel as on wooden poles. It is believed that the guard cable, mentioned previously, and the arresters will furnish adequate protection for the line.

To Dr. F. S. Pearson, Consulting Engineer of the Toronto and Niagara Power Company, which is carrying out this transmission to Toronto, and to Mr. Robert C. Brown, Chief Electrical Engineer of that company, are due acknowledgments for the above facts.

Motor Rating Diagram.

By C. P. Nachod.

A concise and convenient method of expressing the characteristics of a complete line of motors of one type, but of various speeds and outputs is here outlined. In the cut below, the areas, *A, B, C,* etc. correspond to the sizes of frames comprising the line of motors. The radial lines denote speed in revolutions per minute and their ordinates, horse-power. To use the curves, suppose the designer or estimator has an inquiry for a 30-hp motor at 1,100 r.p.m. The intersection of the horizontal line passing through 30-hp and the line denoting 1,100 r.p.m. falls in the area marked *D,* whence this is the frame needed.

Suppose it is required to find the speed of a motor on an *F* frame to give 40-hp. Following the 40-hp horizontal until it intersects the line bounding the areas *F* and *G,* the intersection is seen to be traversed by the radial line denoting 600 r.p.m., which is, therefore, the lowest speed at which that output could be obtained. Or let it be required to find the horse-power that can be gotten from an *E* frame with a motor speed of 600. The intersection of the boundary line between *E* and *F* with the speed curve for 600 r.p.m. is seen to have an ordinate of 28-hp, which is the maximum output. In this "shotgun" diagram, then, every motor is represented by a point, whose ordinate is the horse-power, whose position in certain areas is the frame, and whose position on the radial lines is the speed.

The boundary lines between the areas are not hard and fast, since one combination of slots and conductors is more effective than another; and also since there are only a limited number of combinations available. When a motor rating falls on or very near a boundary line, that rating cannot be positively assumed but must be checked by a further calculation of the motor.

In constructing such a set of curves for a particular line of motors it is only necessary to know the maximum torque, or, what is proportional to it, the maximum horsepower per 100 revolutions for each size of frame. The output of a motor giving 10-hp per 100 r.p.m. at 500 r.p.m. is 50-hp. Therefore, the speed-curve for 500 r.p.m. passes through the point whose co-ordinates are 10-hp per 100 revolutions and 50-hp. It also passes through zero, and is a straight line; and is thus completely determined. By noting that at the abscissa 10 the speed curves intersecting the vertical are those of 10 times the corresponding ordinate, the curves can be drawn without calculation.

The lines marking the frame areas, denoting the maximum horsepower per 100 revolutions are drawn not quite vertically, but with a slight inclination to the right. This is to allow a higher torque for the higher speeds, due to the improved ventilation, the same heating limit being presupposed for all cases. In all strictness, these may not be straight lines; and the amount of slewing may be difficult to determine.

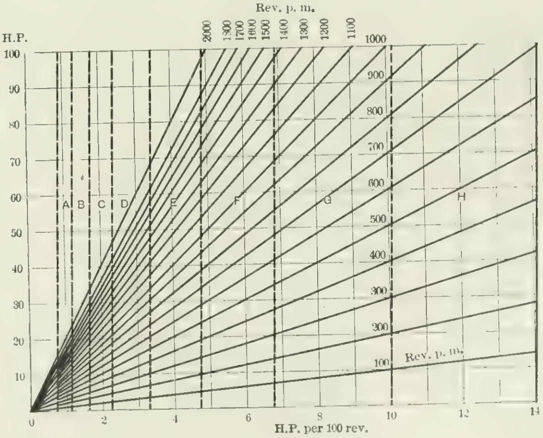


DIAGRAM OF MOTOR RATINGS.

In the line of motors, from which these curves were made and used, the motors are so graded that the maximum torques for each frame are approximately in a geometrical series.

The Bellinzona, Italy, Hydro-Electric Station.

By S. Herzog.

THE city of Bellinzona originally possessed a small station near Corduno, producing single-phase, alternating current at a tension of 2,000 volts for lighting purposes. This, however, soon ceased to satisfy the steadily increasing demand for electrical energy in the progressive industrial development of the capital of the canton. The tender of the Alioth Electrical Co. in Muenchenstein, Bâle, which had been entrusted with the building of the station in the first instance, was accepted for the enlargement of the electrical part of the station. The power is obtained from the Marobbia, a small mountain stream flowing into the River Tessin at Giubiasco, a station on the Gotthard Railway. The work was completed in the year 1901.

The Marobbia, which possesses a very large fall, has its source in the mountains on the left bank of the Tessin. In spite of the fact that the drainage area of the Marobbia is very small, the minimum flow of water is considerable, and judging from the best results of many years, may be taken at the very least at 600 liters per second.

Thanks to extremely well planned arrangement for collecting the water, a gross fall of 350 meters was obtained by means of a comparatively short inlet pipe and a barrel about 900 meters in length.

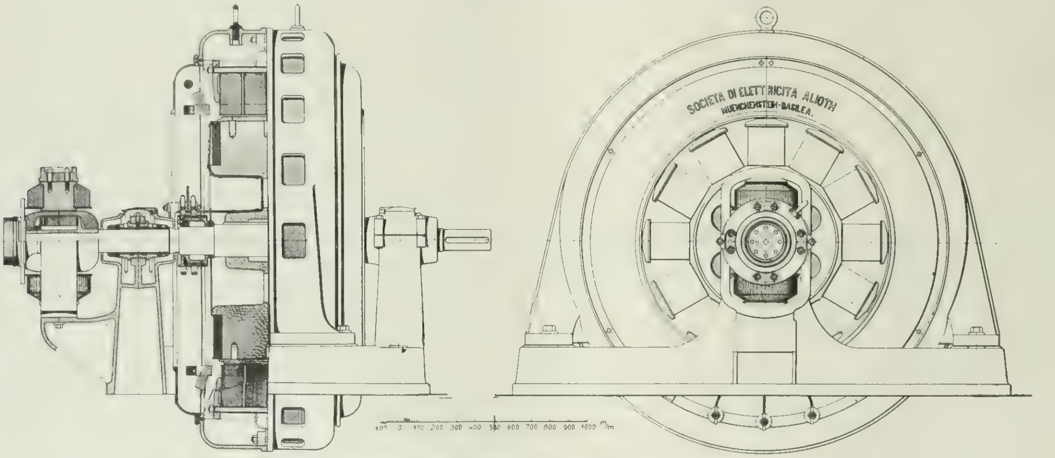

SOCIETA DI ELETTRICITA ALIOTH
MUENCHENSTEIN-BASILEA.
100 0 100 200 300 400 500 600 700 800 900 1000 m/m

FIG. 1. SECTION AND ELEVATION OF 660-HP GENERATOR.

The concrete weir is covered with hewn stones, and has an inclined plane of chestnut wood before the stone inlet. The rake is of rectangular irons with the corsers turned against the direction of flow.

At the inlet there comes a gallery of 1.5x1.85 meters, for the greater part roughly blasted out of the rock. Concrete is used only where it goes through crumbling stone or glacial moraines. The length is about 4 km. and the fall about 2 per cent. Two bridges were necessary for the conduit, one of concrete, the other of brick, with a single arch.

Between the amply dimensioned reservoir at St. Antonio and the end of the gallery, arrangement is made for a large overflow, as seen in Fig. 2, so that the water level may be maintained almost constant, notwithstanding the variation in the consumption of power. Two easily moved racks, one coarse, the other fine, cut the reservoir off from the short piece of inlet canal. In the interior of the reservoir, just at the inlet, there is arranged an automatic cut-out valve which stops the flow of water into the distributing circuit as soon as the speed of the water in the latter exceeds a certain limit that might lead to a bursting of the pipe.

The whole 1,900 meters of the pipe line is divided into two zones. From the reservoir to the pressure 228, a length of 600 meters, the inside diameter of the pipe is 700 millimeters, and from there to the power station the diameter has been chosen as only 600 millimeters.

The pipes are made of best Siemens-Martin sheet iron with rather low ultimate strength, but an extremely high ductility. The factor of safety against fracture is, therefore, very great, for such ductile material would resist shocks, movements, even falling stones and land slips, or any other similar test, without any damage. Six kilograms per square millimeter was chosen as the maximal strain. The thickness of the iron for the pipes of the first zone is, therefore, 6 to 14 millimeters, and the second, 14 to 19 millimeters. Each pipe has a length of 10 meters and is transversely and longitudinally welded, so that there is no rivet along the whole length of the line, and the water flows over a perfectly smooth surface. Particular care was taken with the connections of the flanges, these being the parts of the system most sensitive to such a high pressure. The flanges were formed by bending over the edges of the pipes to overlap, and made broad enough for screws to be put through, increasing the strength of the connection considerably. Two strong wrought-iron rings are used to strengthen the seats of the screws one on each side of the flange. The flanges are made tight by rubber rings. This type of flange allows a large longitudinal displacement of the pipes while still being extremely strong —a feature of great importance. All the pipes were tested at double the working pressure in the factory of Messrs. Escher Wyss & Co., who delivered the pipes and turbines.

As the whole pipe line is on the surface, large supports and adjustable pipe couplings had to be employed at rapid increases of the fall. In all, six were necessary. At the commencement of the pipes, with a diameter of 600 millimeters, an extremely steep fall of 100 meters is covered with a single coupling. The difficulties to be overcome were very great; it was necessary first to blast the rock to form a bed for the piping and raise the steel tubes each 10 meters long and weighing 4,000 kg. up the face of the cliff. The pipe line continued at the foot of the cliff on a bridge about 30 meters long over the Marobbia. (See Fig. 4.) Powerful piers support the bridge and the piping at the banks of the river, particularly on that bank opposite the face of the cliff where the piping makes a sharp bend immediately after leaving the bridge and enters the power station about 50 meters further on. Just in front of the station there is a large cast-steel slide valve. Safety arrangements are also built in the main at the machine house to prevent the occurrence of an excess pressure in the main. At a certain pressure there is made an opening through which a certain amount of the water is allowed to pass. On account of the pressure regulating apparatus on the turbine, as described below, these arrangements will be seldom, if ever, used; nothing has been neglected that tended to make the working of this important system safe and trustworthy in every respect. In fact, since the system was opened three years ago, there has never been a stoppage.

The power station (Fig. 7) lies close to the little village of Giubiasco at the entrance of the Marobbia Gorge, about 4 km. distance from Bellinzona. The station house is built of brick and stone work with concrete foundations. The roof is of wood covered with

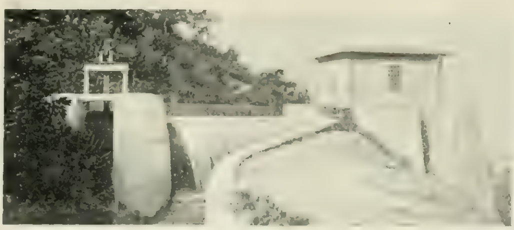


FIG. 2.—VIEW OF RESERVOIR, SHOWING OVERFLOW

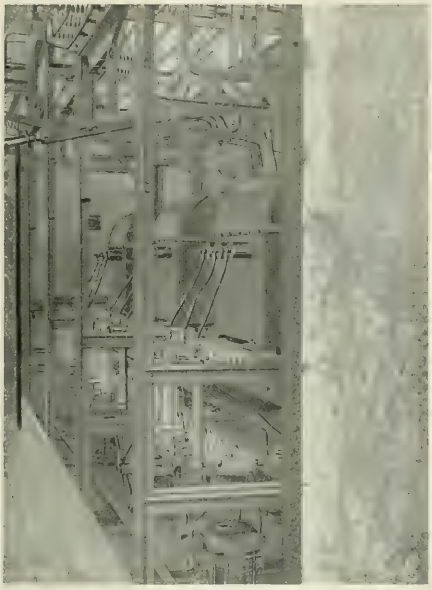


FIG. 3.—APPARATUS ROOM BEHIND SWITCHBOARD.

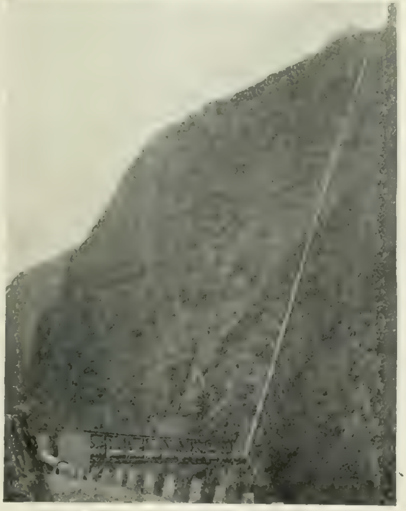


FIG. 4.—VIEW OF PIPE LINE, SHOWING BRIDGE

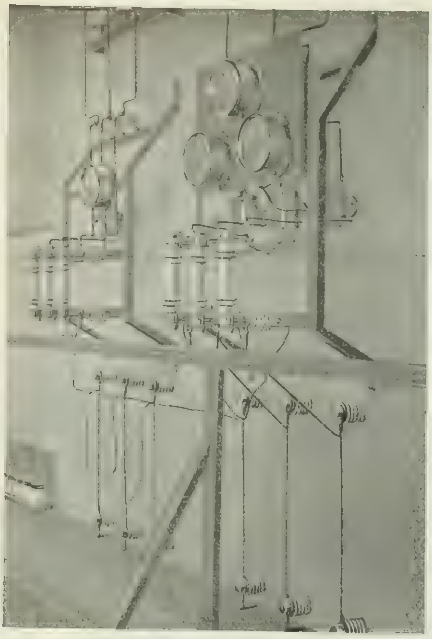


FIG. 5.—APPARATUS ROOM ON FIRST FLOOR.

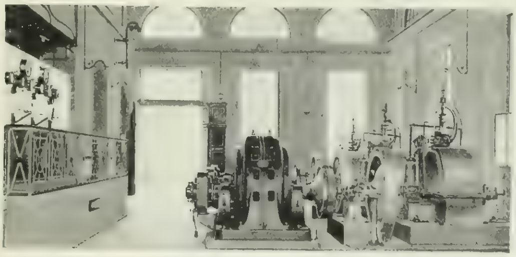


FIG. 6.—INTERIOR OF POWER STATION

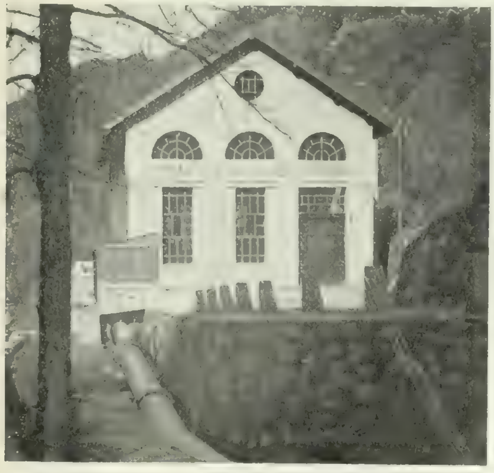


FIG. 7.—EXTERIOR OF POWER STATION.

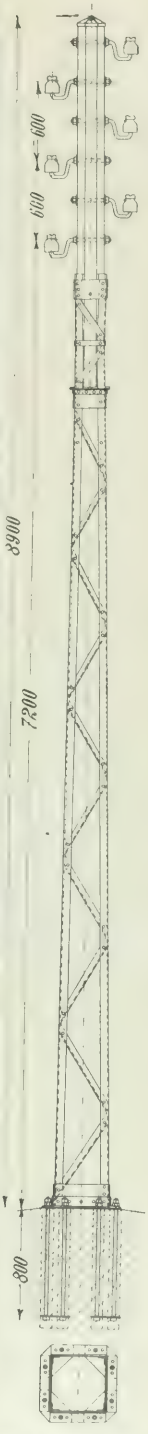


FIG. 8.—IRON POLE FOR HIGH TENSION CIRCUITS

THE BELLINZONA, ITALY, HYDRO-ELECTRIC STATION.

tiles. Part of the machine room is enclosed off to hold the instruments. A 10-ton overhead traveling crane is provided for the erection of the machines.

The turbines are reactional tangential wheels of the Pelton type with external flow. The diameter of the wheels is 1,400 millimeters. The wheels are fitted with shell-shaped interchangeable cast steel buckets. The interchangeability of the buckets is very desirable in the case of high pressures, and of water containing a good deal of sand. For, as time goes on, the blades become worn and blunt and so lose a good part of their effectiveness. The section of the inlet arrangement is regulated by a tongue, which in its turn is directly governed by the speed regulator. This speed regulator acts directly on the hydraulic control valve, which produces in the space above the regulating piston a more or less large pressure effect. The piston is rigidly attached to the tongue so that the latter is moved corresponding to every alteration in the pressure on the piston. Consequently each change in the length of the spring pendulum, caused by the alteration in speed, varies the section of the inlet.

Each turbine is fitted with a pressure regulator to minimize the shock that ensues when the turbine is suddenly cut out. This apparatus is opened by a powerful hydraulic piston in the same degree as the turbine is cut out. To avoid all unnecessary losses of water the apparatus is so arranged that after being opened it closes again automatically without causing any pressure increase. The turbine axles are made of Siemens-Martin steel and run in bearings with automatic lubrication. Each group is fitted with a cast-steel fly-wheel. The covers of the turbines may be taken off for the purpose of assisting the inspection of wheel and inlet arrangement.

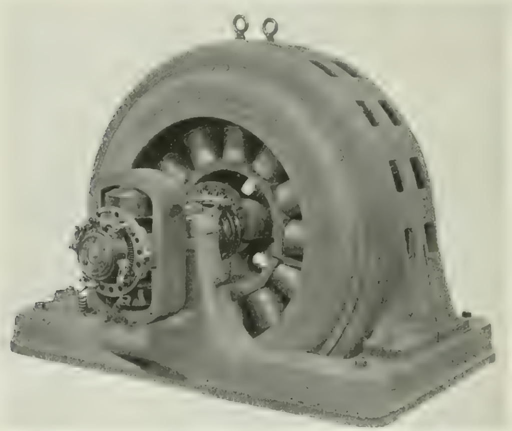


FIG. 9.—VIEW OF 660-HP GENERATOR, SHOWING EXCITER.

There is a filter for each turbine through which the water for the hydraulic regulator passes. The filters may be cut out, cleaned and inspected without disturbing the turbine. The regulators are so arranged that after a sudden cut-out of the total load on the turbine the speed does not exceed the normal by more than 10 per cent, and that during the two or three seconds necessary for the operation the normal pressure does not increase by more than 10 per cent. The turbines are coupled to the generators by means of the elastic and insulating Zodel clutch, as shown in Fig. 6. The generators from the Alioth Electrical Co. are built to take up 660 horsepower. They produce at 500 r.p.m. three-phase current of 5,350 volts and 50 cycles per second. The generators, whose general constructional features may be seen in Figs. 1 and 9, have 12 poles. The exciter is directly coupled to the generator. The stator has two slots per pole and per phase. There are 12 coils of 14 turns per phase. The winding is carried out in the star connection. The conductors are insulated by micanite 2 millimeters in thickness. The field coils are connected in series, and each has 134 turns.

The switching apparatus is arranged in separate rooms shut off from the machines (See Figs. 3 and 5.) One three-pole switch, one regulating arrangement, one three-pole safety fuse, one ammeter, and one voltmeter for the current produced and one ammeter and one voltmeter for the exciter are provided for each machine. A voltmeter switch is arranged to measure the e.m.f. of the lighting or power current. There are provided two general voltmeters for controlling the e.m.f. of the bus-bars. The universal switch is so controlled that it may be worked only after the generator itself is cut out. The lightning arresters are in the top apparatus room set up on the outside wall towards the Marobbia side of the station. One transmission line goes from the station to Bellizona, another goes to Giubiasco. The wires to Bellinzona are carried on an iron pole line, a standard trellis-work pole of which is illustrated in Fig. 8. Triple-cloaked insulators are employed.

At the present time the circuit feeds Bellinzona (seven transformer stations), Giubiasco (two transformer stations), and Castrone (one transformer station). Special brick buildings are provided for the transformers at Bellinzona; the electric fittings were made by the Alioth Electrical Co. Each transformer has a capacity of 33 kilowatts. One station at Bellinzona contains two, another three, and the others one transformer. In the village of Giubiasco there is a 33-kw transformer, and at the railway station, and in Castrone and Mollinazo are used 10-kw, single-phase transformer. In Mollinazs there is also a 10-kw three-phase transformer. All transformers outside of Bellinzona are fixed on poles.

Regulation of Electric Rates In Massachusetts.—III.

By Alton D. Adams, LL.B.

Below are given synopses of further decisions in regard to electric rates, etc., by the Massachusetts Gas and Electric Commission:

Mayor vs. Waltham Gas Light Company.

In this case the mayor of Waltham sought a reduction in the rates charged for gas and public and private electric lighting by the Waltham Gas Light Company. The net rate for arc and incandescent lighting was $1.25 per 16-cp lamp-hour by meter. One commercial arc lamp per consumer was operated daily to midnight at $12.50 per month, and five nights per week at $10 per month, by contract. For larger numbers of commercial arcs the rates were lower. Arc street lamps of 1,200 cp nominal numbering 147, were operated every night during 6.5 hours, on a yearly average, at 23 cents per lamp per night. For arc lamps consuming 330 watts each this rate amounts to 10.7 cents per kw-hour. Street incandescents of 25 nominal cp to the number of 175 were operated 7.3 hours per night, on an average, and 20 nights per month, at the rate of 8 cents per lamp per night, which corresponds to 12.5 cents per kw-hour, with 87.5 watt lamps. The Commissioners fixed the maximum net rate for commercial arc lamps six nights per week at $9 each per month, and lamps burning four nights per week at $7 each per month. For commercial incandescent lighting the maximum net rate by meter was fixed at 18 cents per kw-hour. These rates were to go into effect on June 1, 1901. No change was made in the rates for street lamps. The Waltham company had operated the only systems of gas and electric supply in that city since 1886, when it purchased the electric system.

On June 30, 1900, the company had capital stock of $175,000, bonds of $50,000 and notes payable of $24,000 outstanding. Stock to the amount of $130,000 had been issued by the company before it engaged in the electric business in 1886, and the additional issue of $45,000 in stock and $50,000 in bonds appeared to represent the electric system. The notes of $24,000 seemed to stand for a loss through depreciation rather than any value in the plant, according to a statement of the Commissioners when they refused to allow an issue of stock sufficient to cover the floating debt of the company, in 1899. During the year ending June 30, 1900, the company derived $49,678.98 from sales of electric energy, and the operating expenses in its electric business were $41,077.66, so that the net electric income was $8,601.32. Interest to the amount of $3,609.80 was paid during the year, leaving $4,991.52, or 11.09 per cent of the $45,000 in capital stock devoted to the electric business. During the following year, that ending with June 30, 1901, the electric earnings were $63,087.05 gross, and $18,585.38 net, but in this year the rates fixed by the Commissioners were in force during only one month. In the year ending at the middle of 1902, during all of which the maximum rates fixed by the Commissioners applied, the company earned $78,479.13 gross and $25,758.83 net in its electric business.

At the hearings it was claimed that the Waltham company was supplying current to a street railway at less than cost, and that on this account the prices to general consumers were too high. The Commissioners said that the street railway contract seemed to have been absolutely unprofitable to the company and that "The contract ought not to be renewed at the old rates; and if it shall be, the shareholders, and not the consumers, must expect to bear the burden thus imposed." It was also said, however, that the supply of power to a street railway may be of advantage to all concerned, though the rate for such service is less than those necessary for general business. So, too, it may be to the advantage of a company and its customers that electric power be supplied for general purposes at a lower rate per unit than could be applied to the entire output. Net earnings of the electric business appeared to the Commissioners to have been insufficient to meet the capital and depreciation charges belonging to that department, and the policy of the company had been to impose some of the burden of the electric business on the gas income. As to such a practice in relation to the gas and the electric business, the Commissioners said that: "Neither ought to be distinctly burdensome to the other, unless upon stronger grounds than we are able to find in the present case. In this view, customers for each kind of light are entitled to receive it at its independent fair cost, neither enhanced nor diminished on account of conditions in the other department."

While the rate for arc street lamps was about 10 cents per kw-hour, the rate to private consumers was approximately 16 cents. The Commissioners thought it difficult to determine whether so large a difference in rates was justified, but said that "This Board, however, has no authority to require the rate to be increased, even if it be clear that it is unfairly low." Since the entire electric income, even with a fair rate for power, seemed to promise little more than a fair profit, the Commissioners did not see their way clear to reduce the rates for street lighting.

(12.) Mayor vs. Newton & Watertown Gas Light Company:

A reduction in the rates for gas and electric light supplied by the company was sought under this petition by certain consumers in the city in 1900. The petitioners also desired better gas and electric service. After a hearing the Commissioners on June 24, 1901, refused to make any reduction in the rates for either street or commercial electric lighting. Between the time of the hearing and the decision the Newton company began to operate its electric plant throughout the day, as had been requested, and arranged to spend about $37,000 on this plant in a way that would remedy the defects in its service. No order was therefore made on this part of the case.

Since 1888, when it bought out the local electric company, the company had operated the only systems of gas and electric supply in Newton and Watertown. This was chiefly a residence district, and about 75 per cent of the electric output of the company was used for street lighting, but this service yielded the company only about 40 per cent of its electric income. At the time of the hearing the company was operating 222 arc lamps of 1,200 cp nominal, each on the streets during 3,940 hours per year, at $100 each. This rate corresponded to 7.7 cents per kw-hour. There were also operated on Newton streets 957 incandescent lamps of 25 nominal cp until 12:30 every night, or 2,262 hours per year, at $15.50 per lamp annually. These lamps, therefore, cost the city 7.9 cents per kw-hour. In Watertown there were 395 of the 25-cp. lamps that operated 1,573 hours per year at $13.50 each annually. For commercial arcs and incandescents the maximum rate was 18 cents per kw-hour, and the rate per unit actually received for street lighting was less than one half of that yielded by the commercial service. On June 30, 1900, the Newton company had a capital stock of $250,000, bonds of $90,000, and notes payable to the amount of $6,000 outstanding. In 1888, before it bought out the local electric company, the Newton company had a capital of $200,000, and no bonds or notes outstanding. While the fact is not clear it may be assumed that the increase of $50,000 in stock and of $96,000 in bonds and notes was represented in the electric plant. During the year ending on June 30, 1900, the Newton company derived a gross income of $70,134.54 from its electric business, its operating expenses were $58,839.96 in that department, and the net electric income was $11,294.58. Interest of $4,682.32 was paid, and this left 13.2 per cent on the $50,000 of stock that was probably represented in the electric plant. The Commissioners said that the gross profits of about $11,000 in the electric business was probably no more than was needed to meet a fair investment charge and depreciation. While pointing out that they had no authority to increase the rates for street lighting, the Commissioners said that the return realized by the company on its investment for this service was lower than that at which interest was paid on its loans, and that they could not approve of rates for municipal service so low that the entire burden of the investment charge was imposed upon private consumers.

(13.) Consumers vs. Woburn Light, Heat and Power Company:

In 1900 a petition was brought against the Woburn Light, Heat & Power Company by some of its customers in Winchester, asking a reduction in the rates for electric lighting. The principal cause of complaint was a new system of rates that had been adopted by the company, but during the hearing the company abandoned the new rates and the commissioners did not think proper to make any further changes. For the year ending June 30, 1900, the regular net rate of the Woburn company for incandescent lighting by meter was 20 cents per kw-hour, and a little less than 40 per cent of the income of the company came from its commercial service, at meter and contract rates. On July 1, 1900, the company adopted a new meter rate with a fixed charge in each month equal to 6.25 per cent of the amount paid by each consumer during the previous year. Besides this fixed charge, the meter rate for energy actually consumed was 5 cents per kw-hour. At the hearing the company agreed to abandon this method of charging and to adopt one under which the price to no consumer should exceed 20 cents per kw-hour. Subsequently the company put into force a system under which each consumer paid a fixed monthly sum according to his maximum demand for energy, and also a rate of 6 cents for energy actually consumed. This basis of rates went into force on July 1, 1901, for all consumers, and the Commissioners said that after its operation had been shown the way would be clear for any advisable reduction, or to remove any inequitable features of the plan. During the year ending June 30, 1900, the company had an electric income of $57,439.30 gross, and $25,138.75 net. This latter amount was reduced to $13,670.14 by interest payments on bonds of $175,000 and notes of $24,624.74, and this net earning, less interest, was 8.3 per cent on the $163,000 of capital stock. For the year ending June 30, 1902, the first during which the maximum demand rates were in force for all consumers, the Woburn company earned $84,544.73 gross, and $37,731.38 net. Interest payments reduced this latter sum to $25,600.26, which was 14.6 per cent on the $175,000 of capital stock then outstanding.

(14.) Mayor vs. Worcester Electric Light Company:

In this case the mayor of Worcester sought a reduction in the rates charged for street lighting in 1901. On June 30 of that year the company was operating 696 street arcs of 2,000 nominal cp every night during 10.5 hours, on a yearly average, at the rate of 32 cents per lamp per night. At this rate the charge for energy used in lamps taking 480 watts each was 6.3 cents per kw-hour. There were also 7 street incandescents of 32 cp operated during the same time as the arcs at $24 each. Complying with the petition of the mayor the Commissioners on October 4, 1901, fixed the rate for the arcs at 30 cents each per night, which corresponds to 5.95 cents per kw-hour to go into effect at noon on October 15.

On June 30, 1901, the capital stock of the Worcester company was $400,000, and it had out neither bonds nor notes. During the year the company had an income of $230,796.59 from sales of electric energy. Its operating expenses were $128,236.20, and the net income was thus $102,560, or 25.51 per cent on the capital stock. For that year the company paid a dividend of 7.5 per cent. Meter rates to private consumers in Worcester were 15 cents per kw hour, with varying discounts up to 30 per cent, depending on the amount of each monthly bill. Besides charging off $54,281.53 for depreciation, the company had a nominal surplus of $204,680.53 at the close of the year under consideration.

The Commissioners said that perhaps the most important question in the case was, how far the public might properly share in the benefits of the surplus, and that: "What the corporation has already earned and saved it has a right to retain. It is its own property, and there is no law nor any principle receiving general public opinion by which its surplus can be directly diminished for the purpose of selling at less than a fair profit. But it must not be forgotten that, however wise and skillful may have been the management, the company has been able to acquire its present accumulations only by the exercise of a monopoly which has been enjoyed by the favor of the State, and which is, in a measure, assured to it by law. This is certainly a most important contribution by the public to the company's prosperity, for which the public is entitled to special consideration. When both parties have so clearly contributed to these results neither ought to claim the exclusive right to the benefits they confer. These conditions impose upon the company a duty to share these advantages with the public, if not as a matter of legal right, yet as a sound public policy. Such division of them will be to the company the surest guarantee of the continuance of its monopoly, just as the public interest will be most surely promoted by a ready recognition that a portion of them belongs to the corporation. The reasonable price to be charged is therefore not to be determined by prices which may be paid elsewhere to other less fortunate companies, but is to be one which this company with all its facilities and advantages may reasonably be required to make. We cannot, however, require such a division of profits to be carried so far that any portion of the company's product should be sold at mere cost, without profit, even to the municipality."

As to the duty of the company in the matter of rates the Commissioners said that it should render the public service for which it was created at the lowest reasonable cost, and added: "This proposition, however, does not necessarily conflict with the claim that the municipality may be entitled to some differential advantage, as compared with private consumers generally. The city is the largest customer of the company, and, like other large customers, has the right to supply its own electric lights, if it shall think advisable so to do; and, just as a large private consumer may be entitled to a price as low as he himself could make the lights, so the municipality may be entitled to a price as low as it could render equal service with its own plant."

(15) Selectmen vs. Bridgewater Electric Company:

This was a petition by the town of Bridgewater for lower rates on street lighting in 1901, and a petition by the company for higher rates was heard at the same time. Arc lamps to the number of 34 of 1,200 nominal cp were operated on the streets at $70 per lamp annually. Owing to discounts for low voltage, amperage and outages the rate actually paid was about $65 per year. Apart from the question of price the quality of the lighting service was not satisfactory. During the year ending June 30, 1902, these arc lamps operated 1,201 hours, so that the energy rate on the basis of 330 watt lamps, at $70 per annum, was 16.3 cents per kw-hour. After the hearing the town and the company renewed their negotiations at the request of the Commissioners, and the company proposed to continue the street lighting at the rate per lamp and about the number of hours per year above named. The company also agreed to invest an additional sum that the Commissioners thought would provide ample equipment for the street lighting service. On these facts the Commissioners, on November 14, 1902, said that the conditions as to the service were as rigorous, and the price proposed by the company as low as they could impose, and no order was made. It was also stated in the opinion on the case that the electric service was poor, the price paid by the town too low, and that these conditions could only be changed by the expenditure of a considerable sum on the plant. On June 30, 1902, the company had issued $15,000 in stock and a like amount in bonds, but it was said in the opinion that the structural value of the electric plant was less than the par value of these securities. During the year ending on the date last named the electric income of the company was $6,636.07 gross and $[illegible] net, and it paid $750 in interest.

(16) Consumers vs. Natick Gas & Electric Company:

These were petitions by consumers in Wellesley and Wayland, complaining of the quality of the electric lighting service supplied by the Natick Gas & Electric Company in 1902. After the hearings and an investigation by the Commissioners they stated in the opinion on the case "that the service of the company was unreliable, the lights were often feeble, and the supply at times practically suspended." The company, after the hearings, contracted for apparatus that was capable of giving proper service, and relying on the promises of the company to remedy the defects complained of, the Commissioners made no order in the case.

(17) Mayor vs. Chelsea Gas Light Company:

A petition was filed by the mayor of Chelsea, in 1904, for a reduction in the gas and electric rates of the Chelsea Gas Light Company. The company was then charging 20 cents per kw-hour, subject to discounts from 10 to 50 per cent for consumers using between 500 and 1,000 kw-hours per month for commercial lighting. About one-half of the commercial lighting was done at the 20-cent rate. For electric power the rate was 10 cents per kw-hour, with discounts that varied with the amount of energy used. On October 28, 1904, the Commissioners fixed the maximum net rate for commercial lighting at 16 cents per kw-hour by meter, on and after November 1. No order was issued as to the rates for electric power or for street lighting. On June 30, 1904 the Chelsea company was operating 201 incandescents of 25 cp at 9 cents per night, and 232 arcs of 2,000 nominal cp at 33.5 cents per night on the streets every night, with an annual average of 10.9 hours per night. For the incandescent lamps taking 87.5 watts each the rate just named amounts to 9.4 cents, and for the arcs taking 480 watts each, to 6.4 cents per kw-hour. After the hearing the mayor and the company began negotiations as to the rates for street lighting, and the Commissioners understood that no order was desired on that part of the case. On June 30, 1904 the Chelsea company had capital stock to the amount of $300.000, bonds of $175,000, and notes payable of $15,000 outstanding. The entire capital stock of the company had been issued before it engaged in the electric business, but it is not clear whether the $190,000 of bonds and notes had all been invested in the electric plant, or whether a part of this sum had gone into the gas plant. During the year ending on the date last named the gross electric income of the Chelsea company was $86,776.50, its operating expenses in the electric business were $53,733.54, and the net earnings were thus $33,042.96. The entire payment of the company for interest in the year under consideration was $7,870.97, so that the excess of net electric earnings over interest was $25,171.99. As noted above, the maximum possible par value of securities representing the electric plant was $190,000, in bonds and notes, and of this sum the $33,042.96 in net electric earnings was 17.3 per cent. In this same year the average price of all the energy sold for street and commercial lighting was almost 13 cents per kw-hour, or 3 cents below the price fixed.

The Power Plant of the Post Office Square Building, Boston.

Small, isolated plants are in all essential details very much alike to-day, and these details are well known. Yet it seems worth while, once and again, to describe some such plant in order to give an idea what the current practice is, and how far such a plant embodies it. In many respects, moreover, an isolated plant of minor magnitude differs from a small central station.

One of the latest plants to be placed in service in Boston is the installation at the Post Office Square Building, located in the basement of a new brick and steel structure of eleven stories at 97 Milk Street, between Federal and Congress Streets. The plant is designed to supply the heat for the entire building, power for the elevator service, and current for the corridor lights on each floor. Emergency connections are provided, so that the entire electrical supply of the building may be drawn from the three-wire mains of the Edison system, although ordinarily the central station people take care of only the office lighting. The plant thus furnishes the rather unusual example of an isolated installation which divides its regular load with the outside supply company, the reason for this practice lying chiefly in the desirability of separating the office lighting from the electric elevator load.

Coal is dumped into a bin on the Congress Street side through sidewalk scuttles, the storage capacity being about 35 tons. From the bin the coal is brought to the boiler room in a wheelbarrow holding about 175 pounds, whence it is dumped upon the boiler room floor and fired by hand into the furnaces. About 2,800 pounds of soft coal are now being burned per day in the plant. The boilers are two of the horizontal return tubular type with shells 66 in. in diameter, triple-riveted, butt-strapped and rated at 100 hp each. The operating steam pressure is 80 pounds and the boiler room is about 20 ft. by 40 ft. in width and length. The boilers were made by the Cunningham Iron Works, of South Boston, and installed by Ingalls & Kendricken, of Boston, engineers for the heating and ventilating of the building. A striking feature of the entire plant is the liberal space allowance—a pleasing contrast to many office building installations of the present day. The feed pumps consist of two duplex Blake piston pumps, cylinders 6 in. by 4 in. by 6 in., mounted in the engine room. The two pumps are supplied with high pressure steam through a 1½-in. main in which is located a Curtis automatic valve operated by a float in the receiving tank, which takes all the drip and condensation from the heating system of the building. The receiving tank is also set up in the engine room, and it is about 6 in. in diameter by 36 in. long. The Curtis valve regulates the steam supply according to the height of water in the tank, city water being used to make up the deficiencies of regular operation. This extra feed is brought from the city mains in a 1¼-in. pipe, with an additional ¾-in. pipe from another street. It is also possible to feed the pump steam cylinders directly from the boilers, through a 1-in. main which is joined to a cross-connecting pipe between the steam cylinders. The arrangement of valves is so flexible that both systems may be in operation at once if desired, one pump being supplied by each high-pressure line. The engine room is about 35 ft. by 20 ft., and it also contains a hot water tank for the office service 24 in. in diameter and 8 ft. long, heated by live steam. The piping throughout the plant is arranged with unusual simplicity and directness. The two-pipe gravity heating system is employed in the building.

The single generating unit consists of a 13-in. by 12-in. American Ball horizontal non-condensing engine direct-connected to two 39-kw. six-pole General Electric direct-current dynamos operated on the three-wire system. These are wound for 113 volts, overcompounding to 118, and mounted on a single shaft running in four bearings. The normal speed is 285 r.p.m. Steam is supplied through a 5-in. main and the exhaust is carried through a 6-in. pipe to a Berryman heater, which holds the feed water temperature close to 210° F. The heater is by-passed for feed water supply.

The switchboard was built by the W. S. Hill Electric Company, of New Bedford, and installed by Edwin C. Lewis, of Boston. It consists of three panels of dull-finished black slate 1½ in. thick. All the feeder switches are of the double-throw type, the upper position being connected with the Edison circuits and the lower with the bus-bars of the three-wire generators in the plant. The horizontal and vertical bus-bars at the rear are covered with asbestos to prevent accidental short-circuits from tools, etc. The end panel toward Post Office Square is 26 in. wide and it is devoted to the elevator service, the common height of all panels being 72 in. No instruments are mounted on the elevator panel, but it carries a full complement of Noark enclosed fuses, three double-pole, double-throw switches and two triple-pole switches at present not in use. The next panel is devoted to the generator units. It carries the usual triple-pole, single-throw switch for each generator, two field rheostats, a 6-point potential switch, two triple-pole, 400-amp. main generator fuses, including the equalizer connection, and at the top two 400-amp. Weston ammeters and two Weston 125-volt meters, one for each half of the machine. This panel is 39 in. wide, as is the third and last panel, which is given up to lighting switches, of which there are six triple-pole, double-throw. The bottom of the switchboard rests upon four polished brass columns terminating in circular pedestals of the same material, a space of 12 in. being allowed between the switchboard and the floor. The Edison service is brought in over three cables through the usual service connections, including Wright demand meters. The rear of the switchboard is admirably illuminated by daylight from out of doors through a long skylight set into the Congress Street sidewalk.

There are about 160 16-cp lamps in the corridors and some 750 lights of the same size in the offices, about four lamps per office being allowed. The elevators were installed by the Whittier Machine Company and the motors and auxiliary mechanism are located in a well-lighted room next the boiler room, 30 ft. square. Three elevators are installed, all of the Otis make, with double-worm and gear and lever car switch. Each elevator will readily lift 2,000 pounds at a speed of 400 ft. per minute, the cars holding about 10 passengers each. One elevator is equipped with a back gear attachment which reduces the speed to about 100 ft. per minute for the handling of freight. Safes and other merchandise weighing up to about 5,000 pounds can be handled in this machine. The elevator motors operate compound-wound, at 220 volts direct current, and all three of the 54-in. winding drums are equipped with solenoid-operated driving brakes to prevent back lash on account of cable slackening, and give easy, quick stops. These are the first Otis elevators in Boston to be so equipped. In the temporary absence of Chief Engineer Chapman the plant is in charge of Mr. Frank G. Wright.

Erecting a Large Motor.

By William Burns.

The electric motor, unlike the steam or gas engine, can be stowed away in almost any odd corner, as it requires very little attention, can be started and stopped from any convenient position and has no heavy reciprocating parts to jar and shake the building. It also requires very little foundation; practically the only staying required is against the pull of the belt. For these reasons, when a motor is being installed it is very often fixed near the roof to economize floor space. The motor in the heavier sizes is supported on iron or wooden beams let into the walls or affixed to columns; the smaller sizes of motors are often fixed direct to the walls or to the ceiling.

Erecting a large motor in a confined space and above the floor level is a somewhat different proposition from the fixing of the same machine on the top of a ground or a level floor. Very often to get the machine into its position it has to be taken apart, then re-erected when in position on the ground. There is no difficulty in doing this if the machine is on the floor level and there is plenty of head room, but when the machine is placed close to the ceiling, building up in position is generally impracticable. The hoisting tackle has often to be supported from the floor above, and this involves making an opening in two floors; as these openings have to be kept as small as possible, there is no way of shifting the tackle about when erecting. Of course, if the machine is not too heavy the cutting of the top floor may be avoided by hanging the tackle on some arrangement of beams and trestles on the first floor, but when we have, say, a 60 or 70 hp motor to lift, it is safer to support the load on a beam covering several of the joists on the second floor. A good, long heavy beam should be used, as it is not very easy to determine the strength of the joists in an old building, and, "'tis better to be sure than sorry." When setting up the beams to support the motor it is best to arrange the two, three or four beams so that they can be moved out of the way and allow the motor to be lifted straight up; this is also very convenient for lowering the motor should any large repair be at any time required. Further, it allows the motor to be built up directly underneath on the floor, the beams being very convenient for affixing small tackles to lift the different parts.

A machine of large size is usually built up on a soleplate, which should be got into position first; then the bottom half of the yoke and the bearings for the armature shaft, these sometimes being in one piece with the yoke. Besides these, however, on a large machine an outer bearing is fixed next to the driving pulley to sustain the pull of the belt. When these have been got into position the armature may be placed in its journals and the oil rings and brush gear fitted on. In slinging the armature it is generally possible to get a clear space on the shaft by which it may be slung, at the same time keeping the sling off the shaft journals. A short sling may be put on each end of the shaft and a piece of wood placed on the top of the armature to prevent the sling pressing on the ends of the coils.

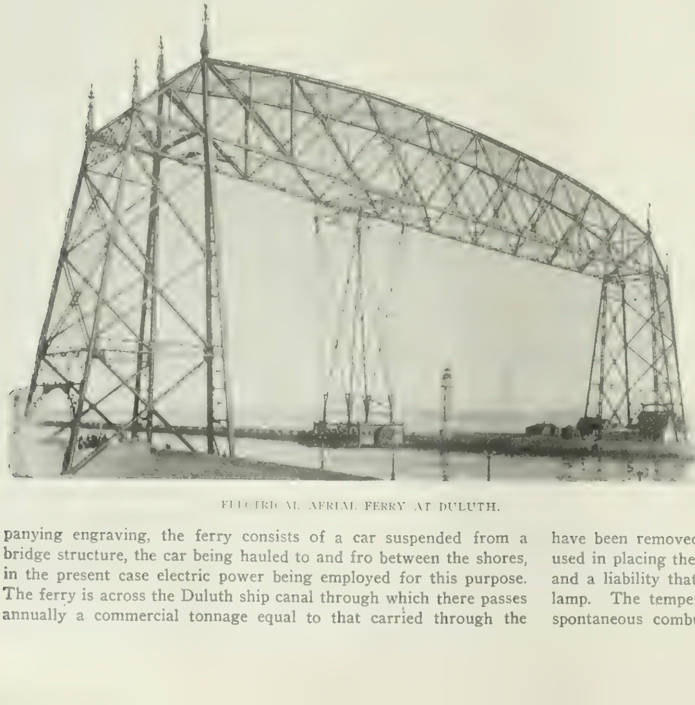
A great many erectors, however, prefer a good piece of rope for work of this nature, as it is much easier manipulated, and in the hands of an experienced man is much more reliable. For instance, in a large armature shaft the armature is seldom in the middle of the shaft; it is central between the two journals which support it, but the broad driving pulley and the outer journal have to be taken into account; and to lift the armature level, the hook of the tackle must be placed some distance from the center towards this long side, the exact position being found by trial. Low slings of suitable length are not always available and to adapt those on hand by shortening the one or the other by turns round the shaft, by a cat's paw, sheep's shank or hitching the sling on to the hook, is somewhat cumbersome and especially so if the head room is limited. On the other hand, in using the rope, the piece of wood on top of the armature is first put into position, then the hook of the tackle brought approximately to its lifting point, the toe and heel of the hook lying axially along the shaft. A clove hitch is made on the shaft when commencing lashing, leaving a fairly long, free end to tie up at the finish; upon passing the rope through the hook a similar hitch is made at the other end, and thereafter as many turns as may be thought necessary are passed through the hook and round the shaft, and the two free ends tied together. The two lashings should be crossed on the hook, thus locking them when the stress comes on, and allowing the hook to be placed a good distance from the center of the lashing without any danger of slipping; it is also very convenient for finding the exact lifting point, as when the stress is off the hook can be easily moved to a fresh position. As the journals are usually smaller than the rest of the shaft the turns of the rope should be kept inside the clove hitch. Then there will be no trouble due to a turn slipping down into the journal.

The top of the yoke should now be lifted into position, a little soft soap being smeared on the joint surfaces close to the journals to prevent oil creeping along the joint; the journal covers are then screwed down and any other details fixed up, leaving as little to be done in position as possible. All parts liable to be injured by dirt should be carefully covered up before lifting. An eye bolt is usually provided for lifting the motor, but as the bedplate is now bolted on, the eyebolt will not give an even lift. Of course another sling or lashing can be used to carry up the heavy end; this, however, throws a strain sideways on the eye bolt, and when handling a heavy weight with a chain block the sling is often subjected to a good deal of jerky pulling, and should there be the least flaw in the eye bolt it would be almost sure to give way. A sling can generally be placed between the ribs on the end brackets or round the shaft, which forms a much safer lift; also, the slings can be kept closer together, and this is of importance when a hole has to be made in the floor. A guide rope should be fixed to one end to keep the motor from swaying about when lifting. The motor should be hoisted about one or two inches from the floor and all the slings, tackles and supports examined to see that no weak parts exist. Should all be right the hoisting can be continued till the motor is high enough to clear the beams, which should now be placed in position and bolted down. The motor can now be lowered and tried for position; if the measurements have been correct no appreciable shifting will be necessary. Leveling up should not be required, as the beams will be level. Holes for holding down bolts are now bored and all connections made. A small platform and rail should be placed round the motor for the convenience of the attendant.

◆

Electrically Operated Aerial Ferry.

The first ferry of a novel type developed in France and which has entered into some use in Europe, has recently been finished and put in operation at Duluth, Minn. As will be noted from the accompanying engraving, the ferry consists of a car suspended from a bridge structure, the car being hauled to and fro between the shores, in the present case electric power being employed for this purpose. The ferry is across the Duluth ship canal through which there passes annually a commercial tonnage equal to that carried through the Suez Canal. Heretofore the traffic across the canal was accommodated by a steam ferry. This was, however, found expensive, and the United States War Department refused to approve of successive plans for a drawbridge, a lift bridge and a roller bridge. A tunnel was also proposed, but it was found that the cost of its construction would be prohibitory. The cost of the steam ferry was $11,000 per annum, and it is estimated that the annual cost of the aerial ferry, owing to the use of electric power, will not exceed $8,000 per annum, including operation, maintenance and interest on bonds.



ELECTRICAL AERIAL FERRY AT DULUTH.

The ferry bridge has a clear height above the water of 135 ft. and a clear span of 394 ft. The car platform is 34 by 50 ft., and provides space for a street car, two wagons and two passenger cabins, each 7 by 30 ft. Its carrying capacity is 125,000 pounds and the normal speed of operation is four miles an hour, though the electrical equipment will permit a speed double this.

A 40-hp, 500-volt General Electric railway motor, controlled by a railway controller, is secured by means of brackets under each end of the car. Each motor is geared to a 9-ft. cable drum, one of which hauls the car in one direction and the other in the opposite direction. One-inch cables from these drums extend overhead to 9-ft. idler wheels on a suspension truck on the bridge and thence to the ends of the bridge, where they are fastened. The track carrying the car and the idler is enclosed on three sides within the box section of the lower chord of the bridge, thus shielding it from snow and sleet in the winter time. The suspension truck is carried on four rails and has 32 wheels, eight bearing on each rail. The bearings of the wheels as well as those of the drums and idlers are fitted with ball end-thrust bearings. To provide for an emergency, the drums in the car are fitted with a hand gear by means of which they may be operated. Current is supplied at 500 volts from two sources, the mains of the Central Lighting Company and the feeders of the street railway company. The trolley wires, one for each of these sources of supply, are supported by the usual electric railway overhead fittings, and a switch under the control of the motorman enables him to switch over from one source of power to the other. All wiring for motors and lights is installed in iron-armored conduit. In one of the waiting rooms a neat cabinet is installed containing the wattmeters and switches for the light, power and signal systems. The average power used for moving the car is 18 hp. In a broadside wind of 60 miles per hour a deflection of the car of but 1 7/16 in. was noted.

The bridge was constructed by the Modern Steel Structural Company, of Waukesha, Wis., and the electrical equipment was installed by the Mutual Electric Company, of Duluth. We are indebted to Mr. Norton Mattocks for the information contained in this description.

◆

Ignition of Coal Dust by Electric Lamps.

A recent issue of *Mines and Minerals* contains an account of experiments with reference to the ignition of coal dust by electric lamps. When an incandescent lamp is placed on coal dust, either uncovered or partly covered, heat is generated very rapidly. In one case, with a slight covering of dust, the temperature rose in ten minutes to 370° F., and in four minutes the lamp exploded at a temperature of 450°. The highest temperature registered was 650°. In two of three experiments the coal dust was found to be red hot on poking into the dust, although the lamp had been removed some time. The interesting part of these experiments resides in the fact that when the heat has been raised to a certain temperature the action of spontaneous combustion begins to operate, and the temperature continues to increase until fire is reached, although the lamp may have been removed. These phenomena indicate that unless care is used in placing the lamps there is some danger of underground fires and a liability that fire damp may be ignited by the explosion of a lamp. The temperature at which coal dust will begin to develop spontaneous combustion has not as yet been determined.

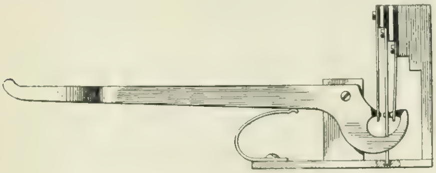
New Telephone Patents.

AUTOMATIC LISTENING DEVICE.

Numerous inventors have struggled with the problem of the automatic keyboard for manual switchboards. A step in this direction has been patented by J. W. Lattig and C. L. Goodrum, of Philadelphia, this being an automatic listening device for the operation. The arrangement includes two switching relays, one associated with the answering plug of each cord pair and arranged to cut the operator's set upon the pair; and the second associated with the calling plug to cut the set clear of the cord pair. It is evident at once that this system in its present state has no flexibility. The patent is assigned to the Eastern Telephone Manufacturing Company.

NEW HOOK SWITCH.

The accompanying illustration shows a type of hook switch patented by J. McK. Clement, of Mineralbluff, Georgia. Mr. Clement has made several different designs of this hook, the distinctive features of which are a stationary middle spring and movable spanning springs, each operated by the lever.



CLEMENT HOOK SWITCH.

SELECTING TRUNK SYSTEM.

It is well known that a large group of trunks is more efficient than a small group. In order to keep the efficiency to a maximum Mr. E. Sand has produced a selecting trunk system. By this system all trunks between any two points are arranged in a single group, irrespective of the number of operating positions necessary to handle them. Then in order to make any trunk available for all positions, a number of selective devices similar to the selectors of an automatic switchboard are associated with each operator's position, wired to trunk jacks. There are just enough of these jacks and associated selectors to handle the traffic from that position. When a call is to be forwarded the operator inserts a plug in any available jack of the desired group and the selector selects the first available, i. e., "non-busy" trunk line.

COMPOSITE SYSTEM.

Mr. C. Turchi, of Italy, has patented a composite system in which the telephone branch of the circuit is bridged off the line and split between two circuits, each led through a condenser and through one of the winding bridges of a differential coil. One of the branches, in addition, contains an adjustable inductance. The telephone proper is connected to an independent winding of the differential coil which overlays the two opposed primaries. Transmission is regulated by the unbalancing of the two branches of the bridged circuit by properly adjusting their relative inductance.

SELECTIVE SYSTEMS.

A novel selective device has been patented by C. R. and D. R. Green, of Rising Sun, Indiana. This consists of a relay which is under control of either the operator or the stations, and by means of which the branch subscribers' circuits may be connected to or disconnected from the main line at will. Another selective device is of the step by step nature invented jointly by Messrs. N. S. McKinsey and A. R. Nelson, of Susanville, Cal. The mechanism is driven by a clockwork under control of either the subscriber or of electromagnetic means operated from the central office.

COMBINED PRIMARY AND SECONDARY CUT-OUT.

Many are familiar with the secondary cut-out button of telephone sets, once almost universally furnished, but now almost entirely obsolete because of the skill required to handle it satisfactorily. This button was wired to short-circuit the secondary of the induction coil and thus cut out extraneous transmitter noises. Mr. C. Adams-Randall, of New York City, has gone this one better by producing and patenting a cut-out whereby the receiver is cut out and transmitter is in one position and vice versa. This cuts out inside tones, as well as extraneous noises.

LETTERS TO THE EDITORS.

Coal and Power in South Africa.

To the Editors of Electrical World and Engineer:

SIRS:—Permit me to correct a somewhat misleading paragraph which appeared in your issue of July 1, under the heading "Power Transmission in South Africa." One would infer from it that coal is so expensive in Johannesburg as to warrant electrical transmission thither from the Victoria Falls, a distance of 1,100 km. (680 miles) at 70,000 volts. The fact is that fairly good coal (having about 80 per cent of the calorific value of Welsh) costs delivered in bunkers at the mines in car load lots from $3 to $4 per ton. The principal central electric power station serving Johannesburg and the adjoining mines buys its coal at about 60 cents per ton at the pit's mouth, which is about 20 miles from the town. All-day power can be contracted for at a trifle over 3 cents per kw-hour, and many mines generate at a cost of 2½ to 3½ cents with not unusually good load factors. Electrical transmission of power from Victoria Falls is evidently not to be considered as commercially possible.

JOHANNESBURG, SOUTH AFRICA. J. W. KIRKLAND.

A Prize for a Prophet.

To the Editors of Electrical World and Engineer:

SIRS:—As an amateur farmer, I am interested in the weather. I have gathered meteoroligical data for years, but as yet have not found the slightest basis on which to ascertain the state of the weather, even twelve hours ahead.

The Government weather predictions are very faulty, and as many laymen claim they can predict the weather more accurately than the weather bureau, without any of the elaborate apparatus of the Government, I hereby appeal to all the weather prophets of this country to enter a thirty day contest for a cash prize of one hundred dollars, which I will give to whoever predicts the weather most accurately and will tell for the benefit of the public by what methods he arrived at his conclusions.

NEW YORK CITY. F. R. FAST.

Electricity in Agriculture.

To the Editors of Electrical World and Engineer:

SIRS:—I wish to call your attention, as the editors of the leading periodical of the world devoted to electricity in its numerous applications, to a matter of great importance to both the electrical industries and to the agricultural interests of the whole country.

Since July 1 I have written to the Congressional delegations of many States, urging them to take active measures, at the coming session, to obtain an adequate appropriation for making experiments in the application of electricity to agriculture, plowing, threshing, etc. It certainly is a strange thing, as I wrote recently to Prof. E. J. Houston, that fifteen years after the masters of applied science freed the horse and mule from grinding servitude in the city streets as the sole motors of the cars of the traction companies, no Lincoln has yet appeared to emancipate them from their weary labor in the fields of the farmer, although in the one case the power is mainly derived from high-priced coal, burned in costly steam plants, while in the other it may be had at a mere normal cost from the water power so abundant in so many parts of our wide extended country.

I have been of the opinion that Congress should make such appropriations ever since I first learned, more than a dozen years ago, of the large quantities of power produced by the dams of the irrigation companies, such as that of the Redlands Company, of California, located 8,400 ft. above the sea. I notice in the catalogue of the Pelton Water Wheel Company that this power is now utilized by the Los Angeles Edison Electric Company, of California, by means of a turbine working under a head of 192⅜ ft.

Besides these artificial sources of water power, there is the great Snake River of Idaho, which is a succession of high falls. The Twin Falls, Lavel & Water Company has along its 270,000 acres on the Snake River, at the Twin (186 ft.) and Shoshone (210 ft.) Falls 100,000 hp, and has just put in a 20,000-hp plant. It is safe to assume that any of these great companies would be more than willing to supply power gratis for such experiments which, therefore, could be carried on at small cost.

The mountain regions of the Southern States in Virginia, West Virginia, North and South Carolina, Georgia, Alabama, Tennessee and Kentucky are admirably situated to take advantage of this scheme by means of the high head impulse wheel which is so admirably fitted to develop power from either a large stream or a small one.

In this region we are interested in the scheme of the Keokuk & Hamilton Water Power Company to dam the Mississippi at the foot of the Des Moines Rapids, at a cost of $6,000,000, to raise the river 30 ft., and produce 60,000 hp. This power could be conveyed over an area of 125,000 square miles—twice the size of Illinois and 15,000 miles to spare, in Iowa, Illinois and Missouri in the very best part of the corn belt.

Engineers are studying the details of a similar scheme at the Falls of the Ohio at Louisville, where at low water the river drops 26 ft., to produce an average of 38,000 hp. The same extent of territory could be covered from this center and from Niagara and the "Soo." It is proposed to dam the Tennessee at Muscle Shoals for the same purpose, and I doubt not that many another large Southern river will before long be treated in this way.

I have had many letters of approval and now arrive by every mail. From 1893 till about 1901 I searched the index of the Electrical World and Engineer for notices of electric plowing experiments and found many, all "made in Germany." I think it is high time that this odious German label should be removed in a branch of applied science where otherwise we Americans stand first.

Barry, Ill. E. W. Baker.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Preventing Sparking in Alternating Current Commutator Motors. A description of a method of Zani which consists in providing the stator with auxiliary poles, in addition to the main field poles, so disposed that when a coil of the rotor is short-circuited it will embrace, in addition to the flux due to the main field, a flux due to auxiliary poles of such direction and intensity as to counteract the action of the flux due to the main field. The stator *a* (Fig. 1) is provided with main poles, *b*, b^1, etc., wound with continuous coils *c*, so as to produce alternate N and S main poles. Between the main poles *b*, b_1, etc., the stator is provided with auxiliary poles, *d*, *e*, between consecutive main poles; the pole *d*, nearer to the S pole *b*, is wound as a N pole and the pole *e* as a S pole. The rotor is provided with a winding partly shown in Fig. 1, the path of current being from the commutator bar, *f*, through the conductor, *g*, across the back of the rotor to the conductor, *h*, and through the conductor, *h*, to the commutator bar, *k*. Under these circumstances the conductors short-circuited by the brush, *l*, embrace the flux due to the pole *b*, and the two auxiliary poles, *d*, on each side of it, and it will be seen that the flux due to the auxiliary poles will counteract the flux due to the main pole and prevent the flow of current in the short-circuited coil. The illustration shows an additional short-circuited winding, *m*, on the main poles for the purpose of keeping uniform the distribution of the flux over the main polar surfaces. On the auxiliary poles is also shown a single short-circuited winding, *n*, embracing a pair of poles; this coil is useful in preventing leakage of the main flux between the main poles through the auxiliary poles. This short circuited coil will also affect the flux due to the auxiliary pairs of poles, *d*, *e*. In the case of a two-pole machine there will be two sets of two auxiliary poles; for a four-pole machine there will be four sets of two auxiliary poles, and so on.—Lond. *Elec.*, Aug. 25.

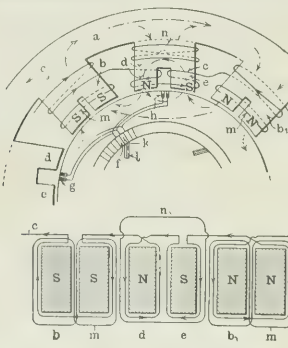


FIG. 1.—PREVENTING SPARKING.

Calculation of Three-Phase Induction Motors.—Sumec.—A mathematical article, illustrated by diagrams, discussing several special problems in the calculation of induction motors. The discussion is quite thorough in various details, and rules are given for the design of such motors, with numerical examples.—*Zeit. f. Elek.* (Vienna) Aug. 27.

Separating Losses of Machines.—Roehle.—An illustrated article describing a method of separating the losses in the bearings and the air friction losses of rotating machinery from the form of the curve giving the decrease of speed when the circuit is broken.—*Elek. Zeit.*, Aug. 24.

Removal of Asbestos from Armature Leads.—Weeks.—A short article describing a device which has been found useful in removing asbestos from armature leads.—*Amer. Elec.*, September.

Lights and Lighting.

Street Lighting.—A report on street lighting in Croydon, giving results of tests of various lamps with a statement of the comparative cost. The figures given are the average total cost in cents per cp-year:

	Cents.
Electric arcs, direct connected, 520 watts, alabaster globes	17.40
Electric arcs, alternating current, 650 watts, half opal globes	17.92
Electric arcs, alternating current, 450 watts, half opal globes	29.18
Electric arcs, alternating current, 500 watts, half opal globes	31.88
Electric arcs, direct current, 690 watts, alabaster globes	17.40
Nernst lamps, ½ ampere	20.32
Incandescent gas lamps	24.90
Croydon Gas Company	31.58
South Suburban Gas Company	31.64
Alternating-current flame arc, 550 watts, opalescent globe	6.15
Santoni lamp, 430 watts	7.34
Incandescent lamp with Reason fittings	24.63

In its conclusion the committee finds that gas lighting has been considerably improved by means of high-pressure lamps, but although these advances have been made, so long as the price of electric arc lamps does not exceed a certain amount, the cost of lighting by means of the ordinary direct-current arc lamps should be more economical than by the high-pressure gas lamps. The committee also find that considerable improvements have been made with electric arc lighting. This has been primarily brought about by the introduction of a new type of arc lamp known as the "flame arc lamp."—Lond. *Elec.*, Aug. 25.

Power.

Braking of Electric Lifting Motors.—A description of a new form of brake gear made by L. Scott & Co. Two brake shoes are held against opposite sides of a drum on the motor-shaft by the tension of one or more spiral springs. These shoes are connected by levers to movable cast-steel plates, which form part of the magnetic circuit of the motor. When no current is supplied to the motor the springs hold the brakes "on," the steel castings being then kept by the levers a slight distance from the framing of the motor. Fig. 2 shows the construction of a 95-hp haulage motor for 500 volts at 430 revolutions per minute. The greater part of the iron is removed from around the roots of two of the pole-pieces, so that the magnetic flux meets with a gap of high reluctance, and passes by preference through the cast-steel plates, which are situated opposite the gaps. These plates, therefore, close in to the sides of the motor immediately when the current is switched on, holding off the brakes and bridging the gaps in the magnetic circuit. In the case of a series motor if the current falls, the brakes will gradually come on again, and prevent the machine from attaining an excessive speed. As, however, a small fraction of the full-load current is sufficient to keep the brakes off, they do not interfere with the speed variation, which is so valuable a feature in series motors for general lifting purposes. The amount of the "holding off" current can be varied according to circumstances, and with a slow-speed motor which is recommended for lifting purposes, the brakes are arranged not to go on until the speed of the motor has increased to about three times its normal. With high-speed motors this would not be safe, so that the brakes are caused to go on with a larger fraction of the full-load current. The latest improvement in these brakes is the arrangement enabling them to be taken off by hand when required. In Fig. 3 it will be seen that a pair of levers, hinged at their lower ends, engage the steel plates in the middle, and at their upper ends are linked to a toggle in the center of the framing. The toggle is operated by a hand or foot-lever. When it is desired that the entire control of the motor should be effected by a single handle, a similar system of levers is employed, operated by a cam on the reversing controller. The cam has a slow rise, so that as the controller is moved into its lowering position the brakes are gradually taken off before current is switched on. If, when the brakes are off, the load does not start itself, the controller is moved one step further, switching current on to the motor through a resistance.—Lond. *Eng'ing*, July 7.

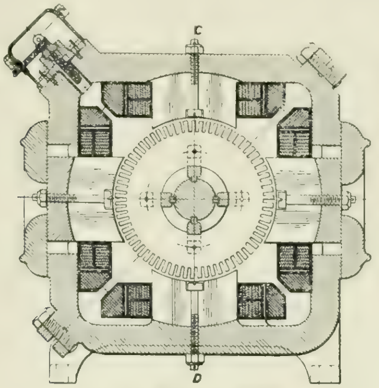


FIG. 2.—BRAKING MOTORS.

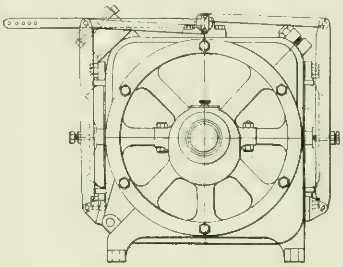


FIG. 3.—BRAKING MOTORS.

French Waterpower Station.—Ryan.—An illustrated description of the Saut Mortier transmission plant which is located in the Jura region, a mountainous district lying in the eastern part of France and next to Switzerland. Four 700-hp turbo-driven alternators deliver 50-cycle, three-phase currents at a terminal voltage of 7,500. Four main transmission lines run from Saut Mortier and cover a considerably extended territory in the Jura region. The total length of the high-tension overhead lines, starting from the station, may be reckoned at 70 miles. The lamps and motors in the different towns are supplied by secondary circuits, and the transformers are installed in kiosks built of cement. In order to supply current for the locality of St. Claude, where the number of lamps and motors is considerable, there has been erected a sub-station containing a number of motor-generating groups.—*Amer. Elec.*, Sept.

Turbo-Electric Drive in Paper Mill Service.—Bibbins.—An article pointing out that the steam-turbine is specially suitable as a prime mover for pulp and paper manufacture, and giving the experience of the West Virginia Pulp & Paper Company. There are two steam turbines of 1,000 kw running at 1,800 revolutions per minute. Three-phase current of 20 cycles is generated at 440 volts. The total motor load connected is 4,920 hp. The installation is described in detail and illustrated.—*Eng'ing Record*, Sept. 2.

Hydraulic Accumulation Plant.—Herzog.—A very long detailed illustrated description. In order to utilize, during the night, the water power plant of the Alten-Aarburg works, there has been installed a hydraulic storage system operated by centrifugal pumps.—*Elek. Bahnen*, Aug. 4, 14, 24.

Hydraulic Installations.—Barr.—An illustrated article on water-power machinery and accessories.—*Eng'ing Mag.*, September.

Power Plant.—Hardesty.—An illustrated description of the electric light and power plant of Brigham City, Utah. Water power is used to drive a 350-kw generator running at 300 revolutions and giving three-phase currents at 60 cycles per second. The voltage between each phase is 4,150.—*Eng'ing News*, Sept. 7.

Electric Power in the United States Navy.—Brooks.—An illustrated article describing in detail the various motor applications on board the warships of the United States Navy. Diagrams are given showing how the motors are coupled to the various auxiliary machinery.—*Amer. Elec.*, August.

Boiler Room Trouble.—Henry.—A short article describing the troubles encountered by the writer, and the remedies applied in the boiler room of a western street railway plant.—*Amer. Elec.*, Aug.

Stoker.—An illustrated description of an improved revolving-chain-grate automatic stoker especially applicable for furnaces of steam boilers, refuse destructors, etc.—Lond. *Elec.*, Aug. 25.

TRACTION.

Three-Phase Electric Railroad.—Some notes on the electric trunk railroad from Vienna to Pressburg which will be operated within the city limits by direct-current and outside by three-phase currents. It is intended both for passenger and freight service. The partial line from Vienna to Gross Schwechat will probably be opened during this year, while the whole line will be finished next year. The total length will be 70.5 km. In Vienna the municipal electric station will furnish the direct-current, while for the road between the two cities a three-phase power station is being erected in Regelsbrunn, at the central point of the line. For passenger service motor cars will be used, for freight service electric locomotives.—*Elek. Bahnen*, Aug. 4.

Direct-Current, Single-Phase Motor Car.—Richter, Cronbach.—Some notes on the description of a motor car of the Allgem. Elek. Ges. which is operated both with direct-current and alternating current, as recently noticed in the Digest. Winter Eichberg motors are used. The brushes which carry the exciting current for the alternating-current operation of the motor, carry during direct-current operation the real load current; that is, the current which with the exciting field gives the torque of the motor. The stator winding which supplies the load current to the armature by inductive action during the alternating-current operation, serves as field winding during direct-current operation. A second stator winding, which is not used in the Winter Eichberg motor when operated by single-phase, compensates the armature flux. Richter makes some remarks concerning sparking of the commutator. Cronbach replies that the short-circuit brushes are not taken off during direct-current operation. There are no resistances in the connections between commutator segments and armature windings. Nevertheless, it is a fact that the operation of the motor with alternating current is sparkless. Richter concludes that under these circumstances the e.m.f. produced by pulsation of the alternating-current exciting field in a short-circuited coil is smaller than that induced by rotation in the direct-current exciting field. In other words, an ordinary series motor without any device for preventing sparks at the brushes and with the same dimensions as the Eichberg motor would also run sparkless at the same frequency (40 per second) and with the same exciting field. It would, therefore, be possible to replace the motor by a simple series motor.—*Elek. Bahnen*, Aug. 4.

Insulation Resistance of Third Rail.—On the Berlin electric elevated and subway the following insulation resistances of the third rail against earth were found: First section, 4.2 km length (elevated), 2,000 ohms, corresponding to 8,400 ohms per km. Second and third sections, 7 km length (elevated), 6,116 ohm, corresponding to 42,812 ohms per km. Fourth section, about 3 km length (tunnel), 29,400 ohms or 88,200 ohms per km. Fifth road, 5.2 km length (tunnel), 28,550 ohms, corresponding to 148,460 ohms per km. These insulation resistances are considered satisfactory, except on the first road where a fault is believed to exist.—*Elek. Bahnen*, Aug. 24.

Third-Rail.—An illustrated description of the new under-contact third-rail which will be used in the New York electrical zone of the New York Central Railroad.—*St. R'y Jour.*, Sept. 2.

Electric Tramway Statistics of Austria and Hungary.—Two statistical tables. On December 31, 1904, there were in operation in Austria 32 electric railways with a total length of 573 km. The largest system is that of the Vienna municipal electric railways with 184 km, while the system of the Vienna Local Railway Co. covers 42 km. In Hungary there were three electric interurban railways with a total length of 172 km.—*Zeit. f. Elek.* (Vienna), Aug. 13.

Installations. Systems and Appliances.

Synchronous Converters in Parallel with Batteries.—Jakobi.—If a battery is connected in parallel with a generator in order to equalize the load, the action depends on the fact that the battery itself has a low internal resistance while the dynamo has a relatively high internal resistance and does not operate with constant voltage. With a synchronous converter changing three-phase currents into direct-current, however, the voltage of the direct-current remains constant as long as the secondary voltage of the three-phase transformer which is connected to the three-phase side of the synchronous converter, remains constant. In order to use a storage battery in parallel with the direct-current side of the converter Siemens & Halske have devised the arrangement shown in Fig. 4, which employs a constantly-running booster. The dynamo, *Z*, is driven by the motor, *M*. The dynamo, *Z*, has two exciting windings, the actions of which are opposed to each other. Through one of these windings the total current of the network passes, while the other winding is connected to the terminals of the battery. If the load is such that the current in the network equals the maximum current supplied by the converter, *U*, the actions of both windings compensate each other and the battery is neither charged nor discharged. If the load rises, the winding through which the main current flows is stronger than the other winding and the dynamo, *Z*, is so excited that the battery discharges. If, on the other hand, the load decreases, the battery is charged. In connection with the street railway system of Remsheid two machines are used instead of the one booster. An auxiliary machine is provided with the two magnetic windings and gives the exciting current for the shunt excitation winding of the dynamo. It is, however, possible to avoid the use of a booster entirely. An arrangement for this purpose is shown in Fig. 5. The method is based on the fact that the direct voltage has a fixed ratio to the three-phase voltage with which it is supplied, so that it is sufficient automatically to change this three-phase voltage. This is done by means of the three rheostats, W_1, W_2, W_3, which are coupled together so that the change of resistance in each of the three phases is the same. The exciting current for the converter, *U*, is provided directly from the battery. The rheostat, *R*, in this circuit, may also be coupled with the rheostat, *W*. In this way for any load the correct excitation and unity power factor are obtained.—*Elek. Zeit.*, Aug. 24.

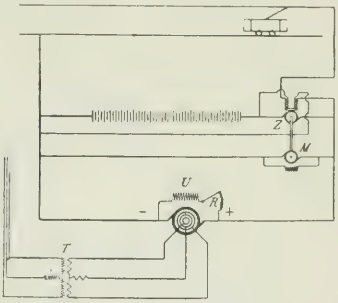


FIG. 4.—DIAGRAM OF CIRCUITS.

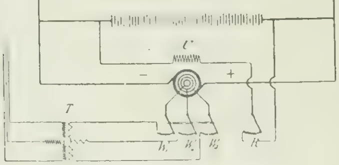


FIG. 5.—DIAGRAM OF CIRCUITS.

Australian Central Station.—An abstract of the report for last year of the electric central station of Melbourne, Australia. The total number of kw-hours sold was 3,981,698. The total works cost per kw-hour sold was 2.796 cents, the total cost, excluding capital charges, 3.228 cents; the total costs, including capital charges, 5.278 cents. Considering the excellent load factor of 26.7 per cent, the works cost of 2.796 cents per kw-hour is high. This is explained to a large extent by the coal cost of 1.352 cents and the wages cost of 0.664 cents. Both fuel and labor are expensive in Australia. —Lond. *Elec.*, Aug. 18.

Lightning Arresters.—Neall.—An illustrated description of present American practice in lightning arresters for high-voltage transmission circuits. The following types are described: First, non-arcing-multigap-pyramid; second, non-arcing-multigap, with resistances and multiplex arrangement; third, non-arcing-multigap, with non-arcing metal, series, and shunted gaps (so-called low-equivalent lightning arresters); fourth, horn-lightning arresters. The experience of three American companies with the latter type is described. They consider this type as very satisfactory for heavy discharges; the chief objection is the length of time the arc holds on after the discharge to ground (a second or a second and a half); considerable disturbances are created on the system when they discharge.—*Elec. Jour.*, August.

Time-Limit Relays.—Fernandez.—An illustrated article describing the clock type of time-limit relay and bellows type of time-limit relay. The author points out the advantages and disadvantages of the two types, and gives methods for testing and installing them.—*Amer. Elec.*, September.

Electric Connections.—Bernard.—Some illustrated notes describing the various cases in which electrical connections may be made by snap clasps similar to those used for the snap buttons of gloves.—*Elek. Zeit.*, Aug. 24.

Wires, Wiring and Conduits.

Calculating Networks.—Li Gotti.—An article illustrated by diagrams on a simple method for calculating distribution networks. —*L'Eclairage Elec.*, Aug. 26.

Electrophysics and Magnetism.

New System of Units.—Rossi.—A paper in which the author recommends that the quantity of electricity should be made a fundamental unit of the same rank as length, time and mass, and possibly more fundamental than mass. Its unit is indicated by *E*. On the new system, electric current becomes ET^1, difference of potential $ML^2T^{-2}\ XE^{-1}$, and resistivity $ML^3T^{-1}E^{-2}$. The last quantity may be analyzed as follows: On reversal it becomes conductivity $M^{-1}L^{-3}TE^2$. This may be written (EM^{-1}) (EL^{-3}) (T). The first of these quantities is the familiar ratio e/m, or the ratio of the charge of the electric carrier to its mass. This is also the acceleration in unit field. The second quantity is the density of electricity in the material, and the third quantity, *T*, may be regarded as the time during which the electron is, on the average, free to follow the impulse of the field; in other words, the time of traversing its mean path. It is obvious that the product of these three quantities gives the rate at which electricity is conveyed under the impressed e.m.f. This is simply another way of stating that the conductivity is measured by the current traversing a conductor of unit cubical dimensions when subjected to unit e.m.f., and Ohm's law follows as a consequence of the viscous resistance encountered by the electrons in moving through metals.—Lond. *Elec.*, Aug. 25; from *Nuovo Cimento*, May.

Alternating-Current Electromagnets.—Underhill.—An article illustrated with diagrams on the calculation and design of magnets for operation on alternating-current circuits.—*Amer. Elec.*, Sept.

ELECTROCHEMISTRY AND BATTERIES.

Electrolytic Valve.—HOLTZ.—An account of experiments in which he determined the "valve effect" of a large number of different electrodes. He used electrodes having a surface ratio of 1:200, and sent currents alternately in the two directions. Most cells show some kind of valve action, even tin, zinc, carbon and platinum, in dilute sulphuric acid. But very decided valve action is shown only by aluminum, copper, cobalt, antimony and bismuth. Aluminum immersed in aluminum chloride shows currents in the ratio of 88 to 3, but in this case the anode must be smaller for the larger current, instead of the cathode, as in sulphuric acid. Copper in chloride of copper shows a similar ratio, but in this case the cathode must be smaller for the larger current. Cobalt shows the reversed aluminum effect in dilute sulphuric acid, whereas antimony and bismuth shows the normal effect. This is very high in the case of antimony, the ratio of the currents in the two directions being about 100 to 1, so that an antimony cell may be used as an effective rectifier. In some of these effects are due to a layer of oxide, the others must be due to a film of hydrogen.—Lond. *Elec.*, Aug. 25; from *Phys. Zeit.*, Aug. 1.

Laboratory Appliances.—KELLER.—The first part of a fully illustrated description of labor-saving appliances in the Baltimore laboratory of the Anaconda Copper Mining Company. The devices described in this installment refer to conveniences for handling beakers and acids, stirring machines and filtering apparatus.—*Electrochem. and Met. Ind.*, Sept.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Slip of Induction Motors.—DRYSDALE.—The author gives a concise summary of the different methods for measuring the slip of an induction motor. They are divided into four classes: First, speed measurement; second, contact methods; third, measurement of frequency of rotor currents; fourth, stroboscopic methods. He considers that a direct-reading slip indicator would be far more convenient, and describes a simple arrangement by which the slip at any instant can be directly read. As shown in Fig. 6, it consists simply of a conical roller of boxwood which rotates with the motor, and upon which rests a pivoted disc, which rolls upon the surface of the roller. The disc can be traversed along the whole length of the roller by a screw and guide, while its position is given by a scale. In order to arrange for both positive and negative slips to be read, the diameter of the disc is made intermediate between the diameters of the two ends of the roller. By attaching a disc of paper with black and white sectors of numbers equal to the polarity of the motor to be tested to the pivoted disc, and illuminating it with an arc or glow lamp from the source of supply, the disc can be traversed along the roller until the figure appears stationary. To enable the readings to be taken with the greatest possible convenience the scale may be made direct reading. If D is the diameter of the disc, d_1 and d_2 the diameters of the small ends of the roller respectively, 1 the length of the roller, N and n the synchronous and motor speeds, respectively, and x the distance of the disc from the position corresponding to no slip, we have slip per cent $= S = 100\ (N\text{-}n)\ /N$, and $x = \frac{D1}{d_2 - d_1}\ \frac{s}{100 - s}$, from which x can be calculated for various positive and negative values of the slip and the scale divided off. In order to set the zero of the scale accurately and check the calibration if desired, the simplest plan is to attach a second disc to the end of the roller shaft with radial slits in it. If the roller is then run by a motor at any speed, and the rolling disc is observed through the slits, or by means of a lamp behind the slotted disc, the figure on the rolling disc is seen and the zero of the scale is set to the position where the figure remains stationary. If then a counter is attached to the roller shaft and the disc traversed to any reading of the scale, we have only to count the number of revolutions of the figure while the roller makes, say, 1,000 revolutions to get the actual slip, which may be compared with the scale reading. The advantages of this device are that it is applicable to all motors by simply changing the figure on the disc, that no time is lost in counting, that no calculation or knowledge of the synchronous speed is necessary, and that on an unsteady brake the observer can watch the fluctuations and observe the slip at the moment the balance is correct. The author recommends to determine the speed of a motor by deducting the slip thus measured from the synchronous speed as given by a frequency meter.—Lond. *Elec.*, Aug. 25.

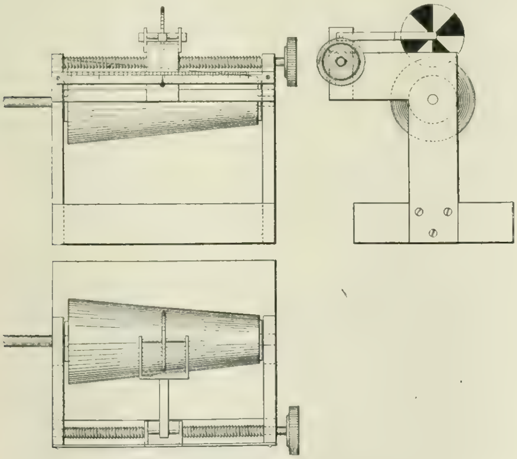


FIG. 6.—DIRECT-READING SLIP INDICATOR.

Meter-Testing Method.—CORNWALL.—In all meter testing departments it is customary to test any meter when returned to stock and find its error percentage. If this error is within certain limits and the meter is otherwise satisfactory, no further testing is needed. If, on the other hand, it is found to be running either fast or slow beyond the allowable limit it becomes necessary to recalibrate it. The author outlines a method for testing meters which he has worked out and found to be entirely satisfactory, giving accurate results and saving a great amount of time.—*Amer. Elec.*, September.

Electricity Meters.—GERHARDI.—A continuation of his illustrated serial. Of double tariff meters, those of Aron, of the Electrical Company and of Hookham are described. The author then passes over to a description of maximum demand indicators and describes the Atkinson indicator.—Lond. *Elec.*, Aug. 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electrolytic Wave Detector.—FERRIE.—An account of experiments with the electrolytic detector which has already been used in wireless telegraph systems. A platinum wire 0.01 mm in diameter just dips into sulphuric or nitric acid, and the cell is placed in a telephone circuit. A train of incident waves may be "read" in the telephone over some 12 miles. But the sensitiveness of the apparatus may be considerably increased by introducing an e.m.f. into the circuit with its positive pole joined to the platinum. The sensitiveness increases with the e.m.f. as long as the latter remains below the point at which electrolysis set in. This point can be ascertained by means of a potentiometer. When it is passed, a continuous hissing is heard in the telephone. If the latter is replaced by a ballistic galvanometer, every wave-train is indicated by a deflection, which is reversed on introducing the e.m.f. This curious fact may be explained on the assumption of a depolarizing current. When at rest the e.m.f. produces a counter e.m.f. of polarization in the detector cell, which forms a kind of condenser subject to discharge by impinging waves, the necessary conductivity being created by a kind of coherer action.—Lond. *Elec.*, Aug. 18; from *Comptes Rendus*, July 31.

MISCELLANEOUS.

Austrian Association of Central Stations.—An account of the recent general meeting of the Austrian Assoc. of Central Stations. This association is one year old, and comprises 46 members which represent 62 central stations. Among the things discussed was the theft of electric current, which is stated to occur frequently. Singer reported on a method of preserving wooden poles, which is said to be used quite often in Norway. A hole is made in the ground two feet deep, and 110 to 140 grams of crystallized copper sulphate are thrown into the hole. The pole is then set into the hole. The water in the earth dissolves the salt and it enters gradually into the pores of the wooden pole which get finally a green color. From time to time new copper sulphate is thrown into the earth. The method is said to have given good results. Niethammer read a paper on steam turbo-dynamos which elicited a long discussion. Scheinig installed in Linz in 1901 a 300-kw steam turbo-generator which gave such good results that another generating set of 500 kw was installed in 1904. He called special attention to the very slight attendance which turbo-generators require.—*Zeit. f. Elek.* (Vienna), Aug. 20.

Electrical Laboratory.—An account of the equipment of the new electrical laboratory of the Institute of Technology at Dresden, Germany.—*Zeit. f. Elek.* (Vienna), Aug. 13.

Atlanta-Marietta Single-Phase Railway.

Between the cities of Marietta and Atlanta, Georgia, there has recently been placed in operation the first single-phase railway to be equipped in the South. This railway, which is owned by the Atlanta Northern Railway Company, is constructed over a private right of way which runs parallel to the tracks of the Western & Atlanta Railway. The interurban line makes no attempt to conduct a local service, although the cars enter the city of Atlanta over the tracks of the Georgia Railway and Electric Company.

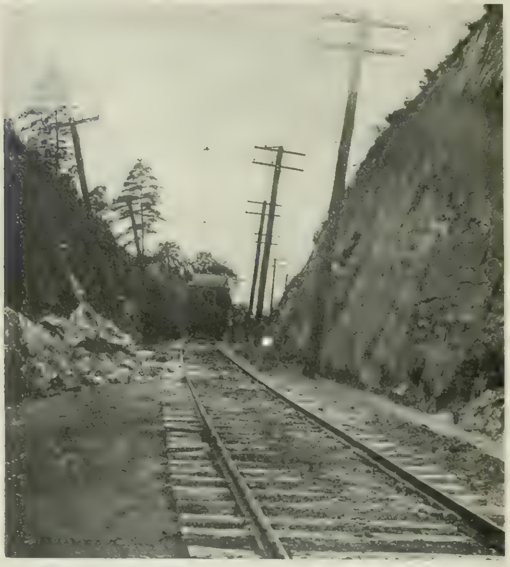


FIG. 1.—VIEW OF RAILWAY, SHOWING LINE CONSTRUCTION

Within the limits of Atlanta, girder rails are used. The track on the interurban section consists of 70-lb. T-rails laid on ties ballasted in the slag, the construction being exceptionally good. The maximum grade is three per cent, and the shortest curve has a radius of 574 feet. The gauge is standard.

The power for the railway is obtained from the hydraulic station of the Atlanta Water & Electric Power, about 18 miles from Atlanta, and is transmitted at a potential of 22,000 volts. The equipment at the hydraulic station includes Westinghouse three-phase, 25-cycle alternators with an aggregate capacity of 10,500 kw. In case of accident to the hydraulic station, current may be obtained from a thoroughly equipped steam-power plant which the Georgia Railway & Electric Company, which also obtains power from the water power station ordinarily, have in reserve for the operation of its lines in the city of Atlanta in emergencies.

The trolley line construction is similar in general to that ordinarily used in direct-current practice, except that specially heavy insulators suitable for the higher voltage are employed. Within the city limits of Atlanta, the trolley voltage is 550, while over all other portions of the railway the trolley voltage is 2,200. A single 4-0 trolley wire forms the entire 2,200-volt distributing system. The trolley wire is suspended from cross spans secured to wooden poles set 90 ft. apart on straight track, and about 45 ft. apart on curves.

The high-voltage trolley line is divided into three sections, each fed from one leg of the three-phase transmission system through oil insulated self-cooling transformers. There are two transformer stations in each section connected to the same phase, making a total of six stations located approximately 3½ miles apart. The transformer stations are well constructed of brick, and each is equipped with one 150-kw Westinghouse oil-insulated self-cooling transformer, together with the necessary lightning arresters, choke coils, switches and fuses. The transformer in Atlanta and one in a car barn near the limit of this city supply the 550-volt section of the trolley, and in order that all transformers may be interchangeable, each is wound so that the secondary voltage of either 2,200 or 550 may be used. Since these stations contain no moving machinery, no attendants are required. An occasional inspection of the stations is all that is necessary.

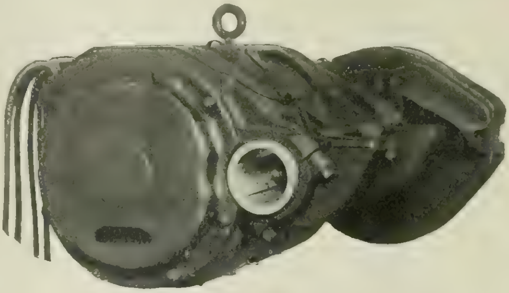


FIG. 2.—CONDUCTIVELY COMPENSATED SERIES MOTOR.

Each transformer is mounted on a low truck, and is installed in the transformer station on a platform at the height of a standard flat car. A reserve transformer is held in the car barn mounted on a similar truck and loaded upon a flat car ready for instant transportation to any part of the line. This outfit serves as a reserve unit for all of the stations. In case of a breakdown or other trouble at any station, the crew of the first car discovering the difficulty would notify the car barn force, who would then have the flat car hauled to this point and on arriving would roll the damaged transformer and its platform on to the flat car and replace it by the reserve unit. As each transformer station is capable of carrying the entire load of its section, practically a duplicate installation has been made. With this arrangement and the reserve unit described above, there is little likelihood of cessation of service because of failure of the power supply.

The rolling stock comprises six passenger and one freight car, four cars being employed in regular service to maintain a half-hour schedule between terminal points. The running time is 45 minutes each way, including some twenty stops. During the heavy rush hours, 180 passengers have been carried on a single car.

The passenger cars measure 50 ft. 6 in. over all, and weigh about 30 tons each. They have a seating capacity of 56 persons. All cars are of the double-truck type, with 38 ft. between truck centers.

The passenger cars are equipped with quadruple Westinghouse 50-hp motors. The equipment of these cars is remarkable for its simplicity. The circuit from the trolley passes to an auto-transformer through a double-throw oil switch, which connects it to either one of two taps on the high-tension winding of the transformer according to whether 2,200 or 550 volts is used on the trolley. After leaving the auto-transformer, the circuit passes directly to the ground. The motors may be connected to various taps on the low tension winding of this transformer, giving five different running points.

The connections are made by a drum-type controller, one controller being mounted on each platform. Each controller consists of three drums, one for reversing the relative connections of the field and armature coils of each motor, and the other two, which are directly geared together and operated simultaneously, for varying the voltage impressed upon the motors. The motors are of the conductively compensated type, and are connected permanently two in parallel, the voltage impressed upon each pair of motors being regulated by one of the controller drums mentioned above.

The feature of particular interest in connection with the operation of the controller resides in the means employed for preventing sparking in the controller when the connections are changed from one tap to another on the auto-transformer. There are on this transformer six intermediate taps corresponding to voltages 144, 174, 204, 234, 266 and 288, respectively. There are, however, only five running points corresponding to voltages 159, 189, 219, 240 and 277, respectively. It will be noted that these voltages are in each case midway between the ones of the transformer taps. The running voltages are obtained from the neutral point of a so-called "preventive coil"—an inductive coil—which is connected across adjacent taps of the auto-transformer. The segments on the controller drums are so arranged that, in changing the preventive coil from one pair of transformer taps to the next adjacent pair, the circuit is never opened simultaneously at both ends of the coil. In parallel with the preventive coil is connected a "preventive resistance" through one-half of which flows the major portion of the current to the motor when the controller is being moved from one running position to another. The preventive resistance is so designed that it takes but little current when subjected to the small voltage between adjacent transformer taps (30 volts) and yet absorbs but little voltage when carrying the full current of the motor. It is evident, therefore, that the motor circuits are never completely opened during operation, and yet there is no direct short-circuit produced between adjacent transformer taps. On the highest running notch of the controller the preventive resistance is cut completely out of circuit, so as to eliminate entirely the loss occasioned by the current due to the voltage between adjacent transformer taps.

The freight car is equipped with four motors similar to those used on the four passenger cars with hand control, but in order that this car may be operated on any part of the city system as well as over the company's own tracks, the equipment is arranged for operation on either direct or alternating current. It can be run from a standard 550-volt, direct-current trolley, the 550-volt, alternating-current trolley in Atlanta, and the 2,200-volt, alternating-current trolley between Atlanta and Marietta. To meet these widely different conditions, a combination of rheostatic and voltage conrol is used instead of pure voltage control as on the passenger cars. The motors are connected permanently, two in series, and the two groups thus formed may be connected to any one of three different taps on the transformer. In starting the car, the motors are connected first to the lowest tap, then to the middle tap through a resistance, next to the middle tap without the resistance, then to the highest tap with the resistance in circuit, and finally to the highest tap with the resistance short-circuited. With this equipment, three different running points are obtained.

When operating on direct-current, the motors are connected all four in series and rheostatic control only is used. There are thus four resistance points in addition to the "full-on" position.

Current is collected from the trolley wire by means of wheels of the ordinary type except that the poles are mounted on porcelain insulators on account of the high voltage which is used. Each car carries two trolley poles, one at each end, and is equipped with Westinghouse straight air brakes, the compressors for which are operated by series-wound motors similar in general to the main car motors.

Great credit is due to the management of this company, which consists of P. S. Arkwright, president; T. K. Glenn, vice-president; G. W. Brine, secretary and treasurer, and A. Balsley, chief engineer, for the successful entrance of alternating-current into the southern railway field, and for their pioneer work in this important development of electric transportation. The work of installation and construction has been done almost entirely by the company itself, including the track and overhead construction which was conducted under the management of William Glenn, engineer of maintenance of way.

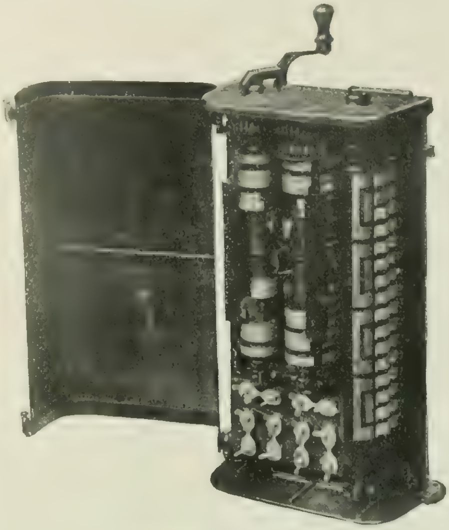


FIG. 3.—CONTROLLER, SHOWING GEARED DRUMS.

◆

Magnetic Switch Controllers for Automatic Ore Unloaders.

On page 239 of our issue for August 5, 1905, an illustrated description appeared of two electrically operated Hulett automatic ore unloaders at the docks of the National Tube Company, Lorain, Ohio. We are enabled to present below a detailed account of the magnet switch controllers on these unloaders, upon which the success of the equipment largely depends.

FIG. 1.—CONTROLLER FOR OPERATING GRAB BUCKET.

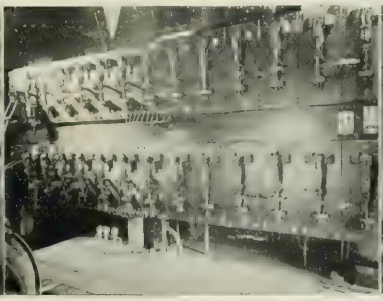


FIG. 2.—CONTROLLERS FOR HOIST AND TROLLEY TRAVEL.

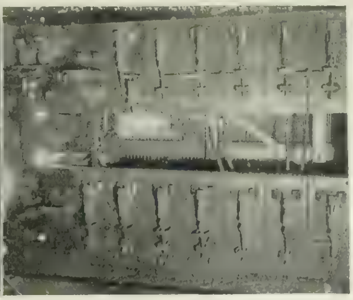


FIG. 3.—CONTROLLER FOR BUCKET CAR MOTORS.

The controllers proper consist of a number of magnetically operated clapper switches which cut resistance in and out of the motor circuits. The switches are operated by solenoids placed on the back of the switch-panel. The main contact of each switch is a heavy laminated copper brush reinforced with a yellow brass contact, the final break being taken between carbon contacts, and the arc is quickly ruptured by a powerful magnetic blowout. The switches are controlled by small master switches located in the operators' cabs. As the solenoids of the switches require but few amperes, the wires connecting the master switch with the controller proper are of very small size.

Each motion of the unloaders is provided with a positively connected or geared automatic output or emergency switch. The cutouts on the hoist and bucket-car motions automatically slow down and stop these motions as the limits of travel are reached. They first gradually introduce resistance and slow down the motor; then change connections to convert the motor into a generator, and apply a gradual dynamic breaking effect until the motion is nearly stopped, and finally apply band brakes.

The application of dynamic braking to the above-mentioned motions is of particular advantage, as the energy of these heavy parts is absorbed and dissipated in the resistance, thus removing practically all wear from the solenoid band brakes. Under these conditions, the band brakes operate as holding brakes and are required to stop the motion only upon failure of the current. The bucket rotation and trolley motions are supplied with automatic slow-down and cut-out devices which gradually insert the resistance and finally apply solenoid band brakes to stop the motion as the limits of travel are approached.

While all of these automatic devices fully protect the machinery and motors against failure of current, confusion and faults of the operator, still they allow the operator full control of the motors at all times, with the exception that he is unable to pass a predetermined limit of travel of the motions.

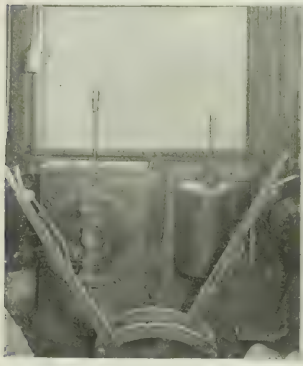


FIG. 4.—INTERIOR VIEW OF THE BUCKET-CAR OPERATOR'S CABIN, SHOWING THE MASTER CONTROLLER.

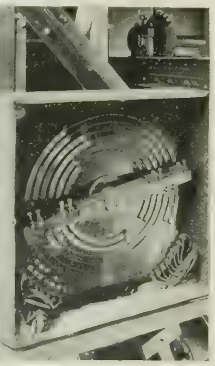


FIG. 5.—AUTOMATIC SHUT-DOWN AND CUT-OUT SWITCH FOR BUCKET CAR MOTOR.

The main controllers are located as near to their respective motors as possible, so that the heavy wires carrying large currents are made as short as possible. The master switches or controllers are small, thus allowing such an arrangement that all operating handles are brought within easy reach of the operator. They are very easily handled and do not fatigue the operator, thus allowing full output of the machines at all times irrespective of the physical condition of the operator.

The magnetic controllers, which regulate the movement of the bucket in and out of the boat and the raising and lowering of this bucket, are shown in Fig. 2. To the left there are seen four pairs of two switches each interconnected by means of horizontal levers. These are the reversing switches, and the function of the levers is to prevent the closing of both reversing switches at the same time. To the right are seen three switches interconnected by means of two levers. The function of these levers is to prevent the closure of the middle or dynamic breaking switch when the motor is still connected to the line and operating as a motor. The levers are also used to hold open the switches at either side of the center switch when the motor is acting as a generator with the center switch closed. Fig. 1 shows the magnetic switch controller for the operation of the clam-shell bucket. The smaller switches at the left are the accelerating or resistance switches. These switches are so interconnected that the succeeding one depends for its closure upon the closure of the one preceding. One terminal of the operating solenoid of each switch is connected to such a point on the resistance that the current taken by the motor upon the closing of the preceding switch must fall to a certain predetermined value before the following switch can close. This means that the motor must come up to a speed corresponding to each accelerating switch before the following switch will close. This results in the smoothest possible acceleration in the shortest possible time consistent with safety to the motor and the driving mechanism, and makes the acceleration of the motor entirely independent of the operator, should he throw the master switch with extreme rapidity.

The result of this design is to cause the motor to approximate almost exactly the operation of a hydraulic or steam cylinder; that is, it will keep a predetermined pressure on the bucket jaws and will not exceed this pressure. The motor is generally stalled once during every closure of the bucket, and this occurs without injury to the motor, controller or attached mechanism.

Fig. 3 shows the magnetic switch controller operating the bucket-car haulage motor. The ore is dumped from the bucket into a car which is pulled up the incline by a motor located in the machinery house underneath the trolley. The car is automatically dumped near the end of its travel by means of mechanical dogs.

Figs. 4 and 5, respectively, show the master controller and the automatic slow-down and cut-out switch which control the motion of the car. The manually operated controller to the left of the master controller is used for the purpose of slewing the entire machine so that it may be brought parallel to the hatches of the boat. This dock being built on a large curve makes this motion necessary to secure the best operation. The main controller house is located on the trolley underneath the walking beam and is divided into two parts, one part containing the machinery and controllers and the other, the resistances.

This type of control was designed, developed and built by the Electric Controller & Supply Co., of Cleveland, O., which also made the magnetic cushion-type solenoids for the band brakes, and all other electrical details.

Electrically-Operated Bulkhead Doors.

On each of the new warships of the navy there is installed what is known as the "long-arm" system of electrically-operated bulkhead doors and hatches controlled from a central point. Each door and hatch plate is provided with a motor by which it is closed when emergency requires. The power for the motors is controlled from a special emergency station which is contained in a two-part water-tight case secured to the side wall of the pilot house or other convenient place above decks. The general features of the system have already been described in these columns.

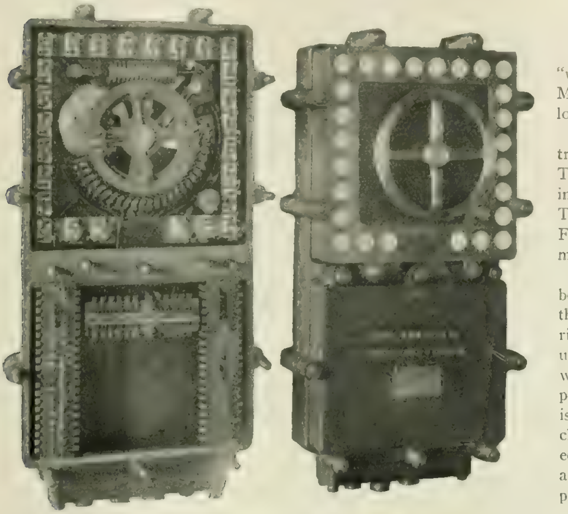
The apparatus of the station consists of three parts: First, the mechanism for controlling the circuits running to each door or hatch gear; second, the lamps which indicate the closure of each door or hatch, and, third, the fuse box in which each entering wire is supplied with its proper fuse. Fig. 1 shows the circuits of the emergency station, while Fig. 2 shows the station complete with the protecting covers.

To operate the emergency station the officer in charge releases a hand wheel, which, in turn, releases a gear driven by a powerful spring and controlled by a suitable escapement. This gearing closes the circuits for operating the emergency switches located in the controller of each door and hatch gear. In performing this function the gearing does not start all the motors at the same instant, for the reason that this would demand a large supply of current from the generators. It starts them one after the other at about a three-second interval, so that there are seldom more than four motors in operation at any one time, although the entire closure of twenty-four doors and hatch gears controlled from one emergency station may be accomplished normally in about a minute and a quarter. When, however, an extremely quick closing of all doors is required, the time can be reduced to thirty seconds by simply using the hand on the wheel of the emergency station to hurry it; and this action does not alter the closing speed of any individual door or hatch.

As each bulkhead door reaches its water-tight seat, it automatically closes a circuit which runs to the emergency station where it is connected with one of the small incandescent lamps. Transparent discs over these lamps bear numbers corresponding to the numbers of the various doors under control. The officer in charge, by pressing a button, can cause the indicator lamp of every closed door and hatch to glow, thereby assuring himself of the successful operation of the emergency action. If any door is prevented from closing by obstructions left in its path, this fact at once is apparent to the officer in charge, and no time need be lost in reaching the scene of the difficulty.

The emergency station contains but one spring which furnishes the entire power for operating the device. This spring is of the helical type and of ample strength for the work it is called upon to do.

Although the experience of hard sea service has shown that the emergency station can be depended upon for successful operation at all times, to guard against the possibility of failure the mechanism can be actuated at any time by turning the hand wheel located in front of the case should the station fail to act automatically by the power of the spring when released. During any emergency period a red indicator lamp glows continuously, so that a casual glance at the emergency station shows at once whether the emergency is "on" or "off." After a danger period is passed and it is desired again to establish normal conditions below, the emergency may be thrown off by a hand reversal of the same operating device which is used to throw it on, so that the mechanism when not in use is always set ready to operate and always available in time of need. These equipments are supplied by the "Long-Arm" System Company, of Cleveland, Ohio.



FIGS. 1 AND 2.—VIEWS OF INTERIOR AND EXTERIOR OF EMERGENCY STATION.

Improvements of Savannah, Ga., Central Station.

Mr. L. R. Nash, manager of the Savannah (Ga.) Electric Company, informs us that extensive improvements of its plant are being made. In the lighting station is being installed a 500-kw, two-phase, 60-cycle, 2,200-volt turbine of the Westinghouse Parsons type. In connection with this turbine is being installed also a surface condenser with wet and dry vacuum pumps, all furnished by the Worthington Company and capable of maintaining a vacuum of 28 in. even under the unfavorable conditions of circulating water temperature which exist at Savannah in the summer season. This turbine will be operated at the present time with steam pressure of 130 pounds without superheat.

An addition will also be made to the direct-current, three-wire system which supplies the business district of the city, consisting of a so-called "three-wire" generator, which not only delivers current to the outside wires of the system, but has a connection also, through balancing coils, to the neutral. New switchboard equipment will also be installed, for generators, feeders, exciters, etc.

In addition to the above improvements in the station itself the company has just purchased a valuable piece of wharf property which lies between its station and the Savannah River, from which condensing water is taken, and from which the regular coal supply is delivered. It is the company's intention to design a pocket on this wharf for coal storage, with a conveying belt between it and the boiler room. This work, however, will not be undertaken at the present time. The total cost of the above improvements is somewhat in excess of $100,000, the work being in charge of the general managers of the company, Messrs. Stone & Webster, of Boston.

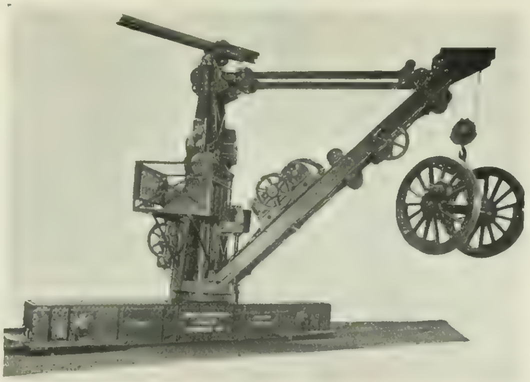
Electric Walking Jib Crane.

The accompanying illustration shows the newly designed type of "walking jib crane," recently erected by Pawling & Harnischfeger, Milwaukee, Wis., for the Chicago Northwestern Railway Co., for its locomotive repair shop at the West Chicago works.

The truck girder, or housing, contains and supports the two main truck wheels which are the drivers of the crane traveling motion. To the side of the girder is fastened the propelling motor, shafting and gearing, directly connected to the two driving trucks. The column socket is also contained in and is part of the girder. Fastened to this socket is the main gear to which is connected the motor for slewing.

The center post is machined from a solid-steel forging about the bottom of which is the heavy cast-iron roller frame supporting the channel frame and main boom. This roller frame also carries the slewing pinion shaft and two thrust rollers. To the upper end of the center post is fastened the pintle with steel idler wheels, between which the guiding rail is placed. On the center post and immediately below the pintle is the steel crosshead which is equipped with plate hangers for fastening the upper ends of the channel frame and which also receives the shafts, sheaves and equalizer yoke of the boom adjusting mechanism. The weight of all the revolving parts and of the load carried by the crane is suspended from the crosshead.

The distinguishing feature of this design is the adjustment of the main boom for different heights, and the auxiliary or extension boom, that can be extended for a hook radius of 23 ft. by a screw arrangement worked by hand power through a pendant chain, and can be operated from the floor. This hand chain is not shown in the illustration. All the other movements are driven by electric power, each having an individual motor. Attached to the side of the channel frame is the operator's cage which swings with the crane at such a height that the operator can always see the hook or load and can observe any obstructions that would be in the way of the swinging boom.



WALKING JIB CRANE.

With the exception of the traveling motion, the mechanism throughout is provided with spur gearing. Safety devices to avoid breakage due to carelessness of operator are provided where needed.

Electric current is supplied to the crane from collectors fastened to the top pintle. To the center post is fastened the collector rings for the main line to the switchboard in the operator's cage and for the distributing lines to the travel motor.

The crane has a capacity of 7 tons at 16 ft. radius of boom and about 20 ft. lift, and its approximate weight is 41,000 pounds. The construction is such that all parts are readily accessible for inspection and maintenance.

◆

Newer Methods of Street Lighting.

President M. T. Morrill, of the Golden (Col.) Illuminating Company, sends us the subjoined interesting data as to the adoption of the Nernst lamp there for street illumination:

Our old plant was the 3-wire Edison system and we had in use on the streets eight enclosed multiple direct-current arc lamps for which we received $8 per month each. In March of the present year we changed to alternating-current system and installed alternating-current arc lamps in place of the direct-current lamps. The service was very unsatisfactory and by permission of the city council we substituted 4-glower Nernst lamps for the alternating-current arcs at the same rental. We furnish the lamps and the maintenance as with the arcs.

The Nernst lamps are mounted on the same brackets as were used for the arcs and are placed at each street intersection. The service has been very satisfactory and the cost of maintenance but little more than for arcs. There is a saving to us in current and attention that more than makes up this difference. In addition to the Nernst lamps, we have 75 incandescent lamps of 25-cp, and we expect to substitute single glower Nernst lamps for some of these on some of the more important corners.

◆

A New Desk Telephone.

Within the past year, the Kellogg Switchboard and Supply Company, of Chicago, Ill., has placed on the market a desk telephone having several novel features, and in which all unnecessary complications are done away with. The stand shown in Fig. 1 gives a good idea of the general appearance of the telephone.

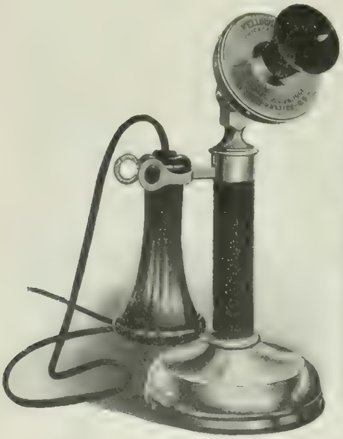


FIG. 1.—GENERAL VIEW OF DESK TELEPHONE.

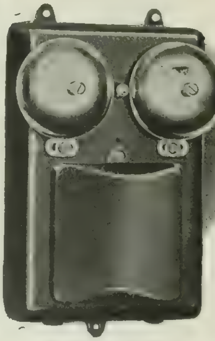


FIG. 2.—EXTENSION BELL.

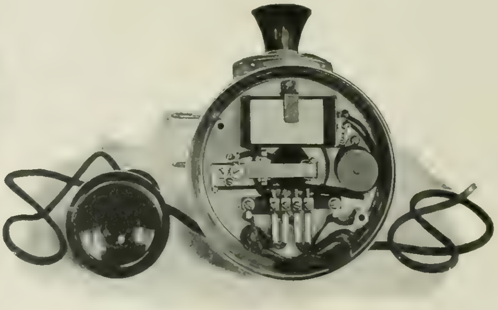


FIG. 3.—VIEW OF STAND WITH BASE PLATE REMOVED.

The transmitter is connected by an adjustable hinge at the top of the tubular standard, and this hinge is so constructed that the two cords connecting the transmitter with the apparatus in the base pass through the inside of the hinge, being insulated entirely from the metal frame of the stand. The weight of the stand is concentrated in the base, making it hard to upset, thus lessening the liability of breaking the receiver shell or transmitter mouthpiece.

The hook-switch instead of being located in the tubular standard or on the outside, is mounted in the base where it is easy to get at when necessary. It consists simply of two stiff German-silver springs with platinum contacts, the springs being actuated by a new kind of lever called the "toggle-joint lever," which makes possible a large motion of the switch springs, insuring good wiping contacts with a small motion of the receiver-hook.

This system has made it possible to locate everything in connection with the talking and signaling circuit in the base of the desk stand, the ringer being mounted in a separate box made of three pieces of drawn steel enameled in black. This extension bell, illustrated in Fig. 2, is a novel departure in extension bell design. The sides and front of this box, instead of being made of five pieces of wood, are in this box all made of one piece of steel drawn into the required shape by powerful punch presses. A condenser having a capacity of 2 microfarads is placed behind the ringer.

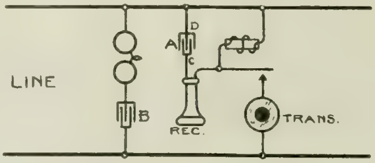


FIG. 4.—DIAGRAM OF TELEPHONE CIRCUITS.

The apparatus mounted in the base of the stand is clearly shown in Fig. 3, where the felt-covered base-plate is removed. The small condenser shown at the top of the cut was especially designed for this desk stand, and has a relatively large capacity. The small impedance coil shown on the right is also of special design, and very effectually accomplishes its purpose. The connecting rack is simple and practical in construction, two connectors being used for the receiver and two for the extension bell.

The circuits are shown in Fig. 4. Current is furnished from the main exchange, and on entering the telephone finds a ready path through the impedance coil and transmitter when the hook-switch is closed. The receiver and condenser are bridged around the impedance coil, and the high-frequency voice currents on entering the telephone find a free and non-inductive path to the receiver, as the condenser, *A*, is perfectly transparent to the high frequency incoming voice currents, while the coil is designed so as to offer the greatest possible impedance to the voice currents. At the same time this impedance coil allows the free passage of the direct-current battery supply. Furthermore, the introduction of condenser, *A*, into the talking circuit has a marked effect on the talking quality of the system. During conversation the condenser becomes charged by the action of the battery current from the exchange, and as the transmitter is spoken into the difference of potential is varied at points, *C* and *D*. This variation causes condenser *A* to charge and discharge, and has the effect of producing a secondary voice current which is superimposed on the alternating currents set up by the action of the transmitter alone. These two effects taken together produce a smoothness and intensity in transmission, that makes distinct speech possible over very long lines. The fact that condenser, *B*, and the ringer are permanently bridged across the line, makes the two-conductor cord and simple hook-switch possible.

New Wireless Telegraph Station at South Boston.

The American DeForest Wireless Telegraph Co. has recently placed in commission a new high powered station at South Boston, Mass., which has already proved to be of notable commercial value in the transmission of messages between coastwise steamships and the shore. The station is one of the company's chain extending between Havana and Portland, Me., and it is capable of transmitting and receiving in connection with both land and marine service. It is located near the edge of Boston Harbor on M Street, between 8th and 9th Streets, and is connected by telephone with the company's commercial office at 152 Devonshire Street, in the downtown district.

The transmitting and receiving instruments are installed in a small one-story frame building, the interior being divided into five rooms. Power is taken from the alternating-current mains of the Edison Electric Illuminating Company, a 30-kw transformer being located on a pole at the company's yard boundary to reduce the potential to 104 volts for service in the station. From the transformer the current is carried to the building in about 25 ft. of underground cabling, to avoid an aerial crossing beneath the high-tension circuit which leads to the mast that carries the antennae. From the cables the power is carried into the transformer room of the station—a 10 ft. by 12 ft. compartment lined with sheet iron—and after passing through the usual equipment of main switch, recording wattmeter, and Wright demand indicators the circuit is brought to a 20-kw reactance coil which controls the main transformer, the latter raising the potential from 104 to 25,000 volts. The main transformer is of the oil insulated type and it is mounted upon porcelain insulators resting upon a wooden base that is set upon the concrete floor of the room close by the reactance coil. The transformer is rated at 25-kw; is supplied at a frequency of 60 cycles and was built by the American Transformer Co., of Newark, N. J. In the transformer room is also a motor-generator set which supplies direct-current to part of the DeForest equipment. This set consists of a 2-hp, 104-volt, 60-cycle Holtzer-Cabot motor direct coupled to a 9-kw, 110-volt generator. On a shelf above the motor-generator set are six special Leyden jars arranged to protect the machines from high-tension discharges. Two of the jars are connected to the motor leads, one being topped into each wire, the other four jars being similarly connected to the generator leads. The outer coatings of all the jars are grounded, as the jars are set upon a copper strip on the shelf, which is connected to earth. Two General Electric magnetic blow-out lightning arresters are also connected to the motor leads.

Adjoining the transformer room is the condenser room. This is about the same size, and the 25,000-volt circuit is brought to it through two glass plates set into the partition wall. There are two large condensers mounted here, each being made up of glass plate coated with tinfoil, the assembler united being immersed in a non-metallic tank, in which is a heavy oil bath. Each tank is 5-ft. long and 30-in. wide. The spark-gap case stands next to the condensers, and on top of this is a helix made of hollow copper wire, used in adjusting the wave-lengths of the wireless signals sent out from the station. The spark-gap case, or "muffler," is designed for operation with sparks as long as 1½ in. if desired; its interior is lined with asbestos to prevent the occurrence of fire, and peep-holes covered with glass are provided to enable the operation of the spark to be observed at will. In a station of this capacity the noise made by such a powerful spark discharge within the confines of a small room is almost deafening, and the importance of shielding the ears of the operators require careful construction at the muffler. In the South Boston station the muffler is supplied with a powerful air blast which is turned directly upon the spark discharge. The air supply is brought into the spark chamber by a porcelain insulated pipe leading to a blower driven by a direct-connected Roth motor rated at 1/6-hp. 110 volts, direct-current. This motor is also protected from high-tension discharges by a half-dozen Leyden jars connected to its leads, and grounded on the outer coatings. The motor wiring is carried along the wall of the condenser room, and it is protected from the high-voltage by a coating of grounded tinfoil throughout its entire run.

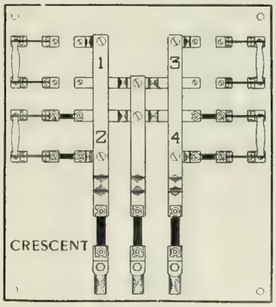
The operating room adjoins the condenser room and in one corner is set up a slate switchboard which controls all the apparatus in the station. The table at which the operator works is equipped with a sending key, double-pole switch for sending or receiving connections, a syntonizer or tuning apparatus for adjusting the wave-length, and the DeForest electrolytic receiver. The latter operates two head telephone receivers through a local battery circuit. With the DeForest receiver forty-five words a minute have been handled, and atmospheric disturbances are said to be far less troublesome than with the coherer systems. Something beyond an ordinary thunderstorm is required to shut down the South Boston station.

From the condenser room the 25,000-volt circuit passes upwards through the ceiling to a pair of porcelain bushings extending through the tarred roof. Changes in direction are made by the aid of tarred hemp guys. The wires then pass through the bushings to two high-tension insulators mounted on the roof, whence they are carried to the 15 antenna steel wires arranged in east and south fans supported by the mast. The mast is 208 ft. high, set in a concrete foundation and guyed by 16 cables, in each of which is at least one strain insulator. The mast was built in sections of four upright pieces each, and the uprights and spacing pieces are strongly bolted together into a single substantial pole section at each point of junction. A horizontal spar, used in spacing the antenna wires, is attached to the top of the pole. It is 50 ft. long over-all. The receiving circuit is composed of steel antenna wires which are all brought together at an insulating bushing in the roof over the operating room, whence they pass to the instruments upon the table. Three men constitute the operating force, and the shifts are 8 hours in length each.

The South Boston station has often communicated with Portland, Me., and it is expected at an early date that regular commercial service will be inaugurated between Boston and New York. Messages are constantly being received from the captains of steamers passing along the New England coast, and from passengers traveling upon these boats. An interesting example of the value of the services given by the company was furnished by the United States steamship Mayflower, when it was conveying the Russian peace envoys from Oyster Bay to Portsmouth. The Government wireless operator on board this vessel was, at one time, unable to establish communication with any of the Government's own stations, and he accordingly requested the DeForest station at New Haven to handle an important despatch for one of the plenipotentiaries. The message was taken with quickness and accuracy. The manager of the Boston office is Mr. F. C. Marrom, and the South Boston station is in charge of Mr. F. S. Dart.

Three-Wire Panel Board.

The cut herewith shows a simple form of panelboard for three-wire circuits. It will be noted that fuses are provided in both the main and the branch circuits, a double-pole switch being placed in each branch circuit. The cabinet for the panel board may be constructed of either iron or wood, and may be of either the flush or surface type.



THREE-WIRE PANELBOARD.

The panel board illustrated is designed and built by the Crescent Electrical Manufacturing Company, Rochester, N. Y., which constructs panel boards of all types and makes knife switches, switchboards, cut-outs and branch blocks.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Excellent reports are made from all sections, and all the conditions favorable to activity in trade are in prominent evidence. Wholesale distributive trade at the Southwest has received renewed impetus from buyers' excursions, in the Northwest by state fairs, and throughout a wide area by the assurance that the corn crop is beyond danger of frost damage. Cooler weather and the ending of the vacation season has brought about more activity in retail lines North, West and East, while the prompt marketing at good prices of the first pick of the cotton crop has improved both wholesale and retail business at many Southern points. In industrial lines the feature has been unprecedented activity in rail buying by leading companies, the placing of further orders for rolling stock, a number of small purchases aggregating a considerable volume of pig-iron sales, and a stiffening in prices of coke and bituminous coal. Anthracite coal has felt the stimulus of cooler weather. Manufacturers of steel express the opinion that the railroads of the country will spend more money for new equipment over the next twelve months than ever before in history. When the mills opened their rail books for 1906, a few weeks ago, they had no idea of the deluge of business that would come in for next year's delivery. The railroads appear to be anxious to place their orders earlier than usual this year, realizing that 1906 is likely to be a banner year from the standpoint of output, and that they are liable to experience some difficulty in obtaining prompt delivery. The structural mills are turning away business, while some of the Western mills are taking no large orders for delivery this year, owing to the already congested condition of their mills. One of the most favorable features of the situation is the improvement in the light finished lines. Marked activity is noted in hardware and lumber at leading Western markets, and collections are reported good. Bank exchanges at New York were 44.7 per cent larger than in the same week of 1904, while at other leading cities the gain averaged 14.6 per cent. Evidences that past and present heavy purchases of commodities, coupled with the usual movement of crops to market, will severely tax the railway interests of the country, are already visible. Gross earnings for the month of August promise to show an increase over August a year ago of fully 7 per cent. Present prices for grain do not, however, seem to tempt farmers, and the wheat movement is not as large as expected. The long-awaited resumption of export trade in cereals is evidently close at hand. Good demand from foreign sources was a steadying influence in wheat, corn and oats, and, in conjunction with less satisfactory crop reports (rains in the Northwest), helped to advance prices slightly. There was a marked decrease in the number of business failures during the week ended September 7, as compared with those of the week previous, according to *Bradstreet's* compilation. The total for the week was 137, and during the previous week it was 161. In the corresponding week last year the number was 144. The copper market was quiet and featureless, with a weaker tendency. The closing quotations were 15¾a16¼c for lake and electrolytic and 15½a16c for casting copper. The brass manufacturers of Connecticut, the General Electric Company and the Westinghouse Company are doing the largest business in their history, and all are being accommodated with hand-to-mouth deliveries of copper.

HOUSING GENERAL ELECTRIC EMPLOYEES.—The General Electric Company has formulated a plan for housing its employees at Lynn. It embraces the proposition to purchase land, erect cottages of six rooms and offer them upon terms that will be as easily met as the rent now paid. The offer is open to every one of the 7,000 employees and a committee of 10 of the latter is engaged in making subscribers. A great many have at once accepted. The company limits the cost of the land to $400 and the cottage $1,800, and will build nothing but cottages. The terms are that each subscriber shall have $4 taken out of his wages every week, which includes the interest on the total cost, taxes, insurance and water rates. The company figures that this instalment will clear the house of all indebtedness at the end of eight years, when the cottage becomes the property of the occupant. In addition the company agrees to give a life insurance policy to each subscriber for a fixed amount, and if the subscriber should die before the house is paid for, so much of it as is required to pay for the house will be deducted for that purpose, and the house will become the property of the widow or other beneficiaries, the balance of the life insurance also to be paid to them. The company has set aside the sum of $300,000 to carry out this project and M. W. Alexander has been chosen to supervise the execution of the plan.

BRITISH INDIA LIGHTING PLANT.—The Department of Commerce and Labor reports that an electric light plant is to be erected in Mussoorie, British India. Offers are invited for the following materials: Steel pipes, water turbines, alternating dynamos, switchboards and instruments, transformers, induction motors, pumps, tools and implements for the workshops. The foregoing are to be supplied and erected by the contracting party, but the following simply supplied: Plain copper conducting wires, isolators, arc and incandescent lamps, telephone plants, tools, sundry materials. The conditions may be obtained from the city engineer, C. H. Chanan, Municipal Office, Mussoorie, upon deposit of 75 rupees (about $25), which sum will be returned upon presentation of bona fide offers. Sealed offers in the prescribed form, bearing the heading "Tender for electric lighting and water works scheme," are to be in the hands of the "Chairman, Municipal Board, Mussoorie, U. P., India," by October 23, 1905.

NEW TELEPHONE METER.—A new telephone meter that was patented some time ago by Frank Powell and E. R. Ellis, of Chicago, has been bought outright by Toledo capital and will be manufactured in that city. The United States Coin Register Company, an Ohio corporation of Toledo, with a capital of $50,000, has been launched with the following officers: President and treasurer, W. G. Nagal; vice-president, W. B. Tyler; secretary and manager, G. S. Powell. The latter is a brother of the inventor. Besides those named a number of prominent local telephone men are stockholders of the company. The concern is organized to manufacture a device for registering cash put into telephone pay stations and for recording measured service. The invention is the product of several years' labor on the part of the men who perfected it. Mr. Nagle is president of the W. G. Nagle Electric Company of Toledo.

NEW YORK ELECTRICAL SHOW.—Madison Square Garden has been secured for an electrical show, from December 11 to 23 inclusive, and active preparations are already being made. It is said that the transient population of New York in December is 750,000 people, many of whom will be glad to visit such an exhibition, to say nothing of the regular inhabitants. Dr. George F. Sever, of the Department of Electricity of Columbia University, is director of exhibits and he has already secured enough exhibitors to make the show an attractive one. The list of exhibitors will be published in these columns shortly and the additions will be given from time to time. While considerable space has been secured, some of the best positions are open. The office address is 26 Cortlandt St., New York, Telephone 6190 Cortlandt.

SUPPLIES FOR NAVY YARD.—Bids will be received until September 19 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish, at the navy yards, etc., at Portsmouth, N. H., Boston, Mass., Newport, R. I., New York, N. Y., League Island, Pa., Washington, D. C., and Norfolk, Va., electric cable, incandescent lamps, motors, electrical supplies, circuit breakers, etc.; also electrical supplies at the navy yard at Pensacola, Fla., and the naval stations at Key West, Fla., and New Orleans. Address H. T. B. Harris, Paymaster General, U. S. N.

THE INTERNATIONAL ELECTRIC & MANUFACTURING COMPANY, of Milwaukee, Wis., with a capital stock of $300.000, proposes to take over the option of the Milwaukee Engineering Company on the plant and business of the Milwaukee Electric Company at West Allis, for the manufacture of electric machinery of all kinds, gas and gasoline engines, steam boilers and engines, switchboards, telephone and telegraph instruments, water and electric meters, street railway motors, alternators and rotaries.

ELECTRIC FANS FOR KITCHEN.—The B. F. Sturtevant Company, of Boston, Mass., has just sold a set of large electric propeller fans for kitchen ventilation in the Government Hospital for Insane at Uniontown, D. C.

NEW BULLOCK ELECTRIC PLANT.—The Bullock manufacturing part of the Allis-Chalmers Company has let the contract for an addition to be built to its shop No. 3, at Norwood, Cincinnati. This new structure will be 105 x 250 feet, two stories high. It will be utilized for the manufacture of auto starters, transformers, controllers and switchboards. An industrial railway has been put across the street connecting the foundry and pattern buildings with the main plant.

POWER DEVELOPMENT IN MEXICO.—The Mexican-American Power Company, which is composed of Philadelphia (Pa.) capitalists, will erect several electric power plants near the city of Mexico and build transmission lines for the purpose of providing power for operating industries there and in a number of towns in the vicinity of the power plants. It is one of the largest electrical projects to be undertaken in Mexico, the amount to be invested being estimated at $10,000,000 gold. It is stated that the first instalment of $1,500,000 in cash has been paid in, and that all preliminary plans are completed for the immediate construction of the power plants. The main plant will be located on the Malinaltenango River, at the foot of the Snow Mountain near Toluca. Other power plants will be erected on the Meyuce and Tizates Rivers. According to the reports of engineers who have investigated the water supply and fall of these rivers, the three plants will be able to generate not less than 90,000 horse power. The initial plant will have a capacity of 10,000 horse power. The falls in these rivers are so great that it will not be necessary to construct dams or long canals. By digging a short canal the water from the Malinaltenango River will be dropped into a barranca, or basin, a distance of 820 feet, and thus afford the necessary power for the electric generating plant. It is stated that aluminum will be used for the transmission lines. The generating plants will be situated at an altitude of about 10,000 feet. In addition to the transmission line to this city, others will be built to Toluca, El Ora and a number of other towns and mining centers in this part of the country. Joel H. De Victor, of Philadelphia, is president of the company. A. S. Harvey, of the same city, is vice-president.

POWER FOR INTERNATIONAL NICKEL.—The International Nickel Company will soon have the power improvements mentioned in its last annual report completed, says the *Wall Street Journal*. It is establishing a power plant at High Falls, on the Spanish River, which is situated about thirty miles from its nickel properties at Copper Cliff, near Sudbury, Ont. The company owns rights to develop over 10,000 hp, and at present a plant is being installed which will develop 3,000 hp. According to the last annual report the cost of this plant, including the original cost of the property and the expenses of the long transmission line, will amount to about $700,000. This plan has been under construction for a considerable time, and it will not be long before it is completed. It is anticipated that when the new power plant is in operation a great saving will be accomplished. The cost of power to the company at Copper Cliff, Ont., is very heavy at present, owing to the fact that the power used is produced from coal, and that commodity in northern Ontario is exceedingly expensive, the cost being from $5 to $6 a ton, even when carried most of the way in the summer time via the Great Lakes. It will not be surprising if the company saves $50 per hp, or even more, per year, on the power used at present, when the new plant is in operation.

SALES OF GREGORY ELECTRIC COMPANY.—The Gregory Electric Company, of South Clinton Street, Chicago, reports business as unusually good. Among recent shipments can be mentioned the following: One 200 kw. General Electric railway generator, Ottumwa Traction & Light Company, Ottumwa, Ia.; one 75-kw., 60-cycle Westinghouse alternator, direct connected to a Gates engine, Newport Electric Company, Newport, Wash.; one Thomson-Houston A-18 alternator, Cheney, Kelley & Reid, Eureka, Cal.; one 100-kw. Edison generator, F. E. Monteverde, Hermosillo, Mexico; one Thomson-Houston M-12 arc machine, Empresa del Alumbrado Electrico del Norte, Guatamala, Guat.; one 300-light Perret dynamo, F. Gutierrez, Guadalupe, Costa Rica; one 150-kw. Stanley alternator, I. W. York & Sons, Portage, Wis.; one 150-kw. National generator, W. B. Conkey Company, Hammond, Ind.; one 100-kw. Edison generator, Laporte Electric Company, Laporte, Ind.; one 120-kw. General Electric alternator, Cosmopolitan Electric Company, Chicago; one 75-kw. General Electric, 3-phase alternator, Galesburg Electric Light & Power Company, Galesburg, Ill.; one 100-kw. Western Electric generator, C. C. Haison, Chicago.

NEW SCHIEREN BELT FACTORY.—A modern belting factory and office building has recently been completed by Charles A. Schieren & Company in New York City. It is elaborately described in the *Iron Age*. The Schieren Building, as it is known, is located in the heart of what is still called the "Swamp" and for many years has been recognized as the center of the leather district. It is a ten-story fireproof building, occupying a site 84 x 124 feet, at the corner of Cliff and Ferry streets. The building is equipped with three large electric freight elevators and one high-speed electric passenger elevator, is provided with a sprinkler system for fire protection and has its own plant for power, light and heating. The basement, first floor, part of the fourth and all of the fifth and sixth floors are occupied by the Schieren Company and the remainder is leased to other tenants. The first floor contains the office and shipping room, and the factory proper takes up the remainder of the space mentioned. The hydraulic presses, pumps and accumulators were furnished by the Watson-Stillman Company. The pump outfit is driven by several Westinghouse motors. Electric drive is also in use elsewhere in the plant.

REINFORCED CONCRETE POWER HOUSE.—The latest addition to the list of reinforced concrete power houses is that being built for the Waltham Gas Light Company, Waltham, Mass., by J. G. White & Co. The entire building is to be of reinforced concrete construction—no exposed steel framework will be used. The design calls for very large windows, thus insuring ample light and ventilation. Steam will be supplied by four 350-hp Sterling boilers, set in batteries of two each, an 8 ft. 6 in. by 180 ft. reinforced concrete stack furnishing natural draft. Suspended coal bunkers occupy the upper half of the boiler room; these are filled by coal conveyors. Chutes from the bunkers operated by valves from the boiler room floor, feed the coal to the boilers. Two 500-kw Parsons turbo-generators direct connected to Westinghouse dynamos form the main engine equipment. The White Company is rushing the work, and when completed the Waltham Gas Light Company will have an electric power station which for fireproof qualities and low operating cost it will be exceedingly difficult to surpass.

DISTRICT MESSENGER SERVICE.—In an application to the New York Board of Estimate and Apportionment for a franchise, the United District Messenger Company charges that the various old messenger companies have formed a combination to increase rates, and adds other severe accusations against the American District Telegraph Company. The parties to this combination, it is represented, are the American District Telegraph Company of New York, the Postal Telegraph-Cable Company's Messenger and District Service, the Brooklyn District Telegraph Company, the Eastern District Messenger Company of Brooklyn, and the American District Telegraph Company of Brooklyn. By reason of this combination, it is set forth, rates are charged in many instances 100 per cent. higher than a year ago. Mr. M. W. Rayens, who was once superintendent of the American District Company, is president of the new system, and claims he is being "held up" as to conduit rights of way and telephone charges.

ECONOMIZERS FOR NEW ORLEANS.—The New Orleans (La.) Railways Company has, through its engineers, Messrs. Sanderson & Porter, of New York City, recently purchased from B. F. Sturtevant Company, of Boston, Mass., six large economizers which will be unique in that they are being built to withstand the highest pressure to which any economizer is known to have been subjected. All pipes are being tested to 600 pounds pressure before they leave the works, and each section is tested to 500 pounds after the pipes are inserted. There is but a single gasket joint running through the machine, this joint being made by two very heavy flanges with a special gasket which has 2¾ inches plane surface through the entire circle.

B. F. STURTEVANT.—Among recent sales of economizers made by the B. F. Sturtevant Company, of Boston, Mass., are the following: Sixteen to the Champion Coated Paper Co., Hamilton, O.; two each to the American Steel & Wire Company, Cleveland, O.; Bourne Mills, Fall River, Mass.; Hampton Co., Easthampton, Mass.; one each to S. D. Warren & Co., Cumberland, Mills, Me.; the Solvay Process Company, Syracuse, N. Y.; Mount Hope Finishing Company, North Dighton, Mass., and the New England Company, Rockville, Conn.

NAVY YARD EQUIPMENT.—Bids will be received until Sept. 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, for delivering and installing three water-tube boilers and machinery for the power house at the Navy Hospital, Washington; also to furnish at the Navy Yards, at Boston, Mass.; Newport, R. I.; New York, N. Y.; Washington, D. C., and Norfolk, Va., incandescent lamps, electrical supplies, voltmeters, ventilating fans, etc. Address C. T. B. Harris, Paymaster-General, U. S. N.

HALL SIGNAL CONTRACTS.—The Hall Signal Company has closed a contract with the Erie Railroad for equipping with automatic block signals its line from Bergen, N. J., to Middletown, N. Y., covering 175 miles of track. This is the first important installation of automatic signals which has been made by the Erie. The company has also closed contracts recently with the Chicago & Alton, the Union Pacific and the Alabama Great Southern railroads.

LARGE TROLLEY CONTRACT.—It is stated from Spokane, Wash., that the Spokane & Inland Railway Company has closed a contract with the Westinghouse Company and the St. Louis Company amounting to $600,000 for equipment.

BIDS.—Bids will be received until Sept. 27 by the State Commission in Lunacy, at Albany, for an engine, generators, switchboard and motors, feed cable and wiring, steam piping and connections, at the Utica State Hospital.

ALLIS CHALMERS CHANGES.—Mr. Walter H. Whiteside was elected president of the Allis-Chalmers Company at the directors meeting in Jersey City, succeeding Mr. Benjamin H. Warren. Mr. Henry Woodland, of Milwaukee, succeeds William L. Chalmers as treasurer. Before the directors meeting the stockholders elected Edward D. Adams, Mark T. Cox, Edmund C. Converse, Joseph S. Neafe, and Edwin Reynolds to the board. Mr. Converse has been well known in connection with the National Tube interests of the U. S. Steel Corporation. A biographical sketch of Mr. Whiteside, who has won very rapid promotion, has already appeared in our pages.

JULY ELECTRICAL EXPORTS.—The reports of the Department of Commerce and Labor, of July exports, show up well as to electrical exports. The total export of electrical machinery for the month was $597,483, as compared with $493,372 last year, a gain of $104,111, while the seven months show $4,421,298 as compared with $3,702,021. The exports of electrical instruments and appliances for July were $373,191, as compared with $369,614, and for the seven months were $3,031,313, as compared with $2,428,756. The gain for the month was $3,577, so that a total healthy gain is shown of $107,688.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular, the bullish sentiment, however, being kept in check by the expectation of higher money rates on account of low bank reserves at New York and greater demands from the interior for funds to move the crops. The bank clearings for August, which mark the record, aggregated $40,838,989,760, a total slightly larger than in July, 36 per cent heavier than in August a year ago, and 21 per cent larger than the heretofore record August total of 1902. Clearings at New York City foot up $6,980,764,919, or 50 per cent larger than the record for August last year and 19 per cent in excess of the August, 1903, record. Outside of New York clearings reached an aggregate of $3,858,224,841, a gain of 16.5 per cent over August, 1904, and to this extent the largest total ever recorded. Bank clearings at ninety-four cities for eight months aggregate $92,298,469,997, a gain of 38.9 per cent over last year and of 13 per cent over the record total of 1901. New York City's total exceeded last year by 55.7 per cent and the aggregate outside of the metropolis is 15 per cent larger than ever before. The declining tendencies of the copper market had a bearish influence on Amalgamated Copper, which was one of the active features, selling down to 79⅜, from which price it subsequently had a moderate rally. United States Steel stocks continued to attract attention, sentiment in regard to them being favorably influenced by the continuance of good reports about current conditions in the steel trade. Electric and traction stocks were featureless and business in them was ordinary. The Allis-Chalmers issues and Western Union are the only ones that show gains; all the others of the list declined. Allis-Chalmers common closed at 16⅜, being a net gain of ⅜, and preferred at 57½, a gain of 4½ points. General Electric lost 1 point, closing at 179, and Westinghouse ½, the last quotation being 166. In the railway list, Brooklyn Rapid Transit closed at 66⅝, this being a net loss of 2⅛; Metropolitan Street Railway lost 2¼ points, closing at 126⅝, and Interborough Rapid Transit made a net gain of 2 points, the closing price being 217. Western Union's closing quotation was 94⅜, a gain of ¼ point. Following are the closing quotations of Sept. 12:

NEW YORK

	Sept. 5	Sep. 12		Sept. 5	Sep. 12
Allis-Chalmers Co	15½	17½	General Electric......	180⅛	179
Allis-Chalmers Co. pfd .	54	60	Hudson River Tel	..	.
American Dist. Tel	30	30	Interborough Rap. Tran...	219	215¾
American Tel. & Cable	90	92	Mackay Cos................	40¾	40¾
American Tel. & Tel... ...	138	139	Mackay Cos. pfd........ .	73¾	74
Brooklyn Rapid Transit	69¼	67½	Marconi Tel...............	..	..
Electric Boat	30	30	Metropolitan St. Ry..	129⅛	127
Electric Boat pfd....... ..	65	65	N. Y. & N. J. Tel..........	..	..
Electric Lead Reduction. .	..	..	Western Union Tel..	94¼	94
Electric Vehicle...........	17	19	Westinghouse com.	166	166
Electric Vehicle pfd..... .	21	23⅛	Westinghouse pfd.... .. .	..	.

BOSTON

	Sept. 5	Sept. 12		Sept. 5	Sep. 12
American Tel. & Tel ..	141½	140¼	Mass. Elec. Ry. pfd	60	59½
Cumberland Telephone.. .	118	120¼	Mexican Telephone.........	1⅛	1½
Edison Elec. Illum.........	253	.	New England Telephone...	134	134
General Electric..	180		Western Tel. & Tel..	*18	*18
Mass. Elec. Ry....	17	15½	Western Tel. & Tel. pfd .	98½	97

PHILADELPHIA

	Sept. 5	Sep. 12		Sept 5	Sep. 12
American Railways.. .. .	53½	52½	Phila. Electric....	8¾	8¾
Elec. Co. of America. ..	11	11	Phila. Rapid Trans.........	28¼	28
Elec. Storage Battery . ..	86	85	Phila. Traction....	101	..
Elec. Storage Battery pfd...	.				

CHICAGO

	Sept. 5	Sep. 12		Sept. 5	Sep. 12
Chicago City Ry . .	..	190	National Carbon....	61	60
Chicago Edison....	.	.	National Carbon pfd.......	115⅛	*115½
Chicago Subway	83¾	.	Union Traction.......	..	..
Chicago Tel. Co	..	..	Union Traction pfd........	..	..
Metropolitan Elev. com. ..	24½	22⅝			

* Asked.

SAN FRANCISCO GAS AND ELECTRIC.—The official announcements of the details of the proposed merger of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation in a great consolidation of lighting and power interests did not give the names of the Eastern buyers. The fact that they were represented by James Stillman, of the National City Bank of New York, led to the impression that the Standard Oil people were interested. There are strong indications that the General Electric Company has more than a passing interest in the transaction. The San Francisco Gas & Electric Company has been licensee for many years for the Edison Electric three-wire system and apparatus supplied by the General Electric Company. Several millions of dollars' worth of machinery has been purchased during the past few years, and it might be advantageous to the General Electric to have an interest in the big deal. The stocks of the California Gas & Electric Corporation and the San Francisco Gas & Electric Company will be deposited with the Union Trust Company, to be turned over to the new consolidation on payment of the price. It is understood that of the $90 per share to be paid for the San Francisco Gas & Electric Company's stock, $25 a share will be paid in cash and $65 in 5 per cent bonds. These bonds will be secured by the properties of the San Francisco company and the stock of the California corporation. The syndicate of Eastern and California capitalists will pay $4,750,000 in cash for the stock of the companies.

THE NATIONAL LIGHT & IMPROVEMENT COMPANY, having its principal offices in the Bank of Commerce Building, St. Louis, Mo., owns and operates several gas, electric light and street railway companies in the Southwest. The company was organized in May, 1905, with a full-paid capital stock of $2,000,000, and an authorized capital of $10,000,000. The National Light & Improvement Company, in addition to operating properties owned by it, is prepared to finance gas, electric light, street railway and water works properties, and to assist the management of such properties in valuing them for the purpose of issuing bonds, in arranging consolidations and in adding to existing equipment or reconstructing throughout such properties. The list of the officers and directors of the company is as follows: Henry C. Scott, president; S. M. Dodd, vice-president; C. W. Keiner, secretary-treasurer. Directors: Henry C. Scott, president Laclede Power Company, St. Louis; S. M. Dodd, president American Brake Company, St. Louis; Thos. H. West, president St. Louis-Union Trust Company, St. Louis; Geo. L. Edwards, A. G. Edwards & Sons, bankers, St. Louis; C. S. W. Packard, president Pennsylvania Company, Philadelphia; W. Hinckle Smith, E. B. Smith & Co., Philadelphia; Geo. B. Post, Jr., Post & Flagg, New York.

DIVIDENDS.—The directors of the Safety Car Heating & Lighting Company have declared the regular quarterly dividend of 2 per cent and an extra dividend of 2 per cent, payable October 2. This is an increase of one-half of 1 per cent in the extra dividend. A dividend of $1.25 per share on the issued capital stock of the San Francisco Gas & Electric Company has been declared. The United Traction & Electric Company of New Jersey has declared the regular quarterly dividend of 1¼ per cent, payable October 2. J. G. White & Co. (incorporated) have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable October 2. The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable October 2. The directors of the Boston & Suburban Electric Company have declared a regular quarterly dividend of 50 cents per share, payable October 15.

ELECTRIC GOLD DREDGING has developed into a large industry, and the San Francisco *Examiner* says that W. P. Hammond and John Hays Hammond have succeeded in bringing about a combination of some of the largest gold-dredging mining companies in Butte and Yuba counties. The company is to be known as the Oreville Dredging Company, Limited, and it is organized with a capital of $4,000,000. London, New York and Boston financiers are interested in the project. The company will control something like 4,000 acres of so-called gold dredger land, where the electrically equipped barges are at work.

THE STREET CAR MERGER.—The syndicate formed to finance the merger of the street car manufacturing companies has virtually acquiesced to the demand of G. Martin Brill, who will be the president of the new company, to provide about $2,000,000 more cash for working capital than was provided by the original plan. In consequence, the syndicate managers will issue a modified plan in about a week. The plan promulgated early in August held in reserve $2,000,000 of 5 per cent bonds out of the total issue of $13,000,000. It is understood that under the new plan this $2,000,000 will be sold at once, the proceeds to be appropriated as working capital. The new company has not yet been incorporated.

General News of the Week

The Telephone.

SANTA MONICA, CAL.—The franchise asked for by the Home Telephone Company, of Ocean Park and Santa Monica was sold to it at auction for $100.

LOS ANGELES, CAL.—The Home Telephone Company has asked the Board of Supervisors for a franchise for a telephone system outside the limits of the city within a radius of eight miles.

SAN LUIS OBISPO, CAL.—An application has been received from R. B. Davis, of Los Angeles, asking that a franchise be granted to him for the installation of an electric lighting and telephone system in the city.

POMONA, CAL.—The city authorities of Pomona are removing the poles of the Pacific States Telephone & Telegraph Company, on account of the latter's failure to secure a franchise. The company claims exemption from the provisions of the Broughton franchise law on the ground that it does an interstate business. A lawsuit is expected.

PARIS, ILL.—The Citizens Mutual Telephone Company is the name of the company consolidating all the trunk lines surrounding Paris.

CHICAGO, ILL.—During the month of August the Chicago Telephone Company added 1,498 more telephones to its list of subscribers. It now has a total of 133,359 instruments in service, a gain of 15,359 since January 1 last.

LOWELL, IND.—The Lowell Telephone Company, with a capital stock of $9,000, has just been incorporated. The directors have not yet been chosen.

INDIANAPOLIS, IND.—The Rev. William Mullendore, who has been manager of the Franklin Telephone Company for the past two years, has sold his interest to Louis Holweg of the New Telephone Company, of Indianapolis. Frank and Victor Smith have also sold the greater part of their interest in the business to Mr. Holweg.

WILMINGTON, IND.—The capital stock of the Luther Telephone Company, of which J. J. Schwartz is president and W. O. Stall secretary, has become inadequate to meet the demands. It has been increased from $5,000 to $20,000 in order that the company may extend its lines in the northern part of the county, and especially in Warren and Clear Creek townships.

HOPE, IND.—It is reported that there will be a telephone war at this place. A company has asked for a franchise and the claim is made that the Central Union Telephone Company is back of it. The Hope independent company already has an exchange in operation. It is believed that the Central Union Company intends to make war on the local independent lines.

MARION, IND.—Oscar Barger, manager of the Converse Telephone Company, has petitioned the Marion Board of Works for a franchise to operate a line from the south side of the city to Fairmount, and also asked permission to operate a line from the central part of the city to the west side, this line to extend to Converse. Previously the Board of Works demanded $1 taxation for each instrument in return for a franchise covering the west route, but the company refused to accept. The new line will be in competition with the Central Union, which now owns the local system.

COLUMBUS, IND.—An effort is being made by the Citizens' Telephone Company of this city to control the telephone situation in this section. Thomas Sheerin, of Indianapolis, son of the late Simon P. Sheerin, and M. F. Hosea, of Columbus, is manager. This company is controlled by the New Long Distance Telephone Company, of Indianapolis. Recently Mr. Sheerin and Mr. Hosea visited Hope, trying to make a deal to purchase the Hope telephone exchange. The Bell people are also trying to get a franchise there, and the local company would be strengthened by this connection with the Citizens' Company. The Citizens' Company is also making efforts to obtain the exchanges at Grammer and Elizabethtown.

SPENCER, IA.—The Western Electric Telephone Company contemplates the expenditure of $50,000 in this vicinity before the first of January.

DUBUQUE, IA.—The Delaware County Telephone Company has purchased the Interstate exchange at this place and it will be moved to the Delaware County exchange.

BOISE, IDA.—The Rocky Mountain Bell Telephone Company has asked for a franchise for the installation of underground wires. Numerous improvements in the present system are also to be inaugurated.

NEWRY, ME.—The Bethel and Newry Telegraph & Telephone Company has been formed with a capital of $5,000, by T. H. Jewett, president, Bethel, Me.

WINDHAM, ME.—The Windham Telephone & Telegraph Company has been formed with a capital of $10,000, by J. Hacker Hall, president, and Hiram C. Hawkes, treasurer.

SPRINGFIELD, MASS.—The New England Telephone Company is preparing to construct a new and improved exchange in this city. It is to be located at the east corner of Worthington Street and Stearns Park, and the company will petition the Board of Aldermen for the privilege of extending the conduits containing its wires from Main through Worthington Street to the new place. The plan is to construct a fireproof building to cost about $200,000 for land, building and a new switchboard.

READING, MICH.—The Reading Telephone Company will make a test of the lockout system for rural lines. The apparatus is now being installed. The experiment will be made on a block of 17 telephones on eight miles of wire.

NORTH ADAMS, MICH.—The North Adams Telephone Company, a co-operative company, has sold to Charles E. Knickerbocker, of North Adams, its switchboard, office furniture, cable and office pole. The company still owns the lines and poles inside the village.

GRAND RAPIDS, MICH.—At a meeting of the board of directors of the Citizens Telephone Company the capital stock of the company was increased from $2,000,000 to $3,000,000. A portion of the added capitalization will be placed on sale, and the proceeds will be used for immediate betterment and extensions.

GRANITE FALLS, MINN.—Work has been commenced on the construction of the Granite Falls Telephone Company's exchange under the supervision of Mr. O'Neil, of Minneapolis. A good number of subscribers have been secured.

FARIBAULT, MINN.—The Northwestern Telephone Company has closed a contract with the Morristown Telephone Company, by which it secures connection with about 85 telephones used by Morristown farmers and merchants. Morristown people can now secure a telephone communication with Faribault at a five-cent rate. The Northwestern has ordered the material and made contracts with 75 farmers about Faribault to install telephones for them, and give them free service in Faribault.

BILLINGS, MONT.—The Billings Mutual Telephone Company will rebuild the line from Billings to Roundup.

GREAT FALLS, MONT.—A petition for a franchise for the operation of a telephone system has been presented to the county commissioners by J. C. Furman, of Augusta.

FAIRFAX, MO.—The Fairfax Telephone Company has increased its capital stock from $18,000 to $24,000.

ST. LOUIS, MO.—The City Register has received a statement of the valuations placed by the State Board of Equalization on telegraph and telephone properties in St. Louis. The following decreases in valuation were made: Bell Telephone Company, $586,984; Kinloch Telephone Company, $115,150, and the St. Louis and Suburban Railway Company, $10,500. The following are the valuations fixed: Bell Telephone Company, $654,178; American Telephone and Telegraph Company, $7,757; Western Union Telegraph Company, $79,706; Pacific Mutual Telegraph Company, $6,382; Missouri District Telegraph Company, $31,604; United Railways, $16,592,737; St. Louis and East St. Louis Railway, $206,540; St. Louis and Meramec Railway, $335,407; St. Louis and Suburban, $1,580,358.

OMAHA, NEB.—Promoters of a new telephone system in Omaha are planning to go before the general council committee and present their plans for getting into Omaha and once more see if the council can be induced to favor the granting of a franchise.

RALEIGH N. C.—The Rose Hill Telephone Company will build lines through the counties of Duplin, Pender and Sampson and through other sections of the State. The incorporators are James C. Williams and Gabriel H. Robinson.

CAPE MAY, N. J.—City Council, at its monthly meeting, passed to its third and final reading an ordinance requiring the Delaware & Atlantic Telephone Company to place its wires underground, at least 2,000 feet to be so placed within a year.

DANVILLE, OHIO.—The Danville Home Telephone Company has been incorporated with a capital of $5,000.

CLEVELAND, OHIO.—The Springfield-New Carlisle Telephone Company has been organized. The company contemplates the erection of a telephone plant in New Carlisle as soon as a franchise can be obtained.

WOOSTER, OHIO.—The switchboard in the city telephone exchange has again outgrown the service needed in the city, and experts in the employ of the North Electric Company, of Cleveland, have began the work of building a large addition to the board. The board has been carrying 699 lines and is to be increased to 938.

TOLEDO, OHIO.—The Toledo Home Telephone Company has received 20 car loads of conduit for the extension of the telephone conduit system. The consignment embraces 100,000 feet. It is the intention of the company to make a number of extensions this fall, and work will begin as soon as the necessary permits are obtained from council.

COLUMBUS, OHIO.—A deal has been closed at Columbus that is of much importance to Toledo independent telephone interests and involves three independent exchanges in Ohio that at present have connections with the local plant. Frank Beam, of Columbus; D. E. Sapp, of Mount Vernon, and Frank Knapp of Bellevue, managers of the local exchanges in their respective towns, have held a conference with the officers of the Toledo Home Telephone Company. The meeting was arranged for the purpose of securing the assistance of the local people in the financing of a scheme to purchose control of the Norwalk, Monroeville and Bellevue exchanges and prevent them from falling into the hands of the Bell Company.

FORT WORTH, TEX.—The Forth Worth Telephone Company is extending a telephone line across Rosen Heights from east to west and there is to be a general improvement in the system and service.

LOGAN, UTAH.—The Utah Independent Telephone Company is installing its system in this city at an estimated expense of $400,000.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has filed with the County Recorder a trust deed for $3,000,000, covering an issue of bonds for that amount.

SALT LAKE CITY, UTAH.—A deal has been consummated between the Western Union Telegraph Company and the Utah Independent Telephone Company, whereby the latter company will be given the use of the telegraph company's poles between this city and Los Angeles.

PRICE, UTAH.—The Eastern Utah Telephone Company, with a capitalization of $60,000, will be organized here within the next few weeks. The Bell Company will be represented on the new company's board of directors. The new lines will connect with the Bell system and will afford a service with adjoining states.

SALT LAKE CITY, UTAH.—An additional 50-pair cable has been authorized by the directors of the Rocky Mountain Bell Telephone Company, from 12th and South Street to Bingham Junction, to cost $14,000; also an additional circuit from Casper, Wyo., to Rund Hill, Idaho, along the line of extension of the Chicago & Northwestern Railway Company. A cable system for Pocatello has also been authorized at an outlay of $12,000; and three additional copper circuits are being constructed to Bingham from this city. The purchase has been authorized of a new switchboard for the Ogden central station. Nampa is also to have a new switchboard.

PORT ANGELES, WASH.—This city is now connected by long-distance telephone with Dungeness, Sequim, Port Williams and other points in Eastern Clallam County, and with Port Townsend and other Jefferson County points, the lines of the Independent Telephone Company, which has been building in this direction for the past few months, having reached here.

Electric Light and Power.

OPELIKA, ALA.—Improvements are to be made by the Opelika Electric Light Company at a cost of about $220,000.

GILROY, CAL.—Bids will be received until September 18 by the Mayor and Common Council for $11,000 bonds for electric light and power works and an electric lighting system. C. N. Hoover is city clerk.

RIVERSIDE, CAL.—The Mercantile Trust Company, of San Francisco, has bought at foreclosure sale, the Riverside Power Company plant for $199,041. The San Francisco firm guaranteed the local bonds, and was forced to foreclosure. The plant had a thirty-one year contract for lighting the Riverside streets.

SONORA, CAL.—Preliminary work for an electric plant at Kennedy's Lake, to furnish power and light to the bay cities, will be commenced at once. Beach Thompson is the promoter of this project. It is proposed to build dams for catching up all the water of the Stanislaus River and conveying it by means of ditches, flumes, etc., to Sulbets Flats to a point where a drop of 1500 feet can be had, and where the power plant is to be installed.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation will install two additional 1,000-kw polyphase generators on the South Yuba transmission system, which was acquired from the Van Nordens. It is understood that Westinghouse machines will be ordered. The three power plants now in operation are equipped with Westinghouse apparatus, transmitting power to Sacramento and other cities. There is an unlimited amount of water available for further development on the South Yuba.

FRESNO, CAL.—A deed has been filed with the recorder transferring the property of the San Joaquin Power Company to the San Joaquin Light and Power Company, to enable work to be done with a larger capital than possible under the old company, which was incorporated for $800,000. The new corporation has a capital of $3,000,000. It is understood that no outside capital has been taken in, the expansion being from within. The action was necessary to cover the plans in contemplation for the development of more than 50,000 horse-power for use in the valley.

NORWALK, CONN.—It is stated that the Mayor is to appoint a committee of three to investigate the cost of installing a municipal lighting plant.

KENSINGTON, CONN.—The directors of the Kensington Water Power Company of Kensington have voted to dissolve the corporation and to wind up its affairs. A final dividend of $1,729 has been declared and distributed among the stockholders. The company was organized in 1890 to secure control of the water privileges which were then held by the Anglo-American Electric Company. Recently the Kensington company sold the privileges and rights to the American Paper Goods Company, which had previously operated them under lease. The water company has been financially successful.

MORRISON, ILL.—The Morrison Electric Lighting Company has increased its capital stock from $20,000 to $60,000.

VALPARAISO, IND.—The Valparaiso Lighting Company has been incorporated with a capital stock of $150,000. The directors are Clarence H. Geist, Charles B. Kelsey, H. W. Noble, Edward Clifford and D. S. Davis.

PERU, IND.—A statement for the year ending June 30, 1905, has just been issued by the committee having in charge the municipal lighting plant at this place. The city maintains 130 lamps at an average cost of $26 per lamp per year. An expenditure of $30,000, the committee reports, is needed to put the plant in good condition.

LE MARS, IA.—The Gas & Electric Development Company, of Philadelphia and New York, reports the sale of the Le Mars plant. The property was purchased by Mr. Bascom Parker, of Niles, Mich., who assumed control Sept. 1. Extensive improvements will be made.

PITTSFIELD, MASS.—It is reported that the Eaton-Hurlbut Company will construct a $15,000 power plant on South Church Street.

LAWRENCE, MASS.—At the regular monthly meeting of the water board Superintendent Collins was instructed to ascertain the cost of installing and maintaining an electric lighting plant at the pumping station and report at the next meeting.

GRAND RAPIDS, MICH.—The M. B. Wheeler Electric Company has been awarded the contract for installing a lighting plant at Rose City.

SAGINAW, MICH.—The Rifle River Power Company has filed its articles of association. The company is organized to produce electricity for lighting, heat and power. Its plant will be erected on Rifle River in Arenac and Ogemaw counties. The capital stock is $2,000,000, all subscribed, $2,000, paid in. The stockholders are George Silsby, Frank E. Kleinfeld, Alvah E. Kendall and Edwin Stapleton, all of Saginaw.

DELRAY, MICH.—The Solvay Process Company has lighted the village of Delray since its incorporation. Its contract expires next April, and unless some arrangement is made the village will have no lighting system. Delray is to be taken into Detroit and the Edison Illuminating Company has secured a contract with the Solvay Company for illuminating when the contract which compels the latter company to light the village expires.

GRAND RAPIDS, MICH.—A trust mortgage has been filed in Kent, Mecosta and Muskegon Counties, given by the Grand Rapids-Muskegon Water Power Electric Company to the Michigan Trust Company, of Grand Rapids, to secure an issue of bonds running 25 years at 5 per cent. The work of building the dam below Big Rapids is being pushed. The concrete work of the gate section is nearly finished. The company is securing a 66-foot right of way into Grand Rapids for its pole line.

MINNEAPOLIS, MINN.—Bids will probably soon be asked for furnishing the city 1,000 electric lights.

HELENA, MONT.—The Helena Power Transmission Company has awarded the first of a series of contracts, aggregating $1,500,000, for the building of a dam across the Missouri River near here to the Wisconsin Bridge Company, of Milwaukee. It is expected that the company will begin the transmission of electric power to Helena, Butte and Anaconda within ten months. About 20,000 horsepower will be developed, and this will be utilized chiefly in the Amalgamated smelters at Anaconda and in mining at points between there and Helena, as well as for lighting and street car purposes in the cities mentioned. The entire product of the present dam is used in the Helena smelters and Butte mines.

ST. LOUIS, MO.—The General Fuel & Illuminating Company, of St. Louis, has filed a statement showing that it has increased its capital stock from $60,000 to $70,000, all the increase paid.

SIKESTON, MO.—The Sikeston Ice, Light & Power Company has filed letters of incorporation with a capital stock of $25,000, one-half paid. The incorporators are Charles D. Matthews, Jr., Edward C. Matthews, Joseph E. Armstrong, Reese B. Boyce and J. Handy Moore.

ST. LOUIS, MO.—Paul D. Cable, president of the General Service & Development Company, announces that he has purchased from the West St. Louis Water & Light Company the lighting franchise obtained by it from St. Louis County Court several years ago, together with all its physical properties. If his plans are developed in full, farming by electric light may be witnessed in St. Louis County within the near future. He intends to light all the main country roads and wires will be strung into the farmhouses, stables or fields, if so desired by the residents along the route. The franchise is a comprehensive one, giving to the owner the privilege to build in any part of the county.

ST. LOUIS, MO.—In a letter that accompanied the Union Electric Company's proposal to illuminate the public buildings south of Washington Avenue, W. M. Powelson, general manager, declared that if the term of the contract were extended from one to ten years, his concern could furnish the energy for 3¾ cents per kilowatt-hour. He recommended that the Board of Public Improvements consider the change. The contracts for lighting public buildings both, north and south of Washington Avenue, were let, the successful bidders being the Laclede Light & Power Company and the Union Electric Company. The former got the contract for the north and the latter for the south district. The Laclede Company's bid was 5½ cents and the Union's 5 cents per kilowatt-hour.

RENO, NEV.—The Reno Power, Light & Water Company and the Washoe Power & Development Company have been secured by the Fleishhacker interests and ruinous competition in the lighting business at Reno prevented. The Hunter Creek Water Company and the Sparks Water Company will be included in the merger. It is understood that a new company will be incorporated that will probably be called the Union Power, Light & Water Company, and capitalized at $2,000,000. The Fleishhackers are heavily interested in the Truckee River General Electric Company, which supplies electric power for the Comstock mines at Virginia City and in the American River Electric Company, with transmission lines from near Placerville to Stockton, Cal.

CLYDE, N. Y.—The Clyde Gas & Electric Company has been incorporated to take over Clyde Gas & Electric Company; capital, $25,000. The directors are: P. W. Summers, Ithaca; G. S. Sheppard, and W. T. Morris, Penn Yan.

NEW YORK, N. Y.—The Suffolk County Lighting Company has been incorporated with a capital of $50,000. The directors of the company are: George MacDonald, Charles A. Hickey and Wm. H. Morgan, all of New York City.

FAYETTEVILLE, N. C.—The board of public works, Fayetteville, has in hand the enlargement of the electric light plant, together with the improvement of several other public utilities.

CONCORD, N. C.—The town of Concord has contracted with the Murray Iron Works, Burlington, Ia., for a 225-hp Corliss engine; with the Allis-Chalmers Company for a 150-kw alternator and with the Adams-Bagnall Company, of Cleveland, for a 50 arc lamps.

CHARLOTTE, N. C.—The Southern Power Company, Charlotte, is making contracts to furnish electric energy to manufacturing plants, and the latest contract is with the Southern Cotton Oil Company at Charlotte, for about 300 horse-power, beginning with the incoming cotton season. The newest development which is at Great Falls on the Catawba River will be completed in 18 months, according to estimate, and there will be available at that point 60,000 horse-power.

READING, OHIO.—Bids will be received until September 25 by the Board of Trustees of Public Affairs, for enlarging the electric light plant.

SPARTANBURG, S. C.—T. D. Ladshaw, of the firm of Ladshaw & Ladshaw, Spartanburg, S. C., is superintending the developing of a hydro-electric transmission on Meherrin River, at Emporia, Va. From 3,000 to 5,000 horsepower will be generated and will be used for operating a cotton mill, city lighting, etc.

WHITNEY, TEX.—Collier Bros., of Whitney, are considering the matter of establishing an electric light plant at that place.

EL PASO, TEX.—W. A. Hawkins, of El Paso, and associates, are considering the matter of erecting electric power plants on the Sacramento River in New Mexico.

GREENVILLE, TEX. Extensive improvements are to be made to the city electric light and power plant of Greenville. A proposition to sell the city plant to parties who propose to construct an electric street railway system here is being considered.

CHATTANOOGA, TENN.—The plans for the power plant of the Chattanooga-Tennessee River Power Company, which is to construct the lock and dam power plant at Hale's bar on the Tennessee River, have, it is stated, been approved by the War Dept. Bids for the construction will probably soon be asked. John Bogart, New York City, N. Y., is the consulting engineer.

KNOXVILLE, TENN.—The board of directors of the Knoxville Power Company has held its annual meeting. Plans for the proposed power plant to be erected on Little Tennessee River have been discussed. The following officers were elected at the meeting: President, Charles H. Treat, New York City; vice-president, John T. Wilder, Knoxville; secretary, John F. Barry, New York City; assistant secretary, L. M. Parker, Knoxville. The Knoxville Power Company will expend $3,500,000 in building the plant.

READSBORO, VT.—The proposed electric power plant on Deerfield River will cost about $1,000,000. W. S. Morton, Hartford, Conn., is the engineer.

RUTLAND, VT.—The annual meeting of the Rutland City Electric Company has been held. These directors were elected: S. M. Hamill, A. H. Jackson and H. M. Francis, of Schenectady, N. Y.; F. M. Butler and George S. Haley, of Rutland. Mr. Hamill was elected president, Mr. Jackson vice-president, Mr, Francis treasurer, Mr. Butler secretary and Mr. Haley general manager.

LURAY, VA.—The Luray Gas Company intends to erect a power plant at a cost of about $30,000. N. W. Davis is the engineer in charge.

LURAY, VA.—Preliminary surveys have been made for developing the Shenandoah River near Luray, and about 500 horsepower is found available. D. G. Strickler, F. G. Grave and other parties in Luray are interested.

PROSSER, WASH.—The Prosser Falls Land & Power Company has started to build an addition to its dam across the Yakima River at this point, which, it is expected, will prevent a recurrence of the present low water next year. The stream at this point is now flowing but 200 second feet, the smallest in its history, and if the dam had not been put in last year Prosser would now probably be without water works, irrigation or electric lights.

ALLENDE, MEX.—A new electric light and power plant is to be installed at Allende. The organization of the company was promoted by Enrique Guerra, of Ciudad Porfirio Diaz, State of Coahuila.

CITY OF MEXICO, MEX.—Modesto R. Martinez, on behalf of Andres Matienzo, has secured a concession to utilize the waters of Atoyac River in the State of Puebla for power purposes.

CITY OF MEXICO, MEX.—Parties whose names are not stated have applied to the Federal Government for a concession to establish an electric power plant on the San Andres River in the State of Zacatecas.

SALTILLO, MEX.—The Mazapil Copper Company will install an electric light and power plant at its new smelter here. It is said that the Mexican General Electric Company, of the City of Mexico, has the contract for putting in the plant.

LAS BARRAS, MEX.—The Guadalupe de los Reyes Mining Company will install an electric power plant on the Piaxtla River at this place. The electric current will be used to operate the machinery in the mines. The proposed plant will cost about $100,000.

CHILPANCINGO, MEX.—The Belgian syndicate which recently purchased the Jeronimos waterfall, situated on the Pedrenas River, in the State of Guerrero, is preparing to erect a large electric power plant at the fall. The power will be transmitted to cities and mining camps of the State.

MEXICO CITY, MEX.—It is reported that the Mexican Power Company, with an authorized capital of $10,000,000 operating under a New Jersey charter, has been organized and is preparing to utilize the water power of three rivers in the State of Mexico near Toluca. It will furnish electric power to this city, estimated at 90,000 horse-power.

TAMPICO, MEX.—The Luz Electrica de Tuxpam is the name of a company which has been organized at Tuxpam for the purpose of installing and operating a new electric light and power plant. Among those interested in the enterprise are Luis Montoto Carsi, Antonio Alvarez, Manuel Perez, Santos Gonzalez and Felix Costilla, all of Tuxpam.

CITY OF MEXICO, MEX.—The Mexican Light and Power Company will erect 15 station and storage buildings along its power transmission line between the main power plant at Necaxa and the City of Mexico. These stations will be used for the accommodation of the linemen and watchmen who will constantly patrol the line and for the storage of materials.

CITY OF MEXICO, MEX.—It is learned that a strong company is being formed in London and Berlin for the purpose of installing a large electric light and power system in the City of Mexico. It is reported that representatives of those back of the company have been in the City of Mexico securing contracts for the furnishing of power and that enough of these have been secured to insure the financial success of the enterprise. The names of the parties interested have not yet been made public.

The Electric Railway.

MONTGOMERY, ALA.—The North Alabama Railway, Light & Power Company has filed with the secretary of state a notice of its recent incorporation. This company has a capital stock of $100,000, and it is understood that its object is to build an electric railway through Albertville, Boaz, Whiteville, Attalia and Alabama City. The incorporators are: J. G. Elrod, W. A. Elrod, W. M. Coleman, George M. Rains, T. B. McNaron and Boykin and Brindley.

AUBURN, CAL.—At a recent mass meeting resolutions were adopted pledging the citizens of Placer County to secure a right of way for the electric railway which John Martin proposes to build through this county.

MONSON, CONN.—Representatives of the Springfield & Eastern Street Railway have held a conference with the Monson Selectmen concerning a petition which the company has presented, asking for the right to build a street railway from the northern part of Monson to the Worcester & Southbridge Railroad at Fiskdale.

STAMFORD, CONN.—It is expected that on September 8 the Stamford Street Railway Company will be taken over by the Consolidated Railway Company. A special meeting of the stockholders has been called for that date to take action on a proposition to sell the local company's property, franchises and contracts to President Mellen's corporation.

STAFFORD, CONN.—It is possible that work may be begun soon on the trolley line from Willimantic to Stafford Springs via Mansfield and Storrs. The company which holds this franchise has already begun work on the line from Norwich westerly, which it owns. It is understood that the company is practically ready to build and has charters permitting it to carry freight as well as passengers.

STAMFORD, CONN.—It is expected that the Stamford Street Railway Company will be taken over by the Consolidated Railway Company at once. A special meeting of the stockholders has been called to take action on a proposition to sell the local company's property, franchises and contracts to President Mellen's corporation. An offer has been received for the stock and it is probable that the proposition will be accepted.

NEW HAVEN, CONN.—Branford's lighting and water facilities and trolley line have all passed into the control of the Consolidated Railway Company. The price paid for the road is said to have been about par, the payment having been made in the 4 per cent. debentures of the Consolidated Railway Company. The New Haven road thus gets the trolley from East Haven to Branford. It wanted to buy the trolley without the water company or electric lighting system, but that could not be arranged.

BOISE, IDA.—Articles of incorporation of the Boise & Interurban Railway Company have been filed. This company, at the head of which is W. E. Pierce of this city, will build an electric railway from this city to Nampa, Caldwell, Payette and Emmett. The company is capitalized at $5,000,000, of which $206,000 has already been subscribed. The directors are: W. E. Pierce, Edgar Wilson, J. A. Pinney, J. E. Clinton, Jr., L. A. Coate, M. B. Gwin and Alfred Eoff.

MUNCIE, IND.—The Muncie, Hartford City & Fort Wayne Traction Company has passed into the hands of the Fort Wayne & Southwestern, representing the Wildener-Elkins syndicate.

HOPKINSVILLE, KY.—John Feland, attorney for Samuel C. Crawford, and other parties of Memphis, has asked for a franchise to build an electric railway and lighting plant in this city. An ordinance was passed in response to the request ordering the sale of a franchise on Sept. 15.

KALAMAZOO, MICH.—Just as the Michigan Traction Company was installing a new rotary converter for use in emergencies, lightning struck the power house at Augusta, made its way into the converter and burned out 40 coils.

FREDERICK, MD.—The officers of the Frederick and Middleton Electric Railway have announced the sale of the road, which is eight miles in length, to new owners, whose names are withheld for the present.

FREDERICK, MD.—It is asserted that the purchasers of the Frederick & Middletown (Md.) Electric Railway are the promoters of the road projected from Baltimore to Hagerstown, to be known as the Baltimore and Frederick Electric Railway. The necessary financial backing is said to have been secured.

KANSAS CITY, MO.—Hugh A. Holmes, of New York City, announces that the contract has been given for the proposed electric railway from Kansas City to Iola. It is the intention to build a branch into Paola.

KEENE, N. H.—At the annual meeting of the Keene Electric Railroad the following officers were elected: Daniel R. Cole, president; George E. Whiting, of Boston, treasurer; Frank H. Whitcomb, clerk; Daniel R. Cole, George E. Whiting, George A. Litchfield, Thomas T. Robinson, Charles O. Whiting, T. Russell Robinson, John H. Jennings, directors. The treasurer's statement for the year ending July 1st showed that the road had earned a slight amount above its operating expenses and fixed charges.

ALBANY, N. Y.—The Tunesassa & Bradford Railroad Company, of Olean, has been incorporated with a capital of $50,000. Directors: J. B. Wright, D. H. Miller, Kane, Pa.; F. L. Bartlett, Olean.

SYRACUSE, N. Y.—The Syracuse, Lake Shore & Northern Railroad Company, Syracuse, has been formed to operate a street surface electric road fifteen miles long, from Syracuse to Baldwinsville. Capital, $2,250,000. Directors, H. S. Holden, C. M. Warner, A. K. Hiscock, William Nottingham and L. C. Smith, Syracuse.

BUFFALO, N. Y.—W. Caryl Ely, formerly president of the International Railway Company, of Buffalo, and president of the American Street Railway Association, has secured options on the electric railways of East Liverpool, Wellsville and Rock Springs, Ohio, and Chester, W. Va., together with the electric lighting plants of all these places. The East Liverpool system on which Mr. Ely has secured an option has the right to construct an additional line from Wellsville to Steubenville, Ohio. Along with the other options secured are an application for a charter for a new line from East Liverpool to Beaver, Pa., and a station track at Chester. In the event of their purchase Mr. Ely will combine the road into one company. The unification of the lines that will necessarily follow their absorption will call for the expenditure of a large amount of money for improvements.

PINEHURST, N. C.—The trolley line from Southern Pines to Pinehurst has been sold to the [illegible] Railroad and will be discontinued.

OBERLIN, OHIO.—The Oberlin & Lorain Street Railway seems to be an assured fact.

LISBON, OHIO.—Another railway enterprise, having for its object the construction of an electric road from this city to East Liverpool, is in the field.

CINCINNATI, OHIO.—The Cincinnati Northern Traction Company has secured a site at Lindenwald, near Hamilton, for its proposed new power station. This will be one of the finest interurban stations in the country and it will cost in the neighborhood of $700,000.

CINCINNATI, OHIO.—The Cincinnati, Lawrenceburg & Aurora Traction Company is planning to build an extension from Harrison, O., to Batesville, Ind., there to connect with the Indianapolis & Southeastern Traction Company, which will build from Shelbyville to Batesville. The road will not be built this year, however.

TOLEDO, OHIO.—The Patrick Hirsch Company has closed all contracts for the building and equipping of the Toledo, Ann Arbor & Detroit Railway. The Arbuckle-Ryan Company, of Toledo, has secured the contract for the steam equipment and piping; the General Electric Company will furnish the electrical equipment, and the Niles Car & Manufacturing Company the cars. The Carnegie Steel Company is making shipments of rails. Ground has been broken for the power station at Petersburg, Mich.

CLEVELAND, OHIO.—Governor Myron T. Herrick, who is prominently identified with some of the traction interests of Ohio, will use the electric railway almost exclusively in his campaign for re-election this fall. Arrangements have been made with the manager of practically every electric railway in the State to handle the Governor's special car. Over two-thirds of the county seats and hundreds of small towns are accessible by electric railway. An ordinary trolley car will be used. The seats will be removed and tables and chairs substituted.

SPRINGFIELD, OHIO.—S. L. Johnson, of New York, is said to be organizing a syndicate for the purpose of acquiring the bankrupt Springfield & South Charleston line and carrying out the original plan of extending it to Washington C. H. and Chillicothe.

PAULDING, OHIO.—The Westinghouse Electric & Manufacturing Company is reported to be preparing plans and estimates for an electric railway from Wauseon through Napoleon and Defiance to Paulding. The project is said to be backed by the Patrick Hirsch Company, of Toledo.

LIMA, OHIO.—It is announced that arrangements have been completed for refinancing the Sandusky Southwestern Traction Company, which has been in the hands of the receivers for some time. It is stated that Percy Dickinson and John R. Lowther, of New York, representing bankers in that city, have agreed to pay off the debts, raise the receivership and subscribe for $2,000,000 of bonds to complete the line between Kenton, Lima and Bellefontaine.

PITTSBURG, PA.—President Frank G. Patterson, of the Southern Traction Company, has announced that within a month a contract will be awarded for the construction of 18 miles of road.

YORK, PA.—The York County Traction Company, through its subsidiary companies, has secured the rights to build an extension from Red Lion to McCall's Ferry; also from Hanover to New Oxford, in Adams County.

COLUMBIA, S. C.—The Hyatt Improvement Company proposes to build an electric street car line developing suburban property, F. S. Hyatt being among those interested.

COOPER, TEX.—It is proposed to build a street railway line in Cooper. Dr. Joe Blackwell can give information.

BROWNWOOD, TEX.—A project is on foot to build an interurban electric railway between Brownwood and Rising Star. The promoters of the project have had estimates made on the cost of constructing the line.

WAXAHACHIE, TEX.—A syndicate of Eastern capitalists have been investigating the situation with the view of constructing an interurban electric railway between Waxahachie and Ennis. The distance is about ten miles.

CORSICANA, TEX.—J. V. Watkins, of Corsicana, is promoting the building of an electric railway between this place and Palestine. Application will be made to the City Councils of the two towns for franchises over their streets.

MINERAL WELLS, TEX.—J. D. Beardsley, of Gibsland, La., is working on the project of building an interurban electric railway between Mineral Wells and Fort Worth. The distance is sixty miles and the cost of construction is estimated at $1,500,000.

BRYAN, TEX.—A large part of the capital stock of the company that is being organized to construct an electric railway line between Bryan and College Station, where the State Agricultural and Mechanical College is situated, has been subscribed. Ed. Hall, A. M. Waldrop, James H. Webb and others are interested.

SALT LAKE CITY, UTAH.—An amendment to its articles of incorporation has been filed with the county clerk by the Salt Lake & Ogden Railway Company, by which the capital stock of the company is increased from $800,000 to $1,500,000. At present the company is operating a steam railroad, but this is to be converted into an electric line with a double track. Arrangements have already been made for a bond issue, to be negotiated through a New York firm.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company is figuring on plans for extensions and new suburban lines.

JANESVILLE, WIS.—It is reported that J. Nutt, of Cleveland, acting in the interests of Farson, Leach & Company, has secured an option on 10,000 shares of the Rockford, Beloit & Janesville Interurban Company and that a deal is likely to be closed which will transfer the controlling interest in the enterprise to Chicago parties. The buyers' purpose is said to be consolidate the Interstate line with Freeport and Belvidere. Madison traction interests, it is said, will also come in.

MONTEREY, MEX.—It is stated that the Canadian syndicate which recently purchased the two railway system of Monterey, paid $550,000 for the Empresa system and $360,000 for the Slayden lines. Steps have already been taken toward merging the two systems and converting them into electric lines.

BACA, MEX.—The Cigarrere Mining Company is preparing to build an electric railway from its mines to Baca Station, where connection will be made with the Mexican Central Railroad. The line will be four miles long. L. Iwansky, of Parral, Mexico, can give information in regard to the project.

CITY OF MEXICO, MEX.—An important concession has just been granted the Mexico Electric Tramways, Ltd., by the Mexican Government for the construction of additional lines of railway in the City of Mexico. The new lines are to be built for the most part in what is known as the Santa Maria quarter of the city. The period of the concession expires February 24, 1982.

GUADALAJARA, MEX.—The stockholders of La Electra Company of Guadalajara have authorized the issuance of $2,000,000 in mortgage bonds for the purpose of providing funds for the construction of the electric street railway system in Guadalajara. The bonds will be issued in blocks of $500,000 and will be taken, it is stated, by banks in this city. By the purchase of the Kunhardt lines, which were acquired recently for $500,000, La Electra secured control of the street railway situation in Guadalajara. The new power house that the company will build in connection with the electric system wil cost $500,000. It will be located a short distance from the falls of the Santiago River, at Juanacatlan, and will generate 7,000 horse-power. The cost of the street railway system and the new power house will be between $2,500,000 and $3,000,000.

New Industrial Companies.

THE ACME ELECTRIC COMPANY, of Knoxville, Tenn., has been formed by H. M. Moses and Lewis Self, to do a general electric business.

THE EGAN ELECTRIC COMPANY has been organized at Dallas, Tex., with a capital stock of $15,000. Its purpose is to deal in electrical fixtures and supplies. G. H. Egan is one of the incorporators.

THE MEXICAN ELECTRICAL CONTRACTING COMPANY has been organized at Guadalajara, Mex., for the purpose of importing and installing electrical machinery. E. W. D. Cummings is interested.

The LOWELL & FITCHBURG ELECTRIC COMPANY, of Lowell, Mass., has been incorporated in Boston with a capital of $400,000. Albert E. Knowlton is treasurer and the directors are Thomas H. Hathaway and Charles N. Goodrich.

THE ELECTRIC FLOOR SURFACES COMPANY, of Gardiner, Me., has been incorporated to manufacture machinery, etc. The capital is $200,000. J. S. Maxey, of Gardiner, is president; G. F. Hall, of Providence, treasurer.

THE TIFFANY ELECTRIC MANUFACTURING COMPANY, of Portland, Me., has been incorporated with a capital of $1,300,000. The officers are: President, C. O. Barrows, of Portland; treasurer, W. M. Payson, of Boston.

THE WOOLLEY ELECTRIC COMPANY, of Clayton, Mo., has been organized to manufacture electrical supplies. The capital stock is $25,000, Walton D. Woolley, of St. Louis, and E. C. Hencken and Fred Essen, of Clayton, being stockholders.

Legal.

ATLANTIC TELEPHONE.—An injunction has been asked for against the Atlantic Telephone Company to restrain it from transferring stock upon its books or increasing its capital stock until the trial of an action brought by D. A. Reynolds for the fulfilment of an agreement alleged to have been made in 1901, under which the officers were to have issued to him $49,993 of its capital stock. The Atlantic Telephone Company recently applied for a franchise to do a telephone business in New York City as an "independent" system.

Obituary.

MR. H. W. EATON.—Harry W. Eaton, assistant treasurer of the Houghton County Electric Light Company, of Houghton, Mich., was drowned on a fishing trip on Lake Superior. He was out with Alton W. Leonard, manager of the company, and Engineer Nelson, both former Brocktonians, and one other man. In some way he fell from the launch into the ice cold waters of the lake. He shouted to have the launch put out to him, but there was a momentary delay, of course, and he sank before any assistance could reach him. Mr. Eaton was formerly an auditor for Stone & Webster.

W. B. GILL.—William B. Gill, formerly a district superintendent of the Western Union Telegraph Company, with headquarters in Philadelphia, died September 6th, at the age of 59 years. Mr. Gill entered the employ of the Western Union Company as a messenger boy, and eventually became superintendent of the sixth district, which embraces eastern Pennsylvania, the southern section of New Jersey, Delaware, and a part of Maryland and Virginia. He retired in 1902. He was president and general manager of the Philadelphia Local Telegraph Company, a director in several other companies, and at one time a vice-president of the Bell Telephone Company.

Personal.

W. S. DORAN.

MR. W. S. DORAN, formerly associated with the British Westinghouse and Manufacturing Company, Ltd., has just been appointed manager of the power department of Allis-Chalmers Company, in which capacity he will have complete charge of the company's commercial affairs pertaining to reciprocating steam engines, steam and hydraulic turbines, condensers, gas engines, blowing engines for iron and steel blast furnace service and rolling mill engines, with headquarters at Milwaukee, Wis. Mr. Doran is excellently qualified to carry on this large and important work. He brings with him not only the knowledge acquired in some of the largest manufacturing concerns in this country, but also the wide scope of technical training gained during the many years he has spent abroad. He started on his business career with the Southwark Foundry & Machine Company, Philadelphia, where he remained for five years engaged in drafting and general shop work. After spending some time with the United Gas Improvement Company, of Philadelphia, in the construction and management of water-gas plants for that company, he became connected with Henry R. Worthington, with whom he remained for many years in New York, Chicago and Philadelphia. In addition to his engineering duties, he had charge of the branch offices, and while located at Chicago had complete charge of their entire western business. In 1899 he joined the Worthington headquarters in London, England, where he took charge of the various branch offices and important negotiations in Great Britain and Ireland. In 1901, he became associated with the Westinghouse interests, and since then has been establishing their branch offices and supervising sales. In that capacity, he has conducted a large number of important negotiations successfully with steam railway companies, power distribution companies and street railway lines. As an evidence of the high esteem with which Mr. Doran is regarded by his business associates, a banquet was given him on the eve of his departure from England, attended by many well-known railway officials, manufacturers, electrical engineers and representatives from practically all the large electrical manufacturing concerns in England.

MR. GEORGE WESTINGHOUSE has returned from Europe this week by the "Kaiser Wilhelm."

MR. JOHNS HAYS KUHNS, who for some years has practiced electrical engineering throughout the West, with headquarters at Omaha, Neb., has sailed for Japan to accept a position under the Japanese Government.

MR. J. E. SCOTT, manager of the Bell telephone exchange at Zanesville, O., has been made traveling auditor with supervision of some twenty exchanges in the fourteen counties of the Columbus district. He is succeeded by Mr. P. R. Brehmer, chief inspector.

MR. H. F. STRATTON, who has been connected with the principal office of the Electrical Controller and Supply Company, at Cleveland, O., has accepted the position of New York representative of the same company, with offices at 136 Liberty Street, New York City.

MR. GEORGE P. LOW, founder of *The Journal of Electricity, Power and Gas,* San Francisco, who has occupied the editorial chair for the greater part of the time, retired August 31. He was elected president of the Pacific Coast Electric Transmission Association at its recent annual meeting.

MR. A. W. LEONARD.—Mr. Alton W. Leonard, former manager of the Brockton (Mass.) Edison Electric Illuminating Company, and more recently manager of the Houghton Electric Light Company in Houghton, Mich., and also of one of Stone & Webster's electric railway enterprises there, has been further promoted by the Stone & Webster management, and has been named as manager of the General Electric Company in Minneapolis.

MR. F. E. VALENTINE, the newly elected president of the Ohio Electric Light Association, whose annual convention has just been reported in these pages, is secretary and manager of the Miami Light, Heat and Power Company, of Piqua, Ohio, one of the progressive concerns of that State. His election to the office of president of the association for the current year is in recognition of the active part he has taken in furthering its interests in every way. He has always taken a prominent part in discussions at conventions and has been active in committee work between conventions. At the last convention he headed the written discussion on meter and billing records.

MR. JAMES C. HAIN has resigned as engineer of masonry construction for the Chicago, Milwaukee & St. Paul Railroad and is now associated with J. G. White & Company as superintendent of masonry construction, with headquarters at 43 Exchange Place, New York. Mr. Hain graduated in 1893 from the University of Wisconsin with the degree of B. S. in C. E. The University conferred upon him the degree of C. E. in June, 1905. Mr. Hain was with the Chicago, Milwaukee and St. Paul Railroad for ten years and in that time gained a broad experience in the work which is supervised by its bridge and building department. While with this company he also had experience in general design and in detail computation and drawing. He also performed outside duties of surveying, collecting data and other work relative to replacing wooden bridges and other temporary structures with permanent masonry construction. During the year 1900-1 he was in charge of the construction of the large ore dock and approaches at Escanaba, Mich. In 1901 Mr. Hain was appointed engineer of masonry construction and in that capacity supervised all work of this nature that has been done during the last four years by the Chicago, Milwaukee and St. Paul Railroad on its 7,000 mile system.

Trade Publications.

LIGHTING SPECIALTIES. Harvey Hubbel, Bridgeport, Conn., has issued circulars illustrating sockets, attachment-plugs, clusters and metal reflectors. A full supply of samples is kept on hand at the New York office, 229 Broadway.

A GOOD RULE has been sent out by the American Platinum Works, of Newark, N. J., as an advertisement. It has a brass edge, is 15 inches long, finished in black enamel, with the name of the company on both sides. It is of attractive utility for the desk.

ELECTROMAGNETS.—Charles R. Underhill, 55 Liberty Street, New York, has recently issued a sheet with thirty-five cuts, showing the various types of electromagnets, alternating and direct-current. This, together with booklet, "Facts about Electromagnets," will be sent free to any address.

ROSETTES.—Pass & Seymour, Solvay, N. Y., has issued a circular describing fuseless rosettes, attachment plugs and weather-proof sockets. Accompanying the circular is a letter which serves to show that the company is making some special prices upon these goods, both in small lots and in standard cases of 250.

THOMPSON-RYAN DYNAMOS. The Ridgeway Dynamo & Engine Company, Ridgeway, Pa., has issued bulletin No. 16, giving a list of customers who have in use Thompson-Ryan dynamos and McEwen engines, in order that prospective purchasers may learn to whom to apply for accurate knowledge concerning the service rendered by these machines.

A RIDE ON LAKE ERIE.—An enjoyable ride is that on Lake Erie between Detroit and Buffalo. The Detroit and Buffalo Steamboat Company, Detroit, Mich., runs a line of steamers between these cities, and the trip at this time of the year affords an opportunity to see the famous lake at its best. The company publishes a pamphlet which tells all about the trip.

MOTOR CONTROLLERS.—The Ward Leonard Electric Company, Bronxville, N. Y., has recently issued a number of leaflets devoted to motor controlling apparatus. The SKE type of motor starter is described as being entirely fool-proof. It is impossible to start the motor under the condition of weakened field. When the voltage is removed from the line, the starting arm carries the handle of the field rheostat back to the position of "all resistance out."

RUBBER GOODS.—The Peerless Rubber Manufacturing Company, 16 Warren Street, New York, has issued a well-illustrated 137-page catalogue, designated as No. 70, dealing with all kinds of rubber goods for industrial purposes. Descriptions are given of sheet packing, sectional gaskets, valve and rod packing, belting, steam and water hose, rubber matting and rubber tiling. The catalogue is printed in colors, which serve especially to show the beauty of the various designs of the tiling.

HOISTING AND CONVEYING MACHINERY.—In bulletin No. 12 of the Robins Conveying Belt Company, Park Row Building, New York, are described in detail the manufacture, erection and operation of hoisting and conveying machinery for power stations. Views are given of the coal-handling equipment in the power station of the New York Subway at 58th Street and 12th Avenue; in the power plant of the Richmond Heat, Light & Power Company, Staten Island, N. Y.; in the coal yards of the Brooklyn Heights Railroad Company; in the new plant of the Edison Electric Illuminating Company, of Boston, and in the Kingsbridge power plant of the Metropolitan Street Railway Company, of New York.

MOVING AIR.—The problems involved in the transportation or movement of fluids differ essentially from those concerned with the conveyance of solid materials. In the case of the latter the process is one of actual carrying, while in the former the movement results from, and is proportional to, the pressure difference existing between the delivery and receiving points. The solid is actually carried in bulk, while the fluid, as its name suggests, merely flows toward the point of least resistance. In other words, the transportation of fluids, of which air and water are the most familiar and plentiful examples, results from the creation of a difference in pressure. A portable receptacle is usually required for the latter, while a conduit is necessary for the passage of the former. A very comprehensive discussion of the subject is presented in the exhaustive treatise on "Mechanical Draft," published by the B. F. Sturtevant Co., of Boston, Mass.

News of the Trade

NERNST LAMP AGENCY.—Mr. Arthur F. Salomon, with offices at 519 Mission Street, San Francisco, Cal., is now general agent for the Pacific Coast for the Nernst Lamp Company, of Pittsburg.

THE AMERICAN COIL COMPANY, West Somerville, Mass., manufacturer of ignition apparatus, sparking plugs, induction coils and other electrical apparatus for automobiles, etc., is to remove to Foxboro, Mass., where a new factory will be erected, 25 x 45 ft. and two stories.

GREGORY ELECTRIC COMPANY.—Owing to constant increase in its business the Gregory Electric Company is again compelled to enlarge its works at 16th and Lincoln Streets, Chicago, and has just begun building an addition which will practically double the size of the present warehouse. The addition is expected to be completed by March 1, 1906.

MR. T. J. COPE, 3244 N. 15th St., Philadelphia, the well-known expert in conduit work and manufacturer of conduit specialties, is on a trip through the West, and will visit a number of cities, including Kansas City and Denver, before his return. Mr. Cope's line of underground specialties is the direct result of his long and successful experience in this kind of work, and comprises conduit rods, cable racks and special machinery for handling and installing cables and wires. Recently increased manufacturing facilities make it possible to handle all orders promptly.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 5, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

798,589. RESISTANCE DEVICE; George Baehr, McKeesport, Pa. App. filed Sept. 28, 1904. Relates to a construction of resistance unit in which parallel side frames have connecting bolts upon which are hung the usual serpentine resistance conductors which the current is made to traverse in series. The side frames have hooks by which they can be hung on a panel board.

798,602. AUTOMATIC CARRIER FOR ELECTRIC WIRES; Frank E. Detchon, Delta, Col. App. filed Aug. 4, 1904. A reel-carrying carriage has propelling wheels with spring motors by which the carriage is propelled along a guide wire. As the carriage moves the wire to be hung is payed out from the reel.

798,606. MACHINE FOR INSULATING ELECTRICAL CONDUCTORS; Charles H. Hawkins, Long Island City, N. Y. App. filed Nov. 28, 1904. A spirally grooved drum rotates continuously within a casing having a conical end so that the rubber or insulating material is compressed toward such conical end. The material is made to traverse diametrically opposite openings so as to be formed into two tapes or shreds. These wrap around the wire as the latter rotates so as to insulate the same.

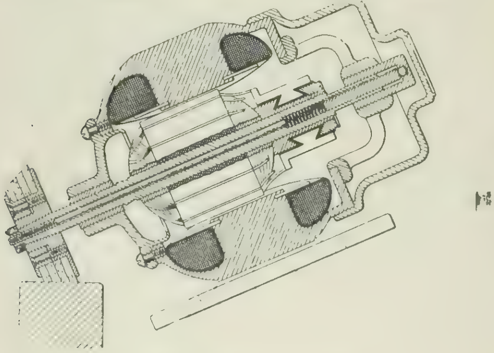
798,659. ANNUNCIATOR; Charles C. Cadden and James I. Gemmill, Cleveland, Ohio. App. filed June 11, 1903. An annunciator for the purpose of indicating a call is combined with a spring jack upon the switchboard. As the spring jack is inserted it moves a small lever which is effective to restore the usual shutter of the annunciator to normal position automatically.

798,671. AUTOMATIC TELEGRAPH; Alfred C. Gilmore, Chicago, Ill. App. filed Mar. 10, 1903. A printing telegraph which is designed to select the proper printing character automatically by means of selecting devices controlled by the usual dot and dash signal. For this purpose the type wheel is stepped around by different electro-magnets, some of which respond to dots and some to dashes so that the proper character is positioned for any combination.

798,673. TROLLEY; Robert G. Griswold and Charles C. Willits, Quincy, Mass. App. filed Oct. 13, 1903. The trolley harp is capable of movement independently of the pole and is spring-pressed to move the wheel upward, whenever the latter leaves the wire. Under these circumstances the relative movement is effective to project upward a pair of horns which assist in repositioning the wheel.

798,691. TROLLEY FINDER; Jerry Morrow, Wellston, O. App. filed July 6, 1904. Relates to modifications of the above and particularly to the construction of the horns or projections which replace the wheel. In this patent these are made integral with a bail or loop which strengthens the construction.

798,720. TELEPHONE-REPEATER; David H. Wilson, Chicago, Ill. App. filed Feb. 14, 1903.



798,770.—Governor for Dynamos

798,742. AUTOMATIC TRAIN SIGNAL; Clay H. Martin, Jackson, Mich. App. filed Dec. 20, 1904. In order to give sufficient notice to all persons in case a freight train parts at an intermediate point, a flexible cord is run along the top of the train from the caboose to a point near the engine. When the train parts, the tension in the cord causes flash powder to be ignited near the engine and an alarm circuit to be run within the caboose.

798,747. ELECTRIC HEATER; Frank O'Hanlon and Joseph F. Kelly, Philadelphia, Pa., and Henry S. Vautier, Camden, N. J. App. filed Sept. 6, 1904. A water heater in which the heating coils are inclosed within an interior drum or cylinder which may be removed whenever desired from its surrounding casing through which the water circulates. The object is to facilitate repair.

798,748. CONDUIT FOR ELECTRICAL CONDUCTORS; William C. Robinson, Allegheny, Pa. App. filed Oct. 5, 1904. A strip of sheet-metal is bent to form a pair of parallel tubes with an intermediate connecting web. The tube serves to contain and protect the electric conductors while the web serves as a means for fastening the whole to a wall or a side of a building.

798,770. GOVERNOR FOR DYNAMOS; Charles A. Eck, Newark, N. J. App. filed Aug. 12, 1903. A magneto for gas engines in which the armature spindle is inclined to the fly-wheel so that its pulley is held in contact therewith by gravity. Under excessive speed the field becomes strong enough to lift the armature spindle away from the fly-wheel.

798,784. CONTROL OF APPARATUS GOVERNING THE PASSAGE OF CARS ALONG RAILWAYS. Henry W. Griffin, New York, N. Y. App. filed Apr. 1, 1905. A slugishly moving relay is set in motion by the passage of a train. If the speed of the train is so high as to pass a succeeding rail joint before the sluggish relay has had time to act, a train stop is effected. The object is to permit a train to run by a caution signal at slow speed.

798,790. ELECTROLYTIC PROCESS; Carl Hering, Philadelphia, Pa. App. filed July 13, 1901.

798,803. POCKET ELECTRIC BURGLAR ALARM; Herman A. Kreh, New Orleans, La. App. filed Dec. 30, 1904. A pair of spring arms may be inserted within the usual crevice of a window so that when the latter is opened the arms will separate and close the alarm circuit.

798,826. REGULATOR; Alphonse F. Pieper, Rochester, N. Y. App. filed Aug. 29, 1903. An arrangement for regulating alternating current motors, including a series of choke coils all in shunt with the armature circuit and a switch by which a greater or less number of choke coils are made effective.

798,838. TELEPHONE-EXCHANGE SYSTEM; Ernest Hugo Strauss, Chicago, Ill. App. filed Aug. 29, 1903.

798,906. STORAGE BATTERY; Alfred E. Knight, Somerville, Mass. App. filed Nov. 16, 1904.

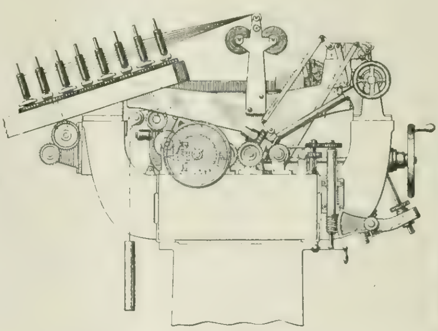
798,915. ELECTRIC SWITCH; McGonigle Miller, Louisville, Ky. App. filed Sept. 30, 1904. A device for actuating a switch intermittently comprising a solenoid having a core which is drawn into the solenoid and subsequently released in the usual manner of reciprocating motors. The core has a pawl which steps around a ratchet wheel which in turn operates the intermittent switch.

798,920. METHOD OF REDUCING OXALIC ACID AND ITS DERIVATIVES BY ELECTROLYSIS; Emil von Portheim, Prague, Austria-Hungary. App. filed Jan. 29, 1904.

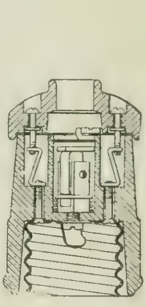
798,932. ELECTRIC LAMP SOCKET; George B. Thomas, Bridgeport, Conn. App. filed Mar. 6, 1905. A porcelain socket having a lamp holding part with the usual threaded shell contained in a cavity and a head which is secured to the first-named part by a sort of flexible bolt. A central chamber within the socket contains the usual switch terminals.

798,933. AUTOMATIC LETTER BOX ALARM; Chalmer D. Tucker, Oxford Junction, Ia. App. filed Jan. 13, 1905. An apparatus for ringing an alarm circuit whenever a letter box is opened to deposit mail. The box can be opened at any time when desired to remove the mail without operating the alarm circuit by pressing a detent which makes the signal closing means inoperative.

798,954. ELECTRIC INCANDESCENT ILLUMINATING APPARATUS; Gerald B. Francis, Woking, Eng. App. filed Dec. 17, 1904. In order to apparently increase the area of the illuminating surface in an incandescent lamp, the filament is mounted on a rotating spindle driven by a small motor, causing it to generate a solid of revolution which apparently constitutes the illuminating surface.



798,864.—Automatic Winding Machine.



798,932.—Electric Lamp Socket.

798,864. AUTOMATIC WINDING MACHINE; James C. Anderson, Jersey City, N. J. App. filed July 16, 1904. A machine for winding material in the form of fibres, filaments, strands or strips into coils, bobbins, etc., and for introducing sheet material, such as paper for insulating the successive windings. The invention is an improvement on an earlier machine which winds bare wire with a separating fibre, but in the present machine ordinary insulated wire is also used. A purality of bobbins can be wound simultaneously. The machine is under control from a single lever.

798,975. ELECTROMAGNETIC POWER GENERATOR; Joseph L. Potter, Indianapolis, Ind. App. filed Apr. 3, 1905. A toy motor comprising a casing having an open end to contain a dry battery and a fly-wheel with a connecting rod reciprocated by an electro-magnet.

799,010. TELEPHONE SYSTEM; Oscar M. Leich, Chicago, Ill. App. filed Feb. 9, 1900.

799,016. ELECTRIC BELL OR LIKE DEVICE; Carl J. Schwarze, Adrian, Mich. App. filed May 31, 1904. Details of construction of a telephone bell relating particularly to the arrangement of the magnets. These are formed of coils secured to L-shaped parts which form the pole pieces of each magnet. The armature is formed by a centrally pivoted lever which is alternately attracted at its respective ends.

798,017. ELECTRIC BELL; Carl J. Schwarze, Adrian, Mich. App. filed Sept. 19, 1904. Relates to modifications of the above and particularly the form of the surrounding casing which includes the two bells and an inermediate cup containing the operating parts. A shield is provided for the hammer.

799,019. TELEPHONE-SWITCH; Michael Setter, Chicago, Ill. App. filed Sept. 13, 1902

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, SEPTEMBER 23, 1905. No. 13.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................................1139 Monadnock Block
PHILADELPHIA OFFICE....................................929 Chestnut Street
CLEVELAND OFFICE ....402 Cuyahoga Building
EUROPEAN OFFICE.......Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico......................Per year, $3.00
Foreign Countries, within the Postal Union............................$6.00
Great Britain and Ireland....................................25 shillings
Germany ....25 marks
France ....31 francs
Single copies ....10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for 1905 to date,* **526,000.**

NEW YORK, SATURDAY, SEPTEMBER 23, 1905.

CONTENTS.

Editorial 509
Bethlehem Meeting American Electrochemical Society........ 512
Street Railway Week in Philadelphia........ 513
The Patent Office Year........ 514
Telegraphs and Pool Rooms........ 514
Direct Cable to Japan........ 514
A Trolley for Yellowstone Park........ 514
A Tour of Independent Telephone Leaders........ 515
The French Cable and Venezuela........ 515
New Stages for Fifth Ave., New York........ 515
Deterioration of Copper Wire........ 515
San Joaquin Power Development........ 516
Telephone Density 516
Current News and Notes........ 516
Electrical Engineers of the Times.—XXVIII. Prof. A. H. Ford........ 518
New Power Plant of the Brooklyn Rapid Transit Co........ 519
British Law on Live Rail Accidents........ 523
Gas Arcs and Electric 523
The Single-Phase Railway in Practical Operation........ 524
Maximum Demand. By J. S. Codman........ 527
Spark Gaps. By James Foster King........ 529
Some Approximations of the B. & S. Gauge and of the Properties of Copper Wire. By C. P. Nachod........ 529
Mercury Vapor Lightning Arresters........ 530
New Telephone Patents........ 531
Recent Electrochemical Patents 531
LETTERS TO THE EDITORS:
  The Use of the Third Person in A.I.E.E. Discussions. By Cary T. Hutchinson........ 531
  Alternating-Current Nomenclature. By R. B. Williamson........ 531
Digest of Current Electrical Literature........ 532
Book Review 536
New Westinghouse Railway Motor........ 536
Machine Tool Controller 538
Steel Frame Motors 538
Battery Volt-Ammeter 539
Galvanometer for Cable Testing........ 539
Alternating-Current Rectifier 540
Automatic Measuring and Mixing Machine........ 540
Industrial and Commercial News........ 541
General News of the Week........ 544

STEAM VERSUS ELECTRIC AUXILIARIES.

It is the customary American practice to install steam auxiliaries in large generating steam stations. That is to say, the power required to drive the pumps and fans of the plant is not supplied by motors receiving current from the bus-bars, but by small independent steam engines receiving steam from the main boilers. The reasons ordinarily assigned for this preference are mainly in regard to security and convenience. It is urged that any failure of current at the bus-bars does not involve the stoppage of the station auxiliaries when the latter are driven by independent steam engines. Moreover, if steam is needed for heating the buildings or for other purposes, this steam has to be taken from the boiler main-steam pipes if all the auxiliaries are motor-driven; whereas it may readily be supplied from the exhaust of the auxiliaries, if these are steam-driven. In Europe, on the other hand, the practice varies in this respect. In the most modern central station steam plants there are some which employ all the steam for driving turbines connected to high-tension alternators, and the auxiliaries are driven by direct-current motors, which are supplied from the bus-bars, through step-down transformers and converters, in connection with a storage battery. The storage battery enables the auxiliaries to be driven for several hours independently of the pressure at the high-tension bus-bars.

As regards economy in fuel, it might seem at first sight as though the advantage might lie in favor of the electric drive, since the steam consumption of the auxiliary engines is wasteful by comparison with that of the large turbo-alternators. It is doubtful, however, whether fuel economy can always be secured by the electric drive. The current for the motors has to be supplied after electric losses have been incurred in storage-battery, converter, transformer, and dynamo. The advocates of the electric drive usually admit that there is no claim to be made on their practice for fuel economy. They claim that the electric drive is much the simpler and more reliable. They point out that they substitute copper wires for steam-pipes, and that they are able to reduce the steam-piping of the station to its simplest elements. There is no doubt much to be said on each side of the question, and the selection is likely to depend upon local custom and local conditions rather than on strictly impartial considerations. Almost everyone will admit, however, that the ideal central steam station is one which employs its boilers solely for delivering high-pressure steam to its main engines, and where the auxiliary engines are as few, as subordinate, and as simple as possible.

◆

THE STREET RAILWAY INDUSTRY.

Elsewhere in our pages this week are given details with regard to the programme of exercises in Philadelphia next week in connection with the annual meeting of the American Street Railway Association. The convention in the city of Franklin promises to be one of more than usual interest and importance. It is a great many years since the association visited Philadelphia, and in fact the last meeting there occurred at the very beginning of the great electrical revolution and development which has given such a tremendous extension to the field of the street car. At that last meeting the advocates of electricity were present almost on sufferance. By many of the members their cause was regarded as wild and visionary, and the whole industry then promised long to remain under the sway of the horse and the cable. But as everybody knows, all that has been changed, the cable has disappeared, the horse has been reduced to a condition of insignificance and electricity reigns supreme. How long the electricity regime may endure no man can tell. The gasoline automobile perhaps challenges the electric street car, but so in a sense did compressed air and steam at one time, while even the bicycle was thought to be in the race. At a time when such radical improvements are still being made in electrical apparatus and systems, it does not seem that we are unduly sanguine in forecasting at least as long a period of supremacy in the street railway field for electricity as steam has enjoyed in the operation of main lines of railroad.

In many ways the Philadelphia meeting this time, like that of 1887, will be a point of new departure for the association. We gave last week the proposed revision of the constitution and the suggested change of name. To electricity alone may be attributed this necessity of reorganizing the association and aligning it to the new conditions and problems of the time. The trolley car has broken through the strict limitations of urban environment and has become the one great vehicle of interurban communication, while it also is rapidly pushing its way upon the steam railroads. Even if it would, the American Street Railway Assoiation can no longer remain an organization of urban corporations, but must take cognizance of its larger actualities, responsibilities and possibilities and place itself in touch for nobler service with the population of the whole country. That the association shows it is ready and willing to do this is the best indication of its continuing influence and prosperity.

In many ways the city of Philadelphia has made a deep impress upon the street railway field, and of late years more particularly on street railway finance. It has been somewhat the fashion to indulge in abuse of the remarkable group of men in Philadelphia that has aggrandized itself by exploiting the street railway systems of many of our leading cities. But after all the personal wealth secured is trivial compared with the incalculable benefit bestowed upon the public, for it is due to their boldness of conception and daring readiness to extend the systems acquired that the industry has been brought up to its present gigantic proportions and has been so distinctively American in its rapidity of growth. Thus once more mere human selfishness has been made by forces greater than ourselves to subserve the common cause of human progress.

The Wireless Telegraph Industry in England.

One advantage to the English public of public business in England is that the financial particulars of the business have to be reported at stated intervals in such a manner that they are virtually published. In this way anyone's business becomes everyone's business to enquire into, when the work done is a public commodity. There are both advantages and disadvantages in this method of procedure; but it is generally admitted that the advantages preponderate. Last year the British Parliament passed an act requiring that a license should be applied for and received by all persons or corporations seeking to send wireless messages by Hertzian waves. The returns for the first quarter of the present year have now been printed as a Parliamentary paper, and an abstract of the same appears in the London *Electrician* for July 28.

The report shows that 1,655 messages were received into Great Britain from ships at sea during this quarter, by wireless telegraphy; or at the average rate of about 18 daily. The number of messages received in Great Britain for transmission outwards to ships at sea, during the same interval, was 111, or rather more than one each day. Of the latter, 21 messages, or 19 per cent, failed to reach their destination. The report also gives a list of 78 applications made for permission to send wireless messages. The great majority of these applications were for private or experimental purposes, and the long list of these toy wireless systems is of somewhat amusing interest. At the same time it must be admitted that the authorities have not acted in an arbitrary or dictatorial spirit; because, although only 48 of the applications are stated as being granted, yet only one has been entirely refused, and in several other cases where they have been partly refused on the grounds of interference with existing stations, alternative sites have been offered.

The Heating of Dynamo Field-Coils.

A report on experiments with the heating of dynamo field coils at the National Physical Laboratory of Great Britain has recently been published in the *Transactions* of the British Institution of Electrical Engineers. Owing to the fact that the measurements were mainly carried out at unduly high temperature elevations, the value of the report is of indirect rather than of direct interest to electrical engineers. Since, however, it embodies the results of a long and careful series of observations, a number of indirect deductions may be drawn from it to practical advantage. It is well known that there are three methods available for determining the distribution of temperature in an electrically active field-coil. One is to insert thermometers into different parts of the coil. The thermometers may be of the ordinary mercurial type, or they may be electric resistance coils. The second method is to bring out tap-wires from a number of sections of the coil, so as to measure the localized increase in resistance of the coil. The third is to insert thermo-junctions into different parts of the coil. All three methods have been used at different times, and with substantially similar results. The third method is that employed in the tests of the report. The details of the thermo-electric tests are clearly described in a manner worthy of study. In some respects the thermo-electric method has distinct advantages over the resistance method.

The results show that when the field coils of a dynamo are overloaded, so as to reach a mean temperature elevation of, say, 70° C., the maximum temperature in the hottest parts of the coil may be 20° higher, or may reach an elevation of some 90° above the surrounding air. When, however, the mean temperature elevation is, say 30° C., representing more nearly the usual practice in dynamo machinery, the results indicate that the hottest parts of the coils would probably not be more than 5° C. above this. Since the distribution of temperature within an active coil is a most complex subject, far too intricate to permit of precise computation for engineering purposes, there may be special cases in which the interior of a field coil may reach an unduly high temperature under continuous full load. This is more likely to occur with deep coils of fine wire employing plenty of insulating material. Consequently, if the mean temperature elevation of a coil is measured by the resistance method, and also the lowest temperature elevation, on the outside of the coil, by the application of a thermometer, the two readings should agree reasonably well, say within 5° C., in order that the maximum internal temperature may not be far from the mean.

Magnetic Effect of Electric Displacement.

When the opposite faces of a dielectric are subjected to a difference of potential, it is found that a certain charge of electricity is required when the wires to the electrodes are first connected to the source of e.m.f., but that after a very small interval of time the demand for electricity practically ceases and the apparatus reaches electric equilibrium. Although the circuit through the dielectric is incomplete, and there can be no current flow in the sense usually implied by that term, there is a transfer of charge into the dielectric, and the rate of transfer constitutes an actual current from the source of supply. As is well known, the rate of transfer of charge within the dielectric is referred to as a "displacement current," and throughout the circuits leading to the electrodes it possesses the properties common to the currents in the usual transmission circuits. Much discussion has arisen as to the exact nature of the displacement current within the dielectric. This discussion has centered largely upon the question as to the presence of any magnetic effect of the electric displacement, since information concerning this property of the current would serve to settle some of the points in dispute as to the nature of electricity itself.

It has been assumed by Lorentz that the displacement current is made up of two parts, namely, the polarization of the ether and the displacements of the atomic or ionic charges within the molecules of the dielectric. On the basis of this assumption one should expect a magnetic effect from the displacement current. On account of the fact that many experimenters have sought for this effect with negative results, doubt has been cast upon the theory proposed. In 1903 Eichenwald reported upon some experiments which seemed to indicate the existence of the magnetic effect. In a recent issue of the *Physical Review* Prof. J. B. Whitehead describes a series of experiments in which the magnetic effect was directly measured by electrical means. The principles upon which the experiments were based are as follows: If a portion of dielectric be subjected to an alternating e.m.f., alternating displacement currents will be set up in the dielectric. If now the dielectric be surrounded by a magnetic circuit, alternating magnetic induction will be set up therein, and if this circuit be wound with a number of turns of wire, an alternating e.m.f. will be induced therein, and this e.m.f. may set up a current. The value of the current may be both calculated and measured. As constructed the dielectric was a cylinder of paraffin. The e.m.f. was applied to electrodes consisting of circular brass plates on the end faces of the cylinder. Concentric with the cylinder and surrounding it was the laminated magnetic circuit, consisting of soft iron discs. The iron ring thus formed was wound with what may be called the secondary winding, in circuit with which the measuring instrument was connected. The wires leading to the electrodes continued straightaway for one meter on each side, so that the magnetic effect of the current in this portion of the circuit was quite small, but it was determined and properly allowed for in the calculations. Care was taken to eliminate all electrostatic effects from the galvanometer circuit. Although there was a difference of some 50 or 60 per cent between observations and calculations, it is worthy of note that the observed effect was of the same order of magnitude as that calculated, and that the discrepancy was well within the limits of experimental error.

Champions of the Past.

Before us lies the first annual report of that well-meaning but somewhat misguided body, the British Weights and Measures Association. It is filled with the usual hysterical appeals to stand by the dear old English inch, and in the name of human liberty to oppose all improvements. It is a curious study in morbid psychology to examine the view-points of the really violent among the contributors. There are opponents of the metric system who are entirely sincere in their objections, but we do not believe that there is among these a corporal's guard really familiar with the working of the system in practice. Most of the contributors chatter volubly about the difficulties of metric measurements without in the least comprehending how they actually work in every-day life. One large class assumes that there is some occult property about metric measures that makes it positively infamous to use anything except even tenths of whatever is measured. In their eyes it is utter subversion of everything metric to make a drawing, for instance, on a scale of 5 cm. to the meter—it must be 1 cm. or 10 cm., else the whole system will fall with a resounding crash. Their attitude reminds one of the amiable old lady in an insane asylum, who often overate because she felt obliged to take three pieces of everything in sight out of respect to the Holy Trinity.

A beautiful example of this position is a quotation from a letter to the *Times*, in which ponderous stress is laid on the fact that the great optical firm of Zeiss makes microscope objectives of 24, 12, etc., millimeters focus to approximate the English inch, ½ inch, etc. The writer also insists that the inch is 25 mm., which of course it is not. Now so far from this manufacture being a source of difficulty to Zeiss, the metric customer would just as soon have 24 mm. in focal length as 25, while the real attitude of the firm is presumably about as follows: "Our excellent but obstinate neighbors rage if they have to buy anything that is not in binary or duodecimal subdivisions like their own barbaric measures; we propose to convert their guineas and such into good German marks, and, since it's really quite the same to us, we will run as near as convenient to their curious system and get their trade." Which they accordingly do in liberal measure. Another group of objectors triumphantly demand how one can quickly and conveniently convert 11 23/32 inches into decimeters, never seeming to realize that no rational human being working with the metric system would ever have the slightest desire or occasion to do so. A very amusing feature of the situation is the appearance of a bold Radical wing of the objectors, which, seeing clearly the abominable complications introduced by the use of vulgar fractions in any but the simplest forms, favors a decimal rearrangement of English units, which would be in most cases more difficult to use than the existing metric system and would simply add to the present difficulties another.

The thing most universal in anti-metric literature is the often repeated tale that the inch is a "natural" measure, that the centimeter is too short and the decimeter too long for "convenience," and much more to the same effect. Now we grant that the inch is a natural measure in the sense that it was once by statute determined as the length of three barley corns. In any other sense it is no more natural or convenient than any other small dimension would be. To a man, particularly an uneducated man, who has been brought up to use the inch, without realizing that anything else was conceivable, the inch seems ideal; but to the man brought up to the metric system the inch seems clumsy and inexact in all its relations as compared with the centimeter. It is this radical difference in point of view that even the most sincere and conscientious advocates of the English system fail to recognize. There is a wide difference between learning parrot-like the metric tables and actually using the system. Too many Englishmen and Americans, we fear, are in the sad case of the school manager who contributes to the report before us a frank confession to the effect that "I am never sure whether to ask for kilogramme of cognac or a hectolitre of bread." Of such there is little to be said. But we wish the people who undertake the discussion of such matters would also take the trouble to familiarize themselves practically with the metric system as an independent working system. Practically all of us who favor its general adoption do know it in just this intimate and practical way, and realize its immense convenience from personal knowledge, not from any preconceived theories as to its fitness. And to those who are thus used to it, as any one may become in a surprisingly short time, the "transition period" has no terrors, as it seems to have for the anti-metric contingent. It will chiefly trouble those who insist on working laboriously in inches and then solemnly converting each dimension into centimeters to the tenth decimal place. For these there is no hope under any regime.

Bethlehem Meeting American Electrochemical Society.

The eighth general meeting of the American Electrochemical Society was opened on Monday afternoon in Lehigh University, South Bethlehem, Pa. Owing to the inclement weather the elaborate arrangements of the Ladies' Committee for Monday afternoon were completely nullified. But at the hotel headquarters and in the chemical laboratory of Lehigh—where the professional sessions are held—the good feeling so characteristic of all the conventions of this society reigned supreme.

Considerably after the time announced for the opening, Dr. Jos. W. Richards, as chairman of the local committee, delivered a brief address of welcome and introduced President Drinker, of Lehigh University, who, in a felicitous little speech, welcomed the society and offered to its members the freedom of Lehigh. President Wilder D. Bancroft replied for the society.

COLLOIDAL SOLUTIONS.

A brief note by Prof. W. S. Franklin and Mr. L. A. Freudenberger was first presented by Mr. Freudenberger to give Prof. Bancroft time to complete the arrangements for his experimental lecture which was first on the programme. The object of the paper was to give some idea of the nature of a colloidal solution by revolving a tube containing the colloid at a high speed. It was expected that on account of the action of the centrifugal force a new condition of equilibrium would be established and that it would be possible to study the variation of the concentration of the solution by optical means, as function of the speed of rotation and of the distance from the axis of rotation. However, these hopes were not fulfilled. No new equilibrium resulted. What happened was that at sufficiently high speed precipitation resulted at the end of the tube, followed by a kind of growth of the precipitation along the tube.

THE CHEMISTRY OF ELECTROCHEMISTRY.

A very interesting experimental lecture by Prof. Wilder D. Bancroft was intended to emphasize a point of view which is singularly strange to electrochemical researches as usually carried out. He made it clear that in a great many cases new points of view are obtained by supplementing electrochemical research by parallel chemical research, and that, for the complete understanding of an electrochemical problem, it is often advantageous to look at it from a purely chemical viewpoint. The action of the electric current is to set the ions free at the electrodes; everything that happens besides and afterwards may be looked upon as a problem of chemistry.

Thus, if we pass a current through a slightly acidified solution of copper sulphate, we get the precipitation of metallic copper. This is merely the normal action of the current setting free the cation, copper, at the cathode. If we acidify the solution still further, adding sulphuric acid in one case and nitric acid in another, we find that a given amount of nitric acid will prevent the precipitation of copper, while much more sulphuric acid must be added to cause the same effect. The reason of this is clear when we consider the chemistry involved. Nitric acid attacks copper readily and sulphuric acid does not. While this is perfectly obvious when stated in this way, it has not been obvious enough in the past to induce anyone to test quantitatively the relation between the decreased current efficiency in a nitric acid solution and the rate of corrosion by that particular solution. We know that the current efficiency increases with current density, which is just what we should expect if the chemical action remains constant; but more than that we do not know.

From the same point of view Dr. Bancroft discussed a great many cathodic as well as anodic reactions, illustrating his discussion by numerous experimental demonstrations. The essence of his paper was that we get a clearer view of the subject as a whole if we consider the chemistry of electrochemistry, and that this point of view is valuable in showing concrete instances of research work which ought to be done. The paper elicited a lively discussion in which Messrs. Hering, Betts, Richards and Burgess participated. Mr. C. J. Reed, in a communicated discussion, disagreed with Prof. Bancroft and brought forward as the fundamental point to be considered in any electrochemical reaction, that only thermochemical or energy considerations can decide which one of different processes—which would be chemically possible—will actually take place. Prof. Burgess thought that Dr. Bancroft's point of view has the great advantage that it enables us to get away from hypotheses and to come right down to the facts.

PHENOMENA OF METAL DEPOSITION.

Mr. Anson G. Betts presented a lengthy paper in which he endeavored to give a general theory of the causes of good or bad metallic deposits. He considered in detail the effect, obtained by the addition of colloids, by reducing agents, strength of acid and alkalinity of base. He then discussed the small local concentration cells which are set up at the surface of a rough electrode, due to differences of concentration of the electrolyte on the ridges and in the hollows of an electrodeposit. He then spoke on crystalline structure of deposits and on hardness.

The chief point brought out was that a hard metal will separate in solid compact form, and a soft metal will deposit in a loose crystalline form. When the hardness is intermediate the valency of the metal will become a determining factor, high valencies producing solid deposits and low valencies loose deposits. If a metal is not hard of itself it will help the solidity if by some means we can deposit it in hard form. Silver deposited from a cyanide solution with the addition of carbon bisulphide, is harder than ordinary silver, and is bright. The author finally discussed the relation between surface tension and hardness. Many detailed applications of his rules were given.

The paper was discussed by Messrs. Burgess, Franklin, Bancroft and Richards. Some of the speakers believed that the broad generalizations of Mr. Betts were not sufficiently proven.

On the evening of Monday the members of the society attended a reception given at the home of Prof. and Mrs. J. W. Richards by the Ladies' Committee and afterwards an enjoyable smoker was held at the club house of the Lincoln Republican Club.

ALUMINUM AS REDUCING AGENT.

The first paper of the Tuesday session by Dr. O. P. Watts contained notes on the use of aluminum as a reducing agent. In the absence of the author it was presented by Prof. C. F. Burgess. Goldschmidt's aluminothermic method is unable to yield the pure metals titanium, tungsten, uranium, since the energy required for the reduction of the oxides has too high a value; i. e., the heat evolved by the oxidation of the aluminum is alone not sufficient. Watts added to it, therefore, the heat of the electric arc. Powdered fluorspar or cryolite was added to the charge to reduce the velocity of reaction. The charge was placed in the cavity of a furnace with a magnesite lining, the cover put on and an arc started just above the charge. The usual heating was for 5 minutes at 300 amp. and 70 volts, followed by 5 minutes more at 600 amp. and 80 volts. The author states that this combination of the Goldschmidt method with electric arc heating is thoroughly safe.

ELECTRIC STEEL FURNACE.

A paper by Gustave Gin on his new process for the electric manufacture of steel was presented in abstract by Dr. J. W. Richards. The furnace contains essentially three compartments: First, a crucible for fusion and refining by oxidation; second, a compartment for reduction and recarburization; third, a chamber for the color test. The current is introduced through the electrodes provided in the first compartment, while the electrodes of the second and of the third compartments are in parallel with each other and are connected with the other terminal of the supply circuit. The electrodes dip into the slag at the top of the bath, but not into the bath itself.

The paper elicited a lengthy and animated discussion in which the practicability of the Gin process was questioned for various reasons. Dr. Leonard Waldo presented what was essentially a new paper—an interesting resume of the development of the induction furnace and of various peculiar observations which he has made with it in practice.

REFINING SILVER.

A paper on this subject was presented by Mr. A. G. Betts briefly, in abstract. It referred essentially to the use of salts of strong acids forming soluble silver salts. The best acid is methyl-sulphuric acid, and a small addition of carbon bisulphide improves the deposit.

INSULATING PAINTS.

An interesting paper on this subject was presented by Dr. Maximilian Toch, which will receive further notice in our next issue, since it is intimately connected with problems brought up by experiences made on the subway and elevated roads in New York. One very peculiar observation made by Dr. Toch was that (while both terminals showed corrosion), yet the minus side (cathode) corroded much more. This particular point was discussed to some extent.

PARTING OF BULLION.

A suggestive paper on electrolytic versus sulphuric acid parting of bullion was presented by Mr. F. D. Easterbrooks, of the Raritan Copper Works, of Perth Amboy, N. J. The author first pointed out the main disadvantages of the sulphuric acid process, which are general uncleanliness and a special difficulty with respect to tellurium. Both disadvantages do not exist in electrolytic parting. The author discussed three printing processes—those of Moebius, of Balbach and what may be called the gelatine adherent deposit method. The latter method has the advantage of greater ease of handling.

ACTIVE OXYGEN.

An instructive paper on the utilization of active oxygen, chemically and electrically produced, was presented by Dr. R. von Foregger, of the Roessler & Hasslacher Company. The paper referred to the manufacture of a new commercial series of peroxides with a high energy contact. They can be used for the production of active oxygen whenever and wherever needed, and are therefore specially adapted for bleaching, sterilizing and analogous processes. Perhaps the most interesting of these compounds, called "oxone," is fused sodium peroxide, which when dissolved in water, develops oxygen, just as calcium carbide, when dissolved in water, yields acetylene.

The paper elicited a long discussion in which Messrs. Toch, Franklin, Doremus, Sadtler, Carrier and Richards participated. One interesting point brought out was that the use of "oxone" not only enables one to produce oxygen but that simultaneously carbon dioxide is consumed. This is, for instance, important for sanitary purposes. The peroxides discussed in the paper are the outcome of the electrolytic production of sodium at Niagara Falls.

ELECTROCHEMICAL INDEX.

Mr. C. F. Carrier, Jr., gave a brief and interesting account of the thorough work being done by Mr. A. Voege and the Concilium Bibliographicum in Zurich in the preparation of a complete card index of articles published on electrochemical subjects in all periodicals of the world.

PICKLING SOLUTIONS.

Prof. C. F. Burgess presented some interesting observations on the influence of arsenic in pickling solutions. It was found that arsenic exerts a marked influence in diminishing the rotting effect of a sulphuric acid solution. In a solution of hydrochloric acid having a corresponding strength, the presence of arsenic exerts a similar but less pronounced influence. A steel spring pickled in an arsenic containing pickle and subsequently nickelplated, was found to be stronger than when pickled in pure acid before plating. The author suggested that the effects of arsenic should be further investigated.

ELECTRIC ZINC SMELTING.

A paper by O. W. Brown and W. F. Oesterle on the electric smelting of zinc was read, in the absence of the authors, by Mr. S. S. Sadtler. The authors discussed the very low efficiency of the ordinary zinc smelting process and gave an extended resume of attempts that have been made to use electricity in such processes. They have worked themselves in the direction of reducing zinc from ores in the electric furnace without preliminary roasting by using a suitable mixture of ore, lime and carbon.

Some notes on the electrometallurgy of antimony were then presented, by title, by Mr. A. G. Betts.

After the conclusion of the Tuesday morning session, lunch was tendered to the members of the society at the Gymnasium by the authorities of Lehigh University. Various buildings, especially that of the Departments of Electrical Engineering and of Physics, were then visited. Then followed two extended and most enjoyable visits to the large zinc works in South Bethlehem and to the magnificent plant of the Bethlehem Steel Company. A subscription dinner was held in the evening in the Eagle Hotel.

The Street Railway Week in Philadelphia.

The twenty-fourth annual meeting of the American Street Railway Association will be held in Philadelphia next week at the Bellevue-Stratford and at the Philadelphia Museum, the exhibit of apparatus, etc., taking place at the museum. Details have already appeared in these pages as to the features of the week, and also as to the proposed reorganization and enlargement of the association; and it is evident that in many ways the week will mark an epoch in the history of the street railway industry. We now give below the programmes as at present constituted, of the parent and allied bodies:

American Street Railway Association.—Wednesday, September 27, 10 a. m.—Address of welcome. Address of the president, Mr. W. Caryl Ely; approval of minutes of last annual meeting; report of the Executive Committee; report of the secretary-treasurer; report of standing committees; report of the Re-organization Committee; consideration of, and action on, new Constitution and By-Laws; appointment of Nominating committee. Paper on "Notes on the Design of Large Gas Engines with Special Reference to Railway Work," Mr. Arthur West, Westinghouse Electric & Manufacturing Company. Paper on "The Application of Gas Power to Electric Railway Work," Mr. J. R. Bibbins, Westinghouse Electric & Manufacturing Company. Paper on "Single-Phase Railway System," Mr. Chas. F. Scott, Westinghouse Electric & Manufacturing Company. 8 p. m.—Theatre party at New Lyric Theatre, John C. Fisher's production of "Babes in the Wood."

Thursday, September 28.—10 a. m.—Unfinished business; new business; report of Nominating Committee; election of officers for ensuing year. 8 p. m.—Banquet at the Bellevue-Stratford Hotel.

Street Railway Accountants' Association of America.—Thursday, September 28.—2 p. m.—Annual address of President W. G. Ross, Montreal, Canada; annual report of the Executive Committee; annual report of the secretary-treasurer; appointment of Convention Committee on Nominations; appointment of Convention Committee on Resolutions; report on proposed reorganization of the American Street Railway Association.

Friday, September 29.—10 a. m.—Annual report of Standing Committee on Standard Classification of Accounts. C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Report of Committee on International Form of Report. C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Report of committee to attend convention of National Association of Railway Commissioners, held at Birmingham, Ala., November 15, 16 and 17, 1904. C. N. Duffy, secretary and auditor, Chicago City Railway Company, chairman. Annual report of Standing Committee on Standard Form of Report. W. F. Ham, comptroller, Washington Railway & Electric Company, chairman. Report of committee to attend convention of National Association of Railway Commissioners, held at Deadwood, S. D., August 15, 16 and 17, 1905. W. F. Ham, comptroller, Washington Railway & Electric Company, chairman. Reading and discussion of questions and answers in the Question Box. This includes those published and any others that may be presented. 2 p. m.—Paper on "The Cost of Carrying a Passenger." C. L. S. Tingley, second vice-president American Railways Company, Philadelphia, Pa. Paper on "Interurban Fare Collections." Irwin Fullerton, auditor Detroit United Railway, Detroit, Mich. Paper on "Interurban Ticket Accounting." J. H. Pardee, general manager Rochester & Eastern Rapid Railway, Canandaigua, N. Y. Paper on "Accounting with Four Departments." H. M. Beardsley, secretary and treasurer Elmira Water, Light & Railway Company, Elmira, N. Y. 2.30 p. m.—Grand ladies' trolley party by courtesy of President J. H. Porter, Fairmont Park Transportation. 8.30 to 12 p. m.—Vaudeville entertainment, by street railway talent, ballroom, Bellevue-Stratford Hotel. Dancing.

Saturday, September 30.—10 a. m.—Unfinished business; report of Convention Committee on Resolutions; report of Convention Committee on Nominations; election and installation of officers.

American Railway, Mechanical and Electrical Association.—Monday, September 25.—10 a. m.—Address of welcome, Hon. John Weaver, Mayor of Philadelphia; address by Hon. W. Caryl Ely, president American Street Railway Association; president's annual address; report of the Executive Committee; report of the secretary and treasurer. 1.30 p. m. sharp.—Paper, "Power Distribution," by C. H. Hile, superintendent of wires, Boston Elevated Railway Company, Boston, Mass. Paper, "The Power Station Load Factor as a Factor in the Cost of Operation," by L. P. Crecelius, chief electrician of the United Railways Company, St. Louis, Mo. Report of the Committee on "Controlling Apparatus," Chairman J. S. Doyle, master mechanic Interborough Rapid Transit Company, New York, N. Y.

Tuesday. September 26, 9 a. m. sharp.—Report of the Committee on Way Matters—"Welding of Rail Joints"; chairman, F. G. Simmons, superintendent of construction and maintenance of way, the Milwaukee Electric Railway & Light Company, Milwaukee, Wis. Report of the Committee on "Maintenance and Inspection of Electrical Equipment"; chairman, William Pestell, New York, N. Y. Paper, "The Power House," by Fred N. Bushnell, chief engineer the Rhode Island Company, Providence, R. I. 1.30 p. m. sharp.—Paper, "The Track Brake," by F. F. Bodler, master mechanic the United Railroads of San Francisco, San Francisco, Cal. Discussion of the Question Box. Reports of special committees. Election of officers. 9 to 12 p. m.—Reception given by local Reception Committee, Mr. James F. Rawle, chairman, in ball room, Bellevue-Stratford Hotel. Dancing.

American Association of Street Railway Claim Agents, Tuesday, September 26—Meeting at 1048 Land Title & Trust Company Building, Broad and Chestnut Streets, 10 a.m.—Reading of minutes of last meeting. Report of membership. Report of treasurer. Discussions of accident claims and methods of fakirs. Election of officers.

The entertainments noted under the various dates are, of course, common to the various bodies participating in the convention, and in general, aside from specific courtesies and functions, are under the supervision of the Manufacturers' Association of the American Street Railway Association, which also has charge of the fine exhibit of apparatus at the Philadelphia Museum. Strong local reception and entertainment committees have been formed, with Mr. John B. Parsons at their head.

Delegates will obtain badges for themselves and their guests and ladies accompanying them from Mr. T. C. Penington, secretary American Street Railway Association. Members of the Manufacturers' committee and their representatives will obtain badges for themselves, their guests and ladies accompanying them from Mr. Edwin H. Baker, chairman Finance Committee, at Appliance Exhibition, South Pavilion, Philadelphia Museum, West Philadelphia. The official badges of the convention are numbered by means of celluloid tags for the purpose of protection against abuse by persons not entitled to wear them. Delegates and guests are especially requested and urged not to remove the numbers, but to wear them in plain sight.

Free transportation on the street railways of Philadelphia will be given those holding tickets, which will be given when taking out membership, by applying to Mr. T. C. Penington or Mr. E. H. Baker. Only those provided with proper badges, etc., will be admitted to the various entertainments.

The headquarters will be at the Bellevue-Stratford Hotel. Rates are as follows: European plan—Single rooms, without bath, $2.50 per day and up; single rooms, with bath, $3 per day and up; if two persons occupy a single room the rate will be $1 more; double rooms, without bath, two persons, $3.50 per day and up; double rooms, with bath, two persons, $4.50 per day and up.

The Patent Office Year.

The annual report of the Commissioner of Patents shows that the twelve months ended June 30 last was the banner year in the history of the United States Patent Office. The receipts of the office were more than a million and a half dollars and the expenditures were a quarter of a million less. The report says:

"There were received in the last fiscal year 52,323 applications for mechanical patents, 749 applications for designs, 174 applications for reissues, 1,846 caveats, 11,298 applications for trade marks, 1,236 applications for labels and 448 applications for prints. There were 30,266 patents granted, including reissues and designs, and 1,426 trade marks, 1,028 labels and 345 prints were registered. The number of patents that expired was 19,567. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 5,154.

"The total receipts of the office were $1,737,334; the total expenditures, $1,472,467, and the surplus of receipts over expenditures, being the amount turned into the treasury, was $264,667.

"The most important event which has occurred in the operation of the Patent Office during the last year has been taking effect of the new trade mark law, which took effect April 1. This new law, in extending the registration of trade marks to those employed in interstate commerce and in its reduction of the Government fee of $25 to $10, has stimulated an enormous increase in the trade mark work of the office. The statute also provides for oppositions to the registration of trade marks, which is a new subject of litigation in the business of this office."

Telegraphs and Pool Rooms.

The directors of the Western Union Telegraph Company have adopted the following resolutions of Mr. Jacob Schiff:

"Whereas, this company, under an order issued by its president on the 18th day of May, 1904, has directed the cessation of the collection of horse race reports, and

"Whereas, it is claimed that the distribution of horse race reports still continues, notwithstanding the action of this company first referred to, be it

"*Resolved,* That it is recommended to the board of directors that the offices of the Western Union Telegraph Company be directed to cease the transmission of any messages containing horse race reports, except where such messages are delivered to a regular office of the company for transmission to and delivery through a regular office of the company or for delivery in such other manner as the president of the company shall authorize over his signature."

Mr. Schiff had to fight hard to retain in the resolution, when introduced originally some few months ago, the clause stating that "the distribution of horse race reports still continues, notwithstanding the action of this company." Some of the members of the committee thought this sounded too much like a confession. Mr. Schiff retorted that confession was good for the soul and insisted on the truth, the whole truth and nothing but the truth.

Direct Cable to Japan.

The Commercial Pacific Cable Company, through its president, Clarence H. Mackay, announces that it has secured the necessary concessions to enter Yokohama, Japan, and Shanghai, China. M. Takahira, the Japanese Minister to the United States, on September 14 affixed his signature to Japan's agreement with the Commercial Pacific Cable Company for landing rights at Yokohama. An agreement for landing rights at Shanghai was signed by China several weeks ago. The cable connections with both Japan and China will be made by extending the present lines of the company, which run from San Francisco through the stations at Honolulu and Guam to Manila. Japan will be reached by laying a cable from Guam in the Pacific Ocean direct to Yokohama. The cable to China will be laid from Manila to Shanghai. Mr. Mackay says the company will proceed at once with the manufacture and laying of these two cables, which will take several months. The Commercial Pacific Cable Company will then pierce the Far East at three points, namely, the Philippines, China and Japan. With the cable which has just been completed to Newfoundland, plus a fifth cable to Europe, which will be laid this month, and the cable from Guam to Japan, and one from Manila to Shanghai, the company will have a system extending over two-thirds of the way around the globe.

A Trolley for Yellowstone Park.

The following letter from Mr. John T. Nagle to the *New York Sun* suggests a means of dealing with the difficulties of transportation in the Yellowstone Park:

I have read with interest an editorial in your issue of Sept. 3 entitled "A Menace to the Yellowstone," and I fully agree with you that a steam railroad should not be constructed through the national park; but the discomforts to which the tourist is subjected in traveling by the stages now in use are such that I believe a trolley road should be constructed and operated by the Government.

The trolley is desirable, I think, for the following principal reasons:

First, because it is the cheapest, cleanest and most comfortable way of traveling. Second, because you can see more in a given time and reach more difficult places of access than you can by stage or coach. Third, because baggage, provisions and other necessities can be carried more conveniently and mail matter delivered more promptly than by horses. Fourth, because more visitors could be carried by trolley than by coaches.

I believe the tourist to this grand national park would appreciate a trolley through it as much as the visitors to Niagara Falls now appreciate the trolley that has replaced the old time hacks. I do not entirely agree with Capt. Chittenden that "a trolley would work serious damage to the game and forests, to say nothing of their effect on the natural beauty of the regions, and that the people prefer to travel by hired horses, even if the discomforts are greater." I cannot see how a trolley line of about 200 or 300 miles would "mar the beauty or work serious damage to the game or forests" of a park which contains 3,312 square miles and a large forest reserve in addition. The cost of a trip by trolley operated by the Government could not possibly exceed three cents a mile, or $4.50 for the distance of 150 miles—the distance traveled by the Yellowstone coaches, while the fare for this distance now charged by them is $27. With the cheaper railroad fares to reach the park and certain improvements in it that would add to the comfort of the visitors, and with proper facilities and low rates to reach the various points of interest in the park, I believe that in a few years the great tourist travel will be directed to this scenic wonder instead of to Europe.

◆

A Tour of Independent Telephone Leaders.

A large party of independent telephone leaders have been making a tour of the country, preliminary, it is said, to the consolidation of long-distance lines in a company with a capital of $12,500,000. In the party are: From St. Louis—Breckenridge Jones, vice-president and counsel Mississippi Valley Trust Company, director Union Electric Light & Power Company and Laclede Gas Company, treasurer Kinloch Telephone Company; C. Marquard Forster, president Kinloch Long-Distance Telephone Company and vice-president St. Louis Brewing Association; William F. Nolker, president Kinloch Telephone Company; H. L. Reber, general manager Kinloch Telephone Company; W. Roy McCanne, assistant general manager Kinloch Long-Distance Telephone Company; W. G. Lackey, bond officer Mississippi Valley Trust Company; Herman C. Stifel, with Altheimer & Rulings Investment Company; Adolphus Busch, president Anheuser-Busch Brewing Company.

From Kansas City—Joseph J. Heim, president Kansas City Home Telephone Company, president Heim Brewing Company; O. C. Snider, general manager Kansas City Home Telephone Company.

From Indianapolis—H. B. Sale, general manager New Long-Distance Telephone Company and Indianapolis Telephone Company; Newton Todd, broker.

From Cleveland—J. B. Hoge, secretary Cuyahoga Telephone Company, president National Interstate Telephone Association.

From Pittsburg—J. G. Splane, president P. & A. Telephone Company; Robert C. Hall, director P. & A. Telephone Company; H. B. Beatty, president Manufacturers' Light, Heat & Power Company; Frank Hart, superintendent Long-Distance P. & A. Telephone Company; N. C. McPherson, general manager Duquesne Light Company; William Flinn, S. S. Lesslie, Jr., D. P. Heighard, director P. & A. Telephone Company; John S. Weller, vice-president and general counsel P. & A. Telephone Company; R. H. Binns, director P. & A. Telephone Company; Ralph E. Flinn, director P. & A. Telephone Company, and H. M. Nichols, president Citizens' Bank, of Oil City.

One of the cities visited was Pittsburg and another was Rochester, N. Y., where the Stromberg-Carlson manufacturing plant was inspected, and where a dinner was given at the Genesee Valley Club. President Hoge, of Cleveland, said in the course of his remarks: "The possibilities in the way of consolidation were never so great as now. We have been talking for years of having two great competing telephone companies, the same as we have two great competing telegraph companies. Our system covers practically the same territory as that of our opponents, and with the stringing of but little additional lines we will be in good shape to take up the fight. We are and have been constantly getting ready for consolidation. We have tried to standardize our rules and regulations and also our methods of accounting so as to make possible at the earliest possible date the forming of this projected national association with each State divided up into districts, with each district holding meetings to elect delegates to the State convention at which delegates to the national convention would be selected. I believe the day is near at hand when all this will be realized."

Among the cities to be visited are Cleveland, Indianapolis, Kansas City and St. Louis. The consolidation proposed is likely to occur, it is said, during the fall of the year.

The French Cable and Venezuela.

Advices from Paris state that a settlement is in sight in regard to the dispute between the French Cable Company and the government of Venezuela. Mr. Foquet, in Paris, is reported as saying on behalf of the cable interests: "When the courts of Venezuela pronounced the canceling of the contract between the French company and Venezuela President Castro issued a decree in execution of that judgment. This decree set forth that on September 16 all the offices of the French Cable Company should be closed for interurban Venezuelan communications, only the office at La Guayra remaining open for communication with Europe. A government representative was to be stationed in the La Guayra office, who would control every message received or sent and would deduct one boliver per word on all messages received or sent as a tax for the government. We were informed on Friday that President Castro had decided to postpone the execution of this decree in order to permit of negotiations, and that a note to this effect would be published in the Venezuelan Official Gazette. Up to the present we have not received official confirmation that the decree has been prorogued, but believe it has been. This shows that Castro is disposed to negotiate; consequently negotiations will proceed."

"President Castro does not wish the French cable to be used for Venezuelan interurban or coast work. He wishes the government land lines used on principle. We are disposed to meet him on this point. So long as we have our land terminus at La Guayra for communication with abroad, that is, after all, the main thing. But we pointed out to President Castro that we have spent millions in laying coast lines. The point now to settle is what compensation President Castro will give us for our property. There is no need for him to resort to brutal methods in the matter."

◆

New Stages for Fifth Ave., New York.

The Fifth Avenue Coach Company has placed on trial for Fifth Avenue service a gasoline-electric motor omnibus, which will run on regular schedule between Washington Square and Eighty-eighth Street. It is now being run for experimental purposes in the evening. In designing this 'bus the object was to produce a vehicle that could be operated with safety and speed through the heavy traffic of the avenue. The vehicle has cross seats, with a center aisle, so that passengers face forward and have a good view. The company declares that five-cent fares would not yield a profit, but in return for the ten-cent fare it is proposed to give every passenger a seat and allow no one to stand in the aisles.

The motive power of the omnibus is from the design of the General Electric Company and the omnibus was built by the Vehicle Equipment Company and consists of a 40-horse gasoline generator outfit and two motors. It is brilliantly lighted from a small storage battery, which also supplies current to start the engine, thereby avoiding the "cranking" operation customary on gasoline cars.

The 'bus makes the round trip from Eighty-eighth Street to Washington Square in about an hour, as against an hour and forty-five minutes with the old horse omnibus.

◆

Deterioration of Copper Wire.

In the discussion on Mr. Fowle's paper on railway telephone service at the recent convention of the Association of Railway Telegraph Superintendents, some interesting facts were brought out as to the life of copper wires. Mr. Kinsman, of the Wabash Railroad, stated that copper wires along that road had been used for 15 or 18 years without showing any signs of deterioration. Mr. Griffith stated that copper wire at a certain point on the Erie Railroad, in proximity to a chemical works, lasted about three and a half years, while Mr. Hewitt referred to a case in Texas where twenty miles of copper wire in the Beaumont oil region had been badly impaired in two years by the sulphurous atmosphere. The iron wire in the same region is eaten up in about one year. In Beaumont lead-covered cable is used with good results, the lead apparently acting as a protection against the sulphur fumes. Mr. Griffith referred to a test of aluminum wire on the Erie road at the point above mentioned. It worked well for about six months when, one day, the circuit was broken. Investigation showed that three sections of the wire had "evaporated."

San Joaquin Power Development.

The San Joaquin Power Co., Fresno, Cal., is now in the midst of the development of a large amount of power to be used in the various Huntington enterprises, and for pumping water for irrigating purposes. The estimated cost of the work now under way is $850,000, and as soon as this is completed, other operations will be taken up. Teams start from Pollasky with freight consisting of cement, steel for the flumes and pipe lines, machinery, etc., much of which is going to a point between North Fork and Crane Valley. The new ditch to be built from the Crane Valley dam to the Morton & Banta mill site, where Power Plant No. 3 is in course of construction, will be cemented. The power house will be completed within a month, probably, but the electrical equipment is not expected until the latter part of October. The water for power will be drawn directly from the lower Crane Valley dam and brought by the ditch and flume to the top of the mountain above Morton & Banta's mill, giving a fall of 401 ft. The pipe line coming down this mountain will be 3,020 ft. long, 52 in. inside diameter. At the head of the latter a reservoir is being built sufficient to hold 12 hours' run supply.

A reservoir is to be constructed in Crane Valley, which will enable the company to store 40,000 acre-feet of water with a 100-ft. dam. It is the intention to rebuild the present ditch and flume from Crane Valley to power plant No. 1, and the two power plants are to be connected with an 8½-pole line, which has already been built. A double-pole line is now being built from power house No. 1 to Fresno, a distance of 39 miles, which will make it possible to step-up the pressure to 33,000 volts instead of 19,000, as at present. At Copper Mine a switching station is being built, through which both pole lines will pass. The contract for the power house equipment calls for Bullock generators driven by Doble water wheels.

◆

Telephone Density.

The question of telephone density as an indication of the limits of the future growth of the telephone business in this country is one which has received considerable attention of late. It has been a matter of common knowledge among telephone interests, says the *Wall Street Journal*, that the density in the Pacific States was abnormally high, and reasoning on this basis the generalization has been easily made that the density of the West was much higher than in the East. A few weeks ago the Pacific States Telephone & Telegraph Company, a sub-company of the Bell system, published figures showing the ratio of telephones per 100 of population in its territory as of July 31, 1905. This company includes in its territory the three States of California, Washington and Oregon, which in the order named lead the country in point of density and for that matter excel any other communities in the world. California, which heads the list, has 133,000 telephone subscribers in a population of 1,300,000—better than 10 per cent.

The six New England States also constitute a section of the country in which the development of the Bell telephone system is very large in proportion to the population. The following table shows the name of the exchange, the number of subscribers and the ratio per 100 of population in several Massachusetts cities and towns and the average for the entire State as of January 1, 1905:

Exchange.	Subscribers.	Ratio per 100 people.
Boston	38,205	6.4
Worcester	6,375	4.9
Springfield	5,040	6.8
Lowell	3,190	3.3
Brookline	3,122	13.5
Cambridge	3,000	3.0
Newton	2,932	7.0
Lynn	2,625	3.4
Haverhill	2,221	6.0
Holyoke	1,626	3.2
Salem	1,312	3.5
Pittsfield	1,191	4.7
Malden	1,152	3.0
State	114,856	3.8

The entire New England field covered by the American Bell companies had a total on January 1 of 208,814 subscribers, or a density of 3.48 per cent. The following table shows the number of subscribers and the telephone density in several countries of the world as of January 1, 1905:

Country.	Subscribers.	Ratio per 100 people.
Germany	445,000	.89
Great Britain	367,000	.86
France	122,900	.31
Sweden	110,100	2.11
Switzerland	52,500	1.59

The above figures show that the nearest competitor to New England in point of density is Sweden, with a ratio of 2.11 per cent. The comparison in favor of New England is likely to be still further accentuated when it is stated that the ratio of increase in the six New England States during the present year is at the rate of over 40,000 subscribers per year—a gain of 20 per cent.

◆

CURRENT NEWS AND NOTES.

CANADIAN STREET RAILWAY ASSOCIATION.—At the last meeting of the Canadian Street Railway Association, held at St. John, N. B., August 30, it was decided that the convention should be held semi-annually in the future. The next meeting will be held in London, Ont. Among the papers considered at the meeting was one on "Street Railway Accounts," J. M. Smith.

A MUNICIPAL PLANT.—It is stated that Mr. Frank G. Ray, of the Ohio State bureau of uniform accounting, has found a bad condition of affairs in the village of Huron in connection with the municipal lighting plant. After five days' work he was unable to make anything out of the accounts, except that there was an overdraft of $3,000. The plant has lost money for the village in the six years of its operation and is now in bad shape. Mr. Ray would give no details of his findings to the Huron council, but his report to the auditor of the State is expected to be a hot one.

EDISON CONVENTION.—An account was given in these pages last week of the convention of the Association of Edison Illuminating Companies at Bluff Point. The meeting closed, at Bluff Point, Lake Champlain, after our forms had gone to press. Mr. Joseph B. McCall, of Philadelphia, the president, received the honor of re-election and will thus serve a third term. The distinction is, we believe, unique, or at least very rare in the affairs of the association, and shows how highly the energetic and successful administration of affairs is appreciated by Mr. McCall's fellow members.

NEW YORK TELEPHONY.—It is stated from Cleveland that the Federal Telephone Company, which controls the most extensive independent system in the United States, is endeavoring to secure a franchise for an independent company in New York City, with the view of competing with the monopoly. Frederick S. Dickson, president of the Federal Company, states that the lines controlled by the company will soon be in operation from Pittsburg to Philadelphia and Baltimore, as well as from Cleveland to Albany by way of Buffalo, and to Rochester and Syracuse.

TELEPHONE RATES REDUCED.—Reduction in telephone rates in The Bronx, New York city, have been announced to take effect October 1. The rate for a business service of 600 messages has been reduced from $54 to $48. For a residence service of 500 messages the rate will be $39 instead of $48, the former rate. Excess local messages will be charged for at five cents each, the old rate being seven cents. A material reduction has been made in the charge for a private branch exchange service. The existing rate is the same as that charged in Manhattan. The new rate will be $150 for a switchboard, two lines to the central office, two telephones and 2,400 messages a year.

FULTON CENTENNIAL.—The Committee on Plan and Scope of the Fulton Centennial Commission, appointed by Mayor McClellan, met this week at the rooms of the Board of Trade and Transportation and discussed the idea of commemorating the establishment of steam navigation on the Hudson River. The committee agreed to report the idea of building a water gate, establishing a marine museum, which would be a permanent affair, and to have a grand naval parade and a three days' celebration. It was also decided to recommend the holding of a marine congress in New York and invite people from all parts of the world to attend it. This would be followed by a conference looking toward the development of the American merchant marine. The plan is to hold the celebration beginning August 1, 1907.

POWER OF THE ASSINIBOINE.—A syndicate composed of Canadian and American capitalists proposes to develop the water power on the Assiniboine at Brandon, Manitoba, and to erect a large power house and plant at Curries Landing.

CONDUITS FOR OAKLAND, CAL.—The City Council of Oakland, Cal., has passed an ordinance providing that all the wires of the city shall be placed under ground within the fire limits. This includes all wires except those of the Oakland Traction Company. The measure was passed unanimously. It will require three years to complete the work of laying the wire under ground.

AUSTRIAN STATE TRACTION.—It is stated that the first steps have been taken by the managers of the Austrian State railways to electrify a large section of the system on the Upper Austrian, Salzburg, Tyrolese and other Alpine lines, as also on the Tauern Railway, now in course of construction. For this purpose water power in the Alpine regions has been secured, as also on the River Salza, near Golling, in the Salzburg area.

MUNICIPAL OWNERSHIP.—The first move of the general commission on municipal ownership and co-operation of public utilities appointed by the National Civic Federation will be made at a meeting called for October 5 at Columbia University, New York City. It is proposed then to appoint a sub-committee of nine to be sent to Europe for four months to investigate the results of municipal ownership abroad. A similar committee will make inquiries in this country.

STARTER FOR MERCURY VAPOR LAMP.—A solution of the problem of rendering the vapor of mercury conducting is disclosed in a patent issued September 12 to C. J. Coleman. The inventor provides means for projecting a complete stream of mercury upward through the tube, so that a closed circuit will be established through the lamp. Within the lower portion of the tube is placed a piston of iron having within it a chamber open at its lower end and closed at its upper end, except at a jet-orifice through which the mercury is forced when the piston is moved rapidly downward. The piston is drawn downward by a powerful electromagnet, the circuit to which is completed when the main lamp switch is closed and is opened when the current passes through the stream of mercury.

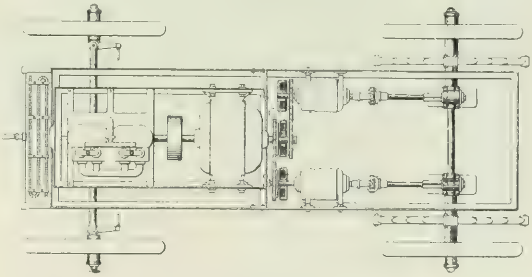
WATER IN THE LAKES.—The International Waterways Commission held a session at Toronto, Ont. Acting Mayor Spence told the commission of the injurious effect of low water at Toronto. Should it go much lower the harbor would be unnavigable, he said. Harbor Master Postlethwaite spoke against the construction of a dam across the Niagara River at or near Buffalo. It would be impossible to raise Lake Erie without reducing the level of Lake Ontario, he said. Several members of the Board of Trade addressed the commission, opposing any measures that would reduce the present level of Lake Ontario. In regard to this inquiry we may note the fact that whatever else the power plants on Niagara may do, they do not lower the level of the lakes. Probably they help maintain it.

ELEVATOR AT LUCERNE.—It is said that the highest elevator in the world has been installed opposite Lucerne, Switzerland, at the celebrated viewpoint of Burgenstock. To reach this elevator the traveler takes the cog-road from Kehrsiten on the shore of the lake to the hotels of Kehrsiten. Thence a most picturesque road cut out of the rocky side of the mountains overhanging the lake takes the traveler in thirty minutes to the elevator, the shaft of which is hidden in a grotto excavated alongside the engine house. The elevator is run by electricity. The carriage or cage is twelve feet square and its passengers are limited to seven. When the signal to start is given the cage rises for 213 ft. through a well of masonry, then comes suddenly into the daylight, and for 387 ft. rises in a steel lattice work to the landing stage, the total ascension of 600 ft. being made in less than three minutes. From the landing stage an open gallery leads to the summit of the Hammet-Schwand Mountain 3,600 ft. above the sea level. From this point a glorious view is had of the lake of the Four Cantons and of the Alps of Uri and Unterwald. The elevator cage is lifted by two steel cables and contains an arrangement by which, in the event of the electric power being interrupted, it can be lowered by hand to the starting point.

LONG-DISTANCE TELEPHONY.—A special dispatch from Pittsburg says: "A member of the Independent Long-Distance Telephone Association which has been meeting here says that while in time all the independent telephone companies may be consolidated by mutual agreement, no such consolidation is probable for several years at least. At the present time the association is endeavoring to perfect arrangements for consolidation of the long-distance lines only. It was not possible to complete arrangements here and another conference will be held next week at St. Louis. The following companies are interested in the movement: The Allegheny Telephone Company, the Independent Long-Distance Telephone & Telegraph Company, of Louisville, Ky.; the New Long-Distance Telephone Company, of Indianapolis, Ind.; the Kinloch Long-Distance Telephone Company, of St. Louis; the United States Telephone Company, of Cleveland, Ohio; the Independent Telephone Company, of Kansas City, Mo."

LAKE MICHIGAN TELEPHONE CABLE.—Preparations for laying the United States Government telephone cable from Charlevoix, Mich., to St. James, Beaver Island, in the middle of Lake Michigan, having been completed, the Federal cable boat started with the actual work on September 12. An hour later the cable boat was four miles out and reported favorable progress. Telephone communication was established with the vessel, so that messages might be sent constantly to Charlevoix, while the cable was being laid. Congress appropriated $35,000 last winter for this line in order that connection might be had with Beaver Island, where the Weather Bureau proposes to establish a storm-warning station. The cable will also furnish means of communication for the large fishing industry, and for residents of Beaver Island, and will be especially valuable to vessels and yachts that seek Beaver Harbor for refuge during storms. The work of laying the cable was done under the supervision of J. H. Robinson, superintendent of telegraphs of the United States Weather Bureau.

COMBINED ENGINE AND MOTOR AUTOMOBILE.—In order to obtain the flexibility of the electric drive for an automobile at low speeds and to eliminate the electric losses at high speed, H. Lemp, according to a patent issued September 12, would equip the machine with a gasoline engine direct-connected to an electric generator, and would provide two electric motors geared to the rear wheels for the purpose of propelling the vehicle at low speeds. The shafts of the motors are connected to the shaft of the gas engine through sprocket chains and magnetic clutches. The controller is arranged for one backward and three forward running positions. At the lowest forward speed the two motors are connected in series. At the intermediate speed the motors are connected in parallel. When the controller is moved to the high-speed position, the motor circuits are open and the generator circuit is closed through the coils of the electromagnetic clutches, so that the shaft of the gas engine is mechanically connected through the clutches to the rear wheels. In the single backward-running position the two motors are connected in series. No differential gears are used because at low speeds the motors produce the proper differential action, and at high speeds it is advantageous to do away with differential gears in order to diminish the liability of skidding. This patent has been assigned to the General Electric Company, and seems to have some bearing on the experiments now being made with reference to the substitution of motor omnibuses for the horse-drawn coaches along Fifth Avenue, New York City.



THE CANADIAN PACIFIC RAILWAY reports expending $635,432 on its commercial telegraphs last year. The stockholders have been asked to approve an agreement for the operation by the British Columbia Electric Company of the Canadian Pacific's Vancouver and Lulu Island railway

SECRETARY FOR LIGHTING COMMISSION.—The State Lighting Commission has appointed Thomas D. Hoxsey, of Brooklyn, as secretary, to be located at the New York office of the commission, at a salary of $3,000. Mr. Hoxsey is a well-known newspaper man. The Albany and Buffalo secretaries of the commission will be appointed later.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.—This body will hold its annual meeting at Canton, Ohio, November 17 and 18, at which a number of papers will be presented and proposed changes in the constitution acted upon. Mr. Richard H. Probert, of Akron, is president of the society and Mr. Corwin J. Miller, of Canton, secretary.

ILLINOIS STATE ELECTRIC ASSOCIATION.—The Illinois State Electric Association will hold its annual meeting in Peoria, Ill., October 5 and 6, with headquarters at the National Hotel, where the meetings of the association will be held and where arrangements have been made for the display of new and interesting electrical appliances. Several interesting papers will be read on various subjects, important questions will be brought up for discussion, and an entertainment committee will see that the members and visiting representatives of electrical manufacturing houses are kept busy. Mr. D. Davis, of Litchfield, is secretary of the association.

HEATER FOR GLOWER LAMP.—An invention of Wilhelm Boehm, for which a patent was granted September 12, relates to that type of incandescent lamp in which it is necessary previously to heat the incandescent body to a certain elevated temperature before it becomes conducting. For such bodies it is necessary to provide a special resistance in order to prevent their fusion by the action of an excess current. The present inventor proposes to use the preheating resistance as a ballast after the lamp is in operation. The heater and the incandescent body are placed in parallel at starting, but are placed in series automatically when the incandescent body becomes a conductor and current flows through it.

A PECULIAR IRISH CITY.—Recently the Corporation of Limerick, Ireland, at a special meeting held to consider the project of a street railway line, voted to reject the plan for such a system because of popular opposition. On the evening of the meeting bands paraded the streets and played outside the council chamber to emphasize the opposition of the working community, and especially the cab drivers, to the undertaking. The counsel for the Great Southern and Western Railway Company also was present to object on the part of his company to the proposal. The solicitor for the promoters agreed to drop the haulage portion, but asked that a committee be appointed to investigate the details, and in the event of the haulage scheme not being found agreeable, to go at least into the passenger proposal. On final vote, however, the entire scheme, both passenger and haulage, was rejected. The population of Limerick by the census of 1901 was 38,000 and of the parliamentary borough 46,000. The distance roughly from end to end of the city is two miles. To traverse this length one must either walk or pay a generous cab fare.

TELEPHONE MANNERS.—An excellent article appears in the New York *Mail and Express* as to the offenders who make telephone service slow by their refusal to recognize the rules, which after all are only the reasonable etiquette of good manners. One of the offenders is the man who calls you up and then insists on knowing who you are before disclosing his own identity. Another is the man who, having called you up, keeps you waiting several minutes before he deigns to start the conversation. Such "hogs" do much to frustrate the best efforts of the telephone exchange and the operators, and as the article says: "Why should the graces of civilization be sacrificed to the horrid uses of the telephone? A slump back to barbarism is too high a price to pay for that convenient instrument. All persons who desire to preserve the remnants of civilized conduct which thus far have escaped destruction at the hands of the selfish animals who commit their ravages by telephone should organize themselves into a vigilance committee to reform or exterminate these enemies of the human race."

Electrical Engineers of the Times.—XXVIII.

PROF. A. H. FORD.

Arthur Hillyer Ford was born in Chicago, Ill., February 6, 1874, and spent his boyhood days in Waupun, Wis., where he completed the second year in the High School. He attended the Wisconsin Academy, Madison, Wis., for one year, and was a student in the preparatory department of Washburn College, Topeka, Kan., for a year. In the fall of 1891 he entered upon the electrical engineering course at the University of Wisconsin, from which he was graduated with special honors in 1895, receiving the degree of Bachelor of Science. He was elected Fellow in Electrical Engineering at the University of Wisconsin in 1895 and again in 1896, and received the advanced degree of Electrical Engineer in 1896, and was elected Fellow in Electrical Engineering at Columbia University in 1897.

Mr. Ford spent the summer months of the year 1898 in the testing department of the General Electric Company at Schenectady, N. Y., after which he accepted a position as draughtsman with the Warren Medbury Company of Sandy Hill, N. Y. In February, 1898, he accepted a position with the Western Electric Company in the dynamo testing and designing department of the Chicago factory, and later in the factory engineer's office of the New York plant.

PROF. A. H. FORD.

While a graduate student at the University of Wisconsin, Mr. Ford showed a faculty for teaching and decided to make teaching his profession if opportunity presented itself. Being offered the position of acting professor of electrical engineering at the University of Colorado, in August, 1900, he served for one year as head of the Electrical Department in the absence of the regular incumbent. In June, 1901, he was elected professor of electrical engineering at the Georgia School of Technology, Atlanta, Ga., which position he now holds.

Mr. Ford has devoted much study to the magnetic properties of iron as affecting the characteristics of electrical apparatus, and in a number of publications has treated these features. In 1896 the University of Wisconsin published an article by him describing "A Complete Test of Modern American Transformers," which attracted considerable attention on account of the bearing of transformer losses on central station economy. This article was one of the earliest to lay stress upon the question of all-day efficiency. On April 25, 1900, Mr. Ford presented before the American Institute of Electrical Engineers in a paper on "Hysteresis in Iron and Steel," a study of the effect of chemical composition on the increase in hysteresis loss in a transformer core with time.

Prof. Ford is a member of the American Institute of Electrical Engineers, the American Association for the Advancement of Science, and the Society for the Promotion of Engineering Education.

New Power Plant of the Brooklyn Rapid Transit Company.

THE new power plant of the Brooklyn Rapid Transit Company now being erected on the Wallabout Canal, which will be known as the Williamsburg Power Station, forms the sixth independent generating station supplying power to the Rapid Transit Electric Railway system. Four of the stations are of the older type with direct-current machinery, as follows: The Third Avenue Station, taken over with the old Atlantic Avenue System; the Thirty-ninth Street Station, taken over with the old Nassau system; the Fifty-second or South Brooklyn Station, and the Kent Avenue or Eastern District Station. The fifth generating plant is the large central station plant at Third Avenue, which has now been in operation about three years. This station is of modern design and contains eight 4,000-hp vertical engine generating units. ,In this station high voltage three-phase currents are generated for transmission to seven sub-stations, the current being in these transformed to direct-current and distributed to surface and elevated networks of the company; several additional sub-stations are contemplated, to be supplied with power from the Third Avenue Station.

The new Williamsburg Station adjoins the old Kent Avenue Station with a frontage of 199 ft. on Kent Avenue, and 257 ft. on the Wallabout Canal, opposite the Navy Yard. The building is divided by partitions at right angles to Kent Avenue into a turbine room 83 ft. wide next to the old plant, and a boiler house 125 ft. wide. The station has been laid out to accommodate ultimately nine steam turbine generating units, one of 5,500-kw capacity and the other eight of 7,500-kw capacity each, thus giving a total station capacity of 65,500 kw, or with a 50 per cent overload rating of about 100,000 kw. At first only three turbines will be installed, two of which will be of the Westinghouse-Parsons type, and the other the new turbine of the Allis-Chalmers Company. A comparison of the generating floor space with that of the Third Avenue central station is interesting as showing the smaller floor area required for steam turbines. In the latter station the engine room occupies nearly 60 per cent of the total ground plan and the boiler room 40 per cent, whereas in the new station this proportion is exactly reversed.

The turbine section of the building includes an 18-ft. basement for condenser apparatus. The main turbine room has a clear height under roof trusses of 83 ft. On the north side are five mezzanine galleries for the electrical switching equipment and a storage battery; on the Kent Avenue side a stage of mezzanine galleries will be devoted to office, locker and toilet rooms and to mechanical and electrical laboratories. The turbine room is traversed by a 50-ton Shaw traveling crane of 62 ft. span.

The station is designed for 36 Babcock & Wilcox boilers on each of two boiler floors, or 72 in all; the initial installation, however, will consist of 36 boilers, and only two of the three chimneys ultimately required are now being erected. Each boiler will be of 650-hp capacity and designed to deliver steam at 200 pounds pressure; superheaters will raise the temperature of the steam 100 deg. above saturation. Both natural and forced draft will be provided, the latter permitting of the use of low grades of fuel. For the forced draft supply there will be installed two Sirroco blowers of 90,000 cu. ft. capacity per minute for each row of boilers. These fans, which will be fitted with cases and driving engines by the B. F. Sturtevant Company, are to be located on elevated platforms at the sides of the boiler rooms or in the basement, delivery being through ducts leading down to cross flues beneath the ash pockets. Sufficient capacity is provided in each blower to supply the entire six boilers to their maximum if at any time this is found necessary.

Coal will be delivered to the new station from barges in the Wallabout Canal, which will be unloaded by a coal tower, whence cars upon an elevated cable railway will distribute it in the pockets over the boiler room. The tower will consist of a steel structure, 100 ft. long, 25 ft. wide and 133 ft. high, containing the barge unloading apparatus, coal receiving bins, crushers, etc., together with an ash handling and storage equipment. The coal unloader hoist jibs, of which there are two, one at either end of the tower, are to be located 73 ft. above bulkhead level, from which the lift to the receiving bins will be 57 ft. The small receiving bins deliver to coal crushers and from thence the coal is elevated 115 ft. by two lines of bucket conveyors to the top of the structure for delivery to the automatic cable railway cars. Of the latter there are to be five of 2½ tons capacity each, which will be loaded at a rate of about two per minute, giving thus a total capacity of about 300 tons per hour. The cable railway crosses to the boiler house by a bridge and makes a complete circuit of the coal pockets above the boilers.

The coal unloading tower equipments are of the two-man type, and each is operated by a combined hoisting and trolley engine set. The buckets are of the improved Rawson type, each of 1¼ tons capacity, and the coal crushers will be of the single-roll swinging-block type. The elevating conveyors will be equipped with a variable-speed motor drive, the capacity guaranteed for the system to be the handling of 300 to 350 tons per hour. The entire coal handling equipment, together with the ash handling apparatus, is being supplied by the Mead-Morrison Mfg. Co., New York.

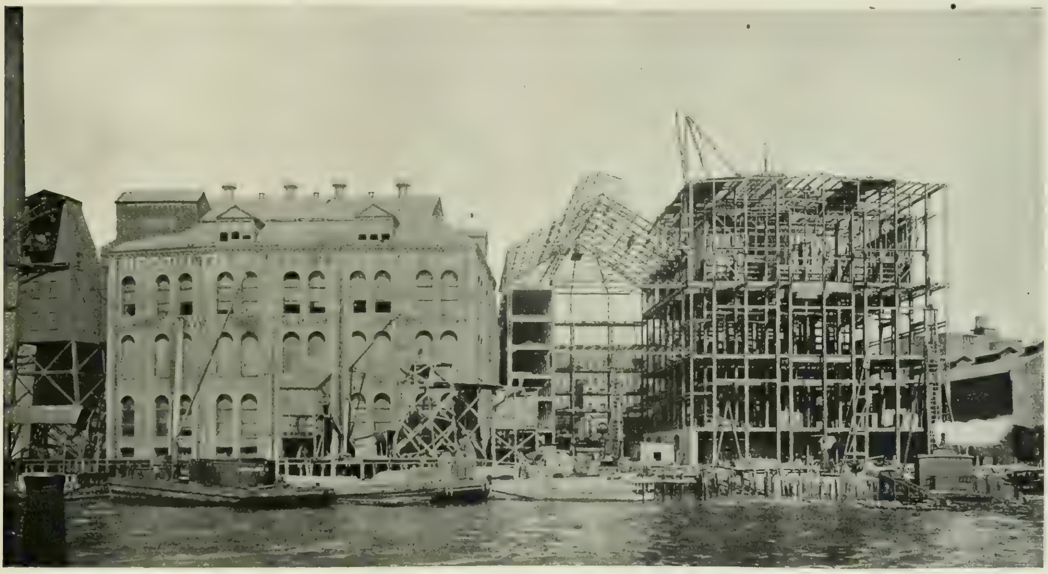


FIG. 1.—NEW WILLIAMSBURG STATION UNDER CONSTRUCTION.

The ash handling system will comprise a line of narrow-gauge railway cars passing underneath the ash chutes in the boiler house basement, which will deliver the ashes to an elevating conveyor in the coal tower, raising them to a 1,000-ton ash storage pocket. Cast-iron chutes are carried from the furnace ash bins of the boilers upon both floors down to outlets over the track for dumping direct to the cars. The latter will be of the V-bottom dumping type, and will be hauled by a 6,000-lb. electric locomotive, which is capable of drawing a total load of 14,000 lbs. at a rate of about three miles per hour up a five per cent grade. The ash elevating conveyor is of the bucket type and is designed to deliver at a rate of from 50 to 60 tons per hour from the receiving bin to the storage pocket. The latter is provided with outlet spouts for delivery either to wagons or boats in the channel.

For the initial installation there will be three vertical, direct-acting, cross-compound Blake simplex boiler-feed pumps of the center outside-packed-plunger pattern. These pumps are designed for delivering against a pressure of 240 lbs. when operating with 175-lb. steam pressure and no suction lift, and are designed for delivering 500 gal. per min. with a piston speed of 75 ft. per min. An open feed-water heater of the Cochrane horizontal cylindrical feed-water heater and purifier, built by the Harrison Safety Boiler Works, Philadelphia, Pa., will have a capacity for heating 400,000-lb. of water per hour from 100° to 207° Fahr. This heater is 15 ft. long and 8 ft. in diameter inside, and has a carrying capacity of 376 cu. ft. per hour. It is fitted with 20 trays for the deposition of impurities, and has the usual coke bed filter for purification of the feed, while a Cochrane oil separator incorporated in the heater prevents contamination of the feed by lubricating oil from auxiliary engine cylinders. There will also be two closed Wainwright heaters, each 48 in. inside diameter, with 800 1-in. corrugated copper tubes 7 ft. 6 in. long, giving thus a heating surface of 1,333 sq. ft. The tubes are divided into four groups through which the water passes in succession, and baffles are used to cause the exhaust steam to pass in counter-current to the feed water.

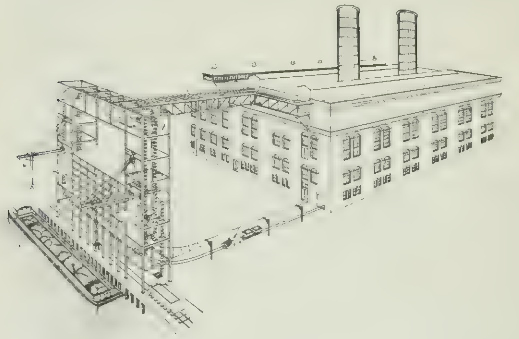


FIG. 2.—GENERAL VIEW OF PLANT, SHOWING COAL-HANDLING APPARATUS.

As previously stated, the station has been laid out to accommodate ultimately nine steam turbine generating units, one of 5,500 kw capacity, and the other eight of 7,500 kw capacity each. The use of turbines of the 7,500 kw ratings and the 50 per cent overload capacity mark an important departure, as each turbine at 50 per cent. overload will be capable of delivering 15,000 hp, which is the greatest amount of power ever developed in a single prime mover in stationary practice.

The new 7,500-kw Westinghouse turbine units will differ in some details from their well known 5,000-kw capacity machines, but the same general type and form of unit is preserved in the new design. The blades are to be made longer, and other modifications of a minor nature are to be incorporated, which materially affect the increase of capacity. The new Westinghouse unit will be 50 ft. long, 17 ft. wide and 15 ft. high, occupying thus a total floor space of 850 sq. ft., or 0.113 sq. ft. per kilowatt capacity. It will thus be only about 4 ft. longer than the 5,000-kw turbine unit, while the width will remain practically the same. These turbines will operate at 175 lb. pressure with 100 deg. of superheat, and the speed will be normally 750 r.p.m. Under the above conditions and a vacuum of 28 in., the steam consumption at full load will be approximately 16 lbs. per kw-hour. An important feature of the new design is that its best economy will be secured around full load, although heavy overloads may be carried at any and all times without material sacrifice of efficiency. The design also permits of the turbine developing its full-rated load non-condensing.

The turbo-generators connected to the above units will be similar to the former standard Westinghouse designs for use with turbines, with the exception that they will embody a new enclosed construction which will be effective in entirely eliminating the hum peculiar to high-speed turbine generators. They are of the four-pole type and are wound so as to deliver either 6,600 or 11,000 volts. As connected they will deliver three-phase currents at a voltage of 6,600 and a frequency of 25 cycles per second. The stationary armatures will consist of a cast-iron frame with laminated core and coils set in partially closed slots. The field cores will be built up of steel castings, with slots closed by brass wedges. Their efficiency will approximate 97.5 per cent at full rated load, and they will be able to sustain 50 per cent overloads for three hours without dangerous rise of temperature of windings.

The Allis-Chalmers 5,500-kw turbine, which will run at a speed of 750 r.p.m., is direct-connected to a rotating-field, three-phase, 25-cycle generator. The turbine was built at the West Allis works of the Allis-Chalmers Company, and the generator was built at its Bullock works, Cincinnati.

The steam turbine is of the horizontal, parallel flow, reaction type, being very similar in general construction and principle of operation to the well-known Parsons type. One of the principal improvements made by the Allis-Chalmers Company in the construction of its turbine is that of the blading, which is manufactured by special machine tools constructed for this purpose.

One of the widest departures from previous practice is in the method of securing the blades to the turbine spindle and cylinder, the blades being first inserted in a foundation ring which is afterward secured in the turbine in such a manner as to withstand safely the high centrifugal force, instead of inserting the blades individually in the turbine.

Another improvement is the addition of a channel-shaped shroud ring which is riveted to the ends of the blades, thereby stiffening them and preventing the effects of vibration in weakening the blades. The flanges of this channel strip are made very thin so that if from any accidental cause the rotating and stationary part should meet the flanges of the ring will come in contact without damage to the turbine, as distinguished from the case where the blade ends are left naked without protection. The use of this protecting shroud ring enables the turbine to be built with less clearance between the rotating blades and the stationary cylinder than would be possible without this device.

The speed of the turbine is regulated by a spring-loaded centrifugal governor acting through suitable mechanism on the steam inlet valve. The turbine is lubricated by a thorough system of piping whereby the oil is forced by a centrifugal pump, which is driven by the turbine, through a system of pipes to the bearings, thence through a large cooler and used over and over again. There is a separate direct-acting steam pump in the oiling system for use in starting up the turbine, or to be used in case of emergency.

The turbine and generator shafts are connected by an enclosed flexible coupling and are carried in ball and socket bearings lined with a special hard babbitt metal. The generator is constructed with special reference to safety of operation at turbine speed, and with thorough ventilation. A new method is employed for supporting the ends of the coils of the revolving field and at the same time thoroughly ventilating it.

The whole unit of turbine and generator measures 47 ft. 1 in. in length over all. The outside diameter of the stationary armature of the generator is 13 ft. 4 in. The greatest outside diameter of the turbine casing over the flanges at the low-pressure end, is 8 ft. 10 in. The highest part of the unit, namely the top of the generator, stands 11 ft. 6 in. above the floor level.

For each of the turbines there is to be installed beneath them in the basement a Worthington surface condenser, with a two-stage turbine hot-well pump, motor driven, and a horizontal rotative dry vacuum pump. The circulating water will be handled by volute circulating pumps, direct-driven by vertical compound engines, short direct connections being had to the inlet and overflow tunnels beneath the basement floor. The condensers are rectangular in section, that for the 5,500-kw turbine having 22,000 sq. ft. of surface, made up of 1-in. tubes, 17 ft. long between heads, over which the

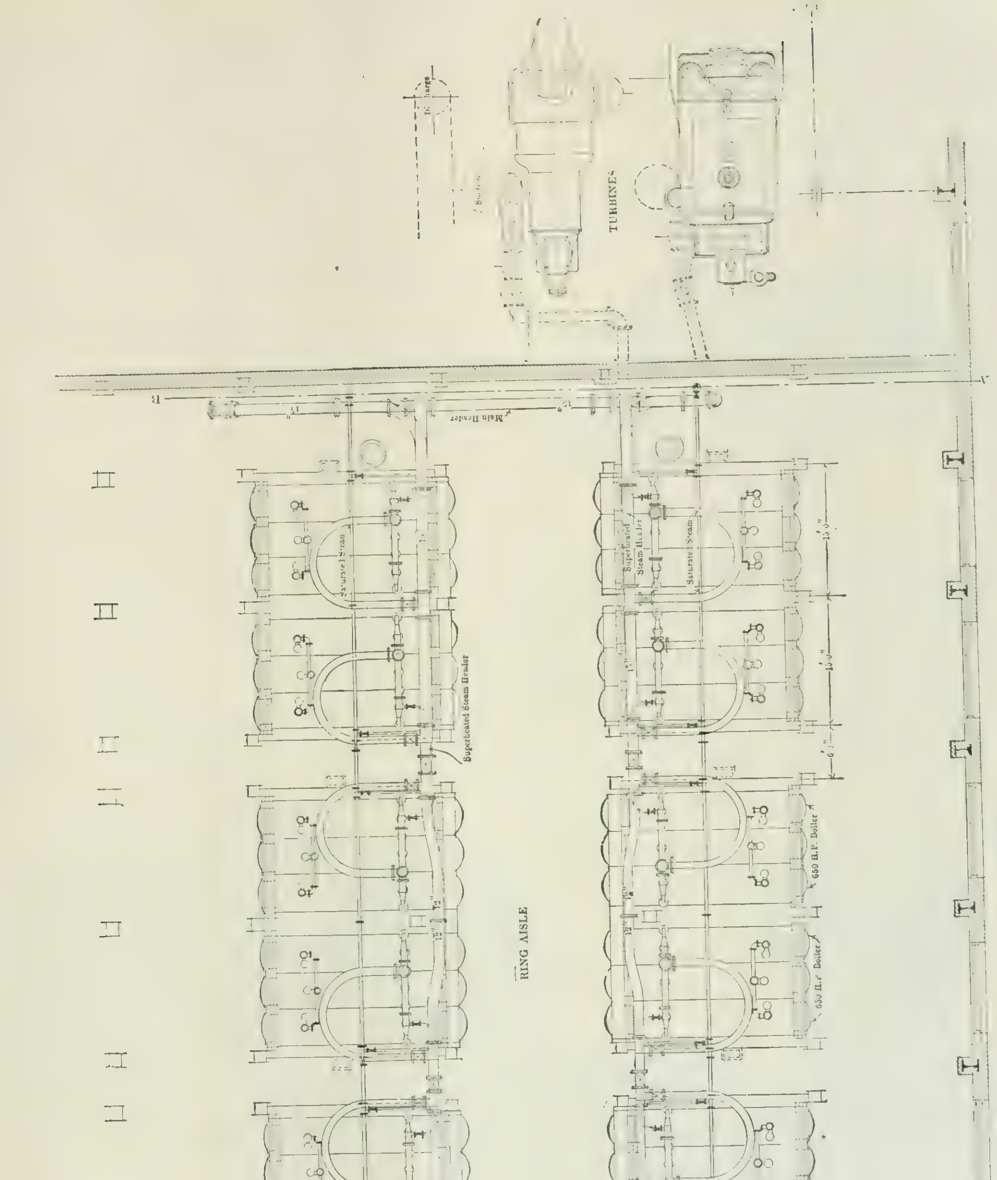


FIG. 3.—Plan of Williamsburg Power Station

steam makes three passes. It has a capacity, when supplied with circulation water at 70° Fahr., of maintaining one pound absolute in the exhaust passages when condensing 150,000 lb. of steam per hour. The condensers for the 7,500-kw units will be of the same general design as the smaller one, but with 25,000 sq. ft. of surface; it is of the same length and height, but sufficiently wider to accommodate the increased tube surface.

The electrical control equipment for the new plant will be similar to that in general use in three phase generating stations of this type, some changes, however, being introduced in minor details where practice has indicated the possibility of improvement. The high-tension system, including oil switches, and control and switching apparatus, will be operated similar to that in the Third Avenue Central Power Station, although, instead of being arranged at one end of the building, this equipment will be located in the mezzanine galleries, of which there are five extending along the entire north side of the turbine room.

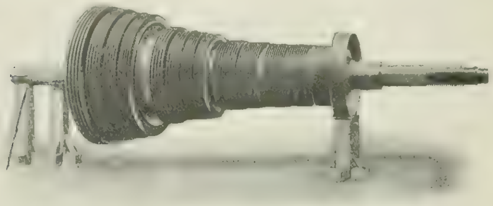


FIG. 4.—ROTOR OF ALLIS-CHALMERS TURBINE.

The arrangement of the electrical galleries adopted is novel. The space under them on the first floor level adjacent to the turbine room will contain the exciter and lighting units and associated control apparatus, and also the lighting and power switchboard panels. The balance of this space and the first mezzanine will be devoted to the cable ducts, while the second mezzanine gallery is to contain the high-tension feeder switches by which the feeders are connected to the group buses. The third mezzanine gallery will carry the control boards and operating stands, which will be located near the middle of the proposed building in the form of an open balcony overlooking the entire turbine section. The potential transformer equipment and the equipment of generator and feeder buses will occupy the rear of this gallery, the latter to be encased in cells of brick wall and alberene partition construction, with wired-glass doors in front and rear where the connecting cables are attached through disconnecting switches. The control boards are to be arranged in two rows of semi-circular shape, the generator panels in front and the feeder panels at the rear. In general, the equipment of the panels will be similar to those in the Third Avenue Central Station. The individual generator and group feeder oil switches are to be located upon the fourth mezzanine gallery, ,from which leads are carried down through the series transformers to the feeder switches.

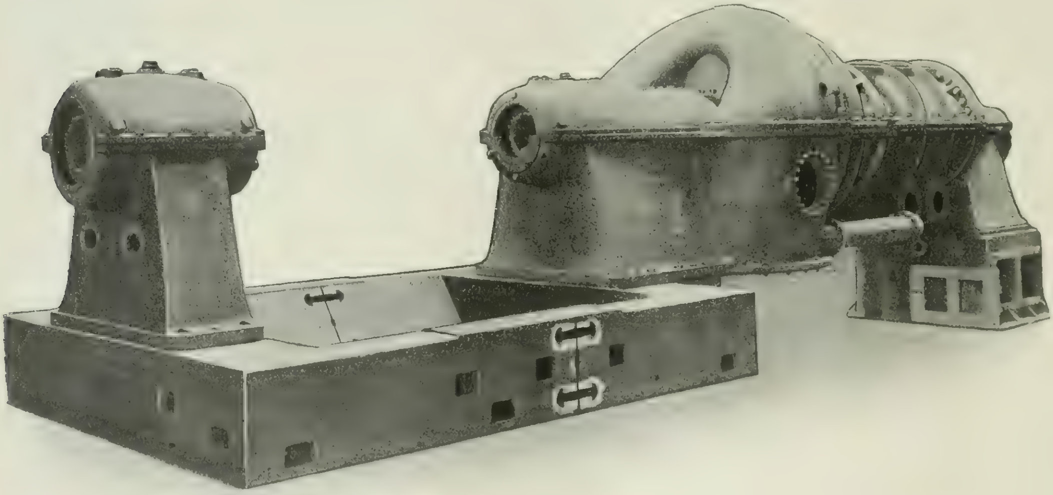


FIG. 5.—ALLIS-CHALMERS TURBINE, LOOKING FROM GENERATOR END. GENERATOR BED PLATE IN FOREGROUND.

The system of connections for the switching system provides for two 1,200-amp. non-automatic switches in series between each generator and the generator bus, while the feeders are supplied in groups of four by a 600-amp. main group-feeder oil switch. The buses are in all cases sectionalized, the generator buses having been planned so that but three or four generators will be assigned to each section, tie switches being provided to connect the various sections together if desired. There is to be only one section of the generator bus installed at present, while there will be three of the feeder buses, each supplying four feeders. The feeder switches, located on the second mezzanine gallery, are equipped with relays for automatic tripping under overload.

The exciter and lighting system will consist of three 150-kw units, two being motor-generator sets and the other a steam engine-driven unit, delivering direct current at from 125 to 150 volts; this is to be supplemented by a storage battery which will float upon the system constantly, but not so much in the sense of reserve capacity as for security from interruptions, which it is designed to prevent absolutely. The battery which will be installed on the fifth mezzanine gallery is to be of 2,000 amp. discharge capacity and will be operated without end-cell switch regulation. A novel form of direct-current reverse relay, or circuit-breaker, will be used in this connection on all the motor-generator leads to prevent a destructive return flow from the battery to a motor-generator in case it becomes inoperative. This relay is designed to open the circuit on any reverse flow from the bus to the machine equal to or above one-half its full-load capacity, although it is entirely inactive when current is flowing properly from the machine to the bus, or even at heavy overloads.

The type C oil switch of the Westinghouse Electric & Manufacturing Company will be used as standard throughout the new station, as well as also in all new high-tension work. These will be automatically controlled by the General Electric diaphragm-type, inverse-element overload relays, which are designed to break the circuit more quickly in proportion as the overload or short-circuit is heavier or more severe. The entire switch and control board equipment is being supplied and installed by the Westinghouse Electric & Manufacturing Company.

This station is being built by the Transit Development Company, an equipment and operating company subordinate to the Brooklyn Rapid Transit system. In the details of design and construction the latter company has been represented by Edwin W. Winter, president; C. E. Roehl, electrical engineer, and R. C. Taylor, mechanical engineer. Thomas E. Murray has acted as consulting engineer.

British Law on Live Rail Accidents.

By W. Valentine Ball, M. A. (Cantab), Barrister-at-Law.

With the introduction of railways worked by electricity on the live-rail system a very interesting problem arises as to whether and how far the company is held responsible for the accidents which happen to persons on the line. At first sight it may appear to be a simple matter to answer this question; but it is not so easy as it seems, as much depends on the answer to a further question, namely, what right had the injured person to be where he was? Although divers accidents from electric shock have occurred since the live-rail was introduced in England, no case in which the question of liability of the railway company has been considered has yet come before the courts. The subject must, therefore, be approached from the standpoint of first principles. And first with regard to persons employed on an electric railway by the company. If any such person meets with an accident by coming into contact with a live rail there is an English statute known as the Workmen's Compensation Act, which would clearly give him a right to claim damages, unless it could be shown that the workman had brought about the accident by his own serious and wilful misconduct. Apart from this and certain other statutes, of which the most important is known as the Employer's Liability Act, there is no rule of the English common law which would entitle a workman to compensation *qua* workman. In fact, the English law as (apart from statute) with regard to the liability of an employer for injuries sustained by a workman is similar to that which, according to Mr. Croswell, obtains in America.

That author states: "As to the liability for an electric (The Law of Electricity (1895) sec. 266) company to its employees for defective construction and maintenance, the leading rule is, as in other branches of the law of master and servant, that the employee in entering the business, accepts all the obvious, incidental and natural risks thereof, and the company is not liable for injuries resulting to him therefrom." The risk of injury by shock from a live rail could hardly be described as anything but an obvious risk, especially if the company took the precaution of posting warning notices in places where the employees were likely to cross the permanent way ("or the road bed") on the level. Since the above work was published special acts dealing with employers' liability may have passed in some States of the Union; but as we are not immediately concerned with the statute law which makes special provision for workmen, we may proceed to consider the liability of an electric railway company in respect of passengers and other persons who may be exposed to danger.

Inasmuch as a railway company are the owners of the land on which their lines are laid, they are entitled to restrain persons from trespassing upon it; if a person does trespass on the line the company is under no duty to take precautions for his safety. In an English case which was decided long before live rails were heard or thought of, a man was found dead on a railway, but there was no evidence to show how he got there or that, although he was clearly killed by a passing train, the company had been guilty of any negligence. So it is apprehended that if a man were to cross an electric railway at a place where the public were not entitled to cross, and put his foot on the live rail he could bring no action against the company. We have said that there is no English decision to this effect; but in a recent American case, where a man trespassed upon certain property of an electric supply company and came into contact with a naked conductor, he was not entitled to recover any damages.

Different considerations apply (a) to the public who may, at certain places, have the right to cross the line on the level and (b) to passengers who may be expressly or implicitly requested to cross the line for the purpose of getting from one platform to another. In all these cases it is clearly the duty of the company to take precautions. For instance, it would be their duty to the naked conductors with wooden rails in order to prevent a persing stepping on the metal. It may here be mentioned that the Boended Trade in England (this being the Government department has worked in these matters) have made regulations to this efment but they have declined to call upon electric railway companies ith guard the naked conductors throughout their length. Failure to post warning notices would probably be regarded as negligence on the part of the company. The law upon this branch of our subject has been thus stated in a text book recently published in England: "Carriage by Railway," by H. Disney, Barrister-at-Law: "If a person is wrongfully on the premises of a railway company there is no duty upon the company to warn him of even concealed dangers. He comes entirely at his own risk, and, though nothing may be done with the intention of injuring even a criminal (as by setting a man-trap to catch a thief), the company is under no obligation for negligence to a trespasser. Thus if a person were in a train with the fraudulent intention of traveling without paying, the company would probably not be responsible if that person were injured by negligence. Again, a person trespassing on the line could not make the company answerable for injuries received while so trespassing.

Gas Arcs and Electric.

An interesting paper on "Gas Arcs" was presented before the recent meeting of the Pacific Coast Gas Association, at San Francisco, by Mr. W. M. Kapus. We give below an abstract of the paper together with a report of the discussion which followed its reading.

With the gas arc at the present time a gas company has great possibilities by which it can largely increase its output, and can obtain a certain class of commercial lighting which would otherwise be impossible to obtain. Among the lighting companies the sale of the gas arc is advocated chiefly by those companies dealing exclusively in the sale of gas, while companies which operate combined gas and electric plants do not take so kindly to the gas arc. Gas companies which have followed a method of free installation and maintenance have met with much success in introducing the gas arcs. The cost of a regular four-burner arc complete with best grade of mantles is not over $7.50. This arc can be installed for the price of $12 and still leave a margin between the net cost and the net selling price to cover the expense of installation and a small profit besides. The gas company does not derive its benefit from this small profit, however, but from the increased sale of gas which cannot be obtained unless gas appliances are within the reach of all. Even a reasonable loss on the sale of the appliance if encountered in order to create a greater demand for gas will appear as a very small percentage on the cost per 1,000 cu. ft. on the annual output as compared to the volume of new business that can and should be thus obtained.

It is of great assistance to the representatives of a company when endeavoring to set forth the advantages of an arc, to be able t that after the first cost the company does the rest. The author asserts that experience with 3,000 arcs has shown that the total cost for maintenance averages about 25 cents per arc per month. Gas arcs constructed with a separate adjustment for each burner are far more satisfactory than those equipped with a single adjustment for two or more lights. When the arcs are used in exposed locations the only precaution that is necessary is the proper adjustment of the pilot light, in order that it will not be extinguished when the lamp is not in use and allow unburned gas to escape.

In opening the discussion of the paper, Mr. E. C. Jones stated that experience proves that the gas arc furnishes the best means of lighting a store, and that its use will interfere seriously with the electric light business. Mr. Newbert remarked that it is important to consider the fact that where the fixtures are already in place single burners are cheaper to install than multiple burners, and that the greatest competitor to the electric lamp is the improved single burner. Mr. Colquhoun said that the gas arc is much more economical than single burners. The small burners consume about 5.5 to 6 cu. ft. of gas per hour, while the four burners on a gas arc use about 21 cu. ft. There is, however, danger of breaking the mantles of a cluster when one is being replaced. A better distribution of light can be obtained from single burners than from arcs.

Single-Phase Railway in Practical Operation.

IN ORDER to show with what success from an operating point of view the several single-phase railways now installed in this country have met, an account is given below of operating experience with the three equipments of this kind which for some months have been in regular service. Each of these equipments was described at length in these columns at the time of its installation. In the issue of last week was given an account of a fourth single-phase railway which has recently been placed in operation between Marietta and Atlanta, Georgia. Although this road has as yet not been in service for a sufficient length of time to furnish any information as to changes, if any, which have been found desirable in operation, a comparison of its equipment with that of the earlier roads may serve to show the trend of the development in single-phase railways.

SCHENECTADY-BALLSTON LINE.

In our issue for August 27, 1904, was given a description in detail of the single-phase equipment used over a portion of the Schenectady-Ballston Railway. This equipment has been in practically continuous operation during the past year for the stated purpose of determining just what defects would develop in actual service. It is worthy of note that, although the armatures differed inappreciably from those used in direct-current practice and were provided with no auxiliary means for preventing sparking, they have given excellent satisfaction. The effectiveness of the initial design may be learned from the fact that the new motors which are now being installed differ from the earlier ones practically in respect only to the speed. The first motors operated at a normal speed of 1,500 r.p.m., while the motors of the latest equipment have been designed for 1,350 r.pm. This change has been found desirable on account of the short life of the brushes at the higher speed.

It will be recalled that the low voltage for the motors on the initial equipment was obtained from a single tap of an air-cooled transformer, the motors being operated on the series-parallel method, with and without resistance, for variations in speed. On the equipment now being installed, the motors are connected permanently four in series, and the control of the speed is accomplished by varying the e.m.f. impressed upon the circuits of the motors. The variable voltage is obtained from five intermediate points on an oil-insulated self-cooling auto-transformer, referred to as a "compensator.". The object in changing from an air to an oil transformer has been to avoid the dust and moisture which was found to collect in the ventilating ducts in the air-cooled transformer. The oil transformer differs inappreciably in design from the standard stationary apparatus, except that it possesses only a single winding, and is mounted under the car in such a position as to occupy the least possible space in the vertical direction. The oil is contained in a strong, well-corrugated sheet-steel case, which is held in place by means of rubber washers which serve to deaden the shock due to the attempted movement of the liquid when the car is accelerating or retarding.

An interesting feature of the equipment is found in the method used for changing from one tap on the auto-transformer to another without opening the circuit to the motors or short-circuiting the intervening coil on the transformer. In passing from a tap to the one next higher in voltage, an impedance is first connected between the two taps. Then the connection to the lower-voltage tap is broken, leaving the impedance in series with the motor circuits. Finally the impedance is short-circuited, leaving the motor circuits connected directly to the higher-voltage tap. It may be of interest to observe that if the impedance is of such a value that when connected between adjacent transformer taps, it takes exactly the same amount of current at the same lag angle as do the motor circuits when connected to the lower-voltage tap, then there will be absolutely no change in performance of the equipment and no sparking whatsoever in the controller when the lower-voltage tap is disconnected. There is an increase in current and a corresponding change in acceleration when the impedance is short-circuited, but the sparking in the controller is practically eliminated. The impedance referred to consists of the blow-out magnet coils for each tip of the controller and a certain additional resistance. It is evident, from the description just given, that the blow-out magnets are in circuit only when the controller is being changed from one running position to another. A notched wheel on the drum shaft serves to insure that the controller will not be left in an intermediate position, so that the energy lost in the preventive impedance is practically negligible. The method of placing the preventive impedance in circuit between running positions may be learned from a study of Fig. 1.

One of the objections which have been urged against the use of a high-potential railway resides in the fact that in the event of sand

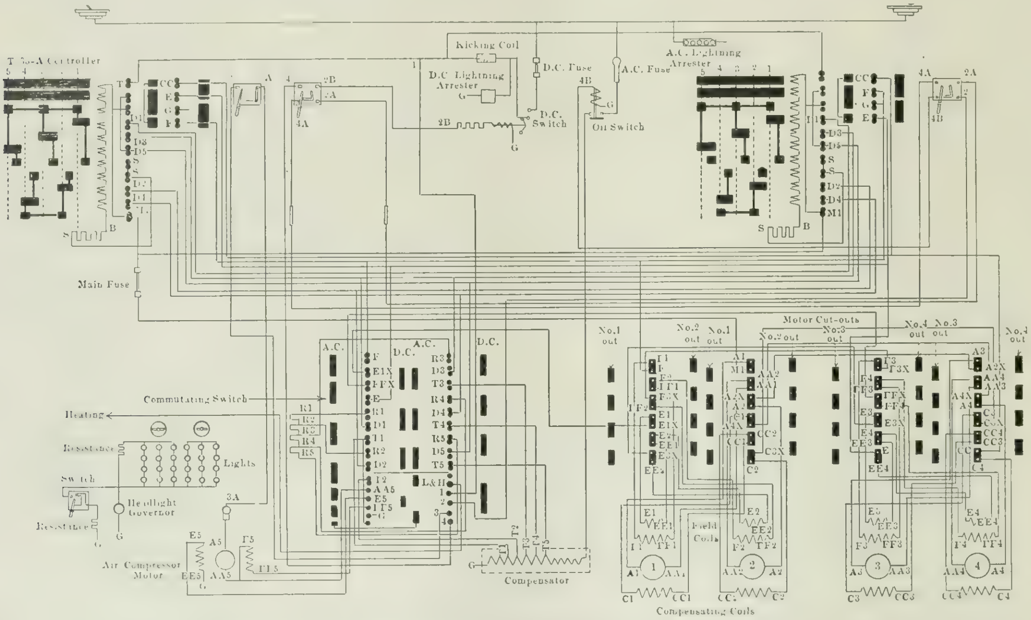


FIG. 1.—CIRCUITS OF CONTROLLER FOR COMBINED DIRECT AND ALTERNATING-CURRENT OPERATION.

or other good insulating substance being upon the rail, the circuit to ground would be incomplete while the metallic frame of the car would be at the potential of the trolley wire, thus introducing a serious danger-to-life element in the equipment. This element has been eliminated in the recent installations by the use in the high-potential circuit of a main-line switch which remains closed only when the circuit to ground is complete. This switch, which is of the oil type and closed by hand, is provided with a retaining coil which receives its current through a circuit entirely independent of the motors, and which loses its strength when the wheels of the car are insulated from the rails.

A characteristic difference between the single-phase motor and either the direct-current or polyphase motor is found in the fact that while the torque of the first machine pulsates with twice the frequency of the alternating current, the torque of each of the other machines is relatively constant. It is evident that the maximum torque exerted at the rim of the car wheels cannot be allowed to exceed the maximum adhesive force between the track and the rails. Since only the average torque is effective in producing acceleration, it would seem that for the same maximum acceleration the single-phase equipment must be much heavier than the direct-current or the polyphase—in fact, if certain modifying features be neglected, it is theoretically impossible for the single-phase motor to produce an acceleration as high as the other machines. Experience has shown that the single-phase motor can be so suspended through springs that the theoretical maximum torque of the machine never reaches the wheels, and the maximum average accelerating torque is but slightly less than that corresponding to the adhesive force at the rails, and the acceleration actually obtained compares favorably with that found in direct-current practice.

As was true of the earlier installation, the latest equipment has been designed for operation by either direct or alternating-current. A change has been made in the new equipment in that for direct-current service the four motors were formerly placed in two groups of two motors in series, and these two groups were connected either in series or in parallel, while in the new equipment all motors are connected permanently in series and plain rheostatic control will be used. It is evident that the elimination of the series-parallel feature of the controller serves to simplify the cross-connecting circuits of the car.

It is believed that the particular service for which the single-phase equipment is preferable to the dirct-current is in connection with long-distance interurban work, in which direct-current will be used only within the city limits where slow speed will be necessary. Obviously such work would seldom require the motors to be placed in parallel. In regard to the disadvantage of having motors in series when the wheels of one may spin and thereby rob the others of sufficient power for acceleration, it is to be noted that the wheels tend to slip only when the car is first started from rest, under which condition the accepted practice with direct-current equipments is to have all of the motors in series. Since the armature of that motor which spins is subjected to an excess of e.m.f., it is necessary to provide each motor with insulation to withstand the highest voltage. It is to be noted, however, that the value of the current to be commutated under such conditions is even less than normal.

The motors are of the conductively-compensated series type, and hence are at once operative by either direct or alternating-current. For alternating-current work it is desirable to have the fields very much weaker than for direct-current work. For this reason the field coils of each motor are divided into two parts which are placed in parallel for alternating current and in series for direct-current. The commutating switch, which is employed for making the changes in the connection of the field coils, serves also to substitute the rheostatic for the variable-voltage control as desired, and to insure that the main oil switch to the auto-transformer is open when the direct-current connections are made, and to hold the main direct-current switch open when the auto-transformer is being used.

The half field circuit of each motor is connected in series with the corresponding half circuits of the other motors, thus forming two separate field circuits for the four motors. The four armatures and the four compensating coils respectively, are permanently connected in series, making only one armature circuit and one compensating circuit for the whole equipment. Since the change of the field circuits from series to parallel connection is accomplished by means of the commutating switch, the wiring of the reversing drum of the controller is as simple as though it were intended for a single motor.

The motor for driving the compressor of the air brake equipment is of the same type as the main car motors, and is provided with two field circuits which are placed either in series or in parallel by the commutating switch, according to the character of the current by which it is to be driven. This motor is so designed that when the field circuits are in series it may be operated from the direct-current trolley circuit.

The circuits of the new equipment, as now being installed, are shown in the diagram of Fig. 1, which represents also the most recent practice of the General Electric Company with reference to equipments intended for operation by both direct and alternating-current.

INDIANAPOLIS-RUSHVILLE LINE.

The line of the Indianapolis & Cincinnati Traction Company, between Indianapolis and Rushville, Ind., which began operation early this year, is at present the most important of the several single-phase roads in the United States. It is a road operating very heavy cars at very high speeds, the cars weighing about forty-eight tons and running at maximum speeds of about 70 m.p.h. A description of the equipment of this road was given in the issues of this journal for February 18 and March 18, 1905.

Most of this 40-mile road is on a private right-of-way, with a 3,300-volt trolley hung from a catenary wire supported by brackets. The transmission voltage is 16,500. In Indianapolis the cars operate from the regular 525-volt, direct-current trolley circuit. Two different kinds of current supply must, therefore, be provided for on the motor cars. Each car is equipped with four Westinghouse series commutator motors rated at 75 hp each, with compensating field windings. Electro-pneumatic train control is employed. For direct-current operation in the city of Indianapolis, rheostatic control is provided. For operating on alternating-current, voltage control is obtained by using two different taps from the transformer.

The motors have field cores of laminated iron, which fit inside an outer casing of cast steel, which forms the frame of the motor. The field poles are slotted like the stationary armature of an alternator. The main field coils surround the field poles in the usual manner. The compensating windings occupy the slots in the field poles, so that they overlap the field coils. Thus one side of a compensating coil occupies a slot in one pole piece while the other side of the coil occupies a slot in an adjacent pole piece. The armature is lap wound and therefore has cross connections like many generator armatures. The armature winding is connected to the commutator by spark-preventing leads of German silver bars which have the same function as the preventive resistance used in many forms of alternating-current controllers. These leads extend the length of the armature and are placed in the bottoms of the coil slots. The copper windings are connected to the German silver commutator leads at the opposite ends of the armature from the commutator, at which point the cross connections are placed.

A sliding contact bow trolley is used in the country on the high tension trolley wire. The ordinary wheel trolley is used in Indianapolis. The bow has a flat contact surface 4 ft. long by 5 in. wide, made of an aluminum alloy. It is raised and held against the wire by compressed air.

The results of the first eight months of operation of this road are such as to be most gratifying. Although there have been troubles, as there always are when new devices are being tried for the first time on a large commercial scale, these have all been of minor importance. The important and fundamental troubles, which were most to be feared, have not shown themselves. Sparking at the commutator seems to be less if anything than on direct-current railway motors. Practically all of the troubles experienced can be traced to the necessity for haste in getting out apparatus in order to place the road in operation in a specified time. For example, the motors used were intended for operation by 250 volts alternating current with a non-grounded circuit, or, in other words, on a purely alternating-current system, such as first outlined by Westinghouse engineers. Operating these on a 500-volt grounded circuit, as was necessary in this case, resulted in a number of motor burn-outs, due to insufficient insulation. This trouble was stopped by rewinding the motors with heavier insulation. It is not one that is inherent in the system and there is no reason to expect further unusual trouble from this source. Tests made to determine the heating of these motors in service show that they are within the safe heating limit. The trouble, therefore, was due entirely to insufficient thickness of insulation.

The sliding-contact bow trolley is proving an entire success and has required much less experimental work to perfect it than was expected. The wearing surface has probably as long a life as would be the case with a trolley wheel under the same service conditions, namely, on 48-ton cars running between 60 and 65 m.p.h., and perhaps even longer. The life of the wearing surface is from one to two weeks, and there is a strong probability that it can be increased by staggering the trolley wire more than at present. The tendency now is to wear grooves in the bearing surface. Even if the sliding bow did not possess a life as long as the trolley wheel, the freedom from the possibility of its leaving the wire at high speeds makes it immeasurably superior to the wheel trolley. The wearing surface of the bow trolleys consists of three pieces of aluminum alloy fastened to a wood back. Two angle pieces which form the edges have about one inch width of wearing surface (see Fig. 1). There is a flat plate three inches wide in the middle. Between the pieces is left a large crack in which grease is placed. The whole wearing surface is liberally greased when in service. These contact plates would last much longer if the wear were more evenly distributed over them. At present a groove usually wears through at one point. By putting in a new piece at this point but little material is needed to make the contact surface nearly as good as new. The tendency of the wire to wear grooves can probably be very much reduced by staggering the trolley wire to the right and left of a center line more than has yet been done. Provision for staggering the trolley wire was made in the design of the overhead work. The insulators which support the catenary cable are in saddles which can be moved either way from the center. Owing to the necessity of operating with the common wheel trolley when the road first started, the trolley wire has not been staggered as much as is possible. The aluminum wearing plates weigh about 5.5 pounds, while a brass trolley wheel weighs about 4 pounds.

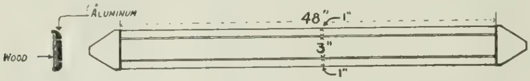


FIG. 2.—PLAN AND CROSS SECTION OF ALUMINUM WEARING SURFACE.

The cars, as now operated when on the 3,300-volt lines, accelerate more slowly while starting than is usual with direct-current cars. The acceleration is very similar to that of a steam train of five or six cars. The acceleration has been placed at a low value in order to reduce the maximum current at the power station. During the latter stages of acceleration the rate of acceleration is more rapid than is frequently found on direct-current lines because of the low line losses. The time tables show that these cars make the fastest schedules of any cars leaving Indianapolis. Express trains make the run of 40 miles from Rushville to the center of Indianapolis in one hour and thirty minutes. Local trains make it in one hour and fifty minutes.

The car equipments have been somewhat improved, lighted and simplified since the description which appeared March 18. In passing from direct to alternating current or the reverse it is only necessary to change from wheel to bow trolley and to throw two small switches in the cab. One of these switches is a part of the master controller and effects the necessary changes in the connections of the control circuits, and the other is an ordinary single-pole, double-throw knife switch, which controls the lighting and pump motor circuits. The air pump motor operates like the main motors on either direct or alternating current.

After all is said and done the surest indication that the single-phase system is believed by the owners and engineers of this property to be the best for the purpose, and that it is more satisfactory than a direct-current system for these conditions is the fact that the company has decided to equip its line from Indianapolis to Shelbyville with the same system. This line is at present a direct-current road which has been in operation several years and was recently bought by the Indianapolis & Cincinnati Traction Company. The decision to replace the direct-current system on the Shelbyville line with the single-phase, alternating-current system was reached only after full consideration by the management of the company and upon recommendation of Sargent & Lundy, consulting engineers. Although this change involved the throwing out of considerable direct-current apparatus, the advantages of the single-phase system were considered by the engineers as ample justification for this move. When the Shelbyville division is changed and the extensions now under way have been completed the company will own over one hundred miles of single-phase trolley wire.

PONTIAC-ODELL LINE.

The Bloomington, Pontiac & Joliet Electric Railway is a single-phase road equipped by the General Electric Company, which began operation between Pontiac and Odell, Ill., March 15, 1905 a distance of 10.4 miles. This equipment was described in the issue of May 6, 1905. The most notable thing about the operation of this road is the uneventful way in which it has maintained its regular schedules from the beginning without any mishaps. From March 15 until about August 1 there was but one car. This left no equipment as a reserve until the second car arrived in July, but the regular schedule of eight round trips per day between Pontiac and Odell was maintained without interruption. In other words, over 23,000 miles was made by this first car in regular service before it was possible to take it off the road to make any repairs that could not be attended to between 9 p.m. and 7 a.m. For over two months there was no car shed, so that inspection and repairs had to be carried on outdoors. This would have been an unfortunate state of affairs had the equipment required much care, but as it did not require this care it speaks more for the satisfactory operation of the equipment than anything else that can be said. Of course, small minor improvements suggested themselves, but on the whole there is very little to say about the performance of the single-phase equipment on this

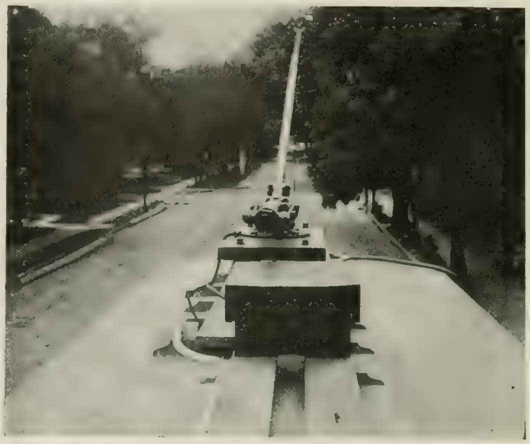


FIG. 3.—CONDUIT AND FUSE BOX FOR 3,300-VOLT WIRE ON TOP OF CAR.

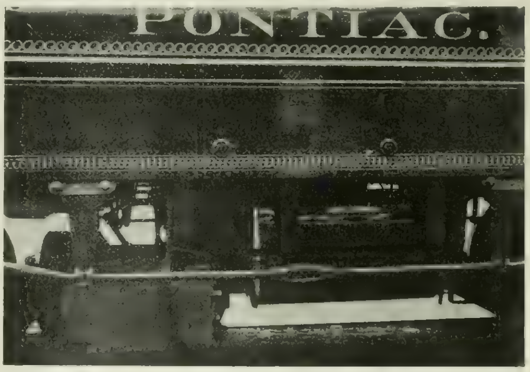


FIG. 4. COMBINATION ALTERNATING-CURRENT AND DIRECT-CURRENT PUMP MOTOR AND MOTOR CUT-OUT SWITCHES.

road for the reason that it has behaved itself very much as would be true of any good direct-current equipment operating under the same conditions.

The car makes a round trip of 20.8 miles between Pontiac and Odell in one hour, there being eight round trips per day, as explained before. The first car received had motors similar to those on the Schenectady-Ballston line, where this type of motor was first tried. The second car has an improved motor and a different method of control. The first car carried a step-down transformer. This transformer had various taps from the secondary. The controller was arranged to start the motors with a low-voltage tap and gradually increase the voltage by changing the connections to higher voltage taps. To avoid short-circuiting the transformer section between taps at the instant of moving from one point of the controller to the other, a resistance was momentarily placed in series at the instant a section of the secondary was cut in or out. This resistance was in circuit only between the controller points. The new controller is similar to the old except that a compensating coil is used instead of a transformer and various taps are taken from the compensator to the controller.

The new equipment is such that it can be readily adapted to operate also on a direct-current line by the addition of throw-over commutating switches and resistance.

The catenary form of overhead construction is used on this line. Cars are equipped with the ordinary trolley wheel. The original intention was to support the trolley wire from the catenary wire at intervals of 10 ft. As yet much of the line is equipped with supports only midway between the poles. The arrangement seems to work very well. The current is taken from the trolley base in iron pipe conduit to an oil switch located under one platform and from thence to the compensator. The lightning arrester and fuse box are located on top of the car. One of the accompanying engravings (Fig. 3) is from a photograph taken from the top of the car, showing the iron pipe conduit and fuse box. The fuse is of the expulsion type and is placed in a fibre tube. A peep hole covered with mica, as seen at the near end of the fuse box in the engraving, makes it possible to see whether a fuse has blown without opening the box. The new car weighs complete about 31 tons and is 41 ft. overall.

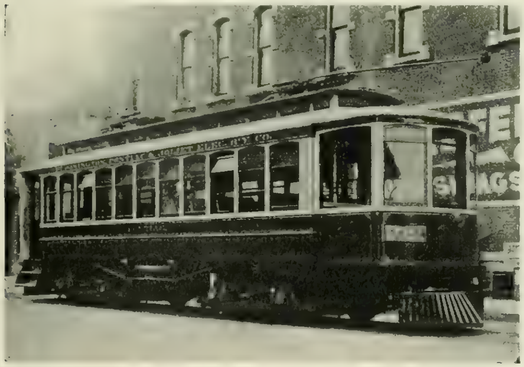


FIG. 5.—VIEW OF EXTERIOR OF CAR.

The acceleration for the first two or three seconds is not nearly as rapid as with direct-current equipments, but after that the speed increases fully as rapidly as in ordinary direct-current practice.

To sum up, it can be said that this little road in the first six months of its operation, has had a car mileage of over 30,000 miles. It has carried over 60,000 passengers, making schedule speeds including layovers at terminals of 20.8 miles per hour. This is a type of road where economy in construction was of first importance as the population per mile of track did not justify expensive construction. When completed from Pontiac to Dwight, the road will be about 20 miles long. The cost, as nearly as can be judged, will be considerably less than for an equally well constructed direct-current road of the same length.

This road is under the management of J. A. Carothers, president, and F. L. Lucas, general manager. The Arnold Company, of Chicago, acted as consulting and constructing engineers.

Maximum Demand.

BY J. S. CODMAN.

Of late a large number of electric light companies have adopted systems of charging for their product by means of which the rate per kilowatt-hour to a customer decreases automatically as the number of hours used per month or per year of his lights or other apparatus increases.

In all these systems the result is accomplished either by splitting up the charge to the customer into two portions, one based on his demand and the other on his consumption as suggested first by Hopkinson in England; or by charging the customer a high rate for a portion of his consumption equivalent to a certain number of hours' use of his demand, and a low rate for all in excess, as later suggested by Mr. Arthur Wright.*

In this country the first method is used, notably by the Cataract Conduit & Power Co. in selling Niagara power; and a slight modification of it is Mr. Doherty's "Readiness to Serve" system. The second method, in slightly different forms, will be recognized as in use in Boston, Chicago, Cincinnati, Cleveland, Detroit, Minneapolis, St. Paul, St. Louis and New York, and in numerous smaller cities.

Now, although the above mentioned companies, as well as those using the "Readiness to Serve" system, all make a charge to the customer based on his demand, there appears to be a great diversity of opinion among them as to the manner in which it is best to determine the demand, and it is this question which it is the object of this paper to discuss.

METHODS OF DETERMINING DEMAND.

1. *Demand Assumed Equal to Connected Load.*

It is the practice of some companies to assume that the customer's demand is the maximum demand possible, which is, of course, the connected load.

This practice is open to very grave objections and the principal one is that the customer's connected load is an unfair basis of charge. In all these systems under discussion the demand charge is supposed to roughly represent the customer's share of the fixed expenses of the station. Now the fixed expenses of the station are ultimately determined by its capacity and its capacity is determined by the demand of its customers. Further, it is the actual maximum demands of the customers which determine the plant capacity, and not the number of lights they may happen to have connected if these are never all in use simultaneously. One customer's maximum demand may be only one-half his connected load, while another's may be the whole of his connected load. It is manifestly unjust that the demand charge to them both should be the same.

There are also numerous practical objections to the use of the connected load as a basis of charge.

At the beginning of a contract a customer's premises can be inspected, the number of outlets can be counted, the candle-power of the lamps or the capacity of other apparatus connected to each outlet can be noted, and in this way the connected load ascertained. But after the connected load is once ascertained it becomes necessary to require the customer to agree to make no change in his installation without notifying the company. Such a requirement is objectionable, insomuch as it seriously impairs one of the great advantages of electricity, viz., its flexibility of use. The customer cannot change the candle-power of his lamps, substitute a fan or heating device in place of a lamp, nor connect apparatus to an outlet not in use before without consulting the company. Furthermore, in spite of agreements to the contrary, a customer either wilfully or through ignorance of his agreement will often make changes without notifying the company and the latter has no means of knowing when this is done unless frequent inspections of the customer's premises are made. Such inspections are an intrusion on the privacy of a customer and are sure to be an annoyance to him. Also, if they are made frequently enough to be of any use, they become a heavy expense to the company.

Another objection to the use of the connected load as a basis of charge is that it discourages the extensive use of electricity. If a customer is to be charged for every additional piece of apparatus connected he will be inclined to connect as few as possible and may even go so far as to use electricity in certain parts only of his premises and in other parts to use other means of obtaining light and power.

---

* "Profitable Extensions of Electricity Supply Stations," read at twentieth convention of the National Electric Light Association in 1897.

It is safe to say, however, that there are but a very few companies in the United States to-day which make use of the connected load as a basis of charge. There are a number that appear to do so, if we judge by their printed forms of contract with customers, but if investigation is made it will be found in almost every case that the word "lights" or "installation" occurring in the contract form is not taken to mean "all the lights" or the "total installation," but is really the customer's maximum demand either estimated or measured by an instrument.

2. *Demand Estimated.*

As just previously stated the estimated demand is used as the basis of charge by many of the companies which appear to be using the connected load, and there are other companies which clearly make the estimated demand the basis of charge even in their printed contracts. This is better practice than the use of the connected load, as the actual maximum demand of the customer is a fair basis of charge.

The principal objection to this practice is, of course, that the estimate is liable to be inaccurate. In the smaller companies a separate estimate can be made for each customer, but in the larger companies it is hardly practical to do this, and it is, therefore, usual to assume the maximum demand for each class of customers as a certain percentage of the load, as for example, [illegible] for residences, 75 per cent for stores, and so on.

The other objections to the use of the estimated demand are practically the same as for the connected load basis. Since the estimate must be based on the connected load, it is not possible to permit the customer to make changes unknown to the company. This necessitates frequent inspections of the customer's premises, which, as before stated, are an annoyance to the customer and an expense to the company. Also in order to keep the estimate of his demand low the customer will be discouraged from extending his connected load.

3. *Demand Measured.*

Measuring the customer's demand with an instrument is a practice which has numerous advantages, the first of which is that the demand can be obtained with accuracy. Further, a customer can freely make changes in his apparatus installed without stopping to notify the company, as his demand will be recorded on the instrument. For the same reason no inspections of the customer's premises are necessary other than the ordinary ones to see if the installation is safe and that no connections are made back of the measuring apparatus. The maximum demand indicator also acts as a guide in determining the proper size of watt-hour meter and, if this information leads to the use of smaller watt-hour meters there may be a considerable reduction made in the loss due to their slow running or stopping when operating on light load. Another advantage of the measured demand is that the customer need not hesitate to connect as much apparatus as he wishes. The demand indicator will show only the power supplied to such apparatus as may be simultaneously in actual use.

The disadvantage of the measured demand is, of course, the necessity of using an instrument. This means, in the first place, the expense of purchasing and installing, and afterwards expense of maintaining, reading and resetting. Also additional resistance is introduced into the line, absorbing energy and injuring the regulation. Still these arguments could also be urged against the use of a watt-hour meter, and they are not valid if in the actual instruments used these objections are reduced to a minimum, which can be done.

Another objection is sometimes urged against the use of the measured demand. It may happen that a customer on some particular occasion, such as the giving of a ball or other entertainment, may have a demand greatly in excess of what is usual, and it is argued that as on such an occasion the demands of his neighbors at the same time are less than usual, he should not be charged for the unusual demand. Also, if the company agrees to cut out the indicator for such an occasion provided due notice is given, this notice is often forgotten and in any case is a nuisance.

The best way to overcome this objection is to assume the customer's demand as the average of several months' reading of the indicator instead of the highest reading obtained. This is the method adopted in the power contracts of the Boston Edison Co. where the customer's annual maximum demand is taken as the average of the monthly readings of his demand indicator for the months of October, November, December and January. It should be noted, where the demand is taken as the highest reading of the indicator for the year or as the average reading of several months, that in the case of a new customer the demand must be estimated until the proper readings can be taken.

In all that has been said above it has been assumed that the customer's demand was his demand for the year and that each month's bill was therefore made out on the basis of the same demand. Where, however, a contract for a year is not made, but a reading is taken from month to month, it is the practice of some companies to base the demand charge on the monthly maximum. This makes a simple system, as the estimate above mentioned does not have to be made, and the customer's bill is determined wholly by the monthly readings of his demand indicator and watt-hour meter.

Some companies combine the measured demand with the estimated demand. Instead of installing a demand indicator on all their customers except the smallest (generally a company cannot afford to assume the maximum demand of its smallest customers as anything less than the connected load) a company will use the indicators to check doubtful estimates, or as a means of detecting a dishonest customer. With this method the indicator is not necessarily permanently installed, but may be moved about from one customer to another.

4. *Demand Limited.*

Still another practice is to determine the maximum demand by agreement with the customer and then to make it impossible for him to exceed this demand. As it would not be expedient to use any means of limiting the customer's demand, which would actually cut off his service, the limiting is usually done by means of a device which will cause his lights to flicker the moment the agreed upon demand is exceeded.

This practice, as compared with the measured demand, has the advantage of positively determining the demand in advance, and it avoids the indicator readings necessary with the measured demand. It has the disadvantage of causing irritation when a customer on an occasion wishes to exceed his demand and finds he cannot do so. The owner of a large residence would probably strongly resent any interference with the use of such lights as he might at any time turn on and it would nevertheless be difficult to make him agree to a demand very much higher than what he usually expected to have. On the other hand, it may be said that many small customers would prefer to have their demand fixed and thus be prevented from inadvertently exceeding it and thereby raising their bills. It would seem that a judicious use of both the measured demand and the limited demand methods of charging might be found advantageous.

	Connected load.	Demand estimated.	Demand measured.	Demand limited.
Advantages -		Fair basis of charge.	same	same
	No instrument.	same.		
	Demand fixed in advance.	same.		same
			Notifications not necessary.	same.
			Inspections unnecessary.	same.
			Accurate determination.	same.
			Large connected load not discouraged.	same.
Disadvantages -				
	Unfair basis of charge.			
			Instrument necessary.	same.
			Demand not fixed in advance.	
	Notifications necessary.	same.		
	Inspections necessary.	same.		
	Inaccurate determination.	same		
	Large connected load discouraged.	same.		

In closing there is given above a summary of the advantages and disadvantages of the different methods of determining demand.

Spark Gaps.

By JAMES FOSTER KING.

TO secure the best efficiency from a spark gap in a space telegraph transmitter, the designer is confronted with a paradoxical proposition whose component parts, when analyzed by themselves and then collectively, are characterized by the imposition of at least two widely differing physical conditions.

In order to enhance the difference between these two conditions, namely, the unenergized non-conductive state and the energized or finally highly conductive state—it has been found necessary to apply boundary conditions whose gradient is both steep and short.

In the application of a potential difference to the metallic boundaries of a circuital discontinuity, there is first a transition of the impressed energy residing on the boundaries to the surrounding medium in the form of an electro-static charge.

The surface temperature rise produced by the heat developed in this transition and the temperature of volatilization of the metal terminal determines the stability of the terminal structure. There can be no highly conductive spark from a positively charged terminal until this critical temperature is reached and a structural instability is established.

For an impressed potential difference, the charge that is radiated from the positive terminal is proportional to the potential, the specific inductive capacity of the surrounding medium, and inversely as the separation of the bounding surfaces of the system. The heat developed is proportional to the square of the current of charge, and the resistance, which in turn is a function of the separation and assumed sectional area through which this charge is appreciably felt.

As the heat developed in the transition depends principally on the current of charge, it is impossible to increase indefinitely the length of gap (even though the impressed potential difference may be greatly increased thereby) and develop the charge necessary to volatilize the positive terminal surface, and still conform with the general resistance imposition after the spark is fully developed.*

There are many ways open to the designer to increase the current of charge in the transition by modifying either the structural conformation of adjacent terminal surfaces from two elementary points to parallel plates of any suitable area, or the specific inductive capacity of the surrounding medium or both.

To render the energy transfer through the gap most sudden, the time-period of the transition should be inappreciably longer. This period depends on many factors, the principal one being the time required in raising the sparking surface above the critical temperature of the metal from its initial surface temperature. The actual temperature of the terminal depends on the present force and the previous temperature condition of the surface.

The temperature rise necessary to produce volatilization with liquid terminals is small, while that necessary to volatilize solid terminals is comparatively great. To secure short periods of transition with terminals of metals having high critical temperatures, the current of charge must be large. Any visible indication of discharge during the period of transition is termed the brush or corona.

Where the terminal surfaces approach one another, the current density of charge is increased, and the temperature developed is relatively greater. Such point or points form the base upon which a highly conductive vapor filament is developed and projected through the path of least resistance to the oppositely charged terminal surface. Usually this filament is initially of infinitely small diameter, which becomes greatly enlarged after it has effected a junction with the negative boundary; which junction determines the collapse of the previously existing static field. This collapse of the static field liberates a large quantity of kinetic energy in the form of a current increment which, added to the normal flow, so increases the temperature and amount of vapor in the arc as to materially increase its volume.

The free chemical dissociation, *i.e.*, the indefinite diametrical enlargement of an arc of terminal vapor of any particular gradient for heat capacity is limited by the rate of heat absorption by the surrounding medium. If this heat absorption is constant, the ratio of expansion of terminal vapor for different temperatures is constant. Consequently, the diameter of the spark depends on the heat absorption, the heat capacity gradient and the current.

As most metallic vapors combine with oxygen, the effects of a heterogeneous mixture with their oxides have to be considered when determining the specific resistance of a spark for its various temperatures. The relative electrical conductivities of a pure metallic vapor and a heterogeneous mixture of that vapor with its oxide differ inappreciably for the high temperature of incandescence attained during the maximum of current flow in a spark, although the specific heat capacity of this oxide may be infinitely less than its parent metal at ordinary temperatures. The resistance effect of the oxides become most apparent when the vapor is condensing.

After the current flow through the arc has reached a maximum and the impressed exciting force is reduced to zero, this arc undergoes a period of decline which results in its ultimate extinction. The length of the period of extinction depends primarily on the rate of vapor condensation allowed by the existing current flow.

If the surrounding medium will support oxidation, the periphery of the vapor column will alone become oxidized. All effects must therefore be transmitted through this layer by external influences.

During the decrease of heat developed in the interior of the spark, this fictive layer of oxide will be first exposed to the cooling effect of the surrounding medium, and will consequently first contract and alter in electrical conductivity.

At temperatures below incandescence, the specific heat capacity of a cooling metallic vapor column becomes greater and the heat stored in individual ions is increased.

Under the force of contraction due to the collapsing oxide boundary the free ions are gradually forced into contact with one another solidifying the structure and equalizing the temperature en masse. Owing to the comparatively greater heat capacity of the solid terminals, these free viscous particles adhere to them in the form of minute though visible burrs. The metallic ions, remaining free, are carried away with the oxides in the form of an infinitesimal powder by convection currents, set up by temperature differences in the surrounding medium, leaving the gap free from conducting ions.

The foregoing may be considered a history of conditions existing in the spark gap and is divided according to logical sequence into the developments of the spark from an initially non-conductive through a highly conductive to a declining state.

Where the character of energy transfer through the gap is oscillatory as in the case of a closed circuit oscillator including an inertia coil, a spark gap and reflecting condenser there are two sparks during a complete period of oscillation, either terminal being alternating positively charged.

Where there is a succession of sparks controlling appreciable amounts of energy, the initial temperature of the spark terminal surfaces mentioned before will rise considerably higher after the first spark has passed than the actual temperature before the first transition.

Some Approximations of the B. & S. Gauge and of the Properties of Copper Wire.

By C. P. NACHOD.

THE Brown & Sharp or American gauge of wire diameters is a geometrical series having .4600 = No. 0000 wire for the first term, and .005 = No. 36 as the fortieth term, the series being extended, however, to No. 40 wire, the forty-fourth term. The relationship is, therefore,

$$.4600\, r^{39} = .005.$$

whence r is found to be .89053.

Denoting the gauge number of the wire by n, the sizes 0, 00, 000, 0000 having the values 0, −1, −2, −3, respectively, the equation for the diameters is

$$d = .46 \times .89053^{n+3}.$$

For the circular mils area, the ratio being the square of that for the diameter, the equation is

$$cm = .46^2 \times 1000^2 \times .89053^{2(n+3)} = 211{,}600 \times .79305^{n+3} \qquad (a)$$

These equations when evaluated will give results corresponding exactly with the tables; but it is easily seen that they are not convenient for reconstructing the table quickly in the absence of it. By making $r^6 = \frac{1}{2}$ (it being more exactly .49873) a great simplification results; and it is then evident that for every numerical increase of six sizes the diameter is halved, and that for every increase of three sizes the sectional area is halved. This approximation involves—assuming the respective series are identical at the No. 40 end—a total departure of 3.6 per cent at the other end, less than the table.

---

*See ELECTRICAL WORLD AND ENGINEER, April 15, 1905, page 710, formula (5).

This approximation may be expressed in various equations, which may be conveniently evaluated for every third size, all involving the same total error, but varying in the distribution of it. Among the simplest of these are:

$$cm = 2^{\frac{50-n}{3}} \qquad (b)$$

$$cm = 10 \times 2^{\frac{40-n}{3}} \qquad (c)$$

$$cm = 25 \times 2^{12-\frac{n}{3}} \qquad (d)$$

$$cm = \frac{2^{20-\frac{n}{3}}}{10} \qquad (e)$$

Equation (*b*) coincides with the table at No. 17, which is near its middle, whereby the error at the ends is divided. It will give integral exponents for any size one less than a multiple of three. Equation (*c*) coincides with the table between No. 25 and No. 28, and gives integral exponents for any size one greater than a multiple of three. Equation (*d*) coincides at No. 36 and equation (*e*) between No. 6 and No. 9. They both give integral exponents for sizes that are multiples of three.

Any one of these equations is sufficient to cover all sizes by approximating the ratio as .8 for the next larger or smaller size, and dividing or multiplying by this as the case may be.

It is well to remember also a few of the higher powers of 2, as $2^{12} = 4096$, $2^{6} = 64$; by which the equation can be easily handled.

An inspection of the table shows that for each numerical increase of ten sizes the cross-section is approximately divided by ten.

From the circular mils the other properties can be very quickly gotten, as follows:

$$\text{Dia. in mils} = \sqrt{cm}$$

$$\text{Weight per thousand feet} = \frac{cm}{330}$$

$$\text{Resistance per thousand feet} = \frac{10400}{cm} \text{ at about } 70^\circ \text{ F.}$$

Mercury-Vapor Lightning Arresters and Circuit Breakers.

Five patents were issued September 12 to Mr. Peter Cooper Hewitt for apparatus using mercury vapor as a conductor of electric current. One of the patents relates to lightning arresters, while the others deal with circuit-breakers.

Fig. 1 shows the circuits of the arresters, the operation of which depends upon the quality of mercury vapor of possessing a high initial electrical resistance which can be overcome by a sufficiently high potential. The apparatus is deranged to resist the normal potential of the line, but will permit current to pass when the potential reaches a certain higher voltage. Should an excessive potential be impressed upon the main conductors by a lightning charge, when it reaches the predetermined limit, it will traverse the vapor apparatus and will be dissipated through a discharge or a succession of discharges through the apparatus to earth. When used on alternating-current circuits, as soon as a lightning discharge shall have overcome the normal resistance of the apparatus, the current will be immediately cut off at the first alternation, since the negative electrode resistance immediately re-establishes itself unless the flow is continued in the original direction. Accordingly the line current will not follow the lightning discharge to earth and the circuit will not be grounded. When the apparatus is applied to direct-current circuits, the same effect of cutting off the flow of current will be brought about by the fact that the particular apparatus applied to the circuit is so designed as to develop too much heat under the influence of the normal current in the circuit to permit the current to flow.

One form of circuit-breaker is illustrated in Fig. 2. The vapor apparatus is here shown in shunt to a switch. The junction of the apparatus is to prevent excessive sparking or an injurious rise of voltage in the circuit when the switch is opened. The apparatus is provided with two starting bands, one near each electrode, which are connected to the secondary terminals of a transformer. By this arrangement of devices the vapor apparatus, which is short-circuited when the switch is closed, will, when the switch is opened, have impressed upon it not only the full voltage of the current at the electrodes, but also a secondary voltage at the starting bands. These combined effects are sufficient to start the vapor apparatus and permit a temporary flow of current through it, thus relieving the sparking at the terminal of the switch. Any tendency to maintain an alternate flow of current through the vapor device will, however, be defeated by the development of too great density of vapor in the apparatus, which is designed in this instant for suppressing the flow after the first passage of current has performed its function of relieving the hand switch. In a modified form of circuit-breaker, the rupture of the circuit within the vapor apparatus takes place through the action of a magnet upon the current passing through the gas. The effect of the magnet is to deflect the current passing through the apparatus which is so designed as to allow the deflection to be sufficiently great to interrupt the current. The circuits are indicated in Fig. 3, where two supplemental electrodes perform the function of starting bands.

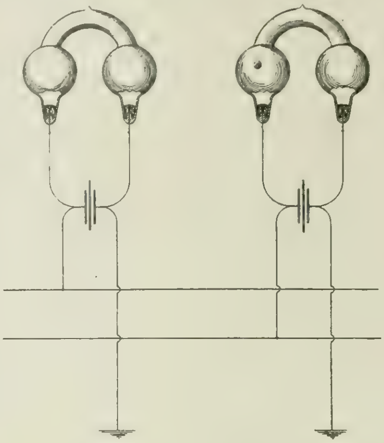


FIG. 1.—LIGHTNING ARRESTER.

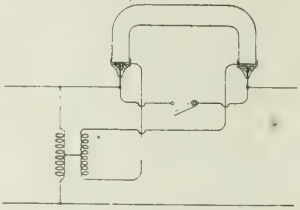


FIG. 2.—CIRCUIT-BREAKER.

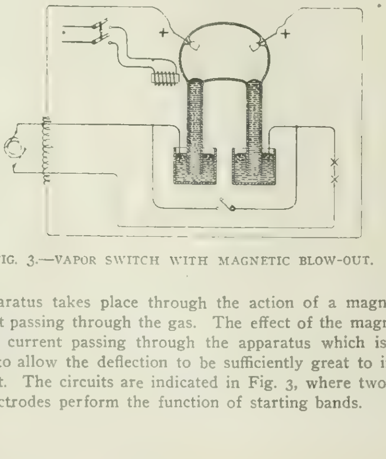


FIG. 3.—VAPOR SWITCH WITH MAGNETIC BLOW-OUT.

New Telephone Patents.

CORDLESS SWITCHBOARD.

The fact that the cords of a manual exchange switchboard are one of the most vulnerable parts with respect to necessary wear and tear, has led to many attempts, all more or less crude, to obviate their use. We have at hand for consideration a cordless switchboard, the invention of J. L. Wright, of Cleveland, Ohio. In this switchboard there are arranged behind a face plate a set of contact plates. For each jack aperture there is a sliding jack which, while maintaining contact with its line, is adapted to connect with any pair of contact plates, according to the distance it is pushed back from the face plate. The plugs are made in assorted lengths and assembled in pairs by thongs of leather or fibre. As each plug of a pair is shoved home, the jack of the line is pushed back into contact with the corresponding connecting plate.

LOCK-OUT COMMON BATTERY SYSTEM.

A lock-out for common battery party line systems has been patented by M. P. Boone, of Peru, Ind. This requires at each station a high inductance relay, bridged from the grounded side of the line to ground. The armature of this, if the coil be energized, swings as a latch to block the hook switch springs. If the two limbs of a line be bridged together at any station there arises a difference of potential between the ground and the grounded side of the line to operate the lock of all stations save the one which made the bridge.

ANTI-HUM.

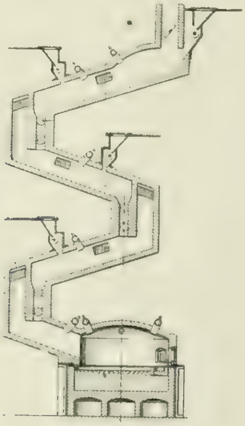
B. P. Bartlett, of Norway, Kan., has patented an anti-hum device for insertion in service wires which hum disagreeably. It consists of a double dead-ending insulator with a central longitudinal hole through which the insulated tie wire, connecting around the lead ends, is led.

Recent Electrochemical Developments.

ELECTRIC FURNACE PROCESSES.

A patent recently granted to W. von Bolton for purifying tantalum metal in the electric furnace is interesting since it covers the method which, according to the latest reports, is now used for the manufacture of the pure tantalum required for the filaments of the new tantalum lamp. The use of electric heat is necessary, since a very high temperature is required.

The process of purification of tantalum from impurities, especially from tantalum oxide, is based on the fact that the oxide is volatilized sooner than the tantalum metal itself. The process is carried out in a vacuum, since at the high temperature employed the tantalum metal reacts with nearly all known elements.



BENJAMIN FURNACE.

A patent recently granted to E. Stassano refers to details of construction of a revolving electric arc furnace. The furnace chamber revolves around an axle inclined to the vertical. This furnace is the same which, according to the report of the Canadian Commission, is now used in the Government Gun Foundry in Turin, Italy, for steel refining. According to this report the furnace consists of a cylindrical outer casing of iron surmounted by a conical roof; it is lined with magnesia brick. The axis of the furnace about which it rotates during the operation includes an angle of 7° with the vertical. Three-phase currents at 90 volts between the phases and 400 amp. are supplied through three electrodes which nearly meet in the center of the furnace. Their distance apart is varied by a hydraulic regulator.

G. H. Benjamin has recently patented a furnace which appears to be mainly intended to be used for glass manufacture. The chief feature is that fluxes with lime are introduced into the sand at successive points in its line of travel from the place where it is charged into the furnace until it reaches the tank of the furnace. The furnace is so designed that the light materials in the form of fluxes are not subjected at the time of their introduction into the furnace to the carrying action of flames or air currents on their way to the exit flux from the furnace. The accompanying illustration shows the construction. The circular tank is at the bottom. Extending from one side of the tank and in an upward direction is a flue in form of a series of communicating inclined and vertical passages. All vertical passages are divided into two compartments, the outer ones forming by-paths for the products of combustion which flow to the chimney flue, while the inner compartments form the connection between two succeeding inclined passages. These inner compartments contain the electrodes for the arcs. The sand falls downward through the arcs. Just before the sand reaches such a vertical passage fluxes are introduced through specially provided hoppers as shown in the illustration.

Letters to the Editors.

The Use of the Third Person in A. I. E. E. Discussions.

To the Editors of Electrical World and Engineer:

Sirs:—Will you permit me—one of the persons instrumental in bringing about the change—to add a word to your reply to Mr. Behrend's letter in your issue of September 9, regarding the use of the third person in the reports of the discussions before the American Institute of Electrical Engineers?

Your comments on Mr. Behrend's letter cover the matter practically conclusively, but I think you could have dwelt more strongly on the one claim that Mr. Behrend makes for the use of the first person—that is, "individuality." So far from preserving the "individuality" of the speakers, I believe it to be highly desirable to suppress it as much as possible; the discussions are designed to preserve technical information, and not to exploit a mass of ill-digested opinions, expressed in ungrammatical and slovenly language, which constitutes almost invariably the only "individuality" of the manuscript of the discussions. It was my duty, as chairman of the Editing Committee, to look over a large mass of this stuff (for there is no other word for it), and the more I read of it the more firmly I was convinced that ninety per cent of it should be suppressed, and I did suppress as much as I possibly could, against strenuous opposition in many cases. As far as I can remember, there is but one member of the Institute whose extemporaneous remarks are fit for printing, as taken down by the stenographer.

Mr. Behrend's specific criticisms are well enough, but they prove simply that the editing in this case, and doubtless in many others, was not well done. The Institute is not able to pay a sufficient force to do this work properly, and a large amount of clerical work was thrown on the Editing Committee, and in consequence did not receive the attention it deserved. I believe that no one acting on the Editing Committee can fail to come to the same conclusion—that is, that the bulk of the discussion should be suppressed, and the remainder of it carefully edited and put in the third person, thus making it as innocuous as possible.

New York. Cary T. Hutchinson.

Alternating-Current Nomenclature.

To the Editors of Electrical World and Engineer:

Sirs:—The point brought up by Mr. Woodbridge in regard to alternating-current nomenclature is an important one, since the difference he mentions has given rise to considerable confusion. The difficulty originated not so much in the conception of a vector rotating in a clockwise direction, instead of counter-clockwise, as in the use by Dr. Steinmetz of polar co-ordinates, i. e., in the representation of instantaneous e.m.f's or currents by the length intercepted on a revolving line by a fixed circle instead of by the projection of a revolving line on a fixed vertical line.

This point came up for discussion at a meeting of the A. I. E. E., the subject being introduced by Dr. Kennelly, who complained that it was necessary to stand on one's head in order to understand Dr. Steinmetz's reactances (*Trans.* A. I. E. E., Vol. XVIII, p. 82). Dr. Steinmetz in this discussion stated his reasons for the use of counter-clockwise rotation. The subject is also discussed, in the A. I. E. E. *Transactions*, Vol. XXI, p. 589, by Prof. Franklin, who is strongly in favor of the counter-clockwise method.

The fact is that up to the time Dr. Steinmetz brought out the symbolic or complex imaginary method of dealing with alternating-current problems, the universal custom, in this country at least, was to use counter-clockwise rotation as exemplified in Bedell and Crehore's "Alternating Currents" and other text-books. Dr. Steinmetz claims that the polar diagram is simpler and less artificial than the one commonly used, but, as stated by Mr. Woodbridge, counter-clockwise rotation is taken as positive in trigonometry and analytical geometry, and if a student who has been taught this is plunged into the study of a text-book where positive rotation is taken in the opposite direction, the whole subject is made unnecessarily confusing. In the book on "Alternating Currents," written by Prof. Franklin and the undersigned, counter-clockwise rotation is assumed throughout, and in cases where the symbolic method is introduced, the signs are changed as suggested by Mr. Woodbridge, the expression $r + jx$ being used for impedance.

Cincinnati, Ohio. R. B. Williamson.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Locating Short Circuits Between Armature Coils.—Gilliam.—A description of a device for locating short circuits between armature coils without disconnecting the windings. As shown in Fig. 1, it consists of three dry cells, a buzzer for interrupting the current and a telephone receiver. A short circuit can readily be located by passing the interrupted current from this apparatus through the winding, and then moving the leads from the receiver from bar to bar on the commutator. If there is a short circuit between the bars of the commutator or winding, there will be no audible vibration in the receiver. If, on the other hand, the winding and commutator are clear of short circuit at the point tested it will be indicated by a distinct vibration or buzzing. In the case where an alternating-circuit of 200 or 100 volts is at hand a more convenient method of finding a short circuit is to attach the leads of this circuit to almost any part of the commutator of the armature to be tested. Then the same method as before can be followed with the result that the vibration is much more distinct than in the former case, and the ceasing of these vibrations can be more easily marked—*Elec. Journal,* September.

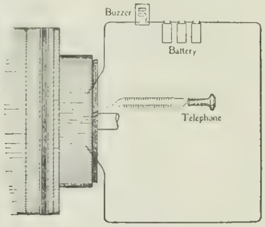


FIG. 1.—DIAGRAM OF CONNECTIONS.

Evolution of Electric Machines.—Tischendoerfer.—An illustrated lecture held before the Berlin Elec. Soc. The author sketched the development of the construction of electrical machines and gave a concise summary of modern practice in the design of direct-current and alternating-current generators and motors. He then gave the principal steps of development in the predetermination of electric machines, giving formulas as well as some empirical constants. The concluding part of the paper deals with the construction of turbo-generators and unipolar dynamos. *Elek. Zeit.*, Aug. 24.

Lights and Lighting.

Temperature of the Arc and of the Sun.—Weidner and Burgess. An account of an experimental investigation. The photometric methods based on the extrapolation of Wien's equation show that the "black body temperature of the arc" (pure graphite) is at least 3,750 deg. abs, so that its true temperature must be higher than this; it is not possible to state how much, in the absence of more definite knowledge concerning the departure of carbon from black body radiation. In the light of the best evidence that is at present available it would seem that the true temperature of the hottest part of the positive carbon is between 3,900 and 4,000 deg. abs. There is a most satisfactory agreement between the results of the different laws of the radiation at these high temperatures. If it is assumed that the Wien-Planck and the Stefan-Boltzmann relations continue to hold good for thermodynamic radiation at these high temperatures, it would seem that the phenomena of luminescence play no very important part in the radiation from the positive pole of the electric arc; for, if so, it might be expected to lead to higher values in the estimates based on the photometric methods than would be found by methods dependent on total radiation. An examination of the available estimates of the temperature of the sun, made by methods based on the photometric intensity, seems to indicate that these methods lead to higher values than those based on the energy of total radiation. Thus, using the former method, Le Chatelier finds 7,900 deg. abs. The estimates, based on total radiation and on the position of the wave length of maximum energy in the solar spectrum, lead to values in the neighborhood of 5,500 deg. to 6,000 deg. absolute. If this difference in the methods really exists it would at least suggest the presence of luminescent radiation. —*Bull. Bureau of Standards,* No. 1.

Lighting of Schools.—Mueller.—An account of experiments on the lighting of school rooms. At the outset a rule is laid down that the strength of the illumination at all points in the room should be at least 2.04 candle-feet. The first experiments were carried out in a room 25 ft. 3 in. x 23 ft. wide x 13 ft. 3 in. high. It was stripped of all furniture and fittings and the walls and ceiling were given a fresh coat of lime wash. The source of artificial light consisted of four groups of tantalum lamps with matte globes, each group containing six lamps of 22 candlepower arranged under a reflector of mirror glass at a height of from 8 to 9 ft. above desk level. This system of direct lighting was found to give a sufficiently bright and uniform light for a room of the size in question, even when allowance was made for the gradual soiling of the walls and ceiling, and the diminution in illuminating power of the lamps themselves. The illumination at writing level is not likely to fall below the 2 candle-feet required. The next series of experiments were carried out upon indirect lighting by means of arc lamps. The room used was 34 ft. long x 24 ft. 3 in. wide, freshly washed as in the former case. Two school lamps for indirect lighting were employed slung approximately from the longer diameter of the hall about 8 ft. from either end wall, i. e., about 18 feet apart. The lamps required 10.4 amperes and absorbed 1,144 watts. They were fitted with metallic reflectors, which threw all the light upwards on to the ceiling and on to a strip about 4 ft. wide at the upper part of the walls. The direct incandescent tantalum lamps which gave an illumination at working level equal on the average to 4.1 candle-feet in the first schoolroom when empty, gave an average equal to 2.85 candle-feet when the room was fully occupied with benches and scholars; i. e., it suffered a loss of about 30 per cent. The indirect arc light employed in the second hall gave a strength of illumination equal on the average to 3 candle-feet in the empty room, which fell to 2 candle-feet when the room was filled. This loss was equal to about 33 per cent. Shadows were distinctly noticeable under the direct light, but were almost entirely absent from the indirect illumination. Using tantalum lamps consuming about 2 watts per candle, the power used in the two cases was about the same.—Lond. *Elec. Rev.*, Aug. 25.

Utilizing Arc Carbon Wastes.—BERNARD.—A note stating that at the electric station in Brixen, in Tyrol, the wastes of arc carbons are pasted together and used again. Two such pieces of carbon are properly cut off and covered at the surfaces to be joined with a paste of water glass and powdered carbon and then put together with slight pressure. It is stated that an ordinary workingman does this work. Carbons thus joined together are said to be as good as new carbons whether used with direct-current or alternating-current. The resistance is not very different from that of new carbons.—*Elek. Zeit.*, Aug. 31.

Mean Spherical and Mean Horizontal Candle-Power.—FLEMING.—A mathematical paper with reference to a recent experimental investigation of Dyke on the ratio between the mean spherical and the mean horizontal candle-power of incandescent electric lamps. The author reaches the conclusion that the performance of a lamp is sufficiently well indicated by the mean horizontal candle-power taken when rotating the lamp about its vertical axis. If this reading is taken at such a distance from the lamp that the whole filament does not subtend a greater angle than 5 deg. to 10 deg. at the photometer-disk, then the mean spherical candle-power of the incandescent lamp is for practical purposes very nearly obtained by multiplying this mean horizontal candle-power by the factor $\pi/4$. From the measurement of the electric power in watts supplied to the lamp, we have at once the means of calculating the total flux of light per watt which fixes scientifically the efficiency of the lamp as an energy-transforming device.—*Phil. Mag.*, August.

Car Lighting.—TWEEDY.—Hints as to how to proceed in considering a system of car lighting. The following points should be considered: (1) The number of lamps and the candle-power of each to give the most effective distribution with the least possible intensity above a certain fixed limit: (2) the best possible distribution of the lamp: (3) the shape and finish of the roof, with special reference to the diminution of deep returns, heavy mouldings and rough surfaces. Not only will the simplest form of roof and decorations be the best for economical lighting; it will also be easier to keep clean and to maintain generally.—Lond. *Elec. Rev.*, Aug. 25.

Metallic Arc.—LADOFF.—A continuation of his summary of various investigations on the electrochemistry of the metallic arc.—*Electrochem. and Met. Ind.*, September.

POWER.

Cost of Energy for Power in a Small Engineering Works.—Some notes on the actual cost of energy used in driving a small engineering works. The various classes of tools are grouped together so as to be driven off line shafts as short as possible, and all are driven by means of cross belts and countershafts in the usual way, except two hoists and a ventilating fan which have each a separate motor. The motors are mostly of fairly low speed, and they drive the line shafts direct without the intervention of countershafts for speed reduction. There are in the whole eleven motors used in the smith's shop, pattern shop, tool room, etc. The total capacity of these eleven motors is 82 horsepower, but the average horsepower used is only between 10 and 11 on account of intermittent running of the majority of the motors. The current is obtained at a charge of 3 cents per kw-hour for the first 1,500 kw-hours, afterward 2 cents per kw-hour; accounts are payable quarterly and 5 per cent discount is allowed. Accounts are given for the last three-quarters and show that in the average the cost per kw-hour was 2.158 cents.—Lond. *Elec. Rev.*, Sept. 1.

Power Plant Design.—KOESTER.—In a continuation of his profusely illustrated serial on modern power plant design and economics he discusses coal and ash handling machinery, boilers, stokers, smoke consumers and draft, the purification of the boiler feed water, the advantages of superheated steam (which he believes are not generally recognized in this country) and steam pipes and covering.—*Eng'ing Mag.*, September 4.

Scotch Power Plant.—An illustrated article on the opening of the first generating station of the Fife Electric Power Company, which will supply power in bulk to an extended area. The first station is situated at Townhill and contains two steam driven 400-kw alternators, giving two-phase currents at 50 cycles at 3,000 volts. This is only a "pilot station." The intention is to erect later an entirely separate new plant on a much larger scale with bigger units and so arranged as to lend itself to expansion up to 60,000-kw capacity. The proposed transmission voltage is 11,000.—Lond. *Elec. Rev.*, Aug. 25.

British Power Company.—The first part of an illustrated article on the Yorkshire Electric Power Company's system of generation and distribution. There will be four generating stations, of which one has just been completed at Thornhill. One prominent feature is the reduction of capital expenditure to a minimum. "In a general sense, the station is built on the separate-unit system, which is now recognized as correct practice for large undertakings." The main generating units at present installed consist of two 2,000-kw Curtis turbo-generators. They are of the 4-stage type and run at 1,000 r.p.m.—Lond. *Elec.* Sept. 1.

High-Voltage Power Transmission.—FOWLER.—An article treating in a general way the subject of high-voltage power transmission. The selection of the line voltage, the arrangement of line conductors, high-tension insulators, and pole lines are considered.—*Amer. Elec.*, September.

Automatic Boiler Feed Pump.—SCHMIDT.—A short illustrated article in which the author calls attention to the merits of the centrifugal pump for boiler feeding, and points out that such an application would confer the benefit of automatic feed to a higher degree and with simpler auxiliary apparatus than would be possible with reciprocating pumps.—*Amer. Elec.*, September.

TRACTION.

Single-Phase Car Control.—JACKSON.—Experience has shown that in single-phase traction the fine gradation of voltage given by the induction regulator is not required for ordinary operating conditions. The author describes the very simple control worked out by the Westinghouse Company. The standard voltage on the trolley is 3,300. This voltage is reduced on the car by means of a transformer of the single-winding for auto-transformer type, one end of which is grounded in order to use the rails as return circuit. The simplest control is obtained by connecting the motors between ground and the desired points of the transformer winding. The required voltage points are brought out from the winding by means of taps. With such a method of control the motors may all be placed permanently in multiple and any series-parallel arrangement becomes a useless complication. In order to step from one tap to the next without opening the circuit or short-circuiting the winding on the transformer between the taps it is necessary to employ a preventive coil to take up the intervening momentary voltage. The drum type of controller is generally used on equipments up to and including four 75-hp motors when multiple unit control is not required. Externally, this controller resembles the ordinary direct-current type. There are, however, no magnetic blow-outs or series-parallel connections. For all ordinary purposes, five points of control are employed and give a smoother acceleration than is usually obtained with direct-current motors. Fig. 2 shows the connection of the auto-transformer for different positions of the controller. On larger cars where multiple operation of several cars from one master controller is required, the control is obtained by means of switches operated by compressed air and of general design similar to the switches used in direct-current multiple control. The method of operation is substantially the same as that used in the drum controller. A magnetic blow-out is necessary for the proper operation of the switches. The method of control applicable to heavy locomotive work is also described. Fig. 3 is a diagram of wiring on a car equipped with two single-phase motors. It has been found in practice that alternating current up to 500 or 600 volts is much

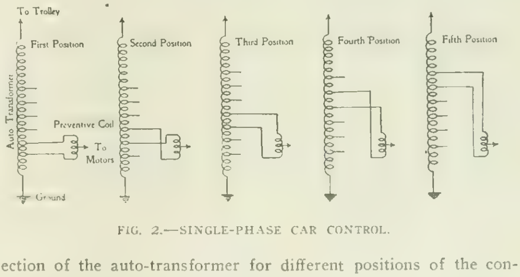


FIG. 2.—SINGLE-PHASE CAR CONTROL.

easier to break than direct-current of the same voltage. There is, moreover, no such tendency to flash to ground or to short-circuit and to maintain an arc over long distances as is manifested by direct-current. With alternating-current, however, switches must be so designed as to provide against excessive generation or concentration of heat due to hysteresis and eddy currents. In an editorial note Storer remarks: "Altogether the prospects of the single-phase railway system are wonderfully bright. At least six lines are in daily commercial operation in this country. The troubles incident to the use of an entirely new type of apparatus are being rapidly eliminated and success is assured."—*Elec. Jour.*, September.

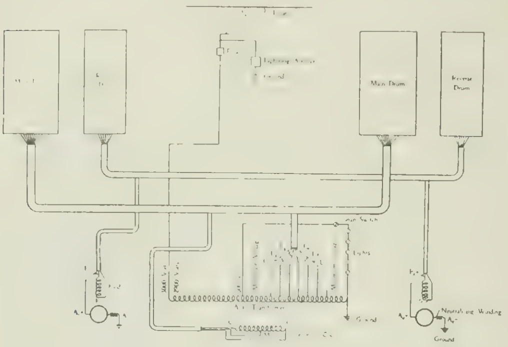


FIG. 3.—TWO-MOTOR SINGLE-PHASE CAR CONTROL.

High-Speed Electric Traction.—A very extensive resumé of the tests made during the first year of the Berlin-Zossen high-speed experiments, giving especially full data on the subject of train resistance and braking at speeds up to 100 miles per hour, with accompanying charts.—*St. R'y Jour.*, Sept. 9.

Retardation Tests.—SAKUNO TANABE.—A note giving the results of retardation tests with an unloaded covered railway wagon. The equation $R = 2 + 0.4\ V + 0.04\ V^2$ gives in this special case a close approximation to the observed relationship between R, the resistance in pounds per ton of 2,000 pounds, and V the velocity of the vehicle in miles per hour. The last term of the equation, namely, $0.04\ V^2$, is nearly equal to the resistance of the atmosphere, leaving the former two as the rolling resistance only of the vehicle.—*Memoirs College Sc. & Eng.*, Kyoto Univ., v. I, No. 2.

Measuring Speed of Locomotives.—An illustrated description of the application of the Frahm speed measuring device for use on locomotives. The principle was described in the Digest April 29. A small alternating-current generator is placed on one running axle of the locomotive and supplies alternating-current of a frequency proportional to the speed. The frequency is measured by means of a comb with a series of teeth tuned to different frequencies as was formerly described.—*Elek. Bahnen.*, Aug. 14.

Electric Plant for Fixing Rails and Packing Permanent Way Construction.—An illustrated description of a portable plant used on some French railways for permanent way construction and repair. The various tools are electrically driven, the current being generated by a steam-driven dynamo. Direct-current at 220 volts is used. The whole generating set weighs but 3.3 tons net. It can be carried by road or rail and contains a pair of main wheels, made with a wide flat rim, for transport on common roads, and at each corner a pair of small flanged wheels for running on railway lines. Current is connected and supplied to the machine tools by small trolleys. —Lond. *Eng'ing*, Aug. 11.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Electrical Equipment of Manufacturing Plant.—BURNHAM.—An illustrated description of the hydro-electric plant of the Willimantic Mills of the American Thread Company. Although contrary to modern practice, the generating units instead of being grouped in one central station are spread out through the various mills, and in each case, driven from the main shaft or the water turbines. There are three dams built across the Willimantic River for impounding the water. The available horse-power of the first is 950 for ten months in the year and 350 for twelve months. The available horse-power at the second is 300 horse-power for twelve months in the year and about 250 horse-power for ten months. The average total available water power is about 1,100 horse-power yearly. The total power consumed is about 3,000 horse-power, of which 1,100 is derived from water and the remainder is furnished by steam-driven units.—*Amer. Elec.*, September.

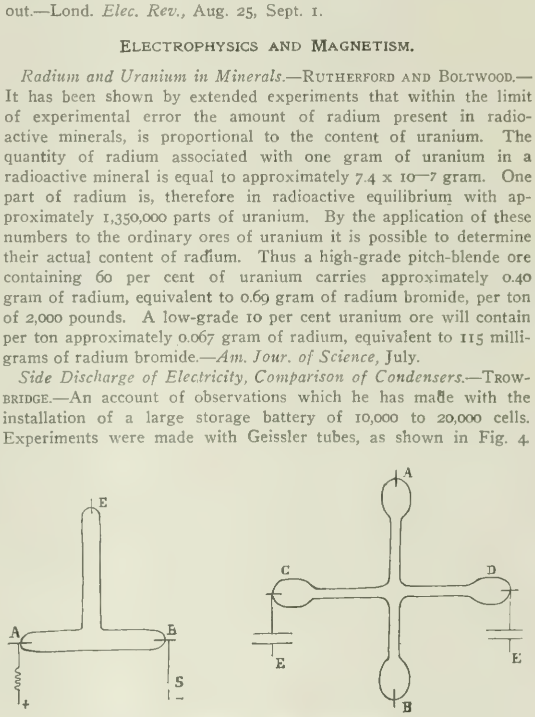
British Central Station.—An illustrated description of the electric plant of Frome-Selwood. The equipment comprises three steam turbo dynamos, two of which have a capacity of 150 kilowatts each, and the third 75 kilowatts. Consumers have the choice of two tariffs. The price per unit on the maximum demand system is 14 cents and 8 cents per kw-hour for lighting and power, respectively, for the first hour and for any further kw-hour 6 cents for lighting and 2 cents for power, or a flat rate of 12 cents for lighting and 5 cents for power.—Lond. *Elec.*, Aug. 18.

Accumulators with Reversible Boosters for Factory Installations. —BIRKETT.—An article giving data from actual practice to show that the installation of a battery coupled with an automatic reversible booster in a factory installation is most satisfactory in taking care of a very variable load so that current for lighting and power may be taken from the same generators and the same system of mains although the fluctuation of load is very large on account of starting and stopping of current motors, etc. The usefulness of a battery for emergency cases of special requirements is also pointed out.—Lond. *Elec. Rev.*, Aug. 25, Sept. 1.

ELECTROPHYSICS AND MAGNETISM.

Radium and Uranium in Minerals.—RUTHERFORD AND BOLTWOOD.—It has been shown by extended experiments that within the limit of experimental error the amount of radium present in radioactive minerals, is proportional to the content of uranium. The quantity of radium associated with one gram of uranium in a radioactive mineral is equal to approximately 7.4 x 10—7 gram. One part of radium is, therefore in radioactive equilibrium with approximately 1,350,000 parts of uranium. By the application of these numbers to the ordinary ores of uranium it is possible to determine their actual content of radium. Thus a high-grade pitch-blende ore containing 60 per cent of uranium carries approximately 0.40 gram of radium, equivalent to 0.69 gram of radium bromide, per ton of 2,000 pounds. A low-grade 10 per cent uranium ore will contain per ton approximately 0.067 gram of radium, equivalent to 115 milligrams of radium bromide.—*Am. Jour. of Science*, July.

Side Discharge of Electricity, Comparison of Condensers.—TROWBRIDGE.—An account of observations which he has made with the installation of a large storage battery of 10,000 to 20,000 cells. Experiments were made with Geissler tubes, as shown in Fig. 4 The terminal A is connected permanently with the pole of the battery through a large water resistance (several megohms). The terminal, B, is connected to the negative pole by a spark gap, S. E is connected to the earth. At the instant the spark occurs a brilliant side discharge occurs between E and B. If the negative pole of the battery is permanently connected through the large water resistance to B, and A connected by a spark-gap to the positive pole of the battery, the side discharge takes place between E and A. At the same time that these side discharges take place, a discharge passes between A and B. It is evident that the capacity of the region outside the battery, the room, and building charges up under the difference of potential between it and the poles of the battery, a difference of potential which is greater than that between A and B, which are connected by the small resistance of the rarified gas. This phenomenon suggests a photometric method of comparing the capacity of large condensers and also of obtaining the



FIGS. 4 AND 5.—SIDE DISCHARGES.

capacity of the immediately surrounding space. Fig. 5 represents a modification of the tube represented in Fig. 4. To the arm *C* and *D* of the cross are attached the condensers which are to be compared. At the instant of the completion of the circuit with the storage battery under the conditions mentioned above, two side discharges take place from *C* and *D* either to *A* or *B*. By bringing the light of these two simultaneous discharges into a suitable photometric arrangement, one can compare the capacity of the condensers, to the degree of accuracy obtainable by ordinary photometric determinations. Since it is difficult to obtain an estimate of the capacity of large bodies of irregular shape and of large extent, this method may be of use. By a suitable vacuum tube and proper exhaustion the method does not require a large number of cells.—*Am. Jour. of Science*, July.

Discharge Potentials.—BOUTY.—An account of experiments in which he found that the critical field beyond which a gas gives way to an electric charge is the sum of two terms. One of these is characteristic of the gas and independent of the temperature when the mass and volume are kept constant. It greatly preponderates at pressures above a few tenths of a millimeter of mercury. The other term, which only comes into force at very low pressure, depends essentially upon the dielectric substance of the wall and upon any gaseous layer which may be adhering to it. When the second term is negligible, the possible difference of potential between two electrodes may be written $= a \sqrt{pe\,(pe + k)}$, where a is the dielectric cohesion of the gas, p its pressure, e its thickness and k a constant varying with the gas. For the same gas, this difference of potential only depends upon the product of pressure into thickness, or, in other words, upon the quantity of gas affected by the discharge. In the case of large masses, the discharge potential depends upon a constant quantity amounting to about 1,760 volts for air, and upon another term amounting to 2.46×10^7 volts per gram of air traversed per square centimeter. At high altitudes the possible field would become so small that the air cannot even support the earth's electric field without giving way.—Lond. *Elec.*, Aug. 18; from *Comptes Rendus*, July 31.

ELECTROCHEMISTRY AND BATTERIES.

Action of Acids on Iron.—BURGESS.—The first part of a paper on the action of acids on iron and the use of the acid pickle. The author discusses the general importance of the problem and present practice in acid pickles. The paper is to be concluded.—*Electrochem. and Met. Ind.*, Sept.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrical Units.—WOLFF.—A discussion of the "so-called international electrical units" giving the different resolutions and definitions adopted by various congresses and in different countries, together with a critical discussion of the whole situation.—*Bull. Bureau of Standards*, No. 1.

Silver Voltameter.—GUTHE.—A full discussion of the silver voltameter and the precautions which must be taken in its use. The electrochemical equivalent of silver is given as 1.11683 mg per coulomb.—*Bull. Bureau of Standards*, No. 1.

Optical Pyrometry.—WEIDNER AND BURGESS.—A very useful summary of the principal methods of determining high temperatures by optical means. "There is an impression current that an optical pyrometer is of necessity a very delicate, mysterious piece of laboratory apparatus, not fitted for shop practice, and not to be trusted except in the hands of an expert, and even then giving results of uncertain reliability; but one of the primary objects of this paper is to show that there are several trustworthy optical pyrometers available, simple in operation, and suited to the most varied and exacting requirements of scientific laboratories and technical works." After a general discussion of optical pyrometry the authors give a concise summary of the laws of radiation. The total radiation is given by the Stefan-Boltzmann law, which states that the total energy radiated by a "black" body is proportional to the fourth power of the absolute temperature. The black body, according to Kirchhoff's definition, is one which would absorb all radiations falling on it and would neither reflect or transmit any. Bodies which depart from black body radiation, emit less total energy than black bodies. The greatest departure from black body radiation is found with polished platinum. The displacement law of Wien states that as the temperature of the radiating source is changed the wave length having the maximum energy in the spectrum will be changed in such a way that the product of this wave length to the corresponding absolute temperature of the source of radiation is equal to a constant; i. e., if the temperature rises the maximum of energy shifts toward shorter wave lengths. Laws concerning the distribution of energy in the spectrum of a radiating body have been given by Wien and Planck. "The remarkable agreement of the Planck equation with the results of experiment throughout the extreme ranges in which it has been tested at least justifies the hope that it is something more than a purely empirical relation, which may some day earn the title of a "law of nature." The authors then discuss the methods of optical pyrometry which make use of one or the other of the above laws of radiation. "In practice a standard of intensity is chosen, and the brightness of the photometric field illuminated by the red light emitted by the body under observation is varied until it is equal in intensity to that of the standard either by use of an iris diaphragm (Le Chatelier), an absorbing wedge (Fery), or by a polarizing device (Wanner), or the standard light may itself be varied according to some known or empirical relation (Holborn-Kurlbaum, Morse)." The various commercial optical pyrometers are described and discussed in detail. In the conclusion of the paper the authors discuss some special problems in optical pyrometry and especially departure from black body radiation. The authors conclude that apparently the several laws of radiation are in quite satisfactory agreement at the highest attainable temperatures (about 3,700 deg. C.) and thus serve to define the same scale of temperatures.—*Bull. Bureau of Standards*, No. 2.

Adjustable Condenser.—SWAYNE.—An article with dimensional drawings on the construction of an adjustable condenser suitable for high-potential currents, especially wireless telegraphy, where it is said to be superior to either Leyden jars or glass plates.—*Amer. Elec.*, Sept.

Factory Testing of Electrical Machinery.—WORKMAN.—In a continuation of his long serial, illustrated by diagrams, he deals with induction motors and describes how to find the power factor for any current and how to determine the primary copper loss, the iron and friction and windage loss, and the secondary copper loss.—*Elec. Jour.*, September.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—PREECE.—A paper read before the (Brit.) Assoc. Advanc. Sc. giving first a summary of the development of wireless telegraphy in Great Britain and elsewhere by private parties, companies and official departments. The author then briefly discusses the fundamental points of the sending station which are the source of energy, the transformer, the antenna and the air and ether; and the fundamental points of the receiving station, namely, the antenna, receiver and the earth. He reaches the following conclusions: "Wireless telegraphy is really still in its experimental stage. Great progress has been made and will continue. The sea is its domain. Here it is practical and even commercial, but not reliable for continuous periods or for long distances. It has not yet been proved effective over land, excepting for comparatively short distances where the earth is moist and rivers abound. There are very few places where it can compete financially with telegraphs and telephone, and it would be folly to apply it for telegraphic purposes where simple wires can be erected and telegraphs and telephones employed. It is not even cheap, for though the capital expenditure is smaller, the working expenses are greater and the speed of working less. "An engineering system that utilizes only one billionth of the energy it generates is scarcely practical economics, though it may, for vital purposes, be of inestimable value. For war purposes wireless telegraphy is imperative whatever its cost."—Lond. *Elec.*, Sept. 1.

Earth Connection in Wireless Telegraphy.—EVANS.—An illustrated note on some experiments with Hertz oscillators. In the course of experiments in wireless telegraphy for military purposes it became important to determine the effects produced by different methods of earth connection of the aerials. For this purpose an oscillator was used, as shown in Fig. 6, consisting of a square capacity, area (17 ft. by 17 ft.) suspended horizontally by insulators 14 ft. above the ground. From the center of this area a vertical wire led to one knob of a spark-gap, the other knob being connected by a similar wire to an arrangement of iron wire netting (17 ft. by 17 ft.) placed directly below the upper area and suspended horizontally by insulators 2 ft. above the ground. The current flowing in the vertical wire was measured, and the lower capacity area (the wire netting) was then connected to the ground by short wires allowed to rest on the earth's surface, and the current in the vertical wire again measured. A third modification was made connecting the lower capacity area to a good telegraph "earth" when a third current reading was taken. It was found that the current flowing in the vertical wire in the first case was reduced by 56 per cent when the lower capacity area was allowed to touch the ground, and by 85 per cent when the lower capacity area was connected to the telegraph earth. The distance between the two areas, the wave length, etc., were kept constant in all these tests, and the figures given above are the means of a considerable number of observations. By means of a receiving station carefully syntonized and of similar design to that of the transmitter, about 1,000 yds. distant from the transmitter, variations in the amounts of the received currents were observed closely comparable to the variations of the current in the transmitter for the three tests mentioned above. The conclusions arrived at were that any connection of the transmitter or receiver with earth was objectionable.—Lond. *Elec.*, Sept. 1.

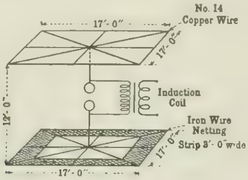


FIG. 6.—CIRCUITS OF OSCILLATOR.

MISCELLANEOUS.

Meter.—FISCHER.—An account of a recomparison of the United States prototype meter No. 27 with the standards of the International Bureau of Weights and Measures in Paris.—*Bull. Bureau of Standards,* No. 1.

Monophone.—COURTOIS.—An illustrated description of the monophone which combines in one apparatus the telephone receiver and transmitter as shown in Fig. 7, which is almost self-explanatory. The microphone consists of two diaphragms, *C, C;* in the hollow space between them carbon grains are placed.—*La Revue Elec.*, June 15.

Electric Rgeulation of Temperature in Incubators.—A note on an electric regulator for incubators which is being used in Victoria, Australia, and consists principally of a thermometer and an electrically operated relay. As long as the temperature in the incubator remains below 103° F.—which is the proper temperature of incubation—the gas or other lamps supplying the heat are full on. When 103° F. is reached, the mercury in the thermometer completes an electric circuit, the relay is actuated, and either turns down the flame or deflects the heat supply. As soon as the temperature falls below 103° F. the circuit is broken, and the full heat is again supplied to the incubator. Current is obtained from one Leclanche cell.— Lond. *Elec.*, Sept. 1.

The South Wales Coal Field.—A note on a detail map on a large scale which has been prepared by Mr. G. E. Gordon, mining engineer, of Swansea, showing the collieries, works, etc., in the South Wales coalfield. Besides giving full particulars under these heads, the map indicates the railways and stations, canals, and the class of coal obtained. There are also diagrams showing the average prices of the last decade and the annual output since 1860. The work, which is admirably executed, shows the various centres clearly, and should be of decided value to engineers for reference. Incidentally, the numerous dots illustrative of the mines and works exemplify what an extensive and, at the same time, compact area the South Wales Power Company have to work upon for the supply of energy for industrial purposes.—Lond. *Elec. Eng.*, Sept. 1.

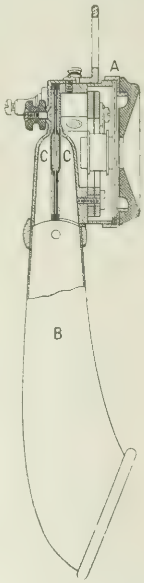


FIG. 7.—MONOPHONE

BOOK REVIEW.

THE CHICAGO TRANSPORTATION PROBLEM. By Bion J. Arnold. New York: McGraw Publishing Company. Two volumes, 310 pages, 15 folded plates and 14 large maps. Price, $5.00.

This work is a reprint of the report of Mr. B. J. Arnold to the Committee on Local Transportation of the Chicago City Council on the Chicago urban transportation problem. Originally, only a very limited edition was issued for the use of the officials of the City of Chicago. The object of the present edition is to supply a demand for the report as a general engineering treatise on the broad problems of street railway construction, operation and management in a large city. The text is divided into six parts, as follows:

Part I is a general discussion of street railway systems and the conditions governing them. Large cities are divided into three classes and the earning capacity per mile in each class is discussed. Part II treats of the present situation in Chicago and recommends certain improvements. Part III forms a study of population and traffic. This is a most interesting part and contains much valuable data concerning the great cities of the world. Curves are plotted for each city and a general law deduced. A very exhaustive analysis has been made of the traffic in Chicago, and the data are given in such a way as to be valuable to those who may be studying the same problems in any other city. In this part tables are given showing the itemized cost of maintenance and operation of electric and cable roads and the capitalization of the various Chicago companies. Part IV discusses the relative merits of operating cars over through routes as compared with downtown terminals and the question of transfers and fares. Part V forms a discussion of a new reorganized and unified system of street railways for Chicago, with an estimate of the gross receipts from all sources.

Part VI is divided into nine chapters and forms the major portion of the book. This part will be found of great engineering value. Chapter I describes plans for a high-level and a low-level subway. The method of construction is clearly shown by eleven folded plates. In making these subways disposition has been made of all public utilities, such as water mains, gas mains, sewers, telephone, telegraph and power cables. Chapter II concerns the underground electric conduit system. Chapter III treats of electrolysis. Chapter IV contains suggestions concerning the improvement of traffic conditions on the existing elevated lines. Chapter V forms a valuable discussion of track rails and track construction in large cities. It contains many cuts showing track construction and rail profiles used in the several large cities of the United States. Chapter VI contains unit price estimates, i. e., the itemized cost of producing complete one mile of track using ten different types of construction. Chapter VII contains itemized valuation estimates of the entire equipment of the various railway companies operating in Chicago. These include estimates on the cost of track, paving and trolley construction, power stations, rolling stock and real estate. These cost estimates are supplemented by an analysis of the depreciation. Chapter VIII contains data similar to that in the preceding chapter, except that the valuation estimates are made on certain grants which expired at a date earlier than July, 1903. Chapter IX deals with the most interesting part, namely, the cost estimate of the construction and operation of the proposed subway and surface lines.

The nine chapters are supplemented by an appendix which contains data concerning all the Chicago street railway lines. The report is contained in two volumes. The first volume is alphabetically indexed, contains 310 pages of text, 50 cuts and 15 folding plates. The second volume contains 14 folding plates, each 18 inches by 33 inches.

New Westinghouse Railway Motor.

The accompanying illustrations refer to a new line of motors for heavy traction now being introduced by the Westinghouse Electric & Mfg. Co. The smallest motor of the new design is rated at 75 horsepower, and the largest at 200 horsepower, there being a number of intermediate sizes.

Among the features of particular interest which characterize these motors may be mentioned the diagonally divided field frame which makes every part accessible; the gear case supported entirely at the ends, so as to avoid the side strains which have been the source of so much trouble; housings for armature bearings clamped between the two halves of the frame; generously proportioned bearings with a system of lubrication claimed to be the most effective yet devised; armature and commutator assembled upon a single spider; bar-wound armature with split coils; commutators with many bars; low-current density in the brushes; bolted-in laminated poles; sealed field coils wound with strap; excellent commutation; high efficiency; low operating temperature and great mechanical strength.

Limitations are naturally placed on the size and construction of a motor by the amount of available space on the truck of the car; therefore, the frame of square cross-section was adopted as utilizing this space most advantageously. All motors in this line have cast steel frames split at an angle of 45 deg. with the horizontal. The axle bearings are carried by the lower half of the field frame and are divided at an angle of 35° with the perpendicular, so that the weight of the motor is supported almost entirely by the part of the frame extending over the axle rather than by the axle cap bolts. By lifting off the upper half of the field casting the armature may be removed from the frame without taking the motor from the truck; or the motor may be removed from the truck by simply taking off the gear case and axle caps. Three bales, conveniently located, make handling of the motor easy. Bolts with nuts and lock washers hold the two halves of the frame together and the axle caps in proper position.

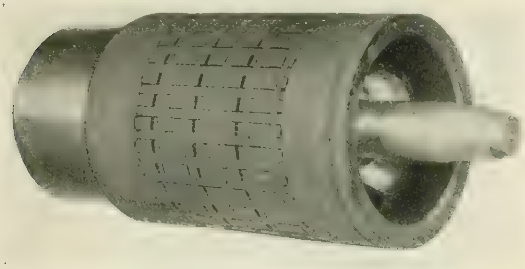


FIG. 1.—ARMATURE.

Housings for the armature bearings are circular in form and are turned slightly larger in diameter than their seats in the frames so that when clamped in place, all the advantages of a press fit are obtained. Finished shoulders on the housings prevent any lateral movement and also take the entire end thrust of the armature instead of imposing this severe strain on the clamping bolts. Two bolts through the frame at each end prevent the housing from turning.

The armature bearings are made of solid phosphor-bronze bushings finished all over, with a 3/32-in. lining of babbitt metal. If from neglect the bearing should become so hot as to melt the babbitt the armature would be supported on the brass shell and would not strike the poles. Both oil and waste lubrication are provided. The waste comes in contact with the bearings on the low pressure side and is supplied with oil from separate pockets from below; in this way it is filtered before reaching the bearing. The amount of oil in the reservoirs may be gauged so that it may be kept at the proper level for economical service. It is stated that with intelligent care these bearings will run 100,000 to 150,000 miles.

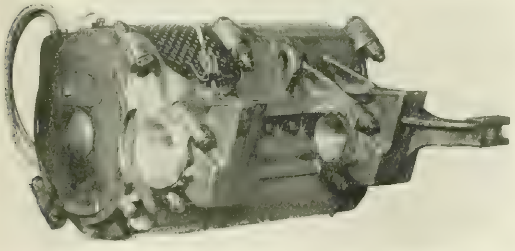


FIG. 2. VIEW OF MOTOR, SHOWING AXLE BEARINGS.

The axle bearings are similar in construction to those of the commutator, except that split bushings are used. Here also lubrication is by means of oil and waste, the oil being supplied from below. This is the same method which has given such universal satisfaction in steam railway service. All bearings have generous dimensions, and the large surfaces readily dissipate the frictional heat and insure cool running.

The laminated pole pieces are bolted to the top, bottom and sides of the motor frame, which, being almost square in cross section, permits the use of flat field coils. These coils are wound of copper strap insulated between turns with treated asbestos ribbon and then carefully taped and given repeated dippings in specially prepared insulating compounds and varnishes which make them moisture-repelling and able to stand internal heat. Brass hangers hold the coils in place independently of the poles.

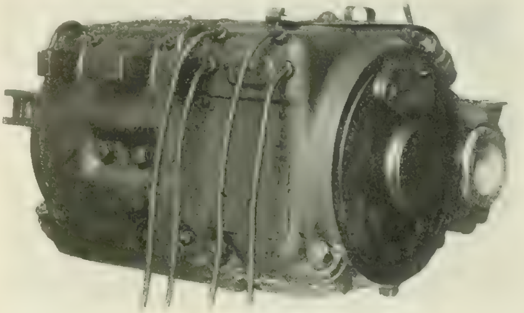


FIG. 3.—EXTERIOR OF MOTOR.

The shaft is forced into the finished armature and keyed thereto and may be removed, should necessity arise, without disturbing the windings or commutator. The armature coils are strap wound and made in two parts. As the top coils are more liable to injury this design makes it possible to remove the damaged part without disturbing any other part of the winding. The coils are liberally insulated with mica, and sealed and further insulated by dipping in varnishes which are oil-proof and moisture-repelling. On each end the armature slots are made deeper and wider, thereby providing space for mica cells, which greatly reinforce the insulation at these points. As a further protection fibre strips are taped to the upper sides of the top coils. A bell-shaped flange at the pinion end and a cylindrical flange on the commutator end form rigid supports for the windings. Countersunk bands of steel wire on the core hold the coils firm and secure. Openings through the spider and core

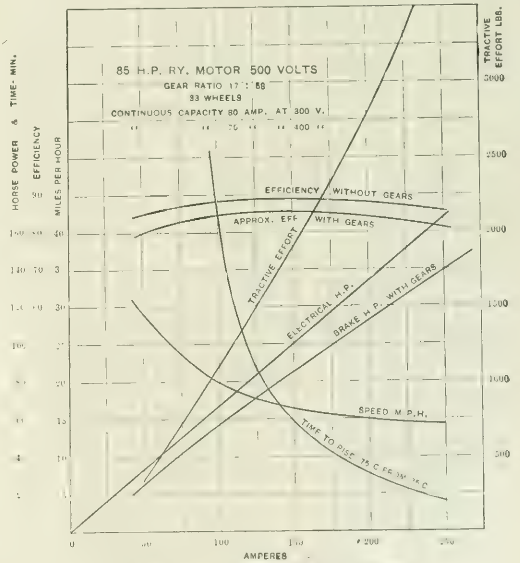


FIG. 4.—CHARACTERISTICS OF 85-HP MOTOR.

allow a free passage of air, which is thrown forcibly against the field coils, thus maintaining a low temperature throughout the motor. The design of the motor windings, the great number of bars in the commutators, and the even wearing qualities of the insulation produce commutating characteristics of the highest merit.

The brush holders are of the sliding type with springs of phosphor-bronze held in a harness which definitely fixes the radius of action of the spring tip, and is so constructed as to practically eliminate friction between turns, making it possible to provide a large number of turns, which gives a very uniform pressure upon the brush over a considerable range without requiring adjustment. The tension of the spring may be adjusted without removing the holder from the motor. The brush holder proper is bolted to an insulated guide and may be removed without disturbing the insulation or connections. Leads of flame-proof flexible rubber-covered cable are brought out at the front of the motor over the commutator through insulating bushings. Access to the brushes and brush holders is provided through a large opening in the frame over the commutator which extends well down the side, making inspection easy from the pit. A hole in the rear end bell and an opening under the commutator provide means for inspecting the clearance between the armature and field poles.

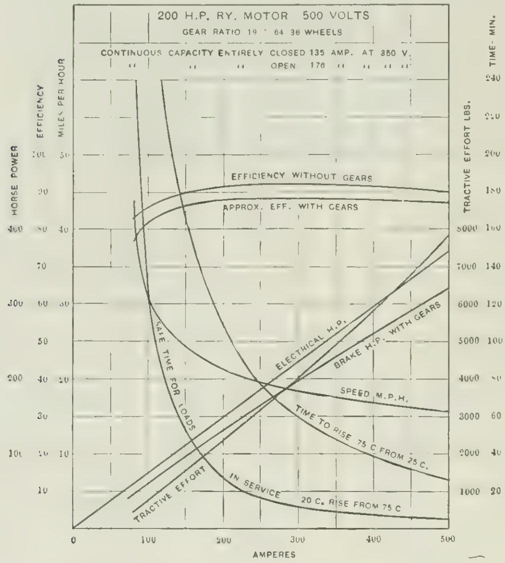


FIG. 5.—CHARACTERISTICS OF 200-HP MOTOR.

Pinions used on these motors are machined from solid steel forgings and held on tapered seats by keys, nuts and lock washers. Gear cases are made of malleable iron and divided along the center line of armature and axle. They are supported only at the ends, which does away with all side strains which are responsible for so many broken gear cases. Nose suspension with safety lugs is used for all motors of this design.

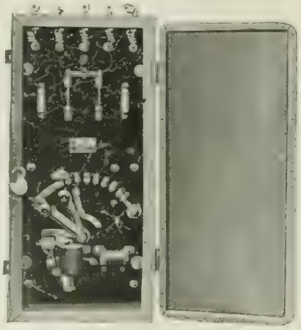
◆

Machine Tool Controller.

The accompanying illustration shows an armature speed controller possessing numerous advantageous characteristics which render it especially well suited for use for machine or similar duty. The method of mounting and insulating the resistance is such that the result of a burn-out would be practically the same as would occur with an entirely enclosed resistance. All the motor-starting stationary contacts are of the segment form. The movable contacts of the speed-controlling lever are of the self-adjusting type, and are able to ride over any projection standing 1/16 in. above the contact segments. To prevent arcing upon the circuit-closing contacts, there is used an independent, spring-operated, renewable, circuit-closing switch, which breaks the circuit with a quick break.

The no-voltage release protective device is responsive solely to the line voltage, and is entirely independent of the field current or the armature current. The overload protective device is an independent interlocking automatic circuit-breaker, which automatically opens the entire circuit whenever, from any cause or under any conditions, a current in excess of that for which the circuit-breaker is adjusted is passed through the rheostat and motor.

There is but one lever carrying current both for starting the motor and regulating the speed of the motor. The rheostat starting and speed controlling lever cannot be left on any of the starting contacts, but can be left continuously on any of the field resistance contacts.



MACHINE TOOL CONTROLLER.

This controller is being placed upon the market by the Ward Leonard Electric Company, Bronxville, N. Y.

◆

Steel Frame Motors.

The accompanying illustration shows the constructional features of a line of steel frame motors which have been designed with a view to supplying the demand for a strong, light machine of high efficiency and good wearing qualities; a machine capable of withstanding heavy overloads and sudden fluctuations of load, universal in its application and with all parts readily accessible.

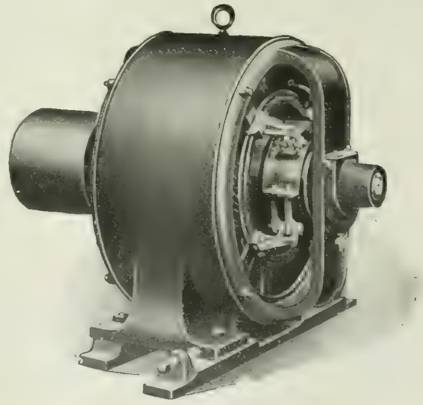


FIG. 1.—STEEL FRAME MOTOR.

The frame is built of close grained steel, making a much smaller and more compact machine to give the same output, than would be possible with cast iron. The brackets are centered against the crown and firmly held by steel bolts; but can readily be removed to allow easy access to fields and armature. (See Fig. 2.) The poles are also of steel and equipped with a special design of laminated tip or shoe, to provide the necessary magnetic fringe, which eliminates sparking at the brushes, produces cool running, and heightens the efficiency of the machine. The bearings are made of a specially prepared bearing metal, and are of the self-oiling and self-aligning type. They are made to standard gauge and reamed, so as to be interchangeable and easily replaced. Oil wells of ample capacity are provided in each pedestal.

The brush holders are of a simple, yet thoroughly effective design. The brushes are of the best quality of carbon, and are rigidly attached to the holder, the proper adjustment being secured by a tension spring. Sparkless operation of the brushes, wearing and heating of the commutator, freedom from noise, and good commutation are to a great extend dependent upon the design of the brush holder, and the design of the Triumph brush holders is all that can be desired in these directions.

The entire brush rigging is carried from the front end of the crown, as shown in Fig. 3, so that no oil can reach the brush holders and cause a short-circuit. All the brush holders are convenient of access, and the yoke, when properly set, is held in that position by a lock screw.

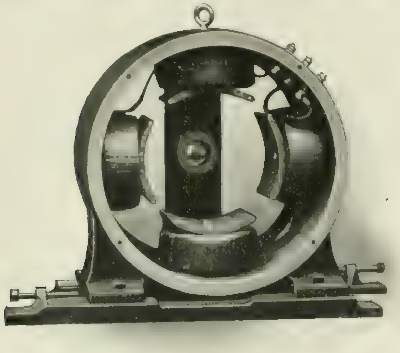


FIG. 2.—VIEW OF POLES.

During the construction all parts are submitted to a series of thorough inspection and tests, the tests for insulation being made with 1,500 volts alternating e.m.f. Before shipment each machine is given a complete running test, under full load, for sufficient time to bring it up to its maximum temperature, so that every machine is known to be correct when it leaves the factory.

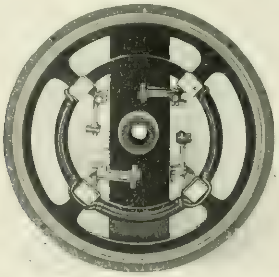


FIG. 3.—FRONT BRACKET AND BRUSH RIGGING.

The motors are being placed upon the market by the Triumph Electric Company, Cincinnati, O.

◆

Battery Volt-Ammeter.

Whenever batteries of any description are employed it is extremely desirable to have at hand some means to test their qualities. If even one of the cells is worn out the efficiency of the others is lowered, and when these cells are used to supply current for telephone transmitters, difficulty in making one's self heard is the result. The Connecticut Telephone & Electric Company, of Meriden, Conn., has placed upon the market a new type of volt-ammeter, shown in Figs. 1 and 2, which is especially designed for testing batteries. It is made up in two styles, one as a combination volt-ammeter and the other reading amperes only. The scales are graduated from 0 to 30 amp. and from 0 to 6 volts, and are very carefully calibrated. The arrangement of the needle supports permits very delicate and accurate reading. This instrument can be used without the cord shown in Fig. 1 by holding it in the hand, as shown in Fig. 2. The instrument is guaranteed by the company to be both accurate and durable.

FIGS. 1 AND 2.—VOLT-AMMETER.

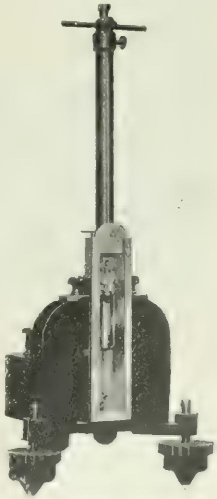
◆

Galvanometer for Cable Testing.

The Leeds & Northrup Company, of Philadelphia, has recently placed upon the market a new form of high sensibility D'Arsonval galvanometer for cable testing, shown in the accompanying illustration. In design it is a radical departure from the old style laminated magnet with suspension tube that allowed but small clearance for the coil and did not permit the suspended system to be visible. This improved design possesses the following prominent features:

The removal of the tube containing the moving system is readily effected by the loosening of two thumb-screws. If any adjustments are to be made, such as the insertion of a new suspension, the tube can be removed from the magnet and laid horizontally on a table, which is often of great convenience. The tube has at its back a simple device for clamping the coil, so that the galvanometer and tube may be moved about. The coil suspension has a spring device in the top of the tube so that the suspension is not easily broken.

The entire system is visible by means of the open glass front given to the tube. A small index point on the coil shows when the galvanometer is exactly level and the coil is swinging centrally in the field. The coil is of the rectangular type and made as small and light as possible in order to give the greatest sensibility with a given period of swing. To provide the highest possible insulation the entire galvanometer is insulated from earth by means of three hard rubber leveling screws terminating in steel points. The bottoms of the leveling screws have deep grooves turned in them, thus making a "petticoat" insulation.


GALVANOMETER.

Alternating-Current Rectifier.

An interesting form of alternating-current rectifier is shown in the accompanying illustration. While the operation of the device depends upon the opening and closing of a circuit at the desired instants according to the relative signs of the alternating e.m.f., no synchronous motor with revolving commutator or equivalent equipment is employed. The position of a vibratory contact maker is determined by the polarity of an electromagnet whose coil is subjected to the alternating e.m.f.

The contact maker, which is mechanically connected to the polarized armature of a permanent magnet, is normally held closed. During operation, the polarized armature is acted upon not only by the permanent magnet but also by the electromagnet. When the polarities of these two magnets are of the same sign, the contacts are held tightly together. When, however, the electromagnet reverses its sign and becomes of sufficient strength, the polarized armature is repelled, and the circuit broken. Thus the circuit is closed when the e.m.f. is of one sign, and is open during the major portion of the time when the e.m.f. is of the opposite sign, so that the resultant current, although pulsating in value, is practically unidirectional.

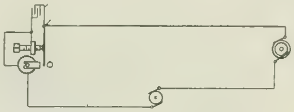


DIAGRAM OF CIRCUITS OF RECTIFIER.

It is evident that a combination of two rectifiers with relatively reversed electromagnets will allow equal values of currents to be taken from the source of supply both when the e.m.f. is negative and when it is positive so that the load on the supply system will be balanced with reference to the successive alternations.

The device is simple, of few parts and quite compact. For charging the storage batteries of automobiles at places where only alternating current is available, the magnetic rectifier possesses the advantageous feature of being transportable by the automobile itself. This rectifier is the invention of Mr. J. Hart Robertson.

Automatic Measuring and Mixing Machine.

Where materials are to be fed to kilns or furnaces, the intermittent introduction of cold materials from weighing machines, or even a continuous, but slightly irregular, feed may cause a deterioration of the product, and in any event cuts down the capacity of the apparatus, sometimes as much as 50 per cent., besides injuring the furnace itself. To meet the urgent need of such apparatus in the works of The Solvay Process Company, Mr. E. N. Trump, chief engineer of that company devised a continuous measuring machine, which is adapted to feed one substance or to proportion the several ingredients of a mixture. More than a dozen of these machines were made for this company, and were used in their different plants for such varying purposes as the feeding of kilns, the mixture of chemicals, the manufacture of coke briquettes, feeding of rocks, the making of concrete, etc., and handled material of 6-in. cube dimensions to the finest of powders—both wet and dry. In actual service-test they were so successful that they are now being marketed by the Link-Belt Engineering Company, Philadelphia.

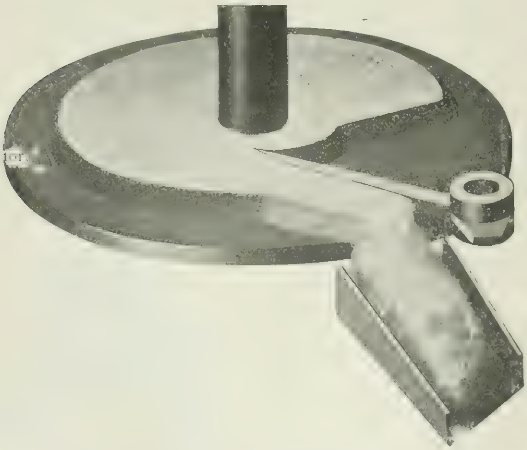


FIG. 1.—MECHANISM FOR INSURING REGULARITY OF DISCHARGE.

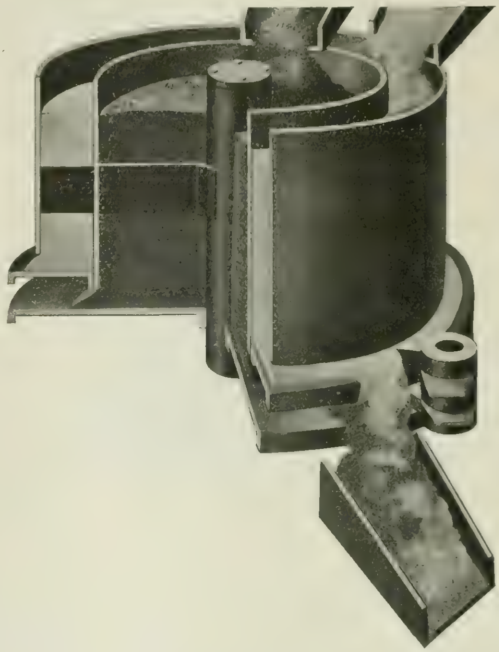


FIG. 2.—SECTIONAL VIEW OF MEASURING AND MIXING MACHINE.

The Trump measuring machine consists essentially of a horizontal revolving table, on which the material to be measured rests, and a stationary knife set just above the table and pivoted on a vertical shaft just outside the circumference. This knife can be adjusted to as to extend the proper distance into the material on the table, at each revolution of which it peels off a certain amount, which falls over the table edge into the chute. This is shown in Fig. 1. The amount of swing of the knife is controlled by a screw attached to an arm, cast as part of the knife, and a micrometer scale with pointer shows the amount of movement.

Where it is desired to measure off and mix two or more materials, the machines are made with two or more tables, set one above the other, and mounted on the same spindle so that they revolve together, each table having its own storage cylinder above it, and the cylinders being placed one within the other as shown in Fig. 2. For each table there is a knife, with its own adjusting mechanism, which allows the user to vary, at will, the percentage of each material in a mixture; and, as the materials flow together constantly and regularly in small streams as they drop down the common chute, each infinitesimal amount of one ingredient is accompanied by the proper amounts of the other ingredients, and the particles become intimately mixed.

In feeding materials to the storage cylinders of these machines a conveyor is necessary merely to see that enough is kept in the storage cylinders so that the amount which the knives peel off will be constant. With some finely powdered materials, which flow very freely, it is necessary to place feeding-seals at the top of the storage cylinders to regulate the density and pressure on the material below, so that it will not pack or flow out at the bottom too rapidly and flood the table.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Business in general is in a very satisfactory condition, and nothing occurred during the week to diminish the existing widespread confidence. There is a disposition to extend plans further into the future, and many plants have their facilities engaged well into next year. As demand broadens there is a natural tendency to enlarge capacity, which adds to the already exceptional structural activity. Jobbers have secured much more forward business than at this date last year, especially in dry goods lines, and the frequent reminders of autumn temperature stimulate retail distribution of wearing apparel. Gratifying reports are made as to crops, and everything points to an unprecedented yield of corn. Several settlements maintain labor disputes at the minimum, and mercantile collections continue prompt. The railways are doing a large business despite the unusually light grain movement, due to the reluctance of farmers to sell their products at current prices. The gross earnings for August were 5 per cent in excess of those of the same month last year, when the present wave of activity first manifested itself, marking a continuing progressive gain for that month in every year since 1896. Reports from Chicago state that the present fall trade has never been equaled and that rail mills and car builders have a year's business booked. Chicago jobbers report business 10 to 15 per cent in excess of their best previous year. In the Northwest the farmers are very busy, and retail trade is still quiet, but will improve as soon as the spring wheat moves to market. Business in all sections, except in the South, where it is somewhat affected by the yellow fever quarantines, is large, and even in the South in some lines it is at the highest level. The business failures for the week as reported by *Bradstreet's*, numbered 188, as against 137 during the week previous and 167 the corresponding week last year. The largest consumers of copper seem to be well supplied for current needs, while the smaller ones are apparently waiting for lower prices. The market was unsettled and slightly lower, Lake and electrolytic being quoted at 16c. and casting stock at 15¾c.

COPPER PRODUCTION.—In a report by Charles Kirchhoff, of the Division of Mines and Minerals, on the copper industry of the world, the following interesting facts are given regarding the same: A comparatively high level of prices, an enormous production and an unprecedented export demand were the characteristic features of the copper trade in 1904. The industry has been exceptionally prosperous and has displayed an activity which promises a further notable addition to production during the year 1905. Undertakings begun in 1904 will only bear fruit in 1905, and some developments will not add to output until well into 1906. Improvements in mining, concentrating and smelting are making available to an increasing extent very extensive bodies of low grade ores, and are rendering the copper industry less dependent upon the discovery and the life of individual rich deposits. The development and operation of low grade properties, however, calls for relatively very large capital investments. The unit of maximum efficiency of plants is growing and tends to an increasing concentration of interests. Broadly, the features were an increase in the production of copper in the United States of 114,492,750 lbs., from 698,044,517 lbs. in 1903 to 812,537,267 lbs. in 1904, and an increase in the net exports of 231,638,043 lbs., from 151,614,632 lbs. in 1903 to 383,252,675 lbs. in 1904. In other words, the enormous export trade absorbed not alone the increase in production, but 117,145,293 lbs. additional. Our domestic consumption, however, fell off in 1904 as compared with 1903, so that instead of drawing upon our stocks to the extent of the whole 117,000,000 lbs., we drew upon them only to the extent of about 56,000,000 lbs. The detailed study of the industry in the leading districts shows that a considerable increase in the production of copper will take place in 1905, unless some disturbance or catastrophe causes a general or partial cessation of work. It is difficult to estimate the quantity for the year, even assuming that normal conditions will prevail, because the new producers swing into line from time to time, usually at a belated date, and at a rate below the tonnage aimed at. The enlargements of old producers are subject to similar delays. But making full allowance for such causes, there is reason to believe that the production of 1905 will be larger by at least 75,000,000 lbs. than that of 1904, and that possibly a production of 900,000,000 lbs. may be reached. The consumption during the second half of 1904 developed on an enormous scale the world over, and the great requirements of the electrical industry and of the Russo-Japanese war are factors which must tell for a considerable time to come, the first named being of the greatest importance. A somewhat puzzling development has been the very large demand from China, which can not well be fully explained by the withdrawal of working forces from the Japanese mines, the usual source of supply, nor by the coinage requirements. It is widely believed that a considerable part of the purchases is on speculative account for Chinese merchants, whose accumulations will in any case flow slowly back into the channels of consumption.

THE DRIVER-HARRIS WIRE COMPANY, of Harrison, N. J., at a recent meeting elected Mr. F. L. Driver, president and treasurer; Mr. F. R. Harris, vice-president; and Miss M. C. Harris, secretary. The directors of the company are the officers, together with Mr. F. A. Driver, Mr. Jas. F. Bless and Mr. J. W. Howell. This company has just completed a new building to be used for offices, shipping room and stock room. At the same time, sufficient extra ground was bought adjoining upon which to erect another building for manufacturing steel wire. According to present plans, this additional improvement will be begun soon after Jan. 1. The company already has a plant of some magnitude, and with present and contemplated additions will rank with Harrison's largest manufacturing concerns. Among the various kinds of wire manufactured by this company are brass, copper and bronze for weaving purposes, electrical wire of all kinds for use in the making of various electrical apparatus and appliances, and "Hercules" tinned steel armature binding wire.

BIDS FOR NAVY YARD SUPPLIES.—Bids will be received until October 3 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C.; Norfolk, Va., and Charleston, S. C., electrical supplies, battery cells, and steel conduit; also October 10 to furnish at the navy yard at Pensacola, Fla., and the naval stations at Key West, Fla., and New Orleans, La., incandescent lamps and conduit fittings; also same date to furnish at the navy yard, New York, N. Y., and the works of the Fore River Shipbuilding Company, Quincy, Mass., the New York Shipbuilding Company, Camden, N. J., and the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., a quantity of electrical elevating, rammer and ammunition hoist equipments. Address H. T. B. Harris, Paymaster-General, U. S. N.

STANLEY-G. I. CO.'S NEW DEPARTMENT.—The Stanley-G. I. Electric Mfg. Co. has added another department to its plant at Morningside, Pittsfield, Mass., that of manufacturing jewels for instruments. Glass tubes for instruments are also made by the concern. The work in the foundry building has grown to large proportions, about 1,500 pounds of brass and aluminum casting being turned out daily. It is possible that the company will erect an iron foundry next spring, as it is now necessary to have all iron castings made out of the city. An officer of the company states that 85 per cent. more help are employed at present than last year, and that he expects to see the number increased to 1,500 by January 1.

ELEVATED AND SUBWAY LINES IN MEXICO.—S. S. Neff, formerly superintendent of the street railway system in the City of Mexico, is associated with a number of Americans and Mexicans in the project of building a system of elevated and subway electric lines for the City of Mexico. Application for a concession for the proposed system has been made to the Mexican government and is now under consideration by a commission of government engineers, who are investigating the project with a view of deciding as to its feasibility. Mr. Neff is at the Hoffman House, New York.

THE ROBINS CONVEYING BELT COMPANY has recently secured an order from the Orlando Water & Light Co., of Orlando, Fla., for a belt conveyor for handling wet muck. Among its other recent contracts are the order for a conveyor from the C. W. Hunt Co., of West New Brighton, and an order for five belt conveyors for the crushing plant of the Semet Solvay Company, Milwaukee, Wis.

BIDS FOR LIGHTING FIXTURES.—Bids will be received until October 3 by the Board of Health for furnishing material and installing electric and gas lighting fixtures in the administration and laboratory buildings and the scarlet fever pavilion on the grounds of the Willard Parker Hospital, Borough of Manhattan, New York City.

CONSOLIDATION OF WATER-TUBE BOILER INTERESTS.—A consolidation of much interest to the engineering world has just been consummated through the amalgamation of the water-tube boiler business of the Aultman & Taylor Machinery Company, of Mansfield, Ohio, and the Stirling Company, of Barberton, Ohio, as a result of which the Stirling-Cahall Boiler Company will be organized with a capital of $4,500,000. The position of the new company will be unique in that it will be able to supply to the trade practically every type of water-tube boiler, for in addition to manufacturing boilers of the Stirling, and Cahall horizontal and vertical types, it will shortly take up and place upon the market an improved water-tube boiler of the water-leg type. Details in respect to the organization of the company have not, as yet, been worked out, but it can probably be assumed that the consolidation will be one of organizations as well as of plants. They report business will be handled through the foreign connections of the Stirling Company in its offices in Johannesburg, S. A. R.; Havana, Buenos Ayres, Yokohama, the Hawaiian Islands, etc., as well as through its stock connection with the Stirling Boiler Company, Ltd., of Edinburgh, which is a prominent factor in the water-tube boiler business of Great Britain and the continent. The Stirling Company was organized in 1890, and in 1898 established its marine department, securing control of the United States patents on the Niclausse, Parrow and Mosher boilers. Its growth is illustrated in an increase of sales in eight years of nearly 800 per cent. The development of the Cahall sales department of the Aultman & Taylor Machinery Company has formed an equally important part at recent American industrial history. The new company thus starts with enviable prestige and with every facility for both manufacturing and selling. The general offices will be at 111 Broadway, New York.

POWER IN MINNESOTA.—B. L. G. Knox, vice-president and general manager of the Cucyrus Company, Milwaukee; F. O. Blackwell, consulting engineer of the Great Northern Power Company, Duluth; A. S. Slichter and B. W. Kirkpatrick, electrical and mechanical engineers for the General Electric Company, and C. C. Cokefair, of the Great Northern Power Company, spent several days recently, according to the *Iron Age*, in an extended trip over the Mesaba iron ore range inspecting conditions of steam shovel mining, etc. The General Electric and Bucyrus companies are now building at the Milwaukee shops of the latter company a large shovel to be operated electrically. The plan of these companies is to utilize the 25-cycle current of the Great Northern Power Company, to be generated at Duluth, for steam shovel service on the Mesaba range, and they propose to adopt the single-phase induction motor. The experiment will be watched with much interest. Work on the power company's project has so far advanced that it is now expected that current can be turned on by July next, at which time pole lines will have been constructed to carry the power to the Mesaba range, to Duluth and other adjacent points and to Minneapolis and St. Paul, which are about 130 miles from the generating station.

CUSTOM RULING.—In a decision by Thaddeus S. Sharretts the Board of United States General Appraisers have overruled a claim of the Weston Electrical Instrument Company, of Newark, regarding the rate of duty applicable to standard cells for electrical instruments. The Collector of Customs considered the cells to come under the provision in the Dingley tariff law for "blown glassware," with duty at the rate of 60 per cent. This classification was opposed by the importers, who set up the claim that the goods should be assessed at 20 per cent as unenumerated manufactured articles. This claim, as well as the classification imposed by the Collector, is deemed erroneous by the General Board. Mr. Sharretts says the cells should have been assessed as "manufactures of metal," with duty at the rate of 45 per cent ad valorem. Inasmuch, however, as the importers failed to make the proper claim in their protest, the board was unable to grant the relief.

OHIO BRASS COMPANY.—The Ohio Brass Company is rebuilding its factory, which was damaged by fire some months ago, at Mansfield, Ohio. There will be a one-story foundry, 106 x 266 feet; a machine shop, 60 x 340 feet, two stories high; a blacksmith shop and galvanizing building, 60 x 291 feet, and a warehouse, 76 x 150 feet. About 600 tons of structural steel will be used in the buildings. Special attention will be paid to fire protection, and a 125-foot steel stand pipe will be erected for use in connection with an automatic sprinkler system throughout the plant. The power plant will be enlarged to take care of the extensions Mr. A. M. Allen, of Cleveland, is the consulting engineer.

TROLLEY ON LONG ISLAND.—The Manhattan and Long Island Railroad Company of New York was incorporated at Albany last week with a capital of $10,000,000. The purpose of the company is to operate an electric road eighty miles long in Greater New York and on Long Island, the terminals to be in Long Island City and at Northport. The directors are Edward Mackey, D. T. Meyer, H. H. Bowtell, Samuel Y. Sauber, Franklin M. Walter, George E. McArdle, New York; Robert M. Stockwell, Yonkers; A. Parontand, Brooklyn, and Henry Guinard, Watchung, N. J.

ANN ARBOR TROLLEY EQUIPMENT.—The Patrick Hirsch Company, of Toledo, has placed contracts for the power plant of the Toledo, Ann Arbor & Detroit Railway, operating an electric line from Toledo to Ann Arbor, Mich. The electrical equipment will be furnished by the General Electric Company; the steam equipment by the Arbuckle-Ryan Co., Toledo; the rolling stock by the Niles Car & Manufacturing Company, Niles, Ohio, and the rails by the Carnegie Steel Company. The road will be 50 miles long, and is to be ready by June 1, 1906.

APPARATUS WANTED.—Bids will be received until Nov. 1 by O. H. Ensign, electrical engineer U. S. Reclamation Service, Los Angeles, Cal., for furnishing complete, one or more alternating-current, 900-kw, 25-cycle generators, one or more 100-kw exciters, and a switchboard containing one panel for the generator and one panel for the exciter, for use in Roosevelt, Ariz., power house, of the Salt River project, in Arizona.

Financial Intelligence.

THE WEEK IN WALL STREET.—Bullish manipulation in the stock market was resumed and maintained during the week, and irregular advances were scored throughout the list, the United States Steel shares being among the chief features of the movement. Money advanced to 4 per cent. Bank clearings for the week ended with September 14 aggregate $2,530,675,996, 9 per cent over last week, and 17 per cent in excess of last year. Exchanges outside New York City total $930,223,333, 12 per cent over last week and 14 per cent above last year. On a fair business the traction stocks advanced, Brooklyn Rapid Transit closing at 69⅜, which is a net gain of 2¾, and Metropolitan Street Railway at 127⅞, a gain of 1¼. Interborough Rapid Transit closed on the curb at 216, a net loss of 1 point. The electric stocks also showed some firmness and all made gains. The Allis-Chalmers issues closed at 17¼ for common, a gain of ⅞-point, and preferred at 59, a net increase of 1½. General Electric made a gain of 2⅞ points, closing at 181⅞, and the last quotations for Westinghouse common and preferred were 169 and 180, respectively. American Telephone and Telegraph closed at 139 and Western Union at 95⅝. Electric Storage Battery is quoted at 85½, which was the lowest price for the week. The market for outside securities was, in the main, quiet and without special feature, but was generally firm in tone. The trading was mainly professional. Following are the closing quotations of September 19:

NEW YORK

	Sept. 12	Sept. 19		Sept. 12	Sept. 19
Allis-Chalmers Co.	17⅛	17¾	General Electric	179	180¼
Allis-Chalmers Co. pfd.	60	59⅛	Hudson River Tel.	..	..
American Dist. Tel.	30	30	Interborough Rap. Tran.	215¾	215
American Tel. & Cable	92	92	Mackay Cos.	40¾	41⅛
American Tel. & Tel.	139	139	Mackay Cos. pfd.	74	74⅛
Brooklyn Rapid Transit	67½	68⅝	Marconi Tel	..	..
Electric Boat	30	30	Metropolitan St. Ry.	127	126⅞
Electric Boat pfd.	65	70	N. Y. & N. J. Tel.	..	..
Electric Lead Reduction	..	..	Western Union Tel.	94	94⅛
Electric Vehicle	19	18	Westinghouse com.	166	167
Electric Vehicle pfd.	23⅛	23	Westinghouse pfd.	..	..

BOSTON

	Sept. 12	Sept. 19		Sept. 12	Sep.t 19
American Tel. & Tel	140¼	139	Mass. Elec. Ry. pfd.	59½	58½
Cumberland Telephone	120¼	120½	Mexican Telephone	1⅛	1¼
Edison Elec. Illum.	..	250	New England Telephone	134	134½
General Electric	..	179	Western Tel. & Tel.	*18	*18
Mass. Elec. Ry.	15⅛	15½	Western Tel. & Tel. pfd.	97	97

PHILADELPHIA

	Sept. 12	Sept. 19		Sept 12	Sept. 19
American Railways	52½	52	Phila. Electric	8¾	8¾
Elec. Co. of America	11	11	Phila. Rapid Trans.	28	28
Elec. Storage Battery	85	85	Phila. Traction	..	..
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Sept. 12	Sept. 19		Sept. 12	Sept. 19
Chicago City Ry	190	190	National Carbon	60	60
Chicago Edison	..	.	National Carbon pfd.	*115½	115½
Chicago Subway	..	..	Union Traction	..	..
Chicago Tel. Co	.	..	Union Traction pfd.	..	..
Metropolitan Elev. com.	22⅝	25			

* Asked.

DIVIDENDS.—The directors of the Western Union Telegraph Company have declared the regular quarterly dividend of 1¼ per cent., payable Oct. 16. Directors of the Interborough Rapid Transit Company have declared a dividend of 2 per cent, payable Oct. 2. The Savannah Electric Company has declared a semi-annual dividend of $3 per share on the preferred stock, payable Oct. 2. The Seattle Electric Company has declared a semi-annual dividend of $3 per share on the preferred stock, payable Oct. 2. The United Gas Improvement Co. has declared a quarterly dividend payable October 14. The General Electric Co. has declared a regular quarterly dividend of 2 per cent, payable Oct. 16. The Westinghouse Airbrake directors have declared the regular dividend of 2½ per cent, and an extra dividend of 2½ per cent.

STREET CAR TRAFFIC IN PHILADELPHIA.—The report of the Philadelphia Rapid Transit Company for the year ending June 30, 1905, as presented to the stockholders at their annual meeting on Wednesday, September 20 shows that for the period named no fewer than 402,893,245 passengers were carried; an increase over the previous year of 12,360,556 passengers. The report of financial operations shows that the gross receipts from passengers were $6,188,645, an increase of $265,137. Deducting from the former amount the operating expenses of $8,183,437, there is left as earnings from operation the sum of $8,005,208, which, compared with 1904, is an increase of $75,015. Miscellaneous receipts, interests, etc., of $185,979, which sum is an increase of $13,124 over the previous year, make the gross earnings $8,191,188. Charging off against this licenses, taxes and fixed charges of $8,082,972, there is left as surplus the sum of $108,209, which is a decrease over the previous year of $112,639. In presenting the report to the stockholders, President Parsons called attention to the fact that the severe weather conditions of the past winter had helped materially to keep down the gross receipts of the company. He said that the total tracking of the system is now 554 miles, but during the past year there were added 28.72 miles. He also called attention to the construction of the Market Street Subway and said that at the present time the tunnel is practically completed to Sixteenth Street. The power equipment of the company has been increased by 6,000 kilowatts, all of which has been installed at the Second and Wyoming Avenue power house, and approximately ten miles of new conduits were laid during the year.

WESTERN UNION EARNINGS.—The quarterly statements of Western Union continue to reflect the loss of pool room business from which the company retired early in the fiscal year. There has been scepticism in some quarters, says the *Wall Street Journal*, as to the company's good faith in promising to cut out its connection with the pool rooms, but the promises made have been fulfilled and that department of the business has been absolutely closed up. The rooms in the Western Union Building at 195 Broadway, which were formerly devoted to the purposes of this department have been cleared of their instruments and are now being used for other purposes. As a result of this change earnings both for the September 30 quarter and for the fiscal year ending June 30 show considerable falling off as compared with the past few years, although it is understood that commercial business has been of satisfactory volume. For the fiscal year ending June 30, 1905, the company earned slightly in excess of 6 per cent. against the 5 per cent. dividend paid and in the quarter ending September 30, earnings amounted to only 1.6 per cent. against the quarter's dividend of 1¼ per cent. This is a pretty narrow margin, but the worst effects of the loss are now being shown.

SEATTLE-TACOMA POWER MORTGAGE.—In the matter of the recent filing of a mortgage on the property of the Seattle-Tacoma Power Company, as the basis for the issuance of $7,500,000 worth of 5 per cent, 20-year bonds, the underwriting was done by the Northern Trust Company, which is named as trustee in the instrument. The issue will be taken up by N. W. Harris & Co., of Chicago, from time to time as the power company calls for funds. The bonds are of $1,000 denomination, and are subject to redemption at 105 after June 1, 1909. It is stated that the purpose of the bonding was to systematize the miscellaneous debts of the concern, and also make possible large extensions of the business. In the pursuance of the first mentioned purpose approximately $2,000,000 of the issue will be used. The remaining indebtedness bonded by the present issue is that incurred by the nearly completed operations at Snoqualmie Falls, which will result in practically doubling the capacity of the plant.

KENTUCKY ELECTRIC CONSOLIDATION.—J. Levering Jones and J. M. Chandler & Co., of Philadelphia, have bought the several electric light plants and interurban railway properties in central Kentucky at a cost of about $10,000,000. The Lexington Street Railway & Light Company brought $2,000,000. The Blue Grass Traction Company got $1,400,000 for its two lines to Paris and Georgetown; the Central Kentucky Traction Company, $1,200,000 for its franchises to Versailles, Winchester and Richmond, and the Frankfort Railway & Light Company $300,000 for the plant at Frankfort and the franchise to Versailles. There are eleven miles in operation of the Frankfort and Versailles company and a fourteen miles franchise, not completed to Versailles.

CHESAPEAKE & OHIO.—The annual report of the Chesapeake & Ohio Railroad says: "The Covington & Cincinnati Elevated Railroad & Transfer & Bridge Company, controlled by C. & O., has acquired the ownership of the entire common capital stock of the Cincinnati Inter-Terminal Railroad Co., organized for transportation purposes within the city of Cincinnati. A connection is under construction between the bridge company's tracks and the Cincinnati, Hamilton & Dayton Railway, and additional tracks are also being provided. For this purpose it was necessary to authorize the issue of $1,000,000 preferred guaranteed stock of the Inter-Terminal Company, $700,000 to be issued at this time in payment for property and improvements and $300,000 reserved for future improvements. There is no bonded debt on that property."

CARBON COMPANY INCORPORATED.—The Independent Carbon Company, with a capitalization of $500,000, has been incorporated at Columbus, Ohio. This is the succeeding organization to the United States Carbon Company, which was purchased recently by M. B. Daly. The plant has been overhauled at an expenditure of about $100,000. The company will eventually establish branch plants in the gas belt of southeastern Ohio and West Virginia. B. P. Foster, manager of the United States Carbon Company, which was formed about eight years ago, will continue in the same capacity with the new company. The incorporators are Gustav Von Den Steinen, G. W. Cottrell, W. B. Stewart, H. E. French and John P. Dempsey.

TRACTION INTERESTS IN KENTUCKY.—A dispatch from Lexington, Ky., says that J. Levering Jones and P. M. Chandler & Co., of Philadelphia, have bought the several electric light plants and interurban railway properties in central Kentucky at a cost of about $10,000,000. The Lexington Street Railway and Light Company brought $2,000,000. The Blue Grass Traction Company got $1,400,000 for its two lines to Paris and Georgetown; the Central Kentucky Traction Company, $1,200,000 for its franchises to Versailles, Winchester and Richmond, and the Frankfort Railway and Light Company $300,000 for the plant at Frankfort and the franchise to Versailles.

OWENS RIVER WATER SYSTEM.—The bonds for the Owens River water system in California, have been voted, and engineers will soon be put in the field to make the surveys. The first actual construction work will be the installation of a power plant on Cottonwood Creek. The power will be carried along the line to drive drills, excavators, tunnel cars, etc. There will be about 900,000 feet of cement conduits, requiring 1,350,000 barrels of cement. The estimated cost of the tunnel work is $30 a foot. The estimates of the total cost stand: Cost of survey and water rights, $1,500,000; cement conduits,, $14,400,000; tunnels, $3,458,000; total, $19,358,000.

HUDSON RIVER POWER.—The report of the Hudson River Electric Power Company for July and the seven months ended July 31, compare as follows:

	1905.	1904.	Increase.
Gross earnings	$63,293	$42,771	$20,521
Operating expenses	37,405	21,529	15,876
Net earnings	25,887	21,242	4,644
7 months gross earnings	379,023	273,065	105,958
Operating expenses	230,170	149,139	81,031
Net earnings	148,853	123,926	24,927

MANILA SHANGHAI CABLE.—A certificate of increase of capital of the Commercial Pacific Cable Company of New York City from $12,000,000 to $15,000,000 has been filed at Albany with the Secretary of State. The company also filed an amendment to its certificate of incorporation providing that it may extend its lines from Manila to Shanghai. The certificates are signed by Clarence H. Mackay and Edward C. Platt.

PURCHASE OF RUTLAND PROPERTIES.—Mr. G. Tracy Rogers, of Binghamton and Buffalo, and Leo H. Wise, of the firm of Wise Bros., New York City, have it is stated, brought recently the public service corporations at Rutland, Vt., including street railway lines, electric and gas lighting plants and the water power franchise of Rutland.

LAKE SHORE ELECTRIC.—The final report of the Citizens' Savings & Trust Company, as receiver of the Lake Shore Electric Railroad Company has been filed in the United States Circuit Court at Cleveland. The report shows that $968,262 has been disbursed by the receiver, who turns over to the company $800,000 above all claims paid.

MORTGAGE TO SECURE BONDS.—The Toledo Gas, Electric & Heating Company has executed a mortgage for $2,500,000 on all its property in order to float a bond issue. The bonds are due October 1, 1935, and bear interest at 5 per cent. The instrument is in favor of the Ohio Savings Bank & Trust Company.

NORTHERN TRACTION.—Stone & Webster have purchased for about $2,000,000 controlling interest in the Northern Traction Company from the Bishop-Sherwin syndicate of Cleveland. The company owns a line from Dallas to Fort Worth, Tex.

MEXICAN LIGHT & POWER.—A dispatch from Montreal states that the Mexican Light & Power Company will increase its capital from $12,000,000 to $16,000,000 to permit important extensions being made.

General News of the Week

The Telephone.

GADSDEN, ALA.—The City Council has granted a franchise to W. H. Crumb and associates to erect a telephone system in this city. The rate for business houses will be $3.50 per month and for residences $1.75 per month.

STOCKTON, CAL.—C. C. Higgins has filed a new application for a telephone franchise with the City Council.

SANTA PAULA, CAL.—J. B. Titus and D. W. Mott have made an application for a telephone franchise. Notice of the sale of such franchise was ordered printed.

LOS ANGELES, CAL.—The San Diego Home Telephone Company now has 1,500 subscribers. All of its telephones are automatic. It connects with all Southern California points.

NEVADA CITY, CAL.—The Home Telephone Company, of Los Angeles, has applied to the trustees of this city and Grass Valley and to the county supervisor for a franchise.

MARTINEZ, CAL.—R. B. Borland has presented a communication from the Pacific States Telephone Company requesting permission to open streets for the purpose of installing an underground cable. His petition was granted.

SAN FRANCISCO, CAL.—The promoters of the Home Telephone Company, of San Francisco, say that they intend to spend about $1,000,000 in installing the system on the Oakland side of the Bay. The North Berkeley Improvement Club has sent the company an invitation to apply for a franchise in Berkeley.

OLNEY, ILL.—The Star Line Telephone Company of this place has been dissolved.

LINCOLN, ILL.—The City Council has granted the Central Illinois Telephone & Telegraph Company a franchise.

ALBION, ILL.—The Edwards County Mutual Telephone Company has increased its capital stock from $4,048 to $25,000.

SYCAMORE, ILL.—The De Kalb County Telephone Co., located at this place, has increased its capital stock from $100,000 to $150,000.

GLASFORD, ILL.—The North Star Telephone Company, of Glasford, has been incorporated for $2,200. The incorporators are Andrew Northrup, M. R. Turpin and C. W. Rusch.

SPRINGFIELD, ILL.—The Beloit Farm Telephone Company, located at Beloit, Wis., with a capital stock of $5,000, is licensed to transact business in Illinois with a state capital of $500.

KEWANEE, ILL.—The Kewanee Long Distance Telephone & Telegraph Company has been formed; capital, $100,000. The incorporators are: William I. Hibbs, Frank M. Ashe, Archie C. Shoemaker.

CHICAGO, ILL.—The Chicago Telephone Company in its bid has offered to supply police and fire telephones to the city at a rental of 50 cents per set. The bid was for 1,600 receivers, 1,552 transmitters, 1,210 induction coils and 150 portable stand telephones.

DUNLAP, ILL.—The Dunlap and Alta Telephone Company has held its annual meeting, at which time the following officers were elected: President, Dr. Walter Allen; secretary and treasurer, W. D. Chas. Threshie; directors, Joseph Robinson, Austin Shaw and Charles Holmes.

SHELBYVILLE, ILL.—The Mutual Telephone Company has just been organized by prominent business men of Tower Hill, Ill. A number of farmers are arranging to attach party lines, and will have connection with the entire county. The officers of the new company are: President, E. G. Foster; vice-president, Dr. A. C. Jackson; secretary-treasurer, J. C. Pitzer; manager, L. B. Fluckey; directors, E. G. Foster, John Jenkins, Dr. J. R. Young, Dr. A. C. Jackson, L. B. Fluckey, R. Shride and J. C. Pitzer.

ALTON, ILL.—The City Council was notified September 9 by officials of the Central Union (Bell) Telephone Company, that the company had a perpetual franchise in Alton. The city officials were about to proceed against the company to compel it to pay 2 per cent. of its gross earnings to the city treasury as a consideration for a renewal of its franchise, which was supposed to have expired. Investigation was started when the company claimed a perpetual franchise, and it was found that the old ordinance granting a franchise gave no stated time for the life of the permit. According to the old franchise the company has a perpetual right. An attempt will be made by the city to have the franchise declared void.

RICHMOND, IND.—The Central Union Telephone Company will not be allowed to lay conduits in the streets of Richmond until the other companies using wires are prepared to do likewise.

INDIANAPOLIS, IND.—The Central Union Telephone Company is making a strong effort to secure the long-distance telephone business in some of the southern counties of Indiana. Arrangements have been made to connect Bloomfield, Bloomington, Nashville and Columbus via Calvert Station, and it is said that Spencer and Ellettsville will also be connected. The Bloomfield-Columbus line will give the Central Union Company a direct connecting line across the southern part of the state.

LAKE PARK, IA.—Local business men contemplate a competing telephone exchange.

CONRAD, IA.—Charles Hurd has recently purchased the telephone exchange at this city.

INTERNATIONAL FALLS, IA.—The Council has granted a franchise for a telephone system to the International Telephone Company.

LE MARS, IA.—The capital stock of the Le Mars Telephone Company has been increased from $50,000 to $100,000 and the name changed to the Plymouth County Telephone Company.

BURLINGTON, IA.—The new line of the American Telephone and Telegraph Company is nearing completion. This line extends from Burlington to Kansas City and points in the southwest. An additional through line from Galesburg to Burlington will be completed within a week or ten days. One from Keokuk to Burlington is nearing completion. All of these circuits enter the office of the Iowa Telephone Company.

STUBBLEFIELD, KY.—The Citizens Telephone Company has been formed with a capital of $500 by H. A. Walston and H. I. Batts.

PADUCAH, KY.—The People's Independent Telephone plant was sold by the United States Commissioner on Sept. 11 to close a mortgage for $252,000, held by Wilkesbarre, Pa., banks. It was bought in by E. L. Barber, of Wauseon, O., for $80,000.

ROWE, MASS.—The Heath Telephone Company has bought out the Rowe Telephone Company, and will take possession October 1.

BAY CITY, MICH.—Within a few days the Michigan State Telephone Company will have in service nearly 50 rural telephones west of the city. The new line is completed to Auburn and takes in many farmers along the road.

SLEEPY EYE, MINN.—The Sleepy Eye Telephone Company will build a rural line to Prairieville.

CLEAR LAKE, MINN.—The Sherburn County Telephone Company has secured a franchise to build an exchange here and also one at Becker.

RUTHTON, MINN.—The Ruthton Telephone Company has been incorporated by Geo. Bingham, president, and N. C. Bertelson, secretary.

NEWTON, MISS.—The Board of Mayor and Aldermen of Newton has granted a franchise to E. E. Grassett and J. J. Mott, Jr., of Meridian, to establish and operate an independent telephone system here. The same people are interested in several private lines that connect with towns adjacent to Newton, and they will also have connection with the Home Telephone Company at Meridian.

FARMINGTON, MO.—The Farmington Telephone Company was sold by T. P. Pigg to local capitalists for about $60,000. The system is one of the largest in Missouri, outside of the large cities, having switchboards at Farmington, Flat River, Bonne Terre and Deer Run.

TRENTON, N. J.—The United States Independent Telephone Company has been incorporated here by Henry A. Bingham, Richard F. Tulley and Robert S. Carmichael, of Jersey City. The capital stock is $100,000.

FULTON, N. Y.—The Fulton Common Council has granted the Empire State Telephone and Telegraph Company permission to place its wires in electrical subways. The company was also authorized to construct lines over the surface of the streets.

LEXINGTON, N. C.—A new telephone company has been chartered here.

ROSEHILL, N. C.—The Rosehill Telephone Company has been chartered with $10,000 capital stock. This company was referred to in last issue in these columns.

BOLIVAR, OHIO.—The Imperial Home Telephone Company certifies to an increase of capital stock from $10,000 to $40,000.

CINCINNATI, OHIO.—The Big Four Railroad will extend its system which was installed between Cleveland and Galion and between Galion and Bellefontaine eight months ago. It is now the plan to install telephone service over the telegraph wires from Galion on to Cincinnati, also from Springfield to Sandusky.

BELLEVUE, OHIO.—Frank A. Knapp, of this place, has purchased a controlling interest in the local telephone company and the Bellevue Home Telephone Company. The local telephone company has 4,200 telephones installed and 200 miles of toll lines in Huron and Crawford counties, with exchanges in sixteen towns. With Mr. Knapp are asociated some of the leading independent telephone men in the state. By the deal Knapp and his associates acquire control of telephone property representing an investment of over $400,000.

WILLOE, OKLA.—The Willoe Telephone Company has been formed with a capital of $1,000, by L. C. Cousins and J. W. Berry.

GUTHRIE, OKLA.—The Quay Rural Telephone Company has been organized. Capital, $200,000. Incorporated by O. F. Hutchinson and C. M. Prowvant.

PORTLAND, ORE.—The Independent Telephone Company has sold $1,000,000 worth of bonds, the money to be used in the construction of a long-distance line between Portland and British Columbia cities.

EAST VANDERGRIFT, PA.—East Vandergrift has granted a franchise to the Vandergrift Telephone Company.

NEWTOWN, PA.—At a meeting of business men of Newtown borough a local telephone company was formed, with a capital of $5,000. Edward P. Hicks has been selected president of the new company and J. Herman Barnsley secretary and treasurer.

PITTSBURG, PA.—It is expected that the Keystone Telephone Company, of Philadelphia, will join the movement for the merging of the independent telephone companies and will take part in forming a trunk line between Pittsburg, Philadelphia and New York.

WILKESBARRE, PA.—At a meeting of the board of directors of the Consolidated Telephone Companies of Pennsylvania, held at Allentown, an order was placed for a new toll board section for the Wilkes-Barre exchange. This company has also just recently installed the two party selecting ringing system.

YORK, PA.—The capital stock of the York Telephone Company has been increased from $200,000 to $500,000. The fund realized by the increased stock will be applied to placing the wires of the company's system in the city underground, to extend rural lines and make a variety of improvements for the betterment of the service.

BRISTOL, TENN.—The Holston Valley Telephone Company has been organized at Holston Valley, this county, with the following officers: David McConnell, president; J. D. Thomas, vice-president; Philip Painter, secretary and treasurer.

KNOXVILLE, TENN.—The East Tennessee Telephone Company, in the near future, will install a central energy switchboard in the Knoxville exchange building, and other improvements to the service in this city will be made.

RIPLEY, TENN.—A stock company has been organized for the purpose of building a telephone line from Halls, twelve miles north of Ripley, by way of Nankipoo to Edith. Application for a charter has been filed in the Register's office at this place, the capital stock being placed at $1,500. The incorporators are J. H. Bibb, G. N. Grear, L. F. Adams, E. Abernathy and A. B. White.

SAN ANTONIO, TEX.—A new telephone line is to be built from this city to Bandera.

EL CAMPO, TEX.—The Coast Telephone Company has been organized at El Campo with a capital stock of $5,000. T. J. Poole is one of the incorporators.

SHERMAN, TEX.—At a meeting of the directors of the recently organized North Texas Telephone Company, held in this city, final arrangements were made for the construction of the proposed line from this city to Gainesville via Southmayd, Pottsboro and Woodbine.

LEANDER, TEX.—The Block House & Leander Telephone Company has been organized to operate the telephone line which runs from Leander to Block House. A. Bittick is president and L. F. Chapman secretary of the new company. The line will probably be extended.

SAN ANTONIO, TEX.—It is stated that the Commercial Telephone Company, which was recently sold by order of court to pay off its bonded indebtedness, will be reorganized and placed upon a solid footing. This company operates about 500 miles of long-distance telephone lines in Texas. The company has filed suit against H. M. Aubrey, of San Antonio, a director of the company, for $77,000 damages, said to have grown out of the alleged overbonding of the plaintiff company. Mr. Aubrey has brought suit against his codirectors in the courts of Ohio, where they reside.

LLANO, TEX.—The Martin Telephone Company, which recently increased its capital stock from $10,000 to $20,000 and changed its principal office from Johnson City to Llano, has made arrangements to either build new lines or connect with other companies' lines from Mason to the San Angelo Company's line at Menardville, and from San Saba either Comanche or Brownwood, to form a junction with the Roberts Independent Telephone Company at Midland, Tex., and the Riddle independent telephone system at Weatherford, Tex. Among the stockholders of the Martin Company are Otto Ebeling, M. H. Reed, R. H. Evans, all of Marble Falls, Tex.; David Martin, of Llano, and Levi Crownover, of Blanco, Tex.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Eastern Utah Telephone Company, with a capital stock of $60,000, have been filed. The purpose of the company is to connect the towns of Carbon and Emery counties by the construction of about 125 miles of local line and afterwards deal with the Independent or the Bell Company at Salt Lake for Utah and other connections. R. G. Miller, a local capitalist, will probably hold a majority of the stock.

HARTWOOD, VA.—The Hartwood and Fredericksburg Telephone Company, with headquarters at Hartwood, has been chartered, with $4,000 capital, by P. W. Irvin, of Falmount, secretary and treasurer, and several others.

PETERSBURG, VA.—The Petersburg Telephone Company has been granted the privilege of laying its wires underground in the business section. An ordinance has also been passed by the aldermen requiring telegraph companies to place their wires underground.

SEATTLE, WASH.—Bonds aggregating $1,000,000 in value are now being circulated in the East by the Independent Telephone Company, of this city, to provide for the extensions to the local and outside service. It is the intention of the company to absorb a number of smaller companies and to carry its lines into the State and Northwest.

BELOIT, WIS.—The Beloit Farm Telephone Company has been incorporated, with a capital of $5,000.

GREEN BAY, WIS.—The consolidation of the Valley Telephone and Telegraph Company, of this city, and the Fox River Valley Telephone Company, of Appleton, has been perfected. J. S. Van Nortwick is president; J. P. Hoeffel, secretary.

MILWAUKEE, WIS.—Albert von Hoffman is the promoter for the telephone company which has introduced an ordinance in the common council, being the third to ask for a franchise to establish an independent telephone, in competition with the local Bell telephone system. The company will ask for a franchise under the title of Registering Telephone Company. The ordinance of the West Shore Telephone & Telegraph Company, and the Milwaukee Home Telephone Company have been the subject of several hours' discussion before the Council.

TORONTO, CAN.—A combination of municipalities and independent telephone companies and manufacturers has been formed for the purpose of fighting the Bell Telephone Company and securing favorable legislation from both the Provincial and Federal Parliaments. About fifty delegates were in attendance, representing private corporations, excepting Mayor Urquhart, who was chosen to preside. Mr. A. F. Wilson, of Markham, was elected secretary. Committees were appointed to draft a constituion and resolutions.

Electric Light and Power.

ALBERTVILLE, ALA.—A number of the business men of Albertville have organized the North Alabama Railway, Light & Power Company, with a capital of $100,000. The purpose of the company is to connect all Sand Mountain towns with an electric railway, provide water works for the larger towns and to light the towns with electricity. J. G. Elrod is president, N. A. Elrod vice-president and business manager, and W. M. Coleman, secretary.

STOCKTON, CAL.—The Middle River Navigation & Canal Company expects to install a number of electrically driven pumps, and purchase ditching machinery.

SAN FRANCISCO, CAL.—The Union Light and Water Company has been incorporated with a capital stock of $2,000,000 by Richard Kirman, John Humphreys, Jos. Martin, M. Fleishhacker, F. H. Buck, R. E. Wallace and H. A. Cooke.

RIALTO, CAL.—The Edison Electric Company has made a proposition to the citizens of Rialto to extend the 10,000-volt line from San Bernardino, the Rialto citizens to establish their own local operating company, furnish wires, meters, transformers, etc.

SAN FRANCISCO, CAL.—The Vancouver Power Company, Ltd., which transmits electric power 16 miles from its plant on Burrard Inlet, is about to place orders for an additional generating unit of 1,500-kw. capacity. The present installation includes three 1,500-kw., 3-phase generators, each direct-connected to a 3,000-hp. A Pelton water wheel operating at 225 r.p.m., under 390-ft. head will be installed. The headworks are arranged to admit of operating five units.

SAN FRANCISCO, CAL.—The Truckee River General Electric Company's new brick sub-station, near the C. & C. Works, Virginia City, Nev., has been completed. It has a capacity of 3,000 kw. in static transformers. There are six 250-kw. and four 675-kw. transformers, used for stepping down from 24,000 to 2,200 volts. The company's second power plant, on the Truckee River, is nearly completed and will be in operation in time to supply current at Virginia City under its new contract with the Comstock Pumping Association in October.

SAN FRANCISCO, CAL.—The Oro Water, Light & Power Company has received bids, through Cory, Meredith & Allen, engineers, for its initial generating plant. The power site is about 15 miles from Oroville and an available head of 480 ft. of water will be utilized. Water will be taken from the Oroville Light & Power Company's extensive system of ditches, which connect with the West Branch of the Feather River. The tail water from the plant will go into the secondary ditch system, supplying domestic water for Oroville and water for mining and irrigating purposes. J. W. Goodwin, San Francisco, is prominent in the management of the company.

SAN FRANCISCO, CAL.—Engineer Noerager, from the General Electric Company's work, is in San Francisco, superintending the installation of the new sub-station equipment in the United Railroads electric power house at 16th and Bryant Streets. This plant is to be remodeled and most of the old generators removed. Motor-generators sets, taking current from the California Gas & Electric Corporation system, will furnish direct current for use on the street railway lines. Before reaching this sub-station, the current will pass through frequency changers at the gas engine reserve plant of the California Gas & Electric Corporation, being changed from 60 cycles to 25 cycles.

SAN FRANCISCO, CAL.—The Union Light & Water Company, which has been incorporated here by Joseph Martin, Mortimer Fleishhacker, John Humphreys and others, amounts to a consolidation of the electric power and water interests operating in and around Reno, Nev. The capitalization is $2,000,000 and it is understod that arrangements have been made to place bonds amounting to about $700,000. The power plants of the Washoe Power & Development Company and the Reno Power, Light & Water Company will be taken over by the new management. A good deal of land and valuable water properties are included in the acquisitions. The power lines tie in with those of the Truckee River General Electric Company, so that whenever necessary current can be transmitted to Viriginia City and the Comstock Mines.

SAN FRANCISCO, CAL.—The two 800-hp. Westinghouse induction motors for the latest pumping plant for the Comstock Pumping Association, at Virginia City, Nev., will soon arrive at their destination. They cost about $25,000 delivered. They are especially constructed, it being necessary to make each frame in four pieces so as to be lowered down the shaft. The motor and pump have a common steel shaft 14 ins. in diameter and 14 ft. long, the cranks being forged on. The combined weight of the two motors is 110,000 lbs. The speed will be 195 r.p.m., which is slow for an induction motor, but fast for the two direct-connected Knowles crank and flywheel pumps. The pumping plant will be installed in a chamber 80 ft. long, 24 ft. wide and 20 ft. high. It will take the Reidler pumps two months to lower the water sufficiently for the new pumps to be installed. Then the chamber must be cut in the rock and it will probably be six months before the installation is completed. Leon M. Hall, engineer for the Comstock Pumping Association, will have charge of the work.

ROCKMART, GA.—About $5,000 has been raised here for an electric light plant. R. R. Beasley is the moving spirit in the enterprise.

JACKSON, GA.—The city of Jackson has voted a bond issue of $40,000, to be used for an electric light and water works system for the municipality.

TALLULAH FALLS, GA.—Louis B. Magid, of Tallulah Falls, has purchased the water power of the same name at Tallulah Falls, and may develop electric power. The available energy is about 35,000 horse-power.

WASHINGTON, GA.—It is stated that Capt. J. H. Fitzpatrick, of Washington, has purchased the Anthony Shoals property in this county and will develop and transmit this power to Washington, Elberton and Anderson, S. C., and build a railroad from Washington to Elberton.

WEISER, IDAHO.—The Swan Falls Light & Power Company has petitioned for a franchise to light the city.

CUBA, ILL.—A new 150-hp. simple automatic engine and a 100-kw., single-phase, 125-cycle alternator are to be installed in the municipal plant. L. Monch is superintendent.

GREENFIELD, IND.—The street lighting system here, which is owned by the city, will be changed to the alternating-current system.

JASONVILLE, IND.—The Jasonville Electric Company will soon ask bids for constructing an electric light plant here. Jas. H. Parsons is president.

VALPARAISO, IND.—The Valparaiso Lighting Company has been formed; capital, $150,000; incorporated by Clarence H. Geist and Charles B. Kelsey.

SUMMITVILLE, IND.—The injunction obtained two years ago by taxpayers of this city to prevent the town trustees from making the first payment on a municipal light and water plant has been dissolved by Judge Lefler, of Muncie, and the city must pay the price, $55,000. The ground for the complaint was that second-hand material was used in the construction and there were evidences of graft.

LEBANON, IND.—The Citizens' Electric Light & Ice Company, Lebanon, Ind., has installed two Diesel engines, one of 400 hp. and the other about 200-hp. capacity. The larger of the two engines was employed at the St. Louis Exposition for furnishing light and power for the Tyrolean Alps, on the Pike. Each engine is direct connected to a General Electric alternator of corresponding size.

MARSHALLTOWN, IA.—The Council has authorized the Water and Light Committee to make repairs to the lighting plant. Two new dynamos are needed.

FORT LEAVENWORTH, KAN.—Bids will be received until Oct. 4 by Capt. J. E. Normoyle, Constructing Quartermaster, U. S. A., for extending the electric lighting system at Fort Leavenworth.

ASHLAND, KY.—The Virginia Light & Power Company has been incorporated with a capital of $25,000. to construct an electric lighting system from Richmond, Va., to Ashland.

DEXTER, ME.—The Dexter Electric Light Company has sold its plant and business to N. Curtis Fletcher, of Boston.

WATERVILLE, ME.—The Massalouskee Electric Company contemplates constructing a new water power station on Rice Rips, to cost about $125,000.

PORTLAND, ME.—The Citizens' Water & Lighting Company has been incorporated; capital, $230,000. Promoters. A. F. Pine, H. L. Cram and C. E. McGlauflin, Portland.

HYATTSVILLE, MD.—A committee has been appointed to report on the construction of a municipal electric light plant. Harry W. Shepherd is chairman of the Light Committee.

BRUNSWICK, MD.—The Brunswick extension of the Harpers Ferry Electric Light & Power Company has been organized at Brunswick by the election of the following directors: Dr. H. S. Hedges, Mr. J. T. Martin, Mr. C. R. Gregory, Mr. William Schnauffer, Mr. G. T. Hogan, Mr. H. M. Jones, Mr. F. E. Adler and Z. T. Brantner.

BALTIMORE, MD.—Upon the complaint of the Consolidated Gas, Electric Light & Power Company and the filing of a bond for $5,000, an injunction has been granted by Judge Stockbridge, in Circuit Court No. 2, restraining the Maryland Telephone & Telegraph Company from interfering with the poles and wires of the Consolidated Company on Broadway, between Baltimore and Thames Street, and from stringing any of its own wires on the poles in question.

WALTHAM, MASS.—The new power house of the Waltham Gas & Electric Light Company, in course of construction, will be one of the largest houses outside of Boston. It will cover an area of 150 feet by 100 feet. The building will be 35 feet high and fireproof. The contract calls for the building to be completed, the plant installed and in operation by Jan. 1, 1906.

UXBRIDGE, MASS. In accordance with a vote of the town at the March town meeting the selectmen have concluded a five-year contract with the Uxbridge & Northbridge Electric Company for lighting the streets of the town. According to the new contract the town is to pay $14.50 per year for each incandescent and $63 per year for each arc light. The former price was $15 and $70 respectively.

ADDISON, MICH.—The contract has been awarded to the Western Electric Company, of Chicago, for the installation of a municipal lighting plant in the village.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Electric Company expects to deliver power in Grand Rapids by Jan. 1. It has contracted with a number of Muskegon firms to supply them with power.

STURGEON FALLS, MICH.—The Penn Iron Mining Company, with lands on both sides of the Menominee River, has completed plans for utilizing the power of the river. A dam is to be erected at once, and 2,400 horse-power will be available. This power will be used for the operation of mining machinery.

GRAND RAPIDS, MICH.—Representatives of the M. B. Wheeler & Co. of this city have filed 15 entries of lands on the Manistee River in Manistee County. It is understood that the rapids of the river will be utilized for the generation of electric power which will be transmitted to Manistee. The Wheeler company has secured franchises in Manistee and in other cities. The Wheeler company is constructing a dam on White River from which it will furnish power to Muskegon.

GRAND RAPIDS, MICH.—Although the city of Grand Rapids is in the municipal lighting business, it pays annual tribute to the Grand Rapids Edison Company approximating $1,500 and the Grand Rapids Gas Light Company, approximating $2,000 for light and power furnished to various departments of the city. This revenue is to be cut off by the plans of manager of the Public Works Department, who will see that the city generates light and power for its own use.

BIG TIMBER, MONT.—The Big Timber Electric Light & Power Company has petitioned for a franchise for water works and an electric light system.

VIRGINIA CITY, MONT.—The Butte Electric Light & Power Company, of Butte, has petitioned for a franchise to furnish this city with electric light and power.

LIVINGSTON, MONT.—The Livingston Water Power Company has begun the erection of a new power house, 60 x 100 feet, two stories high. Foundation will be provided for 4,750 kw in generators and four 1,315-hp turbines. At the start there will be installed a 1,750-kw General Electric generator and a 1,325-hp Leffel water wheel.

NEVADA, MO.—The Nevada water works, gas plant and electric light system and street car lines have been purchased by J. M. Gore, of Jerseyville, Ill., who has assumed possession of the properties. The plants are consolidated.

ST. LOUIS, MO.—Paul D. Cable, president of the General Service and Development Company, of Webster Groves, has been granted a franchise to carry on the electric business of the West St. Louis Water and Light Co., which he recently purchased.

CLINTON, MO.—Proposals to furnish light and water for the city of Clinton will be accepted until Oct. 17 by the water and light committee. Dr. S. T. Neill is chairman. The franchise of the present water company expires in a short time, also the city lighting contract.

ATLANTIC CITY, N. J.—A disinterested authority says there is little probability of a new company being started in Atlantic City in opposition to the Electric Company of America. Among other reasons, the season is short, the expense of a new plant large, and that the city lighting, for which the Electric Company of American has a 10-year contract, is a large portion of the business.

SYRACUSE, N. Y.—Bids will be received until September 25 by the Board of Contract and Supply, for lighting the city for one, two, three, four or five years; also price for incandescent lighting for all city buildings and the maximum price for incandescent lights for private consumers.

ROCHESTER, N. Y.—An application of the Niagara Falls Electrical Transmission Company for a franchise to use the streets of Rochester to construct conduits and to conduct an electrical business in this city has been made. Particularly interesting is the information that the Niagara, Lockport & Ontario Power Company's route takes it around the city rather than through it.

NORTH TONAWANDA, N. Y.—The Niagara Falls Electrical Transmission Company has withdrawn its application for a franchise in North Tonawanda on account of conditions attached by the Common Council. The particular demand which caused the company to withdraw was that it pay 2½ per cent. of its gross receipts to the city. Another proposition held in reserve, though not offered, was that the company be required to furnish 5,000 horse-power within three years.

LOUISBURG, N. C.—The Town Council of Louisburg has appointed a committee to negotiate for the establishment of a municipal lighting plant.

MOORESVILLE, N. C.—The town commissioners of Mooresville have been negotiating with parties desiring to establish an electric lighting plant.

CHARLOTTE, N. C.—The Catawba Power Company reports that there is a greater demand for power than it can readily fill at this time, and new machinery is being installed as rapidly as possible to complete, within a few months, the immediately available power for transmission.

TIFFIN, OHIO.—The Tiffin Electric Illuminating Company has contracted with the Aultman-Taylor Company for a 450-hp boiler, which is soon to be installed at the power house.

TOLEDO, OHIO.—A proposition to bond the city for $470,000 to equip a municipal lighting plant will be voted upon by the electors of Toledo at the regular election Nov. 7. It must have a two-thirds vote to carry.

PLYMOUTH, OHIO.—Contracts for water and light plant have been awarded as follows: Engine and pumps to Strong, Carlisle & Hammond Company, for $4,015, and electrical equipment to the Fort Wayne Electric Works, of Fort Wayne, Ind., for $1,119.

CANTON, OHIO.—The Merchants' Light, Heat & Power Company, of Canton, has begun work on a new power and heating plant. Contracts have been placed with the Arbuckle-Ryan Company, Toledo, for the steam and electrical equipment.

SALEM, OHIO.—The Beam Engineering Company, Electric Building, Cleveland, acting for Cincinnati interests, has purchased the Salem Electric Light & Power Company. It is the intention to install new equipment in the power station and practically rebuild the plant. The Beam Company will superintend this operation.

TOLEDO, OHIO.—The Toledo Gas, Electric & Heating Company, the concern that recently merged the heating and lighting companies of the city, has decided on the location for a new light plant. It will be located next to the Detroit Avenue station of the Yaryan factory. The contract has been awarded to the H. J. Spieker Company for the new building, which will be 120 feet square and constructed of armored concrete. The first stockholders' meeting of the company was held in the office of King & Tracy. Officers and a board of directors were elected. The officers are: President, William F. Robison; first vice-president, James S. Brailey, Jr.; second vice-president, Lawrence Pierce, of St. Louis; treasurer, J. K. Secor; assistant treasurer, L. B. Beckwith; secretary, Frank W. Caughling; assistant secretary, Edgar C. Hampton. The capitalization of the new company is $2,500,000, and bonds to the extent of $2,500,000 will be issued. This is a consolidation of the Toledo Heating & Lighting Company, Toledo Gas Light & Coke Company, and the Citizens' Gas Light Company.

ANDERSON, S. C.—The Hatton Shoals Power Company has been organized at Anderson with $150,000 capial. It proposes to generate electric power on the Tugalee River, 16 miles from the town, for a number of cotton milling plants about Anderson.

The Electric Railway.

SAN FRANCISCO, CAL. The Napa & Lakeport Railway Company has been incorporated in this city with a capital stock of $2,000,000. E. C. Amadee and A. J. Brown, of this city, and F. W. Ansell, of Alameda County, are the incorporators.

WILMINGTON, DEL.—Talk of building an electric railway from Wilmington, Del., to Newark, and thence to Oxford, in this county, has been revived, several capitalists being interested in the movement.

GEORGETOWN, GA.—The Wynyah Traction & Power Company, which proposes to build an electric railway to Georgetown, a distance of six miles, has been commissioned. The capital stock is $50,000, and ultimate capital of $100,000. The incorporators are J. B. Steel, W. W. Taylor, E. W. Kaminski, W. H. Andrews, L. Mouzen, all of Georgetown.

EVANSVILLE, IND.—The Evansville City Council has granted a franchise to the Evansville & Mt. Vernon Traction Company.

ANDERSON, IND.—The Indiana Union Traction Company will soon begin the construction of a new and more direct line from Jonesboro into Marion.

BLOOMINGTON, IND.—The Indianapolis & Ohio Valley Traction Company and the Wabash & Southwestern Company are seeking franchises in this city.

MARION, IND.—John Ratliff, of this city, has asked the commissioners of Grant County for a franchise for an electric railway to run from Marion to Noblesville, which is to connect there with another line proposed to run to Indianapolis.

EAST ST. LOUIS, ILL.—At the meeting of the incorporators of the East St. Louis, Waterloo & Chester Suburban Railway Company, James S. Slade was elected president, A. B. Garrett secretary, and E. F. Schoemring, of Columbia, treasurer.

SPARTA, ILL.—The City Council has passed the water works and telephone ordinance asked for by the St. Louis capitalists and T. M. Jenkins, Harry B. Hawes, James McCaffrey and George J. Kobusch, of St. Louis, have given notice that they will present for passage at the next regular meeting of the City Council ordinances for a street railroad, gas and electric lights.

MT. STERLING, KY.—The Blue Grass Traction Company will shortly begin the building of a 25-mile electric railway from Paris to Mt. Sterling. The road will connect with the Maysville line to Paris.

ATCHISON, KAN.—An amended charter has been applied for by the Atchison Railway, Light & Power Company, which increases the capital stock of the company from $300,000 to $900,000. Under the charter, the company will have the right to construct and operate interurban lines to Leavenworth, St. Joseph, Topeka, Horton and Hiawatha. These interurban lines are a matter for the future.

HAGERSTOWN, MD.—The Hagerstown & Waynesboro Electric Railway Company has been incorporated with a capital stock of $100,000. Operations are to be carried on in conjunction with another corporation just formed in Pennsylvania to handle the Pennsylvania end of the business. The directors of the company are Mayor A. C. Strite, D. Clayton Gilbert, Walter D. Willson, Dr. E. A. Wareham and John W. Feldman, all of Hagerstown.

BOSTON, MASS.—The Boston & Northern and the Old Colony Street Railway Companies have each petitioned the Railroad Commissioners for authority to issue $200,000 capital stock. In April last these companies increased their respective capital stocks by $500,000, bringing the outstanding stock of the Boston & Northern Company up to $10,160,000, and that of the Old Colony Company to $7,312,400. The proposed increases are to pay for extensions and additions to the equipment of the companies.

SEDALIA, MO.—A certificate of incorporation has been granted to the Central Railway Company, of Sedalia. The capital stock is $1,000,000.

MARSHALL, MO.—The City Council has granted the Central Electric Railway Company right of way to locate and operate an electric railway through the city. The line proposed will run from Sedalia north to Miana.

LANSING, MICH.—The Council has let the contract for fifty alternating-current arc lamps to the Adams-Bagnall Company of Cleveland. This is the first step in the change of city lighting system from the direct to the alternating. Seven companies furnished proposals.

MONROE, MICH.—The Detroit, Monroe & Toledo Short Line Electric will probably build a branch to Dundee from this city, a distance of 15 miles. Free right of way for a distance of seven miles was guaranteed by one farmer and Dundee will grant a franchise and give a free site for an auxiliary power house.

KALAMAZOO, MICH.—The West Michigan Railway Company has filed articles of incorporation and will succeed the West Michigan Traction Company in the project for the building of 85 miles of trolley line from Benton Harbor to Kalamazoo, with branch lines. B. L. Brown, an eastern capitalist, has bought the right of way and organized the new company.

BATH, N. Y.—Representatives of the Rochester & Eastern Railway Company propose to construct an electric line between the Flower City and Elmira.

SYRACUSE, N. Y.—The Auburn & Syracuse Construction Company has been incorporated with $25,000 capital to carry on improvements planned for the Auburn & Syracuse Electric Railroad.

NEW YORK, N. Y.—The Manhattan and Long Island Railroad Company has been incorporated to operate an electric road 80 miles long in Greater New York and Long Island, the termini to be in Long Island City and at Northport; capital, $10,000,000. The directors are Edward Mackey, D. T. Meyer, H. H. Bowtell, Samuel Y. Sauber, Franklin M. Walter, George E. MacArdle, New York; Robert M. Stockwell, Yonkers; A. Parontand, Brooklyn; Henry Guinard, Watchung, N. J.

SYRACUSE, N. Y.—The Syracuse, Lake Shore & Northern Railroad Company has been incorporated at Albany with a capitalization of $2,500,000, to take over and operate the old Syracuse, Lakeside & Baldwinsville Railroad, between Syracuse and Baldwinsville, which is to be extended to Fulton and Oswego. The directors are: H. S. Holden, C. M. Warner, A. K. Hiscock, C. D. Beebe, William Nottingham, W. A. Holden, W. K. Pierce, Edward Joy, L. C. Smith, J. S. Gray, A. R. Peck, H. C. Beatty and C. B. Benson.

NEW YORK, N. Y.—At a meeting of the Board of Estimate and Apportionment of the City of New York, held last week, the application of the New York & Port Chester Railroad Company for a franchise to construct that portion of its line within the limits of the city of New York, about ten miles, which is necessary for the completion of its system, was unanimously granted and the controller was directed to prepare the ordinance as required by law. This action of the Board of Estimate and Apportionment completes the last legal step of the Port Chester Railroad, and gives it a complete set of franchises and charters through all the towns and cities lying between the Harlem River and the Connecticut state line.

PINEHURST, N. C.—The electric railway from Southern Pines to Pinehurst has been bought by the Aberdeen and Asheboro Railroad. It is not known what disposition will be made of the property by the new owners.

GREENSBORO, N. C.—The Greensboro Electric Company is reported to have contracted with the American Suburban Corporation to build an electric railway through the property of the above named land concern near Greensboro.

ALLIANCE, OHIO.—The Alliance, Akron & Cleveland Railroad Company has been formed by Hugh Bleakley, of Alliance. He proposes to build a line from Alliance to Akron, where connection will be made for Cleveland.

GALLIPOLIS, OHIO.—Capt. John C. Shepard is securing right of way for an electric line from Gallipolis to Point Pleasant and Pomeroy. He claims to have ample capital to put the project through. He has applied for franchises in Gallipolis.

NEWARK, OHIO.—The Newark & Mount Vernon Traction Company has been incorporated by S. C. Morse, F. A. Crane, A. H. Wilson, Dwight Sapp, F. L. Beam and others. The initial capital is $10,000. The line will extend from Newark to Mount Vernon, touching Utica and Gambier.

CAMBRIA, PA.—The Blair & Cambria Street Railway Company has filed notice of intention to apply for a charter. The proposed incorporators are H. P. Wilson, F. D. Wray, W. S. Lee, W. B. Douglass, F. J. Thompson, James Malone and F. G. Patterson.

HARRISBURG, PA.—A charter has been granted at the State Department to the Hagerstown & Waynesboro Street Railway Company, capital $25,000, to build a line over the Waynesboro, Maryland & State Line Turnpike and private right of way from Mason and Dixon's line, to Waynesboro. The directors are: W. A. Morgart, Cumberland, Md., president; J. A. Strite, Jacob S. Lesher, W. Towmake, Jno. W. Fieldman and Roderic Clary.

HARRISBURG, PA.—The directors of the Pennsylvania Traction Company have selected Mason D. Pratt, of Harrisburg, Pa., as the engineer to make the plans for the new power house in South Harrisburg and to superintend its erection. The new power plant will be erected on the site of the old car barns erected by the East Harrisburg Passenger Railway Company about twenty years ago on South Cameron Street, and will adjoin the present plant acording to the statements of officers of the company. The present plant will supply the power until the new one is completed, which will be early in 1906.

ALEXANDRIA, TENN.—The Alexandria Street Railway is constructing a new line. G. W. Borde, of New Orleans, is superintending the work.

NASHVILLE, TENN.—Four large automobiles have been purchased by R. H. Boyd, president of the Penny Savings Bank, of Nashville, for use in a bus line here for negroes. A company recently incorporated here as the Union Transport Company, with a capital of $25,000, is organized and owned by negroes, and will be run in the interest of negroes in competition with the local street car lines, because of the "Jim Crow" law.

CORSICANA, TEX.—The Board of Trade of Corsicana is considering a proposition for the construction of an interurban electric railway from Corsicana to Palestine.

PALESTINE, TEX.—The City Council has received an application from the representative of local capitalists for a franchise to build and operate an electric railway in this city. The franchise will probably be granted.

OLYMPIA, WASH.—Two railway companies have filed articles of incorporation with the secretary of state. The Puyallup Valley Traction Company, with a capital stock of $250,000, and headquarters at Puyallup, has announced the object of building a railway from Puyallup to Tacoma. The incorporators are: Fred. J. Chamberlain, W. D. Cotter and W. H. Elvins. The other company is the St. Helena Public Service Company, with headquarters at Castle Rock. It purposes to build a line of railway from that town to the St. Helena mining district, thence to a point on the Columbia River in Clarke County, thence to the place of beginning, with a bridge or ferry across the Columbia and a line running south to Portland. The company also announces its intention of engaging in electric lighting, etc. The capital stock is placed at $1,000,000, and Henry W. Coe, L. O'Connor and Joseph O'Neil are the incorporators.

PACHUCA, MEX.—The Pachuca & Real del Monte Railway system is to be converted into an electrically operated line and otherwise improved. Engineer B. M. de Arozarena, the owner of the system, is now in New York, arranging the details of the transaction.

SANTA ROSALIA, MEX.—It is stated that the material to be used in the construction of the electric street railway system in this city has been ordered in the United States. Paul Ginther, who is promoting this enterprise, is also organizing a company in Europe to take over a concession acquired by him from the Mexican Government for the erection of a large electric power plant on the Conchos River above Santa Roslia. This company will have a capital stock of $5,000,000. The proposed power plant will furnish electrical energy for operating the electric street railway system in Santa Rosalia. Power will also be transmitted to Parral and other towns of the State.

CHIHUAHUA, MEX. It is announced that J. W. Conger, brother of Hon. E. H. Conger, former ambassador to Mexico, who recently obtained an option on the street railway system and electric light and power plant in Chihuahua, is meeting with success in organizing a company of Americans to take over these properties. The street railway system will also be extended by its new owners.

◆

New Industrial Companies.

THE SCHMIDT-WILCKS ELECTRIC COMPANY has been incorporated at Weehawken, N. J., with a capital of $100,000. The incorporators are Lambert Schmidt, Felix Wilcks and Ferdinand Wilcks.

THE SHELBY SAFETY SWITCH COMPANY, of Shelby, Ohio, has been incorporatord by W. R. Cochran, Jr., C. J. Edwards and others. The capital is $10,000. The company will manufacture switches and other railroad devices.

THE AMERICAN ELECTRICAL REPAIR COMPANY, of Pittsburg, Pa., has been formed to specialize in the repairing of electrical machinery of all kinds. The officers are: R. Zeringer, president; Thos. McCreary, vice-president, and H. A. Rife, general manager.

◆

Legal.

ATTACKING TELEPHONE FRANCHISE.—Information in quo warranto was filed in the Circuit Court, Chicago, last week, by State's Attorney Healy and Corporation Counsel Lewis against the Chicago Telephone Company. The company is asked to show why it should continue as a corporation. Misuse of franchise is alleged, and violation of the city ordinances. The petition attacks the "grounded service" system of the company, the toll rates between points within the city limits and the alleged excessive rate for business telephones. An ordinance in 1889 fixed the rate for business telephones at $125 a year. The company charges $175 a year.

◆

Personal.

WALTER H. WHITESIDE.

MR. WALTER H. WHITESIDE, recently elected president of the Allis-Chalmers Company, joined that organization in July, 1904, when he accepted the position of general manager of sales. He came at a time when the company, which had just taken over the Bullock Electric Manufacturing Company, needed the injection of a vigorous and energetic personality into its sales force. It was not merely that he had to become familiar with all the intricacies of the company's widely varied products, but the new interests and the old had to be consolidated, the sales organization enlarged and its efficiency increased. His promotion to the presidency indicates with what success Mr. Whiteside has met in his efforts. In taking up this higher and more responsible position, Mr. Whiteside has behind him not only the confidence of his organization, but a long and varied business experience, in which he has filled many executive positions. His achievements have won him recognition as a man of marked administrative ability. Mr. Whiteside is a member of the American Institute of Electrical Engineers, of the Engineers' and Lawyers' Clubs of New York, of the Mid-Day Club, Chicago, and of the Milwaukee Club.

MR. C. V. ASPINWALL, general manager of the Mississippi Valley Telephone Company, has resigned. His place has been taken by Mr. A. C. Reid, chief electrical engineer of the company.

MR. ERNEST A. REGESTEIN has resigned his position as instructor in electrical engineering at Lehigh University to accept a position in the general sales department of the Standard Underground Cable Company, at Pittsburg, Pa.

MR. J. B. COWEN.—The General Storage Battery Co., New York City, has secured the services of Mr. J. B. Cowen (formerly prominently connected with the General Incandescent Arc Light Company) for the management of its sales department.

MR. U. N. BETHELL, general manager of the New York Telephone Company, has just left on a trip to Europe, where he will enjoy a much needed vacation and rest. The system has now something like 220,000 telephones, and is growing at the rate of over 4,000 subscribers a month, reflecting vigorous and effective management.

CAPT. LEONARD D. WILDMAN, who recently returned from Alaska, where he had charge of the wireless telegraph system operating between St. Michaels and Fort Davis at Nome, has been made chief signal officer of the Department of California, with headquarters in San Francisco. In the face of great difficulties Capt. Wildman established and maintained very good wireless communication between the two places, 125 miles apart. His achievements in the field of wireless telegraphy have won him great distinction.

EUGENE HOLCOMB.

MR. EUGENE HOLCOMB has been appointed manager of the newly created foreign department of the Allis-Chalmers Company, which includes supervision of all the foreign agencies and foreign selling representatives of the company. In this position, Mr. Holcomb will supervise the work of the established European and South African offices, and all Eastern Hemisphere agencies, but he will have direct control over the South and Central American business for the company. With the engineering possibilities and projects in South America Mr. Holcomb is thoroughly familiar, having spent a number of years in that hemisphere. The past three years he has had immediate charge of the Westinghouse companies' interests in Argentina, with headquarters in Buenos Aires. Under his supervision was designed and installed the great gas power plant of the Southern and Western Railroads of Argentina, including the complete gas producer plant, manufacturing gas from bituminous slack. These complete power plants operated entirely by gas and installed at an aggregate cost of upwards of a million dollars, supply not only power for operating the machinery in the immense railroad shops, but through underground cables transmit power ten miles to operate the cranes and ship-loading devices at the docks of the railroad company, marking a step in advance of any gas power plant up to date. Mr. Holcomb received his early training in the steam engine and electrical industry on the Pacific Coast and Middle West, and sold his electric light and contracting interests in Illinois to take up foreign work with the Westinghouse companies. His knowledge and experience in the engineering fields of this country, and the engineering projects he has carried through abroad, make Mr. Holcomb a valuable acquisition to the Allis-Chalmers Company. His headquarters will be at the general offices of the company at Milwaukee, Wis.

DR. F. S. PEARSON.—A big game preserve is being prepared in Southern Berkshire by F. S. Pearson, the street railway engineer, who has been buying farms in the southern section of Berkshire; and it is understood that when all preparations have been completed the estate will be stocked with game. The farms lie in Alford, Hillsdale and Austerlitz and up to date comprise some thousand or more acres. The view obtained from portions of the farms cannot be equalled in this section. Much of the property is heavily wooded.

MR. T. A. EDISON, according to rumors circulating at Gardner, Mass., may establish a manufacturing plant there. This is what the local *News* says: "Less than a week ago, the inventor and his party stopped over at the Templeton Inn, and while there, it is alleged that parties in Gardner, who have land which they are desirous of disposing of, met him by appointment on business. The great inventor and his party also stopped over at Fitchburg, and it is stated that while there he consulted with parties in relation to procuring a suitable site for a factory in the vicinity." Other towns in the State have still to be heard from.

MR. W. G. CARLTON, formerly of the Chicago Edison Company, has just been appointed superintendent of power of the electrical zone of the New York Central & Hudson River Railroad Company. In this capacity Mr. Carlton will have charge of the two main electric power stations which the company is building near New York, the eight substations and the transmission system. He will report to the electrical department. Mr. Carlton, who is a native of Warren, Ill., graduated from Cornell University in the class of 1892. He was one year in the General Electric student course at Lynn, and then went to the Chicago Edison Company, advancing from the construction department and draughting room up to his present position of assistant to the chief operating engineer.

MR. A. J. LATHOUSE.—A. J. Lathouse, who has been superintendent of the Columbus Citizens' Telephone Company, tendered his resignation recently in order to carry out his plans of organizing a construction company to build a series of telephone exchanges in Ohio and to construct in addition to these electric light plants in various towns in the State. Mr. Lathouse has been with the Citizens' Telephone Company since its infancy and constructed its first subway. For seventeen years he has been engaged in the telephone construction business, having built fifteen exchanges in Franklin County. Mr. Lathouse says that there is a great opporunity awaiting the man who could gather the capital and launch this undertaking. Not only in the telephone exchange construction is the field lying open, but also in the erection of electric light plants in the smaller towns throughout Ohio.

◆

Trade Publications.

EXHAUST STEAM.—Warren Webster & Company, Camden, N. J., have issued a pamphlet describing the Webster system of steam circulation for heating purposes. The details of this system are fully treated in booklet F. 20 and in the general catalogue of the company.

TRANSFORMERS.—Bulletin No. 72 of the Wagner Electric Manufacturing Company, St. Louis, is devoted to standard lighting and motor transformers. The internal construction of the transformers is well shown by numerous illustrations, while the operating features are described at length.

MACHINE WRENCHES.—The Billings & Spencer Company, Hartford, Conn., has issued an illustrated booklet dealing with drop-forged machine wrenches. These wrenches are of the milled, semi-finished and finished types and are furnished in the international, metric and Whitworth standards.

STEAM HEATING. The Monash-Younker Company, 203 South Canal Street, Chicago, Ill., is sending out an effective trade publication in the form of an illustrated folder dealing with the Monash automatic air valve for steam radiators. The advantageous features of this device are presented in an attractive manner.

REGISTER FOR EMPLOYEES.—The Universal Register Company, 88 Centre Street, New York, has issued a circular dealing with the "in-and-out" register. This register is for use in clubs, and all classes of retail as well as wholesale mercantile establishments, and in places wherever it is desirous of recording the absence or attendance of employees.

SPARK COILS FOR GAS ENGINES.—The Autocoil Company, Jersey City, N. J., has recently issued a loose-leaf catalogue dealing with various types of ignition coils, gas engines. The vibrators are of the compound, single-spring, double-spring or bow-spring type. Each type of "Autocoil" unit is illustrated, and the prices of the various parts are indicated.

SINGLE-PHASE MOTORS.—The paper by Mr. G. Percy Cole on "Recent Developments in Single-Phase Alternating-Current Motors," which was read before the Ohio Electric Light Association Convention, August 16, 1905, as noted in our columns at that time has been reprinted and is now being distributed by the Wagner Electric Manufacturing Company, St. Louis, Mo.

LIGHTING TRANSFORMERS.—The numerous improvements which have been made recently by the Fort Wayne Electric Works, Fort Wayne, Ind., in the design of the coils of Type A transformers are treated in detail in bulletin No. 1067. The coils are subdivided in order to allow a large surface to be presented to the cooling oil and to insure a low reactance drop in the coils.

DULUTH AERIAL BRIDGE.—With regard to the Duluth aerial bridge, described in our pages last week, it may be stated that a handsome and admirably written little booklet on the subject has recently been prepared under the supervision of the city engineer's office, for general information, and issued and published by the City of Duluth. Mr. Norton Mattocks saw this creditable brochure through the printing office.

COMBINED VOLTMETER AND FREQUENCY INDICATOR.—The Wagner Electric and Manufacturing Company, St. Louis, Mo., has issued bulletin No. 73, dealing with a combined voltmeter and frequency indicator, which is provided with two scales, one reading "volts" and the other "cycles." The frequency indicator is useful in paralleling two generators, as the instrument will indicate the frequency of the incoming machine, and used in connection with lamps, or a phase indicator, the paralleling of generators becomes a simple matter.

STEEL SHEET PILING.—The United States Steel Piling Company, 135 Adams Street, Chicago, Ill., has issued an illustrated catalogue devoted to steel piling. This piling has a plain rolled section ready for use as it comes from the mill. Each pile is uniform in strength, interlocking, interchangeable and complete in itself. Numerous views are given of the piling as actually installed. A folder, which accompanies the catalogue, contains a complete description of the steel sheet piling used with the 18-story extension of the Tribune Building, Park Row, New York.

SERIES ALTERNATING-CURRENT LIGHTING SYSTEM.—Bulletin No. 1070 of the Fort Wayne Electric Works, Fort Wayne, Ind., it is devoted to the Wood system of lighting by means of series arc lamps. The regulator, which is used to keep the current at a constant value, consists of a reactance coil and core movable with respect to each other. The reactance coil and core are connected with levers in such a manner as to balance each other, one end of one lever being connected to the coil while the other end of the same lever is connected with the iron core. The bulletin describes the operation of the regulator as that of a choke coil of varied reactance. Both the switchboard and the lamps are likewise discussed fully as to constructional details and operating features.

BALANCED COMPOUND LOCOMOTIVES.—A recent booklet of the Baldwin Locomotive Works, Philadelphia, gives a reprint of a paper read before the Richmond Railroad Club by Lawford H. Fry, on "Notes on the Principles and Performance of the Balanced Compound Locomotive," together with an article from the *American Engineer* on "Instructive Tests of a Baldwin Balanced Compound Locomotive," and an article on "Counterbalance for Balanced Compound Locomotives," by Mr. Fry, which appeared in the *Railway Gazette*, June 9, 1905. A table is given to show that in comparison with a single-expansion locomotive, a balanced compound locomotive can be built with 25 per cent. more heating surface and 40.6 per cent more effective horse-power, with an increase in weight of only 3 per cent. It is stated that at high speeds, the hammer blow in a two-cylinder engine balanced in accordance with the best practice, may amount to 40 or 50 per cent of the pressure of the wheel on the rail when at rest. The elimination of the hammer-blow in the balanced compound makes this locomotive very much easier on the track and bridges than a single-expansion locomotive of the same weight.

ALTERNATING ARC LIGHTING SYSTEM.—Bulletin No. 7036 of the Western Electric Company, 259 South Clinton Street, Chicago, describes the numerous features of the Western Electric system of series enclosed alternating arc lighting. The system consists of a transformer, a regulator and enclosed arc lamps. The primary windings of the transformer are in two sections which may be connected either in series or in multiple, according to the primary voltage for which the system is to be operated. Numerous taps are provided on the secondary so that the voltage may be varied to conform to the number of lamps in operation. The laminated iron core of the regulator is composed of three vertical limbs cross connected at the upper end, and supported upon rigid uprights attached to an iron sub-base. The reactance coil is mounted below the core. It is stated that the regulator can be adjusted to maintain the current to within 0.1 of an ampere under any load. Each lamp is designed to act as a regulator and helps to maintain a constant current. The voltage across the arc and the current through the arc are regulated by the mechanism of the lamp, so that a change in current is taken care of by the lamps as well as by the regulator. The bulletin describes the mechanical details of the lamps, and treats of the various accessories for the arc lighting system.

News of the Trade.

T. A. MULLOWNEY, formerly connected with the Leominster Electric Light & Power Company, has opened a store in Leominster, Mass., under the firm name of the Leominster Electric Company. He will trade in all kinds of electrical work.

THE AMERICAN ARC LAMP COMPANY, successor to the Lea Electric Manufacturing Company, of Elwood, Ind., is now located in a new factory at Kalamazoo, Mich., and invites orders from old friends and prospective customers, for the filling of which it now has adequate facilities.

THE VIADUCT MANUFACTURING COMPANY has just patented a portable, or pocket telephone, which will prove a most convenient outfit for many purposes. The fire department of Baltimore has been using this pocket telephone exclusively with much satisfaction. It will be found useful almost anywhere, and inspectors of telephone exchanges should find it indispensable.

THE ROCK ISLAND DRY BATTERY COMPANY, of Rock Island, Ill., is seeking a building in Cincinnati which will provide from 12,000 to 15,000 feet of floor space. The company is controlled by Mayer Loeb, president and general manager, and by M. S. and H. C. Rosenthal, of the firm of H. Rosenthal & Sons, Cincinnati. The company has recently acquired control of patents on dry batteries.

THE CRESCENT ELECTRICAL MANUFACTURING COMPANY, Rochester, N. Y., manufacturers of panel boards, knife switches, switchboards, cutouts and branch blocks, has recently reorganized and increased its capital stock. This was made necessary by the increase of business, and to include its new manufactures. It is fully equipped with up-to-date machinery and have more than double the size of its factory. It is particularly competent to take care of orders for panel boards, as one of the foremost experts in the line is in charge of this department.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 12, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

798,790. ELECTROLYTIC PROCESS; Carl Hering, Philadelphia, Pa. App. filed Sept. 5, 1905.

798,906. STORAGE BATTERY; Alfred E. Knight, Somerville, Mass. App. filed Nov. 16, 1904.

798,920. METHOD OF REDUCING OXALIC ACID AND ITS DERIVATIVES BY ELECTROLYSIS; Emil von Portheim, Prague, Austria-Hungary. App. filed Jan. 29, 1904.

799,035. REVERSING MECHANISM FOR MOTORS; Abe L. Cushman, Concord, N. H. App. filed May 31, 1904. A reversing switch controlled by an electro-magnet, is actuated each time the rheostat controller is thrown to the off position, so that the motor will always start up in a reverse direction.

799,049. LIGHTNING-ARRESTER; Peter Cooper Hewitt, New York, N. Y. App. filed May 16, 1902. (See page 530.)

799,050. CIRCUIT CONTROLLER; Peter Cooper Hewitt, New York, N. Y. App. filed Mar. 7, 1903. (See page 530.)

799,051. VAPOR CIRCUIT-BREAKER; Peter Cooper Hewitt, New York, N. Y. App. filed Mar. 20, 1903. (See page 530.)

799,052. CIRCUIT-CONTROLLER; Peter Cooper Hewitt, New York, N. Y. App. filed Aug. 10, 1903. (See page 530.)

799,053. METHOD OF CONTROLLING ELECTRIC CIRCUITS; Peter Cooper Hewitt, New York, N. Y. App. filed Aug. 10, 1903. (See page 530.)

799,061. ELECTROLYTIC APPARATUS AND ELECTRODES THEREFOR; Carl Kellner, Hallein, Austria-Hungary. App. filed July 7, 1896.

799,064. PNEUMATIC OR HYDRAULIC TRANSMISSION OF ELECTRIC POWER; Hans Kowsky, Hastings-Upon-Hudson, N. Y. App. filed Sept. 5, 1902. A piston is thrown from one position to another by electro-magnetism and thereby forces air through a system of conduits to a second piston which actuates a railway switch signal or other device.

799,105. REVOLVING ELECTRIC FURNACE; Ernesto Stassano, Rome, Italy. App. filed Apr. 9, 1902. (See page 531.)

799,106. CONDUIT POLE; Frank Stevens, Philadelphia, Pa. App. filed June 27, 1904. A specific form of joint for the pole or rod used to thread a conductor through a conduit.

799,110. COVER FOR THIRD RAILS; William G. Taylor, Forest City, Pa. App. filed Dec. 3, 1904. The cover consists of ceramic material applied over a T rail in such a manner that air passages are left between the cover and the rail to protect the latter from excessive changes in temperature.

799,135. SWITCH; Antoine Benassy, Geneva, Switzerland. App. filed Dec. 17, 1904. Details.

799,137. TRANSMITTER-ARM; Jules A. Birsfield, Rochester, N. Y. App. filed Feb. 13, 1905.

799,146. CIRCUIT-CHANGING APPARATUS; Merritt S. Conner, Chicago, Ill. App. filed Mar. 17, 1904.

799,160. SWITCHING APPLIANCE FOR TELEPHONE-EXCHANGES; Carl M. Hedman, Chicago, Ill. App. filed May 22, 1902.

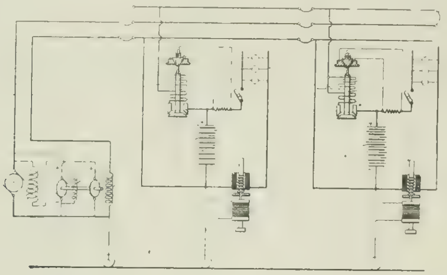
799,177. POWER TRANSMISSION SYSTEM; Victor Martinetto, Chicago, Ill. App. filed Feb. 18, 1904. Two induction motors with their rotors mechanically connected together, have their secondary windings joined in series and so placed mechanically that the currents in one secondary produced by the voltage of the other will give tongue in the desired direction on account of its mechanical position with reference to the primary field.

799,183. JUNCTION BOX; Ludvig H. Nielsen, New York, N. Y. App. filed Jan. 16, 1903. The box is intended to be inserted in a partition, and its faces are extensible or telescoping with respect to the body to fit different thicknesses of partition.

799,191. ELECTRICAL ATTACHMENT PLUG; Bert E. Salisbury, Syracuse, N. Y. App. filed July 20, 1904. A metallic cap for protecting the base of the plug is provided with a fibre lining, the edges of which project into an annular groove in the cap to hold it in place.

799,205. TELEPHONE-RECEIVER CASING; Axel R. Thollander, Chicago, Ill. App. filed Nov. 10, 1904.

799,213. TROLLEY CATCHER AND RETRIEVER; Charles F. Wilson, New York, N. Y. App. filed Jan. 24, 1905. A spring drum, pawl and ratchet arrangement.



799,526.—Lighting System.

799,218. PROCESS OF DEPOSITING METAL ON NON-METALLIC BODIES; Cassius F. Blacklidge, Washington, D. C. App. filed Jan. 14, 1905.

799,219. ELECTRIC INCANDESCENT LAMP HAVING SECOND-CLASS CONDUCTORS; Wilhelm Boehm, Berlin, Germany. App. filed June 23, 1900. (See Current News and Notes.)

799,237. TELEGRAPHY; Sterns F. Jones, New York, N. Y. App. filed April 6, 1905. The transmitter sends to line groups varying in length and sequence of short, rapid current alternations, and the receiving relay is located in a balanced separate circuit which is connected inductively with the main circuit.

799,238. SEXTUPLEX TELEGRAPHY; Sterns F. Jones, New York, N. Y. App. filed Apr. 7, 1905. A sextuplex arrangement of apparatus, consisting of three relays, one or more of which are polarized, and associated transmitting system, including a pole changer, an ampere changer, and a controller of short and rapid alternating current impulses; also means whereby signals are rendered neutral upon the home relay system, a separate circuit for one relay, and means for inductively connecting the relay with the main and artificial lines.

799,239. TELEGRAPHY; Sterns F. Jones, New York, N. Y. App. filed Apr. 19, 1905. Modification of the preceding systems patented by the same inventor.

799,240. TELEGRAPHY; Sterns F. Jones, New York, N. Y. App. filed Apr. 21, 1905. A further modification.

799,245. SELF-PROPELLED VEHICLE; Hermann Lemp, Lynn, Mass. App. filed Mar. 31, 1904. (See Current News and Notes.)

799,305. MAGNETO ELECTRIC GENERATOR; Robert C. Crouch and John A. Titzel, Sr., Newcastle, Pa. App. filed Nov. 19, 1904. The armature of the generator consists of a number of magnetic balls which may be given a certain amount of movement, causing fluctuation of the current in the circuit that may be felt by connecting the terminals of the circuit to parts of the body.

799,346. CALLING DEVICE FOR AUTOMATIC TELEPHONE-EXCHANGES; Frank A. Lundquist and John K. Norstrom, Chicago, Ill App. filed Aug. 27, 1900.

799,358. ROSETTE; Albert P. Seymour, Syracuse, N. Y. App. filed Feb. 26, 1903. A one-piece rosette having side passages through which the lamp cord passes in order to take its weight from the terminals.

799,377. CUT-OUT FOR ELECTRIC HEATERS; Johannes Harden, Schenectady, N. Y. App. filed Dec. 1, 1904. A fluid receptacle having an electric heater applied thereto and a cut-out for the heater actuated when the heat of the fluid rises above or falls below a predetermined point.

799,392. TELEGRAPH TRANSMITTER; William H. Leonard, Mount Vernon, and Joseph H. Lewis, New York, N. Y. App. filed Dec. 14, 1904. In this transmitter the keys when pressed downward rotate disks having segments in their peripheries variously spaced to send signal impulses over the line.

799,402. ELECTROPLATING APPARATUS; Louis Potthoff, Brooklyn, N. Y. App. filed Apr. 30, 1904.

799,410. REFRIGERATOR DRIP PAN; Charles E. Smith, Morris Park, N. Y. App. filed Apr. 30, 1904
pan to give notice when the pan is full of water.

799,419. TROLLEY; William S. Tichenor, Owensville, Ind. App. filed Feb. 4, 1905. Details.

799,420. LAMP SOCKET; Julius C. Tournier, Schenectady, N. Y. App. filed Nov. 27, 1903. Details.

799,423. TRANSFORMERS; William L. Waters, Milwaukee, Wis. App. filed Apr. 28, 1905. The core and coils are placed in a vessel of oil and surrounded by cooling coils through which a circulation of air is maintained.

799,433. SUPPORT FASTENER FOR LIGHTNING CONDUCTORS; Carl Bajohr, St. Louis, Mo. App. filed Mar. 29, 1905. The fastener has a foot extending below its lower surface and projections extending outwardly from the body thereof to assist in holding it in position in a wall.

799,441. PROCESS FOR PURIFYING TANTALUM METAL; Werner V. Bolton, Charlottenburg, Germany. App. filed Oct. 12, 1904.

799,451. STARTING APPARATUS FOR VAPOR ELECTRIC LAMPS; Clyde J. Coleman, Rockaway, N. J. App. filed Feb. 7, 1904. (See Current News and Notes.)

799,452. RELAY; William W. Coleman, Edgewood Park, Pa. App. filed Apr. 7, 1905. An interlocking relay comprising electro-magnets and co-acting armatures, and an interlocking device operative upon the movement of the armature of one of the electro-magnets to lock the armature of the other electro-magnet.

799,516. TRAIN LIGHTING SYSTEM; William L. Bliss, New York, N. Y. App. filed Apr. 27, 1904. This patent and those that follow in the same name, describe a system of car lighting, comprising a single generator and storage battery adapted to supply all the lamps throughout a train, and a controlling device whereby the generator will maintain a substantially constant voltage, notwithstanding the removal of one or more cars or units from the train or the variations of the number of lights in the circuit.

799,517. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Jan. 30, 1905. (See brief of patent, No. 799,516.)

799,518. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Mar. 18, 1905. (See brief of patent, No. 799,516.)

799,519. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, New York, N. Y. App. filed July 17, 1905. (See brief of patent, No. 799,516.)

799,520. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Apr. 24, 1905. (See brief of patent, No. 799,516.)

799,521. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Mar. 15, 1905. (See brief of patent, No. 799,516.)

799,522. LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed June 15, 1904. (See brief of patent, No. 799,516.)

799,523. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Mar. 15, 1905. (See brief of patent, No. 799,516.)

799,524. TRAIN LIGHTING SYSTEM; William L. Bliss, Brooklyn, N. Y. App. filed Mar. 15, 1905. (See brief of patent, No. 799,516.)

799,525. TRAIN LIGHTING SYSTEM; William L. Bliss, Brooklyn, N. Y. App. filed Mar. 15, 1905. (See brief of patent, No. 799,516.)

799,526. LIGHTING SYSTEM; Wm. L. Bliss New York, N. Y. App. filed June 16, 1904. (See brief of patent, No. 799,516.)

799,527. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Apr. 24, 1905. (See brief of patent, No. 799,516.)

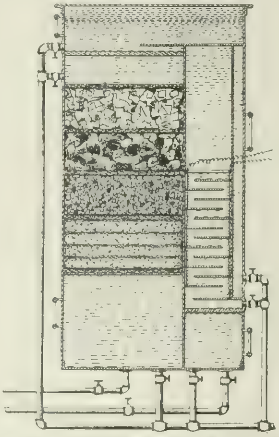
799,528. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Apr. 24, 1905. (See brief of patent, No. 799,516.)

799,529. TRAIN LIGHTING SYSTEM; Wm. L. Bliss, Brooklyn, N. Y. App. filed Apr. 24, 1905. (See brief of patent, No. 799,516.)

799,530. REGULATING SOCKET; Louis F. Bogia, Jr., Philadelphia, Pa. App. filed Apr. 25, 1904. A lamp socket having a resistance which may be varied by turning the usual key.

799,554. TELEPHONE-RELAY; Bela Gati, Budapest, Austria-Hungary. App. filed Feb. 9, 1904.

799,555. TELEGRAPHY; Bela Gati, Budapest, Austria-Hungary. App. filed May 9, 1904. Apparatus comprising a coherer containing a small gap having a fluid between its terminals, ionizing means adapted to constantly act on the fluid in the gap, but with insufficient intensity to produce ionization, and means whereby electric waves may be made to act on the fluid in the gap for producing ionization.



799,605.—Apparatus for Electrically Purifying Water.

799,567. MULTIPLEX TELEGRAPHY; George L. Hogan, London, England. App. filed Aug. 11, 1902. The main feature consists in placing the transmission line in repeated connection with three contacts at one station and three corresponding contacts at another, by means of a synchronizing current consisting of a series of alternately positive and negative electric impulses separated by zero periods, the positive impulses effecting one contact, the zero period another, and the negative impulses, the third.

799,585. ELECTRIC GENERATOR FOR TELEPHONE SYSTEMS; Enos B. Willix and John Young, Mount Vernon, Iowa. App. filed Feb. 25, 1905.

799,605. APPARATUS FOR ELECTRICALLY PURIFYING WATER; James F. Lester, Atlanta, Ga. App. filed Nov. 28, 1904. An apparatus comprising an electrolytic water treating chamber, an ozonizing chamber and a filter in a single casing, the electrolytic chamber and ozonizing chamber being totally surrounded by water to prevent the heating of the water being treated.

799,613. MOTOR ATTACHMENT FOR LINOTYPE MACHINES; Melvin W. Morehouse, Brooklyn, N. Y. App. filed Jan. 10, 1905. A bracket adapted to be quickly secured to the frame of the machine without alteration of the latter.

Philadelphia Convention of the American Street Railway Association.

In interest and attendance the twenty-fourth annual meeting of the American Street Railway Association, held this week at Philadelphia, ranks among the very successful gatherings of that body. Of predominant interest were the matter of the adoption of a new constitution and a reorganization of the association, and the announcement by Mr. C. F. Scott of the adoption by the New York, New Haven & Hartford Railroad of the single-phase railway system, accompanied by an order for 25 Westinghouse single-phase locomotives. The details of this announcement are given elsewhere in this issue.

The papers and discussions of the various societies, as noted below, were admirable, although it is believed that in coming years the association proper will provide a larger programme and bring a wider range of topics within its own specific arena of discussion. The exhibit of apparatus as a whole can only be characterized as the best the association has ever made, and here the subtle, strong influence of the Manufacturers' Association made itself felt. Notes of the exhibits themselves will be found elsewhere in our columns. The general setting was admirable, and the meeting hall was far enough away up stairs to be quiet all the time. The buildings of the Philadelphia Museum are of a solid, exhibition type, and thus the various concerns were encouraged to give a beautiful and substantial environment to their apparatus and wares, with illuminated signs, brass railings, handsome rugs and furniture and plenty of elbow room for inspection. The general public was somewhat conspicuous by its absence, so that contrary to frequent experience the street railway men were able to study things quietly and easily; and most exhibitors expressed a keen sense of relief in not having to encounter promiscuous throngs of miscellaneous people to whom the exhibit meant chiefly a chance to indulge in a wild and fevered chase after "souvenirs." There were, of course, some souvenirs, and neat ones at that, but they went where they will do the most good. While it required a long car ride and a short stage jaunt to get from the hotel to the Museum, the attendance at the exhibits was markedly excellent, and the arrangements were all carried out very efficiently, especially those for registration, issuing of badges, etc.

The chief comment called for by the exhibits is that due to the increasing solidity and massiveness of the apparatus shown. For example, one conspicuous feature consisted in the all-steel cars shown in various parts of the hall. The tendency in this direction, in view of such an exhibit, seems quite irresistible, so that while wooden cars may yet enjoy a long vogue, the steel car has evidently made a place for itself and will be used in rapidly growing numbers. In other respects "weight" was the keynote—in line construction, rails, insulators, motors and well-nigh every other constituent part of the system. Alongside such material as was shown during the week, as the standard of the art, most of that in use only a few years ago is toylike and trivial to a degree. Some lines indicated a fair approximation to that perfection which constitutes the best starting point for novelty and improvement on hitherto untried lines.

The exercises of the week were led off by the meetings of the American Railway, Mechanical and Electrical Association, extending over Monday and Tuesday. The parent American Street Railway Association took up the tenor of discourse on Wednesday and Thursday and the Street Railway Accountants' Association of America overlapped from Thursday into Friday and Saturday. These meetings with the Tuesday session of the American Association of Street Railway Claim Agents rounded out a very full week of work, supplemented by the annual banquet which was given on Thursday night in great style at the Bellevue-Stratford. The entertainments included a reception at the same hotel on Tuesday night; a big theatre party on Wednesday night; a vaudeville show with amateur talent on Friday night; trolley rides, dinner parties, etc. Numbered badges were issued to all delegates accompanied by coupon ticket books for all the trolley lines in the city.

Great credit for the general arrangements is due to President W. Caryl Ely and to Mr. John B. Parsons, president of the Philadelphia Rapid Transit Company; Mr. James Rawle, chairman of the Reception Committee; Mr. C. C. Peirce, chairman of the Manufacturers' Association Entertainment Committee; Mr. Edwin H. Baker, chairman of the Manufacturers' Finance Committee, and a host of others who worked with them. Mr. William Wharton, Jr., was chairman of the Exhibit Committee, Mr. George Keegan was its secretary, and Mr. Thomas K. Bell acted as director of exhibits, in charge of all details. The Western Union and Postal Telegraph Companies and the Bell and Keystone Telephone Companies extended special facilities to the convention and the delegates.

American Railway, Mechanical and Electrical Association.

POWER DISTRIBUTION.

The paper on this subject by Mr. C. H. Hile, describes the power distribution system of the Boston Elevated Railway Company. Only five of the eight stations on the system are considered, the three stations not considered being of obsolete construction. The five stations are fairly representative of the modern type of station, and include in their equipment direct-connected direct-current units varying in size from 800 to 2,700 kilowatts rated capacity. The total output of the five stations during the year was 124,876,492 kw-hours.

The several stations are tied together and operate in parallel. The tie between stations is accomplished through feeder wires running into so-called feeder sections common to two or more stations. The advantage of this arrangement is evidenced by the high load factor on the individual stations, which varies from .632 to .881, and by that on the individual machines, which varies from .817 to .929. It is stated that the cost of coal per ton at the several stations varies from $3.50 to $3.73, and that the average cost of energy for all stations is $.00778 per kw-hour. There are approximately 72 sq. miles of populated territory included within the limits of 12 cities and towns served by the company's lines. This total territory is divided into 64 feeder sections. By the use of section insulators in the trolley wires in connection with legs leading down from the trolley wires to switches, any two sections, or number of sections, may be tied together and run as one large section. There are installed 964 section insulators, and 1,540 switches. On Oct. 1, 1904, there were 424 miles of trolley wire and 16 miles of third rail being served by 806.5 miles of conductor.

About 32 per cent of the power distributing system is carried underground, all feeder cables and a large portion of the return copper being carried in conduits, and the balance of the return wires being buried in trenches or just outside the conduits. The total length of conduit is 28.4 miles, there being 683 manholes.

An experience extending over a period of several years shows that the installation and maintenance of underground cables cost more than with overhead lines, and the chances for trouble to the transmission system are greatly increased. The following figures are believed to represent a fair average cost per foot for complete installation ready for service:

Size of conductor.	Cost of inst. per foot.
500,000 cm.	2.0 cts.
1,000,000 cm.	2.5 cts.
2,000,000 cm.	3.25 cts.

The cost of maintenance per foot per year, which includes testing, inspection, repairs and changes, is from 1 ct. to 1.25 cts. Under fair conduit conditions and with proper care and usage, it is believed that the average life of an underground cable will be from 25 to 30 years.

The discussion of Mr. Hile's paper assumed the form of a conversation in which the author continued to reply to questions put by various members. To the query of Mr. L. P. Crecelius in regard to the form of terminal construction used where the overhead lines enter the cables, Mr. Hile stated that in order to afford protection from lightning two arresters are placed, one at at either end of the cable, and that these have afforded adequate protection. Very little trouble had been caused by lightning. An insulated conductor is run down an iron pole. Perhaps a wooden pole would prove better, on account of the lack of the great inductive effect found with the iron pole. Automatic circuit-breakers are used at the power station, the circuits being so arranged that these will open in event of an arc being formed. When trouble arises, the defective feeder is at once located, and repaired, because complete plans of the feeder sections are available at numerous places for the repair men. Mr. H. H. Adams stated that observations, over an extended period during which all points on the circuits at which trouble had developed, had been properly recorded on a chart, had shown that the lightning caused damage most frequently at places where circuits crossed each other, such as at street corners. In reply to Mr. Adams' question as to the distribution of lightning arresters, Mr. Hile said that on the circuits of the Boston Elevated Railway Company, the arresters are placed approximately one mile apart. Mr. Chas. Hewitt, Mr. M. LeH. Smith and the author entered into a lengthy conversational discussion of the conditions under which compound-wound generators can be operated in parallel. In order that the generators may tend to equalize the load it is desirable that they be not over-compounded, that the tie conductor be not of too small resistance, and that the generator be connected together through feeders and not directly at the bus-bars. These conditions are obtained in the Boston circuits, and the service is quite satisfactory. Mr. Hile stated that as a general rule the cables are operated at loads which would correspond to not more than 200 amperes per 500,000 circular mils, and that no trouble had been experienced from overheating. In order to prevent leakage return current from traveling along the lead covering of the cables, the lead pipe has been cut to interrupt the electrical continuity. Each cut is about ¼-in. wide, the space being filled with pure rubber and insulating paint. The joints are frequently inspected and given fresh coats of paint, and no difficulty has arisen from any lack of insulation. Electrolysis is prevented by different schemes, according to the location. Numerous return wires have been installed. In some cases these did more harm than good, and such wires were disconnected. Trouble from moisture has been largely eliminated by placing the positive feeder cables in the top ducts and installing the return circuits in the lower ducts.

EFFECT OF LOAD FACTOR ON COST OF OPERATION.

The paper by Mr. L. P. Crecelius on "The Power Station Load Factor as a Factor in the Cost of Power," presented evidence to show the advantage of interconnecting several stations by means of bus-bars and shutting down certain ones completely during periods of light load. The author first discusses the character of the load on railway systems.

In urban railway systems the load curve is double peaked, having the characteristic morning and evening peaks of city travel when the people go to and from work; the breadth, magnitude and duration of these peaks depending, of course, upon local conditions, such as the size and lay-out of a town, and upon its sociology. In a manufacturing center the peaks are often remarkably symmetrical, and are little affected by climatic conditions, as the people usually go to work at about the same time in the morning and leave to go home at nearly the same time in the evening. In the larger cities, where it becomes necessary to transport a mixed community consisting of factory employees, merchants, clerks, shoppers, theatergoers, etc., the peaks lose their symmetry, the morning peak becoming lower and not so sharp as the evening peak.

The writer describes the system of the United Railways of St. Louis, which has in operation four power stations. Two of the larger stations, one of 13,950 kilowatts and one of 7,000 kilowatts capacity, are kept in operation continuously, and constitute the main central stations. The two smaller stations are operated on swing watches on week days, that is, operated during the peak hours only. Bus wires have been run from the larger stations to both of the smaller ones and there connected through circuit-breakers and double-throw switches to either one of the two feeder buses, with which the smaller stations have been supplied. Installing double-throw switches the feeder sections can be connected. During the rush hours the bus wires are connected to the same bus on which the stations are operated, thereby becoming equalizer wires. The amount of copper in the bus wires is just sufficient to carry the load of the smaller stations during the lighter part of the day, allowing a reasonable drop in potential.

The resulting economy of operation in this case more than justifies the expenditure of a good many dollars in the bus wires, and also the resulting increase in the cost per kilowatt hour of the power generated under this arrangement in the smaller stations. Thus it is found that in bringing up the load factor of the main stations from 50.23 per cent in the first case to 57.7 per cent in the second, that a saving of .000575 of a cent per kilowatt hour has been made on the total power cost. And on a basis of 310,000 kilowatt hours per day, which is about the average output of the stations of this system during the summer months, this would represent a saving of $178 per day when operating under these conditions.

It has been found that since the installation of a storage battery, which is located in the business district of the city where the traffic is very congested, the character of the service has been improved to a marked degree during the rush hours. Also a large reduction in the amount of copper required to handle the sections located in this district from the four stations has been effected. This, together with the fact that a battery can always be called upon in cases of emergency to take hold of the load, points to the advantages to be derived in using storage batteries to smooth up the load curve when conditions warrant their use.

In discussing his own paper, Mr. Crecelius stated that no difficulty is experienced in arranging for the operating force of the two small stations to report for duty twice per day during the morning and evening rush hours. Mr. H. LeH. Smith called attention to some of the more important items that depend upon the load factor. These include the electrical losses, the radiation losses from the stack, and the inability of automatic stokers to respond readily to rapidly fluctuating loads or to be adjusted for a great range of load. He thought a better definition of load factor than the ratio of average to maximum load could be found in the ratio of the actual energy developed to the maximum possible output of the station.

CONTROL APPARATUS.

The report of the committee on "Control Apparatus," of which Mr. J. S. Doyle was chairman, was rendered in the form of two papers, of which one on "Multiple Unit Systems of Train Control" was prepared by Hugh Hazelton, and the other on the "Series Parallel Railway Controller" was written by W. A. Pearson.

After giving some historical notes on the development of control apparatus, the paper of Mr. Hazelton deals at length with a comparison of the more important features of difference in design of the apparatus supplied by the Westinghouse and by the Sprague-General Electric companies.

In both systems independent switches, or contactors, are now used for closing and opening the main motor circuits. With these independent switches large current valves may be handled with greater safety and certainty than was possible with the drum type of controller, for a wider air-gap and stronger magnetic blow-out is provided, and the contacts of the independent switches open more quickly than was possible with the revolving drum controller.

In the General Electric contactor the contact fingers are closed and opened by a solenoid wound for line potential, which is operative between the limits of 300 and 750 volts. The advantages claimed for this design are simplicity and low cost of maintenance, by reason of the small number of working parts.

The Westinghouse contactor consists of a similar switch and blow-out coil, but an air cylinder is provided for opening and closing the contact fingers of the switch, and electro-pneumatic valves for controlling the admission of air to the cylinder. The valve magnets are energized by current at 14 volts potential, supplied by a duplicate equipment of storage batteries. In the present design the Westinghouse contactor provides a wider air-gap between the contact fingers when open, and greater pressure to the contacts when they are closed, than in the General Electric design. The amount of air gap and pressure necessary for satisfactory operation is, however, capable of definite determination, and with either solenoid or air cylinder operation results equally satisfactory may be secured. The rapidity of closing the contacts is less with air operation, and the wear resulting from the hammer blow correspondingly less. While the use of 14 volts potential for the operating circuits makes it necessary to install and maintain duplicate storage batteries on each motor car, there are compensating advantages, for the operation of the contactors is made independent of line voltage and of interruptions of current on the forward car. Another advantage of the independent operating circuit is the possibility of stopping the train, even in the unusual event of simultaneous failure of brakes and power supply, by reversing the master controller handle to multiple so that the motors are made to act as generators.

The current limiting relay, common to both systems, consists of a solenoid placed on each motor car through which the current of one motor passes. The armature of this solenoid is attached to a contact disc which opens and closes the operating circuit for the main contactors. The operation of the current limiting relay may be described as follows: In starting the train the motorman usually turns his master controller to the full multiple position. The current is first completed to the contactors that connect the motors in series with all resistance in circuit. This connection is maintained, and the armature of the current limiting relay is drawn up until the counter e.m.f. due to the increasing speed of the motor armatures, causes the current in the motor circuit to drop to a value which no longer holds up the armature of the current limiting relay. This armature then drops and makes connection to the operating circuit of the next resistance unit. The contactors are thus interrupted in their progression at each successive step, so that a nearly constant amount of current is allowed to the motors during the period of acceleration until the motors are in full multiple without resistance.

The provision made in the master controller, of both systems of control, for opening the main circuit and applying the air brakes whenever the motorman releases the controller handle, is considered a valuable safety feature, and its application is so simple as to well warrant its use. The master controller on both systems is very small and compact, as it handles only the small currents of the operating wires. In the Sprague-General Electric system the control circuits require not over 2½ amperes at 600 volts, with two 125-hp motors, and in the Westinghouse system not over 10 amperes at 14 volts for a 10-car train.

In both systems a potential or line relay is provided which opens the main circuit whenever the supply of current from the line is interrupted. When the current is again restored to the line the contactors are closed through successive resistance steps before returning to their former positions. This device obviates the shock which would otherwise occur in passing over road crossings or turnouts where the continuity of the third rail is broken.

The prominent features of the multiple control system are the ability to run cars in trains of any desired length without reduction in speed, and without overloading the motors; the advantage of limiting the current during acceleration to a predetermined value, and of the decreased fire risk by placing the control apparatus under the car.

The paper of Mr. W. A. Pearson treats more specifically of equipments for cars intended to operate singly. The various steps in the development of the series-parallel controller are outlined, after which the statement is made that the final outcome of the series-parallel controller for street car service the present well-known K-type, which has been practically standard for about 12 years. This controller owes its success very largely to the form of magnetic blow-out employed, and to the method of making the transition from series to parallel. In this type of controller, after the motors have reached the full series position, a portion of the starting resistance is reinserted in the circuit and a shunt is put around the other motor. It was found that the arcing in this controller was too great to permit its use for large currents. For car equipments using more than 250 hp, there is used the type L, in which, instead of maintaining the current through one motor during transition, the circuits of both motors are broken. In the later "bridge method" the current is kept on both motors during transition.

There is a growing tendency to place controlling apparatus for large and medium size motors under the car. It removes the heavy capacity parts from the platform, and not only leaves a greater passenger space but also eliminates all possibility of danger from controller "explosions."

In discussing the report Mr. E. W. Olds pointed out that most of the accidents to the car circuits did not occur in the controller but elsewhere. Difficulty arose in the controller, however, on account of the fact that it was not able to rupture the arc. The circuit interruption should not occur on the platform but under the car. Experiments are now being carried on with some controllers which are arranged to open the circuit under the car in event of short-circuit. Each motor is provided with enclosed fuses of the no-arc type, placed under the center of car in a box. These fuses are designed to blow only on short-circuit, circuit-breakers being provided for ordinary overloads. This scheme is now being applied to 30 equipments each of four 40-hp motors for city service. Mr. Case stated that the removal of the circuit-opening device from the front platform is merely a partial step in the right direction. The proper solution of the problem of securing safety for the public lies in placing all of the control apparatus under the car and in using the equivalent of multiple-unit equipment. Mr. Adams remarked that all street railway companies are willing thus to place the apparatus, but the cost of multiple-unit control is too large. Mr. Olds said that the manufacturers have not devised apparatus which can be placed beneath small city cars. Mr. Hill pointed out that it is a difficult matter for a cylinder-type controller to withstand a 5,000-amp. short-circuit. To break such an arc requires more room than is available. The ordinary multiple-unit equipment cannot be used on small cars. Multiple-unit is ideal for heavy cars and for circuits where the heavy feeders from generators of large capacity will allow of dangerous short-circuit currents. There is now being developed a multiple-unit equipment for a four 40-hp motor car for the Brooklyn Elevated Railway. Multiple-unit for double-truck cars for city work is at least feasible, but, obviously, the cost will be large. Mr. Taylor described a recent development in the K-11 controller, which has been designed for simplicity. All heavy-current circuits are under the car body. The main controller is operated by a plunger electromagnet, the coil for which carries a very small current when the plunger has reached the end of the stroke. The controller operates automatically. The car is supplied with straight air-brakes. When the pole flies off the wire, the brakes are applied and the controller is returned to the "off" position. The motorman need not return his handle to the starting position when the pole is replaced on the wire. When the cost of the two platform controllers and of the necessary wiring for an ordinary equipment is considered, the new type of controller is found to be equally as cheap as the old.

RAIL JOINTS.

The paper by Mr. F. G. Simmons on "The Treatment of Rail Joints" consists of a collection of articles dealing with modern methods of treating rail joints in order to obtain high electrical conductivity and good mechanical alignment. The present most accepted methods are divided into two exact types: (First).—The mechanical joint, bolted, riveted or wedged, and connected by means of a metal bond in order to decrease the electrical resistance. (Second).—The various kinds of welded joints (thermit, zinc, electrical and cast). The author states that the most successful makes of the mechanical joints are the "Weber" and the "Continuous." These are briefly described. The major portion of the paper is devoted to the various welded joints, each described by a different writer.

The "Thermit" process is treated by G. E. Pellisser. Thermit consists of a mixture of powdered aluminum and oxide. If the mixture is ignited by means of a special ignition powder (peroxide of barium and aluminum), combustion proceeds without further supply of external heat and without any combination of oxygen of the air, at the same time developing a temperature estimated at 3,000 degrees centigrade. The chemical reaction is such as to produce pure iron and aluminum oxide. The iron separates from the aluminum oxide on account of its higher specific gravity. This iron, when poured upon the metals to be welded, has the property of uniting intimately with them, due to the very high temperature to which it is raised.

On a certain section of track of the Holyoke Street Railway Company, 170 Thermit joints were made in 107-lb. grooved rails. The cost per joint was about $6.23. This work has been down nearly a year and not a break has occurred, although the temperature has been as low as 10 degrees below zero. The wear throughout the rail is perfectly uniform. The alignment of the track has remained perfect, both on straight track and on a curve of 300-ft. radius. Tests show that the conductivity of the joints to be practically equal to that of an equal length of rail.

An account of results obtained in the cast-welding of rail joints by the Milwaukee Electric Railway & Light Company is given by F. G. Simmons. View are given of the apparatus required, including a utility car, a cupola car, and a sand-blast car. A mixture of three parts of good pig iron and one part of soft scrap is placed in the cupola and heated in the ordinary manner. The sand blast is used for thoroughly cleaning six or eight inches of rail end to be welded, since all scale as well as dirt must be removed. An absolute fusion of a portion of the ball and stem of the rail is necessary in achieving a successful cast-welded joint. The author states that of about 7,000 joints welded during the past three years, not one has pulled or broken. Electrical tests show the conductivity to be from 100 to 140 per cent of that of the abutting rails. The total cost of a joint 95-lb. tee rail is about $3.50 for the joint proper and $1.00 for the opening and closing of the street.

A description is given of the process of electrically welding rail joints, as applied by the Lorain Steel Company, Lorain, Ohio. The first operation is that of sand blasting, which is done by means of a 10-hp motor-driven air compressor. The welder itself consists of an alternating-current transformer, the secondary circuit of which consists of one loop of copper and the rail joint to be welded. Of 5,308 joints welded in Rochester, N. Y., in 1901, there were but six broken rails in the spring of 1902.

The zinc process in use in Philadelphia was described by H. B. Nichols and C. B. Voynow. The joint consists of what may be called two Z-shaped bars which are riveted on to the web of the rail. These plates are not made to fit the fishing section of the rail; on the contrary, spaces are left under the head, tram and around the foot of the rail. These spaces are filled with molten zinc, which enters into and fills out all the irregularities of the rolled surfaces, thus giving an absolutely continuous and perfect bearing throughout the whole length and width of the flanges of the plates. It is obvious that such a continuous contact could not be obtained by the most laborious machining or milling of those surfaces. The adhesion of the molten zinc to the rails and plates, together with the body-bound rivets, hold the joint permanently tight, and at the same time prevent expansion, thus making the rails continuous.

In comparing the several processes of welding and joining the rails the following summary is given: The electrical welding operation appears undoubtedly to require the most cumbersome and very much the most expensive equipment, to such an extent, indeed, that, except in case of the very largest systems, private ownership would be virtually impossible, and all work would necessarily have to be done through contractors. The zinc joint appears to rank next in point of expensive apparatus, but is followed very closely in this respect by the cast-welded joint. The thermit welding process certainly requires very much the least expensive apparatus, and from this viewpoint stands in a class by itself. It is believed that under the present conditions the cast-welded joint is the most economical, from the viewpoints of both the mechanical efficiency and the actual monetary expense.

Mr. W. B. Reed said that the rail joint had always been the "thorn in the flesh" in railway work. He outlined the development in splice bars. It is impossible to keep bolted joints tight, and the rail ends wear much more rapidly than other portions of the rails. When the continuous rail was first suggested, old railroad men believed that troubles would arise from expansion and contraction. When the rails are laid in concrete, no such trouble is experienced. On certain cross-town lines in New York City, where the rails are continuous from street to street, the slots at the crossings have been found closed on the hot days, but they will open at once when water is thrown upon the rails in the immediate neighborhood of the slots, thus showing that the rails do not expand within the concrete. The objections to welding rails reside in the large amount of apparatus required. A proper cast-welded joint is perhaps the best that can be obtained, but the process is objectionable on account of the numerous conditions which affect the weld and yet cannot be controlled. Experience has shown that "thermit"-welded joints break through the old bolt holes, but the weld itself is perfect. The thermit joint supplies a real continuous rail without excess of metal. In reply to a question of Mr. Paul Winsor, it was stated that the temper is not removed from the head of the rail because the head reaches only a cherry-red temperature. Mr. Sloan said that in Chicago the price for each cast-welded joint was found to be $2, which would be about 2 cents per pound for the material used. Under proper conditions the cast weld is of sufficient strength to break a 7-in. rail. Mr. Simmons stated that in certain old tracks the cast-welded joints were found to be higher than other parts of rail. This condition is to be explained by the fact that the rail wears more rapidly than the welded joints. Mr. Pratt said that of the 15,000 or 20,000 cast-welded joints in Newark, very few had been found defective. The cost of the weld is from $3.23 to $3.48 per joint for a 7-in. rail. It was explained that the estimate given in the paper for the cost of thermit joints is based on a 9-in. rail. The cost for a weld in a 5-in. rail is much lower, and average about $3.30. Thermit works best on new rails. The thermit process is desirable on account of the small outfit needed. Mr. Clarke stated that only eight men were needed for welding by the thermit process. These men can weld as many as 46 joints per day. From 2,000 to 2,800 joints have been completed. No failures have occurred since a composition of 8 pounds of thermit to 1 of punchings has been used. The conductivity averages from 90 to 100 per cent. No bonds are used on the joints, but the rails are cross-bonded. Mr. Kleinsmith explained the electrically-welded joint. Railway men do not get acquainted with the electric process because the apparatus is not sold, but is operated by the contractors who are paid for the completed joints. With this process it is possible to eliminate trouble at the bolt holes by using long bars. The process does not require that the street be opened below the rail. About 1,200 joints are now being welded per week. Each joint is fully guaranteed.

ELECTRICAL EQUIPMENT.

The committee on the "Maintenance and Inspection of Electrical Equipments" did not submit a complete report at this meeting, but stated its intention of doing so at the next. The chairman, Mr. William Pestell, explained that all railway companies of the United States had been written to in order to ascertain the methods in use. The result had been only fairly satisfactory, and more time is needed to complete the work. He drew attention to the present lack of uniformity of equipments, and suggests the desirability of standardization. Mr. Doyle stated that the New York railways had saved considerable money by standardization on account of less labor and more easy inspection. He expressed the opinion that the standardization of parts would prove one of the most valuable features of the association. Mr. Olds said that in Milwaukee all mechanical parts had been standardized. All axle boxes and brake shoes have been the same for all cars for the last few years. He thought that standardization of new equipment is most desirable, but that it is not practicable to standardize old equipment. Mr. Winsor discussed the proper method for timing the inspection of cars and suggested that a mileage basis would be preferable to a time basis. This plan is followed in Boston. In St. Louis a record is kept of the mileage of each car, which information is particularly useful in judging of the life of bearings. Mr. Stearns stated that in Chicago all parts of each equipment are inspected once per week. Each car requires the work of one man for ten hours.

POWER STATION.

The paper by Mr. Fred N. Bushnell on "The Power Station" was read by title, the author not being present. The paper describes the modern station as one which in its simplest form consists of a boiler room, engine and generator room and switchboard gallery, arranged in parallel lines and separated from each other by substantial fireproof walls. The requirements imposed upon the designer in the selection and installation of power house equipment are treated in detail. In discussing the steam turbine the author states that the remarkable progress made in the manufacture of these machines and their general adoption by many of the most progressive railways in the country, proves them to be a most formidable competitor of the reciprocating engine, if indeed it does not indicate that they have already established their commercial superiority.

It is to be regretted that most of the information concerning the efficiency of steam turbines has been derived from tests covering very short periods of time, usually only a few hours, and that so little information is available as to their performance under actual service conditions. To the street railway manager or engineer, power station records for long periods, showing the coal consumed per kw-hour, or, better still, the efficiency of the plant expressed in percentage of heat energy in the coal converted into electrical energy at the switchboard, are of much greater interest and value than the record of any number of short-time tests for steam consumption only. As an example of a steam turbine plant the Quincy power station of the Old Colony Street Railway Company is cited. This station contains five 2,000-kw, four-stage vertical turbines, running at 750 r.p.m., and connected to 13,200-volt, 25-cycle, alternating-current generators. The steam pressure is 200 pounds. There are ten horizontal water-tube boilers of 750 hp each, equipped with internal superheaters, giving to the steam an average of 65° superheat. Underfeed stokers are used. There are no economizers. One turbine is supplied with steam-driven auxiliaries; the other four have motor-driven auxiliaries. At present, while only two units are in operation, the feed water is heated to 200° F. by the exhaust from the steam auxiliaries. The average daily output is 52,500 kw-hours, giving a load factor of 54.7 per cent for the two machines. Georges Creek Cumberland coal is used, having an average calorific value of 14,000 B.T.U. per pound. The average coal consumption for this station, operating under the conditions outlined above, is 2.94 pounds per kw-hour, showing an efficiency of 8.36 per cent. This record covers a period of six months, ending June 30, 1905.

At the Rhode Island Suburban Railway Company's Manchester Street station all of the usual records are kept, and the quantities and costs carefully determined for each month, and tests of the entire plant are also made. It is believed that these tests have a sufficient influence upon the regular performance of the station to justify a brief description of it, and the publication of the results in the matter of coal consumption from the time it was placed in commission, showing the gradual improvement in efficiency.

This station was originally designed for the Rhode Island Suburban Railway Company to furnish power for its lines operating in the vicinity of Providence. It was intended to use horizontal units, and two 1,500-kw alternating-current units and one 1,600-kw, direct-current unit were purchased. Before work on the building had progressed beyond the foundations, however, it was decided to increase the capacity of the station by installing two additional direct-current units of 2,500 kw each. This required a number of changes in the structure, and necessitated double-decking the boiler room in order to provide the necessary additional boiler capacity. The present equipment of the station consists of fourteen horizontal water-tube boilers of 520 hp each, eight on the lower floor and six on the upper floor. The boilers on the lower floor have no superheaters, but those on the upper floor are equipped with internal superheaters, each made up of 84 2-in. tubes suspended below the boiler drums. The superheaters on two of the boilers were designed for only 125° of superheat, and contain 615.3 sq. ft. of effective heating surface each. Those on the other four boilers were designed for 150° of superheat and contain 255.5 sq. ft. of heating surface. Each boiler has 5,159 sq. ft. of heating surface.

The following is the performance of the station under actual service conditions from the time it was started in regular service, February, 1904. It should be borne in mind that the first battery of boilers with superheaters was installed eleven months after the station was started, and four months thereafer two additional batteries of boilers with superheaters were commissioned, and the performance of the station is, therefore, given for the periods covered by these different conditions.

Eleven months, saturated steam, 2.87 pounds of coal per kw-hour. Four months, slightly superheated steam (no record of temperature kept), 2.37 pounds per kw-hour. Three months, superheated steam, average temperature at engine throttle 465° (102° superheat), 2.46 pounds of coal per kw-hour. The apparent reduction in coal consumption per kw-hour with steam superheated about 100° is 14.3 per cent, but all of this saving cannot be attributed to this cause. A large part of it is undoubtedly due to the increased efficiency of the fire room attendants. Probably not over 8 to 10 per cent should be credited to the use of superheated steam.

In opening the discussion, Mr. H. Le H. Smith said that it was astonishing to hear that with engines operating with superheated steam the efficiency as given in the paper is not high, although the station is of modern design. He said that in a certain old station where low-grade coal is used and where the steam is not superheated, an efficiency almost as high is obtained. It is to be doubted if there is a very marked economy with superheat when the coal consumption of the auxiliaries is considered. The real test of efficiency is the pounds of coal per delivered kw-hour. Mr. Green discussed the detrimental effect of superheated steam upon lubrication and doubted if there could be obtained any beneficial results from its use. In reply to a question by Mr. Winsor, Mr. C. O. Mailloux stated that centrifugal pumps are now being used in Europe for station auxiliaries. He has been informed that they will soon be obtainable in this country. He stated his belief that the lubrication of cylinders using superheat would be solved by adopting some form of graphite. Mr. L. R. Nash said that experiments over a period of two years had demonstrated that a graphite compound makes an excellent cylinder lubricant. The cost is very moderate and no trouble is experienced from deposit on the walls.

TRACK BRAKE.

The paper on this subject by Mr. F. F. Bodler was presented in printed form and not read. It illustrates and describes an emergency track brake which is used on practically all the cars in San Francisco. The brake mechanism consists of a wooden shoe, about two feet in length, which is forced downward against the rails by means of toggle levers operated by the motorman. Channel irons are so arranged as to allow the shoe to travel in only a vertical direction. The shoe is made of Oregon pine. It costs about 2¾ cents and lasts about one week. Each shoe is held in place by a shell made of pressed steel in two parts. Two bolts which pass through holes in the shell, and through recesses in the shoe, not only clamp the shoe by means of the shell, but also prevent the shoe from slipping backward or forward. The brake was originally intended to be used only in emergencies, but it has proved so satisfactory that it is used almost as much as the wheel brake. It ought not to be used on curves, switches or crossings, but should it be used about the only damage resulting would be a split shoe.

Mr. Paul Winsor thought that a brake which could not be used at curves, switches or crossings would seldom be in use, for practically all of the track in cities consists of such construction. Mr. Dewson said the use of Oregon pine involved an increased coefficient of friction to which increase the effectiveness of the new brake could be attributed, since if iron were used there would be no advantage in the type of brake described. In the magnetic track brake, however, there is an actual increase in force on the rail so that the frictional force is greatly augmented. Mr. Schreiber and Mr. Bridge described the good results which have been obtained with magnetic brakes on the West Pennsylvania Railway. It was found that the air brakes were not capable of holding cars on a certain 14 per cent grade where the rails were covered with soot. The air brakes were removed and magnetic track brakes substituted therefor and no further trouble has been encountered.

Abstracts from the "Question Box" were discussed by N. W. Storer, L. R. Nash, A. Green, E. W. Olds, W. H. McAloney, C. O. Mailloux, W. Wallerstedt, J. R. Cravath, H. H. Adams, J. S. Doyle. The questions discussed dealt with lubrication.

The following officers were elected: President, H. H. Adams, Baltimore; first vice-president, F. G. Simmons, Milwaukee; second vice-president, J. S. Doyle, New York; third vice-president, Paul Winsor, Boston. Executive Committee—W. H. Twining, Philadelphia; F. N. Bushnell, Providence; W. B. Reed, New York; A. D. Campbell, Seattle.

American Street Railway Association.

The session on Wednesday morning was devoted to the American Street Railway Association before which were presented three papers, abstracts of which are given below.

LARGE GAS ENGINES.

The paper by Mr. Arthur West was given the title "Notes on the Design of Large Gas Engines with Special Reference to Railway Work." The author stated that the smaller sizes are unsuited to important electric railway installations on account of first cost, multiplicity of parts and greater expense for attendance, etc. The tendency of the modern plant is constantly in the direction of large size units. This is indicated by the rapid increase in size of steam turbines installed in modern stations. Similar reasons will, it is believed, cause a demand for large size gas engines for electric railway work in conjunction with producers to operate them.

One of the most important considerations in the design of large gas engines is the arrangement of the cylinders. In a single-cylinder single-acting, four-cycle engine an explosion takes place once in every two revolutions. In order, therefore, to get the same rotative effect as with a double-acting steam cylinder, it is necessary to work four single-acting cylinders on the shaft or two double-acting gas cylinders tandem on one crank pin. With this arrangement four explosions are obtained in two revolutions, or an explosion every 180° of crank angle. In case of a misfire or premature ignition due to bad gas, the crank can only move one-half a turn before another explosion takes place. In a single-cylinder single-acting engine the crank must move two whole turns before the next explosion, while with two single-acting cylinders opposed to each other or one double-acting cylinder the crank may be required to move one and one-half turns before the next explosion. The relative evil effects of a premature or misfire are, therefore, in the following ratios:

Two double acting cylinders	1
Two single acting cylinders, opposed type	3
One double acting cylinder	3
One single acting cylinder	4

Gas engines and producers to be commercially successful must be designed to be run with the same class of help as is employed on Corliss engines and boilers. This being the case, misfires and prematures are liable to occur occasionally, and the designer must minimize their possibilities for evil. These considerations, as well as the capacity for caring for heavily swinging railway loads, have caused our adoption of tandem double-acting cylinders for railway work.

It is sometimes argued that cylinders so arranged are inaccessible. If, as is the practice of the Westinghouse Company, ample space is arranged between the cylinders, and if the inlet and exhaust valves are not located in the heads, but in the cylinder body and entirely above the floor level, such a gas engine is as accessible as a tandem compound Corliss engine or as a Corliss engine driving an air compressor.

The question is frequently asked as to whether large gas engines will drive alternating-current generators successfully in electrical synchronism or "parallel." This has been done for several years past in Germany with entire succes, and it has also been done in a number of instances very successfully by our company. We have at the present time orders for several such plants on our books, one of which is to drive an electric railway from Warren, Pa., to Jamestown, N. Y., which we expect will be in operation some time during the autumn.

We are frequently asked, "What is the overload capacity of your gas engine?" A clear understanding on the part of the purchaser of the limitations in this direction is very desirable, from the point of view both of the buyer and the seller. A gas engine and producer is thermally very much more efficient than a steam engine and boiler. It is, perhaps, not amiss to say that, with a well-designed producer and gas engine plant, a horse power can be delivered with one-half the cost of fuel that is possible with a well-designed steam engine plant. The power of the gas engine, however, is limited by *the total volume of explosive mixture which can be drawn into the cylinders* during the suction stroke, compressed and finally ignited. This condition sets a limit which does not allow of a large temporary increase of the power, such as obtained with the Westinghouse steam turbine by the automatic operation of the secondary admission valve. Such overload capacity is, of course, convenient for the purchaser, but it is unobtainable on a gas engine, unless the engine is largely under-rated, and the purchaser should consider that this is one of the prices that he pays for the enormously increased output obtained with the gas engine per pound of coal. *The overload capacity is, therefore, simply the amount which the builder rates his machine below its ultimate capacity.* It has been our practice to rate our gas engines in such a way that they would have a safe overload capacity of 10 per cent. Our machines are ordinarily good for somewhat more than this, but conservative engineering requires that there be a margin of power in order that overloads may not materially reduce the speed. The above remarks on overload furnish a general guide which may be of service in selecting suitable generator capacity for a gas engine. For ordinary cases the overload capacity of the generator and that of the gas engine should be about equal, although the gas engine will indefinitely carry its overload while the generator will not, in all cases, unless it is bought with that understanding.

The mechanical efficiency of a large gas engine is very much greater with a four stroke cycle than with a two stroke cycle, this being one of the arguments against the two cycle engine. It is no uncommon thing to see two cycle engines which do not realize as brake horse power more than 60 per cent. of the work actually done by the combustion in the cylinders. The efficiency of a four cycle engine varies considerably, but it may be said in a general way that a well-designed engine will deliver about 85 per cent of the gas indicated horse power in the form of brake horse power.

The thermodynamic efficiency of the gas engine varies so much with different kinds of gas that it is hard to say just what the average value would be. It is probably not far from the truth, however, that its thermal efficiency is about 25 per cent, though in favorable cases gas engines have obtained efficiencies well over 30 per cent.

The large size gas engine has come to fill such an important place in Europe, and has there proven itself to be so reliable and serviceable, that there is no question about its being adopted in this country in the near future, in a form suited to American operating conditions.

APPLICATION OF GAS POWER TO ELECTRIC RAILWAY SERVICE.

The paper on this subject by Mr. J. R. Bibbins outlined the characteristics of street railway service and discussed the adaptability of the gas engine and producer plant to meet the severe requirements. Owing to the limitations of gas engine capacity, dealt with in the paper by Mr. West, there is needed storage capacity at some part of the system. Electric storage is evidently the most desirable, as it relieves the machinery of the wear and tear of fluctuating loads. As to the fuel consumption of gas as compared with steam, it is stated that taking a common heat valve for average bituminous coal at 13,000 B.T.U. per pound, the gas plant requires less than 2 pounds for kw-hour, while steam requires 5.5 pounds. These data are based on tests made at St. Louis by the Government. Tests made at Guernsey, England, showed that the gas plant consumed about 2.25 pounds of coal per kw-hour and the steam plant used 5.5 pounds. The comparative cost of labor and supplies for gas and steam plants is difficult to state in definite terms. With the same character of labor there should be no appreciable difference between the two. In regard to maintenance it may be stated that in the station at Bradford, Pa., which has been in service for more than six years, the average cost of repairs on the engines for the last two years has been 11.6 cents per hp-year, or .0125 cents per kw-hour generated. The author states his conclusions as follows:

1st. That the gas engine has been brought to a state of development where it is capable of doing the same work as the steam engine, with far greater efficiency, and usually at reduced cost.

2d. That the producer has been so far perfected as to be a reliable and more efficient generator than the steam boiler.

3d. That the gas power plant "in toto" is entirely suitable for even the severe service incident to electric railway operation.

4th. That is component parts, engine and producer, are possessed of characteristics leading to harmonious co-operation.

5th. That practical difficulties incident to gas power working have been so far overcome as to warrant commercial confidence.

6th. That experience with gas power in almost every known line of modern industry has proven its general sufficiency for any power service.

SINGLE-PHASE RAILWAY.

The paper by Mr. C. F. Scott on "The Single-Phase Railway System," presented some of the salient features of the single-phase railway system, and the results of the work which has been accomplished in the development of apparatus to meet the increasing demands in electric traction. In discussing the field for the single-phase railways the author stated that the direct-current interurban railway has its limitations. If a region be sparsely settled the available traffic will not show a profit on the cost of circuits and rotary converter sub-stations. There is a material reduction in the investment and operating expense incident to the single-phase railway that will enable it to be built and operated with a profit in cases where the traffic would not support a rotary converter system.

On the other hand, in heavy service the direct current has not made much headway, being handicapped by the heavy cost of sub-stations and of conductors. Heavy and relatively infrequent trains are the hardest loads for sub-stations. For example, if sub-stations be 8 miles apart, each will supply 8 miles of track. A train running 40 miles per hour will receive current from a given sub-station for 12 minutes. In order that a sub-station may be continuously supplying current to trains in one direction they must have a headway of 12 minutes. If they be an hour apart the current from each sub-station is used but one-fifth of the time. Trains in two directions will double the sub-station output, but as the peak load is considerable when two trains pass near a sub-station the load factor is extremely low. Therefore as the aggregate capacity of the sub-stations must be large in proportion to the actual power taken by the cars, it follows that the sub-stations will involve a relatively large expense if they are equipped with expensive rotary converters and require constant attendance, whereas the cost will be relatively small if they require simply lowering transformers having an efficiency very much higher than the rotary converter sub-station and not requiring attendance. The reduction in the sub-station is therefore of especial value when the service is infrequent. Moreover, the single-phase equipment by reducing the size of conductors frequently enables the sub-stations to be more widely separated. This possibility in the reduction in the number of sub-stations and in the aggregate capacity of sub-station equipment, as well as the elimination of rotary converters with their energy losses and their attendants, makes practicable the operation of long-distance roads which could be operated by direct current only at an excessive cost.

The most notable recent event in electric traction is the purchase of Westinghouse single-phase locomotives by the New York, New Haven & Hartford Railway Company. The passenger trains on this road which enter the Grand Central Station in New York run over the tracks of the New York Central Railroad for about 12 miles. As steam locomotives cannot enter the new terminal station, and as the New York Central is equipping its track for direct current, it is imperative that the New Haven trains be handled over 12 miles by direct-current power. Instead of changing from electric to steam locomotives for all local and through trains at the end of 12 miles it was decided to extend the electrification and to do it, not by extending the direct current, but by changing to alternating current. The single-phase locomotives will be designed so that they may operate interchangeably from direct current or from single-phase alternating current.

The adoption of the single-phase system by one of the leading railroads of the country for its heavy and important passenger service is all the more noticeable: First, because its officials are already familiar with electric traction matters through the operation of many important city and interurban railways in New England, and second, because the obvious thing to have done would have been to follow the example of the New York Central by adopting direct-current locomotives. Probably this is the turning point, and the coming electrification of heavy railways will follow the conspicuous example set by the New York, New Haven & Hartford Railroad Company in adopting the single-phase system.

EXHIBITS.

The exhibits at the twenty-fourth annual convention of the American Street Railway Association were made under very favorable auspices in one of the fine main buildings of the Philadelphia Museum at West Philadelphia, where they were housed and displayed very effectively, most of the exhibitors having gone to lavish expense in the way of setting and decorations. In fact, the display had nothing of a hasty, ephemeral character about it, but was such as is made for a national fair of months' duration. Appended are items with regard to the leading electrical exhibits of interest to our readers:

The General Electric Company's display covered a large space in the main aisle of the large hall in the north of the building. The company exhibited many of its latest products in the railway field, and for the first time at a street railway convention showed a Curtis steam turbine. The exhibit includes a special car equipment for use on either direct or alternating current, with air compressor, motors and control in operation. The air compressor is designed for operation on alternating current and supplies air for the braking system. GE-505 motors were supplied with this equipment. The necessary alternating current for the motors is furnished by a 200-kw rotary converter running "inverted" from the 500-volt, direct-current circuit. On another frame was shown a two-motor Sprague-General Electric multiple-unit control, similar to those in operation on the Boston Elevated Company's lines. In addition to railway motor equipments, various General Electric railway single motors were shown, including the GE-80, GE-87, GE-66 and GE-69. Railway supplies were also on exhibition. These included field and armature coils in various stages of construction, giving a good idea of the care used in their manufacture, as well as the general structure. The company's lines of "catenary construction" material were also shown, as well as the various types of rail bonds. Aside from this car equipment material, a 500-kw Curtis steam turbine was shown, dismantled, so that it was possible to see its general construction. A 25-kw turbo-exciter represented the company's development of this type of apparatus, and a voltage regulator, an advance along another line. Both the latter were "still" exhibits. Various types of circuit-breakers completed this general class of apparatus. The entire exhibit was lighted by the new "G.E.M." lamps and enclosed arcs. The mercury arc rectifiers operating in parallel supplied current for the sign and general lighting effects. A feature of this exhibit which particularly attracted the attention of practical electric railroad men was a pair of GE-69 (200-hp) railway motors loaned by the Interborough Rapid Transit Company, of New York. These motors have been in continuous service since their installation on October 2, 1903, and December 10, 1903, respectively. One motor had been operated 45,248 miles and the other one 53,005 miles. The General Electric Company's representatives at the Philadelphia convention included the following: General Eugene Griffin, Messrs. J. R. Lovejoy, W. J. Clark; W. B. Potter, B. E. Sunny, J. G. Barry, L. R. Pomeroy, C. C. Pierce, J. C. Calisch, G. D. Rosenthol, A. H. Armstrong, F. E. Case, H. L. Monroe, J. H. Livsey, J. W Buell, W. G Carey, J. J. Mahoney, S. W. Trawick, F. H. Gale.

Allis-Chalmers Company, finding it, of course, impracticable to erect and exhibit, for one week, a 6,000 or 8,000-hp engine and generator, or any of its huge apparatus, confined their efforts to welcoming the visitors in a large and attractive reception room which it had fitted up in the Museum hall, at the foot of the stairs leading to the Convention Hall. Here, and also at the Bellevue-Stratford, where its representatives dispensed courteous hospitality throughout the several days of the meeting, the Allis-Chalmers badges and watch-fobs, reproducing in oxidized silver the Liberty Bell, and bearing the company's well-known "Four Powers" trade-mark, were worn by hundreds of the visiting railway men. The Allis-Chalmers representatives at the convention were Mr. F. C. Randall, manager New York office; Mr. G. B. Foster, manager Chicago office; Mr. George H. Berg, manager Boston office; Mr. J. W. Murray, manager Pittsburg office; Mr. W. S. Doran, manager power department, Milwaukee, Wis.; Mr. B. A. Behrend, chief electrical engineer, Cincinnati, Ohio; Mr. Charles E. Lord, electrical patent counsel, Cincinnati, Ohio; Mr. David Hall, assistant chief electrical engineer, Cincinnati, Ohio; Mr. A. H. Whiteside, manager Philadelphia office; Mr. C. C. Buttenfield and Mr. H. A. Moore, Philadelphia office; Mr. D. W. Pulver, manager Buffalo office; Mr. L. C. Marburg, Milwaukee, Wis.; Mr. Arthur Warren, manager of publicity, Milwaukee, Wis.

Albert & J. M. Anderson Mfg. Co. showed its complete line of overhead materials, "Aetna" railway insulators, etc., a 4,000-amp. switch and one of its pure cast copper terminals. It was ably represented by Mr. Ernst Woltmann and Mr. A. E. Meixell.

Gould Storage Battery Company was represented by Mr. D. W. Winship and Mr. W. S. Gould. The exhibit consisted of its large size S-49 lead-lined battery and an interesting display of plates of various types for stationary and automobile batteries; besides which a number of photographs of electric railway installations made by this company attracted considerable attention.

Lord Electric Company, maker of the Shaw non-arcing lightning arresters and static discharges, which business it took over recently and enlarged, exhibited a line of instruments for direct-current and alternating-current work, rail bonds and other specialties.

Osburn Flexible Conduit Company exhibited its conduit in various sizes and distributed literature calling attention to its toughness.

H. W. Johns-Manville Co. had a very attractive exhibit, among which was a complete line of overhead line materials, a full line of "Noark," Standard and National Electrical Code standard fuses and blocks; its asbestos and magnesia coverings, a varied line of molded insulating material, "Monarch," etc., a line of high-voltage insulators and "electrobestos" fire-proof insulation and "Transite" asbestos fire-proof lumber. The two latter mentioned materials attracted a great deal of attention, as they are being so extensively used now, in connection with fire-proof construction of cars. The exhibit was looked after by Messrs. J. W. Perry, H. E. Manville, T. T. Lyman, D. T. Dickson, H. M. Voorhis, H. M. Clymer, J. E. Meek, C. N. Manfred, E. B. Hatch and W. W. White.

Sterling Varnish Company displayed armatures and field coils insulated with "Sterling" extra insulating varnish and "Sterling" black plastic insulator, finished with "Sterling" black air-drying varnish and extra black finishing varnish. This company distributed ships of copper coated with "Sterling" black iron enamel. It was represented by Mr. A. S. King and Mr. C. L. Cool. Mr. James Todd, president of the company; Dr. Riddle, vice-president, and Mr. Arthur Hartwell, general manager, attended the convention.

Western Electric Company and the D. & W. Fuse Company exhibited together, the former exhibiting a full line of overhead railway material, and the latter a full line of fuses, transformer cut-outs, service switches, cut-out boxes, etc. Demonstrations were made of the usefulness of their "Deltabeston" magnet wire. Messrs. R. H. Harper, F. D. Killon and F. C. Jaeger represented the Western Electric Company, while Messrs. W. S. Sisson and C. F. Harmon took care of the D. & W. Fuse Co.'s interests.

Electro-Dynamic Company exhibited a 5-hp, 500-volt, inter-pole, variable-speed motor with a speed variation of 4 to 1 (350 to 1,400 r.p.m.), belt-connected to a 5-hp generator; a 110-hp and a 220-hp motor. Messrs. G. H. Condict and F. G. Bell were in charge.

Electric Storage Battery Company exhibited one of the cells to be installed by the New York Central & Hudson River Railroad, of which there will be 20,000 hp; one of the cells of the type installed for the electrification of the Pennsylvania Railroad; one of the batteries being now installed at Hammel, L. I.; power house and line switchboards, the former showing the carbon regulator designed by the Electric Storage Battery Co. for booster control; also a 75-kw booster, an automatic cell-filling device, a recording hydrometer, a signaling hydrometer and a compensating hydrometer; also cell-testing apparatus. The company was represented by Messrs. Blizzard, Albert Taylor, H. B. Gay, F. J. Stone, Reynolds, E. L. Woodbridge, G. H. Atkin, F. L. Kellogg, and R. C. Hull.

MERRITT & Co. showed a line of expanded metal clothes lockers of various styles enclosed in an expanded metal booth.

NATIONAL CARBON COMPANY displayed samples of its carbon brushes, headlight arc carbons, Columbia dry batteries and flash lamps. The company was represented by N. C. Cotabish, A. D. Spear and A. E. Carrier.

BENJAMIN ELECTRIC MFG. COMPANY exhibited a line of Benjamin car clusters and steel shades, its street lighting fixtures, weatherproof sockets., and its new turn-down arc-burst cluster. The exhibit was energetically explained by Mr. Basil G. Kodgbanoff, of its New York office.

NATIONAL ELECTRIC COMPANY had a large booth in which was exhibited an auto-starter for a 200-hp induction motor, a 10-hp motor weighing only 575 pounds, its air brake devices, its switchboard apparatus, a motor-generating set, 250-volt, direct-current generator connected with an induction motor, its new engines, slide-valve and new type E-3 governor. It also exhibited a 20-ft. car air-compressing outfit to operate upon either single-phase, alternating or direct current, together with an alternating-current governor. It was represented by S. I. Wailes, William W. Power, J. T. Cunningham, J. H. Denton, J. F. Perry, C. N. Leet, C. G. Burton, F. L. Waters, W. H. Goble and Walter G. Clayton.

JORDAN BROS. exhibited their device for turning commutators without removing the armature.

THE CHICAGO PNEUMATIC TOOL COMPANY, in addition to its well-known pneumatic tools such as riveters, hammers, drills, etc., exhibited its new pipe-bending machine for conduit work. The company was ably represented by Messrs. J. W. Duntley, W. O. Duntley, Thomas Oldcorn, W. P. Pressinger, G. A. Barden, J. M. Towle, C. B. Coates, F. C. Severin, Julius Keller and B. H. Tripp.

CROUSE-HINDS Co. exhibited its time clocks, headlights, guy anchors, switches, Norbitt specialties, etc. It was represented by Messrs. James H. Hurd, W. D. Hawley, Nathan Shute and Frank Buchanan.

DEARBORN DRUG & CHEMICAL COMPANY made a novel display under the heading of "The Dearborn vegetable treatment for boilers," consisting of a table full of nearly every known vegetable, calling attention to its "vegetable boiler compound." The booth was ornamented with photographs of its laboratories, a free telephone service was supplied for its friends, and a warm welcome was extended by Messrs. Robert F. Carr, William B. McVicker, Grant W. Spear and Thomas Brannan.

PEERLESS RUBBER MANUFACTURING COMPANY had an attractive display of Peerless packing, Rainbow packing, Eclipse gaskets, Wizard gaskets for use with superheated steam, rubber tiling and step-treads. It was represented by Messrs. W. J. Courtney, F. O. Donnell and J. L. McGilvray.

STANDARD PAINT COMPANY showed samples of its "P. & B." insulating tape, "Ruberoid" roofing, "S. P. C." armature varnish and "Flexite" metal paints. Their merits were explained by Messrs. Paul M. Wade, Charles Earnshaw, James M. Richards and Ralph L. Shainwald.

THE BUCKEYE ENGINE COMPANY had a tastefully arranged reception booth, decorated with photographs of the various types of Buckeye engines, where flowers were supplied to all comers. The genial Mr. C. H. Weeks was in charge, assisted by Messrs. H. E. Troutman and A. H. Riddell. They also showed a model of their "Class B engine."

YALE & TOWNE MFG. Co. showed its various styles of hoists, both manually and electrically operated. Many visitors accepted the standing invitation to "pull the chain and see the load go up."

THE GARTON DANIELS Co. exhibit of its line of controller regulators for the automobileer attracted a great deal of attention and called forth considerable comment of a favorable character. The company also made a fine display of Garton lightning arresters. It was represented by Messrs. Garton, Titus and Cosper.

W. N. MATTHEWS & BRO. exhibited their well-known Stombaugh guy anchor and also their latest specialty, "The Kearney Cable Clamp." Mr. W. N. Matthews was kept busy explaining its merits.

AMERICAN STEEL & WIRE COMPANY, in addition to its wire samples, showed a line of track drills, rail bonds, etc.

WESTINGHOUSE EXHIBITS.—The exhibits of the Westinghouse Electric & Manufacturing Company and the Westinghouse Traction Brake Company at the American Street Railway Convention were notable for their feature of complete operative demonstration, and included a greater number of important new products than have been seen in Westinghouse displays for a considerable time. The natural interest shown in the exhibit of two types of Westinghouse single-phase railway motors—Nos. 107 and 108—with which a number of interurban lines in the South and West have been equipped in the past year, was enhanced on Wednesday upon the announcement of the order of the New York, New Haven & Hartford Railroad for 25 1,600-hp Westinghouse single-phase locomotives for use, at first over the New York Central's direct-current terminal system in New York, and, eventually, over long electrified sections of the New Haven's main lines. The various parts of the Westinghouse electro-pneumatic control for single-phase traction service were shown with the motors; and the Westinghouse multiple-unit control for direct-current railway service, with the latest type of rectangular switch group introduced in the equipment of the new cars of the Long Island Railroad, was shown in operation in a working arrangement of two No. 113 railway motors, each of 200 hp capacity; also of the type designed for the Long Island equipment. One of the most interesting features of the Westinghouse electrical exhibits was a 30,000-volt demonstration of the protection afforded by Westinghouse multi-path lightning arresters to either direct-current or alternating-current railway systems, through a complete installation of apparatus for the equivalent spark-gap tests which have been used in the development of the arresters. Souvenir sheets of paper showing the pure static discharge, the static discharge with line voltage impressed on the multi-path discharge block, and the static discharge and line current passing simultaneously over ordinary resistance were distributed during the demonstrations. The most important new traction brake equipment shown in the space of the Westinghouse Traction Brake Company was the type now in service on the Oak Square cars in Boston, automatic air application, with provision for straight-air release, for motor and trailer service. A new type of combination equipment for motor and trailer service was shown also in the SMA brake, straight-air, with an extra train line to provide for automatic brake application in emergencies, through the movement of the motorman's operating valve, or in the event of the separation of cars. Both equipments were shown in full operation, and the exhibits included also a rack arrangement of the standard combined automatic and straight-air Westinghouse brake for traction service, and different types of air compressors, valves, blowing outfits and sanders. Both the electrical and the brake exhibits were brilliantly lighted with Westinghouse 500-volt, direct-current arc lamps and with the incandescent globes of the Sawyer-Man Electric Company. Among the exhibits of the car-building companies were a car for the Long Island Railroad, equipped with Westinghouse motors and with the Westinghouse AMR traction brake, an automatic type, with provision for gradual release; and one of the 160 new Brill cars for Baltimore for which the Westinghouse traction brake is to be furnished. The Westinghouse reception headquarters in the Bellevue-Stratford blue room was well filled throughout the week, and Walter M. McFarland, acting vice-president of the Westinghouse Electric Company, was in almost constant attendance to act as host. Joseph R. Ellicott, eastern manager of the Westinghouse Traction Brake Company; F. M. Nellis, the New England representative, and Frederick V. Green, of the New York office, were prominent among those at the brake exhibits. Among the books and pamphlets given out by the Westinghouse Companies was a small map folder mentioning numerous Westinghouse engine and electrical installations in Philadelphia, and presenting in detail the figures of the leading part that has been played by the Westinghouse Companies in the equipment of the power houses and new sub-stations of the Philadelphia Rapid Transit Company.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, SEPTEMBER 30, 1905. No. 14.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7005 CORTLANDT. CABLE ADRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER

CHICAGO OFFICE ..... 1130 Monadnock Block
PHILADELPHIA OFFICE ..... 929 Chestnut Street
CLEVELAND OFFICE ..... [illegible] Cuyahoga Building
EUROPEAN OFFICE ..... Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico ..... Per year, $[illegible]
Foreign Countries, within the Postal Union $6.00
Great Britain and Ireland ..... 25 shillings
Germany ..... 25 marks
France ..... 31 francs
Single copies ..... 10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen moths from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New Advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **539,000.**

NEW YORK, SATURDAY, SEPTEMBER 30, 1905.

CONTENTS.

Editorial 551
Single-Phase Locomotives for New York, New Haven & Hartford Railroad Company 554
Report of Central Station Statistics 554
Colorado Electric Light, Power and Railway Association 555
Officers of the American Railway, Mechanical and Electrical Association 555
September Meeting of the A. I. E. E. 556
Bethlehem Meeting of the American Electrochemical Society 557
Telephone Capitalization 558
A Home for Science in New York 558
George Washington University 559
Current News and Notes 559
Electrical Engineers of the Times. XXIX. A. E. Winchester 562
Electric Light, Water Works and Central Station Hot Water Heating Installation at Ada, O. By A. E. Buchenberg 563
The Hoho Process of Heating and Working Metals by Electricity. By Paul Hoho 565
"Welfare Work" of the New York Edison 566
Thermodynamics of the Electrical Incandescent Lamp 567
Recent Electrochemical Developments 570
New Telephone Patents 570
LETTERS TO THE EDITORS:
  The Use of the Third Person in A. I. E. E. Discussions. By Lamar Lyndon 571
  "Made in Germany." By Franz Koester 571
  Central Station Rates. By J. S. Codman 572
  Submarine Boats—The Compass. By B. Potamian 572
Digest of Current Electric Literature 572
Book Reviews 576
Sensitive Bench Drill 576
Electric Equipment of the B. F. Sturtevant Company's Works. By Howard F. Knowlton 576
Weather Proof Socket Plug 580
Expansion Connection Carbon Brush 580
New Portable Boring, Milling and Drilling Machine 580
Industrial and Commercial News 581
General News of the Week 584
Philadelphia Convention of the American Street Railway Ass'n ..... Supplement

THE AMERICAN STREET RAILWAY CONVENTION.

The twenty-fourth annual meeting of the American Street Railway Association was held this week at Philadelphia, while the younger bodies and offshoots, representative of the electrical and mechanical engineers, the accountants, the manufacturers and supply men also held their meeting during the same period. From small beginnings a quarter century ago, the street railway convention has grown into one of the very largest of the annual gatherings brought together by a typical and leading American industry, and even a registration of between two and three thousand names does not fully exemplify the magnitude of the occasion. It is seventeen years since the last association met in the city of Franklin. Then the convention was a few hundred strong and did not perceptibly crowd a modest hotel, nor do much to arrest the public attention. This week it has filled every room in the city's largest hostelry to overflowing and swamped all the lodging facilities in the vicinity. The columns of the newspapers have become an exuberant part of the electrical press, and the railway exhibit of apparatus at the Philadelphia Museum has, in extent, interest and beauty, been more than equal to the pretentious displays in the same spacious halls which have been heralded the country over.

Unusual importance has attached to the convention of the past week on account of the formulation of a new constitution for the parent society, attempting to recast the work and membership of the association in a manner that would enable it to keep abreast of the enormous advances in the art and industry, and that while broadening its bases would add also to its dignity, responsibility and influence. This question whether in the prolonged executive committee meetings, the fugitive conversations in the hotel lobby and restaurants, or the animated discussions in the meeting hall, was in reality the predominant one of the week, as it was felt that on its wise settlement depended not alone the welfare of the association, but the very future of the industry itself, if the association were to be its exponent and representative body. Another vital element of interest also made itself apparent during the week in the attention given to fundamental methods of operation, for the association after occupying the streets of all the cities in the Union, has gone out into the highways and byways of the country and made suburb and rural region alike part of its territory. At the present moment the member companies of the association rest definitely on direct-current apparatus and distribution in urban limits, but the newer work outside the city walls points strongly to alternating-current systems, and this, too, seems the outlook for main steam railroads.

Even during the convention a profound sensation was caused by the announcement that the New York, New Haven & Hartford Railroad had placed a contract with one of the great manufacturing companies for no fewer than 25 single-phase electric locomotives, to cost $30,000 apiece. Such a brilliant new departure, like lightning out of a clear sky, developed at once a universal wonder and speculation as to whether the tendency to unification of street railway and steam railway electrification would be helped or otherwise by a change of this character, or whether the urban work would settle down definitely to direct current, while the extra-urban work would go over to the erstwhile rival—the alternating-current—which has already so significantly changed the whole aspect of electric lighting and of power transmission. By many of the "old-timers" who attended the cosy little convention of 1887 it was suggestive of the rate at which electrical history is made that just as a patent runs out in seventeen years so the art had lived through one whole period of gigantic development, and, in spite of the magnificent creations of the term, and of the tremendous investments it had seen, and the armies of capital and labor it had enlisted, was now ready for revolutionary processes, and the assumption of more onerous tasks than any previously attempted.

THE OPERATIVE SIDE OF THE ELECTRIC RAILWAY.

The account given elsewhere of the proceedings of the Philadelphia meeting of the American Railway, Mechanical and Electrical Association show that the papers presented formed as a whole an admirable contribution to the practical side of the electric railway art. In general they cover apparatus and appliances in actual service, and the treatment of the subjects was from the standpoint of men directly connected with he operaing side of the electric railway, and for the particular benefit of men similarly engaged. The discussion of the report on "Controlling Apparatus" brought out the interesting fact that operating engineers would welcome a system of car control for single cars equivalent to the train multiple-unit system of control. That manufacturing companies, in view of this situation and assisted by the operating engineers, will eventually be able to develop such a system cannot be doubted, and indeed much work has already been accomplished in this direction. The old problem of operating compound-wound generators in parallel was presented in a modified form when the paper by Mr. Hile on the "Power Distributing System of the Boston Elevated Railway Company" was being discussed. The distributing system of this company is so arranged that the main bus-bars in the several stations are connected together through feeder wires running into so-called feeder sections common to two or more stations, as noted in our abstract, and it appears that attempts to cause several stations to assist each other in carrying the load had met with varying success.

Experience has shown, as a study of the problem would indicate, that the determining factors are the resistance of the connecting lines, the points at which the loads are applied and the degree of compounding of the generators. With over-compounded generators it is absolutely essential for stability of operation that the drop in voltage across the connecting lines for a certain current be less than the increase in generator voltage due to the passage of this current through the series field coils. In order that the load shall be divided equally between two stations, it is necassary that current be supplied at a feeding point between the two stations. If the load is applied directly at one station and it is desired that another station shall assist in carrying the load, the generators must be adjusted for a drooping-voltage load characteristic. In order to preserve as much as possible the compounding features of the generators, a compromise is found in the use of generators having flat characteristics indirectly joined through feeders. While such a scheme evidently permits the generators to divide the intervening load between them, and is perhaps the best that in practice can be devised, it is evident that a lightly-loaded station will in no wise assist another which is heavily loaded in its immediate neighborhood.

THE THEORY OF INCANDESCENT LAMPS.

Dr. Roeber's admirable paper, read at the meeting last week of the Electrochemical Society, summarizes very clearly the physical theory which lies behind the phenomena of luminous radiation. It is only within the last few years that so broad a view has been possible. Given a lamp with a conducting filament which is at all temperatures free from selective radiation, and the ratio between the temperature and the energy radiated becomes fairly simple. Following up this trail a very direct relation appears between the temperature and the wave length of the maximum energy so that, within limits, the color of the light can be determined and also the distribution of energy in the spectrum. A step further and it becomes possible to compute the temperature at which the maximum proportion of the total radiated energy would lie within the visible spectrum—that is, the temperature of maximum illuminative efficiency. Unfortunately, at the point of the chase one gets into a *cul de sac*, for this temperature appears to be about 4,600° C., which is very far out of reach so far as incandescent lamps are concerned. And even if it were attainable the lamp would still be very far from giving the maximum possible efficiency. For while the wave lengths of the visible spectrum lie roughly between 4×10^{-5} and 8×10^{-5} cm, those which are physiologically useful lie in a far more restricted range, say from 4.8×10^{-5} to 6.5×10^{-5} cm., and those outside the limits 5×10^{-5} and 6×10^{-5} cm. are comparatively unimportant.

Hence, as Dr. Roeber points out, what we really want as a radiant is not the theoretical body without selective power, but a body which shall, without waste of energy, deliver a radiation entirely within these narrower limits. A nearly monochromatic light, which no heated filament comes anywhere near to giving, is the real desideratum, so far as mere efficiency is concerned. The only light which approximates such quality is that of the firefly, which would seem to bring the ideal source of illumination within the realm of physiological rather than physical chemistry. To meet fully the physical requirements of the case, color must be taken into consideration, and this requirement calls not for one monochromatic source, but for all three primary colors. If one could to-day steal the firefly's secret he would have a light that for aesthetic reasons would be almost unsalable. He would have to improve upon his booty to make it really valuable. In all commercial work it is physiological light, not physical radiation, which is important, and hence all the attempts to determine a mechanical equivalent of light rest on a somewhat shaky foundation, interesting as they are. The figures thus far obtained range from 0.2 to 0.1 watt per candle. This region has been reached by both the instantaneous value obtained from an incandescent lamp burned out on the instant, and by an arc struck between electrodes of composition similar to Welsbach mantles.

It is quite evident, however, that in both these cases there was considerable energy outside the visible spectrum and still more outside the useful spectrum, so that with a selective radiating body it should be possible to get far below these limits. And if such a selective radiant is ever obtained, it need not necessarily be worked at an enormously high temperature. This is the *rationale* of the attempt to use gaseous radiants of which the radiation is discontinuous, with the accompanying high efficiencies that have been obtained from the mercury arc and from Geissler tubes. The trouble met at this point is the extreme difficulty of getting a high enough intrinsic brilliancy from the latter and a useful color from the former. Hence little has been accomplished. The new incandescent lamps of tantalum, osmium and graphitized carbon, are reversions to the region of enormous temperatures, and hence must be regarded as strictly limited in efficiency, although that has gone before. The Nernst lamp shows similar limitations. By using these newer lamps, however, one can reach an economical life of much greater efficiency than heretofore. We are pleased to see Dr. Roeber come strongly out for the mean spherical measurement of incandescents. It is the only one which defines fairly the total light available. When there was furious competition between electricity and gas, there was commercial reason for adopting the measurement comparable with one's rival, but to-day electricity has the field very much in its grasp and would really gain by adopting a rating that, while strictly scientific, is also one by which it would benefit rather than suffer in comparison.

Surges on Transmission Lines.

The theory of surges on transmission lines has been fairly developed from an engineering standpoint and some observations of the magnitude of these surges have been made on artificial transmission lines. The transactions of the Societé Internationale des Electriciens for the current year contain a paper by M. Ch. David upon some experiments conducted on actual transmission lines operated at nine kilovolts pressure, under conditions favorable to the production of surges. The circuit experimented upon formed a loop having a perimeter of 40 miles. The lines were overhead, with the exception of 8 miles of underground cable about midway along the loop. The capacity of the underground cable would tend to aid the development of surges. On the other hand, there would be reflections set up at the junctions of the cable with the overhead wires, which would tend to diminish the surges. There were also a few unloaded transformers left connected with the circuit. Consequently the circuit was somewhat special in its character, but the surges observed upon it would, at least, be illustrative. The three-phase alternator employed at the sending end of the circuit generated a charging current of about 5 amperes at 9 kilovolts. This changing current was made and broken by a switch at the sending end of the line.

The voltage at the receiving end of the line was observed by means of an oscillograph, when the switch at the sending end was opened and closed. A number of these oscillographs are reproduced with the paper. They show that there is always an oscillation or surge produced on the lines when the latter are connected to an alternator, except when the connection happens to be made at the or near the zero of impressed e.m.f. That is to say, if the lines are switched on to the bus-bars near the instant at which the e.m.f. of these bars is changing sign, there will be no oscillation produced. If, on the contrary, the switching is made near the peak of an e.m.f. wave, there will be a surge of e.m.f. and current set up in the lines. Under some conditions the surge e.m.f. reflected from the distant end of the circuit may add itself negatively to the impressed e.m.f. and actually reduce for the moment the magnitude of that e.m.f.; but it usually happens that the reflected surge wave adds on to the impressed wave, and so augments the pressure on the lines for the time being. According to theory, the maximum value of the surge e.m.f. is equal to the impressed e.m.f. which produced the surge. Consequently, the maximum augmentation which can occur when the reflected surge add on to the impressed e.m.f. is 100 per cent. In practice, the augmentation must be less than 100 per cent, owing to the attenuation of the surge during its passage to and from the distant end of the line. Moreover, it will be only rarely that the switching occurs at the full crest of the alternator e.m.f. wave; so that even if there were no attenuation in the surge during reflection, it would only be in rare instances that the maximum normal voltage on the line would actually double. In the course of a very large number of switchings the average percentage of the surge increase of the maximum normal voltage would be 63 per cent, with no attenuation of the surge. With attenuation present the average would be considerably less than 63 per cent. In the course of 16 oscillographic records reported on this particular circuit, the average percentage of rise was slightly less than 40 per cent, the maximum being 67, and the minimum 8 per cent.

The oscillograms, which are very interesting, show that the surge e.m.f. had a natural frequency about seven times greater than that of the impressed e.m.f., as might be inferred from the inductance and capacity of the line; so that while the alternator had a frequency of 25 cycles per second, the line had a frequency of 175. The phase of the surge at one end of the line was opposite to the phase at the other end. The actual e.m.f. at any instant was the sum of the impressed and surge e.m.f's there existing. There was not much difference between the maxima attained at the sending and receiving ends. The surge was evidently subject to great attenuation and was practically damped out in about six oscillations. Consequently, in about the period of one complete cycle of the alternator the surging had practically dwindled to zero, and the charging regime had become steady. In opening the switch, or removing the lines from the alternator bus-bars, the voltage on the line does not instantly vanish, but undergoes a surge, partly due to the sudden removal of voltage and partly to the interruption of the charging current. The resultant surge has a period longer than that of the alternator and subject to so much attenuation that it is practically damped out in a single oscillation. As there is no impressed e.m.f. at work upon which the surge e.m.f. can be superimposed, the voltage on the line at breaking was always much less than the normal voltage. This was, however, only because the charging current was about 5 amperes. If the switch had interrupted a full-load working current, or more particularly an overload current due to short-circuit, the voltage in the surge might greatly exceed the normal impressed voltage.

As the result of these valuable oscillograph experiments, the theoretical deduction is confirmed that when a transmission line is suddenly switched on to the generator bus-bars, there will be a few surges of voltage which may momentarily raise the voltage on the line by somewhat less than 100 per cent, perhaps at most, 70 per cent. There is no danger of taking such a line off the bars when the line is idle, because the charging current to be interrupted is so relatively feeble. There is, however, a danger of overvoltage if the switch opens a load current, or particularly, if it opens an overload current. The oscillograms taken on the unloaded line with an oil-switch did not differ appreciably from those obtained with an air-switch. From a practical standpoint, it is unlikely that a cable in good condition would be damaged by a few momentary overvoltages of 70 per cent, such as are apt to occur in switching on. Nevertheless, when very high voltages are in use and the factor of safety of the cable is low, it is desirable that the switching-in should only occur at or near the zero of voltage when the e.m.f. is changing sign. This might be arranged for automatically, by exciting an alternating electromagnet from the bus-bars in such a manner that this electromagnet would bring the switch contacts together only at the zero of the voltage waves. Some engineers actually employ a separate set of bus-bars for slowly raising the voltage of a high-pressure transmission cable prior to connecting this with the bus-bars, in order to avoid the surge of closing. It would seem that there is no danger to be apprehended from switching an unloaded cable off the high-tension bus-bars; but that there is considerable danger in unswitching when there is an overload of current through the cable. It is important in such cases that the unswitching should occur at or near the zero of current. This might be accomplished automatically by causing the overload circuit-breaker to produce a pull on the switch lever, which pull would be opposed by alternating electromagnets in the main circuit. The latter would lose their excitation at the zero points of current and thus allow the switch to open near the proper instant. The paper referred to contains a number of other experiments, and the copies of the oscillographs printed therewith well deserve detailed study by electrical engineers

Single-Phase Locomotives for New York, New Haven & Hartford Railroad Company.

Perhaps the most interesting event at the convention of the American Street Railway Association, held in Philadelphia the present week, was an announcement made by Mr. C. F. Scott in a paper read at one of the meetings (an abstract of which is printed elsewhere in this issue) that the New York, New Haven & Hartford Railroad Company had decided upon the use of the Westinghouse single phase railway system. Following this it was made public that the railroad company had awarded a contract to the Westinghouse Company for 25 locomotives for high-speed passenger service, the price being $30,000 each.

The locomotives will each weigh, approximately, 78 tons, and will be capable of maintaining a schedule speed of 26 miles per hour in local service, hauling a 200-ton train making stops every 2.2 miles, and reaching a maximum speed of about 45 per hour between stations. In express service a speed of from 60 to 70 miles per hour can be maintained with a train weighing 250 tons. To handle heavier trains two or more locomotives will be coupled together and controlled from the forward cab by the multiple-unit control system.

The motors will be the Westinghouse single-phase commutating type, which, as is well known, can also be used with direct current. The locomotives will thus be able to operate over the direct-current section now being installed by the New York Central Railroad Company, the New York, New Haven & Hartford utilizing the tracks of that company between Woodlawn and the Grand Central Depot in New York. For a time the service will be confined to this section, so that it was with a view to the future rather than to present requirements that the alternating-current system was adopted.

Each locomotive will be equipped with four gearless motors and with the unit-switch system of multiple control. The motors will be permanently connected two in series; on direct current the pairs of motors will be operated in series parallel and on alternating current by voltage control. The motors will be spring supported and connected by a flexible drive in such a way that all dead weight will be taken off the axles. On direct current each motor will be capable of developing an output of 400 hp.

◆

Report on Central Station Statistics.

The Bureau of the Census has just published a report on central electric light and power stations for the year ending June 30, 1902, prepared under the supervision of Mr. W. M. Steuart, chief statistician for manufactures. It is the third of a series of reports on the operation and utilization of electric current. In addition to the text, which was prepared by Mr. Thomas Commerford Martin, of New York City, expert special agent, there are elaborate tables and an interesting series of illustrations.

The chapters of text discuss, respectively, the scope and method of the investigation, financial operations, employes, salaries and wages, physical equipment, output of stations, franchises and the history and development of electric lighting.

The statistics do not include isolated electric light and power plants installed in manufacturing establishments, hotels, office buildings, etc., for the purpose of furnishing the light and power primarily for the use of the individuals, firms or corporations operating such establishments.

For convenience in study the various electric stations have been divided into two grand classes: First, those operated by individuals or corporations, and second, those operated under municipal control. Each of these classes is subdivided into, first, those doing a purely electric business, and second, those operated in connection with other industries. The latter are designated composite stations.

Further subdivisions have been made, one being based upon the population of the place in which the station is located and the other upon the horse-power capacity of the generating apparatus of the station.

The growth of this industry is shown by the following figures: From 8 stations beginning operation in 1881 the number rose to 100 in 1886, to 208 in 1889, and to 247 in 1892. During the following years of depression the number of new stations fell; but in 1895, though a time of financial stringency, it again rose to 239. In 1898 it reached 277, or more than the number beginning operation in the entire period from 1881 to 1886, inclusive. The number for 1901 was 250, and for five months of 1902 it was 146. In the twenty years from 1881 to 1901, inclusive, an average of 165 private and municipal stations have begun operation each year. The spread of the agitation for municipal ownership of public service enterprises is illustrated in a somewhat striking manner. Of the 815 municipal stations enumerated, only 68 had been installed up to 1889. In that year 40 were introduced, and in 1895 the number of new stations reached 73, increasing in 1898 to 82. The returns for 1902 indicate that the ratio was fully maintained in the census year.

In 1902 there were in the United States 3,620 central electric stations, with a cost of construction and equipment of $504,740,352. Employed were 6,996 salaried officials and clerks with salaries amounting to $5,663,580; and 23,330 wage-earners with wages amounting to $14,983,112. The gross income was $85,700,605, comprising $84,186,605 from sale of current and $1,514,000 from other sources. Total expenses were $68,081,375. The total output of stations for the year, in kilowatt-hours, was $2,507,051,115. The number of arc lamps was 385,698 and of incandescent lamps 18,194,044.

Private stations form by far the largest portion of the industry, constituting 77.5 per cent of the total number of stations in operation during 1902. Their income from sale of current was $78,735,500, or 91.9 per cent of gross income, the expenses of operation 92.3 per cent of the total, while they gave employment to 89.4 per cent of the total number of wage-earners engaged in the industry and paid 90.5 per cent of the total amount of annual wages. The primary power plant equipment of these stations formed 91.3 per cent of the total horse-power of all stations while the generating equipment formed 90.6 per cent of the total horse-power of all dynamos. The kilowatt-hour output of private stations formed 92.2 per cent of the total, and the arc lamps in such stations formed 86.8 per cent of the total number wired for operation.

The comparison of the income of the two classes of stations is not a fair indication of their earning capacity, because of the gross income reported for municipal stations. Of this gross income $6,836,856 resulted from the sale of current and included income from public service which was necessarily largely, if not wholly, a matter of estimation.

The private stations employed 20,863 wage-earners, who were paid $13,560,771, and 6,046 salaried officials and clerks with salaries amounting to $5,206,199, while the municipal stations employed 2,467 wage-earners, who were paid wages amounting to $1,422,341, and 950 salaried officials and clerks, who were paid $457,381.

The cost of construction and equipment of the municipal stations was only 4.4 per cent; their income from sale of current, 8.1 per cent; their expenses 7.7 per cent; and the horse-power capacity of their power and generating plants 8.7 and 9.4 per cent, respectively. The output of such stations was 7.8 per cent of the total kilowatt-hours produced by all the stations, while their arc lamps were 13.2 per cent and their incandescent lamps 8.7 per cent of all the lamps reported for the country.

In addition to controlling practically the entire industry, the average private station is much larger than the average municipal station. Considering the total of 2,805 private stations, it appears that the average total expense per year per station was $22,401, as compared with $6,437 for municipal stations. The private stations gave employment on the average to 7.4 wage-earners, while the municipal stations gave employment to 3. The average private stations reported 823,938 kilowatt-hours per year, as compared with 240,373 for the municipal stations.

It is found that 732 municipal stations operated in that number of communities in which there was no competitive private service. It would appear that in all probability a great many if not all of these places would have gone without electric lighting had the supply been left to private enterprise seeking a return upon its investment. The population served by these stations was 2,052,485, an average of a little over 2,800 per station, and towns of this size rarely offer inducements to private capital, regarded from the per capita basis of consumption of current. These stations also represent a total cost of construction and equipment of $15,369,382, or about $21,000 per station, whereas the average cost of construction and equipment for the 3,620 central stations of all classes was slightly short of $140,000. The largest average population per community is shown for Massachusetts, having 17 stations, with an aggregate population of 151,407, or an average of 88,906. The smallest population per community is shown for Colorado, with two municipal stations supplying 1,402 people, or an average of 701 for each station. An average of 5 persons to a family or house would give barely 140 houses.

The largest number of stations was in Illinois, followed by Pennsylvania, New York, Ohio, Michigan, Indiana, Iowa and Wisconsin in the order named. No other State reached the 150 mark. The New England States were well supplied with stations. Massachusetts reported the largest number, then came Maine, Vermont, New Hampshire and Connecticut. Among the Southern States Texas led, with Kentucky, Tennessee and Georgia following. Of the Western States, California reported the largest number of stations, Colorado, Washington, Oregon and Montana being next in order. Of the 1,892 places reported at the Twelfth Census as having a population of 2,500 and over, 1,511 had one or more central electric lighting stations. Of the places with a smaller population, 1,060 had similar stations.

A number of companies supply areas of many square miles in which are located scores of cities, towns, incorporated villages and mere hamlets, all enjoying the benefits of electricity and constituting a source of income for the enterprise. The extreme limit of such work at the time of this report was marked by the long-distance power transmission on the Pacific coast, where current from the Sierras was actually delivered for general consumption in San Francisco and Sausalito, and was also distributed from the same plants over lines which ramify into half the counties of the State of California. The whole aspect of central station current supply in its relation to population has in reality been utterly changed by the development of polyphase power transmission plants. There are at least a thousand such plants, with lines frequently 15 or 20 miles long, in many cases 40 or 50 miles, often 60 or 90 miles, and sometimes even 150 or 200 miles.

These transmission enterprises are peculiarly typical of the far Western States, but are by no means concentrated there, being scattered all over the Union.

The total capital stock and funded debt authorized amounted to $743,296,266, but the amount issued was considerably less, being $627,515,875. Of the total amount authorized, $435,178,372, or 58.5 per cent, was capital stock, and $308,117,894, or 41.5 per cent, was funded debt. Of the total authorized capital stock, $372,951,952, or 85.7 per cent, had been issued at the end of the year covered by the report. Of the capital stock issued $23.871,671, or 6.4 per cent, was preferred stock and $349,080,281, or 93.6 per cent, was listed as common stock.

Private stations expended $40,050,613 and municipal plants $1,741,834 in construction and equipment during the year covered by the report. The total for private stations from their origin until 1902 was $482,719,879, giving an average outlay of $328 per horse-power of dynamo capacity. It is interesting to compare these figures with those for municipal stations, which show a cost for construction and equipment of $22,020,473, and an average of about $145 per horse-power of generating capacity; it is not safe to accept this average as a basis of comparison, on account of the wide variations revealed in the different States, which range from $114 in Ohio to $844 in the State of Washington.

Although the practice of supplying current for motive power and other uses had grown rapidly, the supplying of current for light was still preponderatingly the business of both private and municipal stations. Of the total income $70,138,147, or 81.8 per cent, was directly derivable from lighting. The private stations obtained 80.5 per cent and the municipal stations 96.9 per cent of their income from this source. This income from sale of current for lighting purposes was derived from 385,698 arc lamps and 18,194,044 incandescent lamps. The average income per lamp for arc lights in private stations and used for commercial or other private lighting was $48.88; used for public lighting, $83.20. In municipal stations, for commercial or other private lighting, it was $41.46; for public lighting, $69.98. The incandescent lamps in private stations in commercial use earned an average income of $2.40 per lamp; in public service, $6.06. In municipal stations these lamps earned $1.92 in commercial service and $5.93 in public service.

The total expenses for private and municipal stations were $68,081,375. Of this $20,646,692 was for salaries and wages, $22,915,932 for supplies, materials and fuel, $11.895,206 for rents, taxes, insurance and miscellaneous expenses, and $12,623,545 for interest on bonds.

Physical equipment is considered under the three heads: Power and generating equipment, line construction and service line equipment. The power plant equipment showed 5,930 steam engines with 1,370,941 hp. and 1,300 water wheels with 438,472 hp; and the generating plant equipment 3,823 direct-current, constant-voltage dynamos with 442,440 hp; 3,589 direct-current, constant-amperage dynamos with 105,531 hp. and 5,122 alternating and polyphase current dynamos with 987,003 hp. The line construction had 107,263 miles of mains and 17,880 miles of feeders. For the service line equipment, meters, lamps and motors are the important items. There were 582,689 meters, 575,004 of these were mechanical and 7,685 chemical. The aggregate of arc lamps of all classes was 385,698, of which 334993, or 86.8 per cent, were operated from private stations and 50,795, or 13.2 per cent, from municipal stations. In addition to these 385,698 arc lamps connected to the circuits of central stations, the street railways operating electric lighting stations reported 33,863 arcs, making the total for the United States 419,561.

The average output in kw-hours per day for all stations was 6,960,783, making a total for the year of 2,507,051,115. For private stations the output was 2,311,146,676 kw-hours, and for municipal stations 195,904,439. Among the private stations the totals for New York are at the head of the list; among the municipal, Illinois.

* * *

Colorado Electric Light, Power and Railway Association.

The third annual meeting of the Colorado Electric Light, Power & Railway Association, held at Glenwood Springs, Colorado, Sept. 18 to 20, was well attended, about two-thirds of the membership being represented at the convention. An important action taken at the meeting was the adoption of an amendment to the Constitution whereby eligibility to membership in the association was extended to residents of Utah, Wyoming, Idaho, Nevada, New Mexico and Arizona. Members from these states will be given full privilege under the active membership clause. Following are the officers of the association elected for the ensuing year:

President, Mr. F. W. Frueauff, Denver; vice-president, Mr. William Mayher, Greeley; secretary and treasurer, Mr. George B. Tripp, Colorado Springs. Messrs. J. Beeler, of Denver, and J. F. Vail, of Pueblo, were elected additional members of the Executive Committee. The members of the Finance Committee are Messrs. D. F. Harper, Trinidad; P. R. Stout, Central City, and H. M. Gilbert, Pueblo. The Membership Committee is composed of Messrs. J. J. Cooper, Denver; J. E. Blackall, Denver, and B. K. Sweeney, Denver. The five members of the Advisory Committee are Messrs. William T. Wallace, Canon City; E. J. Temple, Boulder; R. L. Goodale, Colorado Springs; A. M. Ballou, Denver, and W. J. Barker, Denver.

Five papers were presented at the meeting as follows: "Notes on an Up-to-Date Sub-Station," by Mr. A. M. Ballou; "A New High Candle Power Incandescent Lamp," by Mr. C. B. Mahaffey; "The Application of Electric Power to Gold Dredging," by Mr. J. F. Dostal; "Isolated Plants," by Mr. H. L. Wolfenden; "Getting New Business," by Mr. R. L. Goodale; "The Mercury Arc Rectifier," by Mr. G. N. Robinson. A feature of the convention was the "Question Box," which was a printed programme comprising 66 questions on the subjects of management, boilers and engines, lightning arresters, pole lines, meters and miscellaneous.

* * *

Officers of the American Railway, Mechanical and Electrical Association.

At the conclusion of its meeting in Philadelphia on September 26, the American Railway, Mechanical and Electrical Association, elected the following officers: President, Mr. H. H. Adams, superintendent of shops of the United Railway & Electric Company, Baltimore; first vice-president, Mr. F. G. Simmons, superintendent of construction and maintenance of way of the Milwaukee Electric Railway & Light Company; second vice-president, Mr. J. S. Doyle, master mechanic of Interborough Rapid Transit Company, New York; third vice-president, Mr. Paul Winsor, Boston Elevated Railway, Boston. The executive committee elected is as follows: Messrs. W. S. Twining, Philadelphia; F. N. Bushnell, Providence; W. B. Reed, New York; and A. D. Campbell, Seattle. Mr. S. Walter Mower, Detroit, was re-elected secretary and treasurer.

September Meeting of the A. I. E. E.

The 199th meeting of the American Institute of Electrical Engineers was held September 22 in the assembly room of the New York Edison Company, at 44 West Twenty-seventh Street, New York. The retiring president, J. W. Lieb, Jr., called the meeting to order and introduced the entering president, Dr. Schuyler Skaats Wheeler, prefacing his introduction by the remark that presidents come and presidents go, but the Institute goes on forever. President Wheeler, after a few well-chosen words of appreciation of the honor conferred upon him, gave the floor to Mr. Lieb, who on the part of the New York Edison Company, welcomed the Institute to the assembly room, which was placed at the disposal of the Institute for its meetings until the Engineering Building may be completed. This room, which is now being placed in service for the first time, is well arranged for the purposes of the Institute. The seating capacity is adequate, blackboard facilities are provided and provision is made for a projection lantern when occasion may require. The secretary announced that 32 associates had been elected at the last meeting of the Board of Directors. Mr. C. O. Mailloux was elected a Manager by the Board of Directors to fill the vacancy in that grade due to the election of Dr. Wheeler to the presidency.

FLUX IN INDUCTION MOTOR.

The first paper presented was that of Prof. A. S. Langsdorf, entitled "Air-Gap Flux in Induction Motors." The paper, which is largely mathematical in character, deals with the law of the variation in magnitude of the synchronously rotating flux in polyphase induction motors. The author states that it is common practice in determining its mean value to consider the flux a maximum (in the case of three-phase motors) when the three currents are, respectively, $-\frac{1}{2}I$, I, $-\frac{1}{2}I$, where I is the maximum current per phase, and a minimum when the currents are $\frac{\sqrt{3}}{2}I$, 0 and $\frac{-\sqrt{3}}{2}I$; the mean of these two values being then considered as the average for the cycle. This method is, of course, only approximate. The author deduces equations which tend to show that the actual average is not only greater than the value obtained as above, but it may even exceed the above assumed maximum. Four distinct cases are considered: Three-phase motors with even and with odd number of slots per pole per phase and two-phase motors with even and with odd number of slots per pole per phase. On the assumption that the reluctance of the teeth and core is negligible in comparison with that of the air-gap, and that the currents in the separate phase windings follow a sine curve of time value, the value of the flux and its distribution are determined by means of magnetomotive force equations. It is shown that the actual flux can be considered as made up of two components: one a flux of uniform value, the average flux rotating synchronously; and the other a flux consisting mainly of one of sextuple frequency in the case of three-phase motors, and of quadruple frequency in the case of two-phase motors.

In discussing the paper, Dr. A. S. McAllister remarked that the author had neglected to consider the modifying effect of the secondary current. When the secondary circuit is closed, and especially with a squirrel-cage secondary winding, the synchronously revolving magnetism is of constant strength, the combined magnetomotive forces of the primary and secondary currents producing this result. The effect of neglecting the presence of the secondary current will be appreciated if the method of analysis proposed be applied to a single-phase motor. The resultant equations would indicate a field magnetism unidirectional in space and alternating in value, while in reality the magnetism of a single-phase motor at full speed revolves synchronously and is of practically constant strength. The conclusions as to the magnitude of the fluctuations in the magnetism would apply to a polyphase motor, devoid of hysterisis, when operated with the secondary on open circuit, as implied in the original assumptions upon which the equations are based.

Mr. B. A. Behrend stated that the paper indicates an excellent power of analysis, and it is useful in presenting a convenient method for dealing with electrical problems. It is to be regretted, however, that all of the factors entering into the present problem have not been considered, for the results as obtained are not applicable to a commercial induction motor. It is improper to assume that the resultant transformed equations express conditions other than those taken into consideration in forming the original equations. The actual distribution of flux around the air-gap of the motor is materially modified by the mechanical dimensions, and is essentially different from that assumed.

Mr. H. Pikler said that the equations given in the paper are quite simple and permit of easy interpretation. They are based on the assumption of sinusoidal exciting current, while in reality the current is always distorted, on account of the cyclic change in permeability of the magnetic material. The practical application of the author's conclusions to machines in use would, therefore, not be attended with satisfactory results.

ENCLOSED FUSES.

Upon the conclusion of the discussion on Prof. Langsdorf's paper, Mr. H. O. Lacount presented his paper entitled "Standardization of Enclosed Fuses." The paper is divided into four parts, as follows: 1 The necessity of standardizing enclosed fuses. 2 The work of standardizing such fuses. 3 The results of this work, which is contained in the specifications for National Electric Code standard enclosed fuses. 4. The test of enclosed fuses designed to comply with the specifications.

As indicated by its divisions, a large portion of the paper deals with the history of enclosed fuses and shows the methods adopted to obtain the opinion as to requirements of all parties concerned in the manufacture and use of fuses. After reviewing the work of the standardization committees, note is made of some of the main features of the approved standard fuses.

The terminals chosen are of the spring-clip and knife-blade types, which are believed to possess as many of the advantages of the Edison plug and as few of the disadvantages of the screw-and-washer terminals, with respect to wrong fusing as could be obtained and still retain other desirable features. The dimensions for the fuses finally chosen are not those of an entire line of any one of the several manufacturers. The new dimensions, however, are not radically different from those of fuses that have been in use for several years.

The previous specifications of the underwriters require that the fuses be marked with 80 per cent of the maximum current they could carry continuously. While this rule was retained for the line fuses, it was slightly modified in the specifications for the standard enclosed fuse, which require that the fuse must carry 10 per cent more current than that for which it is rated, and must melt with 15 per cent current above its rating. The melting point of the fuse is, therefore, at an overload of between 10 and 15 per cent. The 25 per cent overload necessary to melt a link fuse is thus reduced to from 10 to 15 per cent for the standard enclosed fuse. This smaller margin between the rating and the maximum carrying capacity was considered sufficient, as it was claimed by manufacturers that the enclosed fuse could be rated more accurately than the link fuse, and possibly would be less affected by surroundings, although accurate tests have not yet been made regarding the temperature rise, it is believed that the present approved fuses will meet this requirement satisfactorily.

The paper outlines the result of 11,000 tests on fuses. The failures noted during the tests might be divided into two classes: first, failures in which the circuit was opened properly, but the fuse tubes burst or the end caps or ferrules blew off and second, failures in which the arc held either through or around the fuse. While both classes of failures were rated "poor," the second class is, of course, by far the more dangerous. In one of the worst failures the arc held inside the tube until the emergency switch was opened; in the meantime flame and melted metal were thrown in a continual stream from both ends of the fuse a distance of, say, 20 ft. and a volume of flame and gas or smoke was discharged upward through the side of the tube at least 25 or 30 ft. Lest it might be thought that these failures were frequent, it should be stated that the reverse was true. Such failures clearly indicated defects, which in later tests of improved samples under practically the same conditions were found to have been removed.

The indicator is considered in the trade as an essential part of a commercially successful enclosed fuse. Although the indicators are not mentioned in the specifications, a record of their performance was kept throughout the tests, and it may be of interest to know that, while the majority operated as intended, some of them failed to give the proper indication.

As a rule it has been found that if the fuses meet the specifications regarding the 10 per cent and 25 per cent overloads, they require a somewhat longer time to melt than given in the specifications. Manufacturers are still confident that the "blowing" time can be brought within the limits specified, and are at work on this feature which was not considered of sufficient importance, however, to prevent approval of the fuses at present. It is believed that the enclosed fuses that had been approved and included in the List of Approved Electrical Fittings, published by the National Board of Fire Underwriters and the Associated Factory Mutual Fire Insurance Companies, are safe for general use. Accidents will occur, and so also will defective fuses be found now and then, but the danger from this cause should be small.

The discussion of the paper was opened by Mr. L. W. Downes, who, as a manufacturer, expressed his entire sympathy with the work of the standardization committee. Standardization eliminates special orders which, although not desirable, cannot ordinarily be refused. The effectiveness of the work of the committee may be learned from the fact that no complaints have been received concerning National Code Standard fuses. The screw clamps used with fuses might, however, be improved upon. The only practical form is the one in which the terminal is positively bolted to the contact. In regard to the knife-blade terminals, it is to be noted that it is extremely difficult to make blades to the exact thickness, a variation of .002 in. not being uncommon. This fact must be considered in attempting to make the fuses interchangeable. In commenting upon the tests to which fuses are subjected Mr. Downes remarked that fuses which opened properly when the generator capacity was, say, 5,000 kw, would frequently fail entirely to prevent an arc when the generator capacity was increased to 10,000 kw. It has been found that the resistance in circuit has much to do with the operation of fuses. The opening of the fuse depends upon the vaporization of the material, and upon the rapidity of the vaporization process, which rapidity depends upon the value of the current. When the current is excessive the vapor pressure around the fuse may be enormous and cause a destructive explosion. A vapor pressure as high as 900 or 1,100 pounds per sq. in. has been observed with 400-amp. fuses.

Prof. W. L. Puffer explained that when a fuse opened under condition of short-circuit, the supply generator being of large capacity, there frequently occurs a certain spark-coil action which causes the voltage to rise much above normal value. On a certain 50-amp. fuse which was blown by 5,000 amp., the voltage of the compound-wound direct-current generator first decreased to 75 per cent of normal and then quickly increased to 200 per cent, the whole action taking place within a small fraction of a second.

Mr. H. G. Stott stated that great difficulty had been experienced in obtaining a suitable fuse for the contact shoes used upon the third-rail systems. When the fuse is subjected to a short-circuit many thousands of kilowatts are available for causing the explosion at the fuse. The great permeability of the rails causes the heavy current to produce around itself a strong magnetic field which when the fuse is blown tends to decrease rapidly to zero value and thereby to generate in the conductor an e.m.f. in a direction to maintain the current. Observations on the New York railways have shown that this excess e.m.f. may amount to 100 per cent of the normal voltage, thus subjecting the fuse to extremely severe conditions. It is imperative that for such service the fuses be given very liberal dimensions. It does not appear to be desirable, however, to require that all fuses of a similar capacity should be designed for such service, and doubtless the fuses should be designed with special reference to the uses to which they will be put.

Mr. Jos. Sachs expressed his approval of the standardization work which had been done and said he believed that all of the recommendations of the committees were good. He thought, however, that there are cases where a "screw-driver" type of fuse terminal is preferable to a "screw-driverless" type, and that both types should be approved. Although he had been one of the first to use indicators with fuses, and he yet believed in them, experience had shown that there are many installations where non-indicator fuses are better than indicator fuses. In regard to the heating of fuse terminals, it is to be noted that lack of proper contact, such as may occur when the knife-blade fails to fit its jaws, may cause a large increase in temperature locally at the terminals. In measuring the temperature at the terminals it is essential that the thermometer be placed immediately in contact with the metal, because heat is quickly transferred from one part to another of the copper.

Bethlehem Meeting of the American Electrochemical Society.

In our last issue we gave an account of the proceedings of the first two days of the eighth general meeting of the American Electrochemical Society, held in Bethlehem, from September 18 to 20.

At the banquet on Tuesday night the president, Dr. W. D. Bancroft, announced that the next meeting will be held in Ithaca, N. Y., probably early in May, and arrangements are already being made to provide for an excellent program of papers. The board of directors of the society has decided to use some of its funds to encourage important research work. The society will hold in future only one yearly meeting, although a second meeting may be held in conjunction with one of the other large national engineering societies.

INSULATING PAINTS.

In our last issue we noticed briefly the interesting paper which was presented on Tuesday morning by Dr. Maximilian Toch. We refer to it again, since the industry of insulating paints is a new industry for which electric traction is responsible. An old steel bridge over which a new trolley line passes soon shows the corrosion of the steel and this deterioration is called electrolysis. A peculiar point is that in all cases the greatest corrosion was found on the steel connected to the minor side (cathode).

The subject is a very broad one. Insulating paints which will do under one condition will not do under other conditions. Thus materials which may be good for a tunnel, and which must withstand moisture, may prove useless in sunshine. The speaker gave a brief review of the chemistry of the subject and remarked that his researches have shown how to predict in a general way what a paint will do from the way in which it is made up.

For cross arm paints a very high resistance is not as essential as that it will withstand the weather, and a liquid medium which sucks into the pores of the wood is better than one which dries by oxidation and forms a film which peals.

Third rails are subject to so much variation and oxidation that often they must be replaced even sooner than the running rails. The web of the rail can be protected with a paint which will resist corrosion and short-circuiting. The wooden core which is sometimes used as a cover for the top should be painted with a fire-resisting material.

The speaker emphasized that here is a good field to be taken up by students of electrochemistry.

DETERMINING THE SPECIFIC RESISTANCE OF ELECTROLYTES.

The first paper, presented at the session of Wednesday morning, related to a standard method for determining the specific resistance of electrolytes, the author being Mr. R. Threlfall. In his absence the paper was read by Mr. C. Hering.

The author employs the potentiometer method and makes use of single reversible electrodes, such as those of Ostwald, to connect the potentiometer to the electrolytic resistance. He measures the resistance of a long uniform cylinder, which contains the solution to be tested, and then calculates the specific resistance. The cylinder is embedded in a bath so that it may be uniformly heated to various temperatures. The two terminals of the cylinder are connected on the one hand to the standard Ostwald electrodes, a resistance box and a galvanometer, and on the other hand through platinized platinum electrodes with a storage battery which is in series with a very high resistance and furnishes the main current through the electrolyte. The main current is reversed after a group of observations and several sets of comparisons are made alternately with the current, first in one direction and then in the other. The arithmetical mean of the results is then taken.

The paper was discussed by Messrs. Hering, Burgess and Esterbrooks.

Prof. C. F. Burgess' report on the electrochemical exhibits at the Louisiana Purchase Exposition in St. Louis, 1904, was then read by title.

REVERSIBLE AND IRREVERSIBLE POLARIZATION.

A paper by Prof. W. S. Franklin and Mr. L. A. Freudenberger was presented by Prof. Franklin. It gives the results of a continuation of researches on which he had already presented a paper at a former meeting of the society. The gist of the method is to divide the total e.m.f. into a sum of three terms, the first being $r i$—that is, the e.m.f. consumed by the resistance according to Ohm's law; the second being the reversible polarization, due to changes of concentration of the electrolyte, changes of temperature, etc., while the third is the irreversible polarization which is a function of the current. The endeavor of the experimental research was to separate these three terms from one another. The main part of the paper gives measurements which were so arranged as to give the values of the reversible polarization with considerable accuracy, thus enabling the values of the irreversible polarization to be found since the term ri can be calculated. The results were tabulated in diagrams. The paper was discussed by Messrs. Hering, Burgess, Bancroft and Betts.

AMMETERS FOR ELECTROLYTIC WORK.

A paper on this subject by Mr. Lawrence Addicks, of the De Lamar Copper Refining Company, was presented in the absence of the author, by Mr. Easterbrooks. For electrolytic work very heavy currents are required, and care must be taken to measure them accurately. It is necessary to place both shunt and instrument in suitable positions when designing the switchboard. In the first place the shunt should be obtained from the maker with short bars inserted in the slots usually provided in the shunt terminals, these bars in turn to be bolted to the bus-bar carrying the current to be measured. Unequal heating of the two shunt terminals will introduce a constant error from the thermo-electric junctions formed where the alloy leaves are soldered on to the copper blocks. This may easily amount to one per cent of the full scale reading; may be either positive or negative, and will show as a zero error on shunting down the circuit and will gradually disappear as the shunt cools off. Sometimes compensating devices are applied to avoid thermo-electric errors, but if the shunt is so placed in the bus-bar that the facilities for conducting away heat are approximately equal on both sides, there will be no appreciable error, and such devices should be unnecessary. There should be practically equal radiating surfaces of bus-bar for three or four feet each side of the shunt. If placed close to a switch on one side there is sure to be a thermo-electric error in the shunt, as high capacity switches frequently run hot. The best plan is not to attempt to place the shunt back of the switchboard at all.

The power wasted by a 5,000-amp. shunt at full load is about 300 watts. It is perfectly practicable to build a shunt for 25,000 amp. One of the most important sources of error is the magnetic effect of stray field in the immediate vicinity of a bar carrying several thousand amperes. Instruments should never be placed within two feet of such bars.

THERMODYNAMICS OF THE ELECTRIC INCANDESCENT LAMP.

A paper on this subject was presented by Dr. E. F. Roeber, who gave a summary of the thermodynamic theory of radiation as applied to incandescent lamps and exhibited the following three new types of lamps: the tantalum lamp, the osmium lamp and the graphitized carbon filament of the General Electric Company. An abstract of the paper will be found on another page of this issue.

The discussion was participated in by Messrs. Bancroft, Richards, Franklin and Brown, and dealt mainly with problems of optical pyrometry and with the question whether the black deposit on the globe of the carbon filament lamp is due to actual evaporation of the carbon. Prof. Richards thinks that for certain metallurgical reasons it should be assumed that evaporation of carbon takes place, even at not too high a temperature. Dr. Roeber remarked even if this takes place yet there must be some other action by which carbon particles are given off from the filament, since they are mainly given off from one terminal of the filament and are emitted in straight lines, there being a distinct screening effect under proper arrangement of the experiment. Mr. Brown called attention to the importance of finding the cause of the change which goes on in the tantalum filament during use and which results in the contraction of the filament and final destruction.

RADIOACTIVITY.

Two papers by Prof. H. Schlundt and Prof. R. B. Moore dealt with problems of radioactivity. In one paper the authors showed that a separation of the products constituting the excited activity of thorium can be readily made by chemical means. The second paper gave an account of tests of the radioactivity of some natural waters of Missouri, mostly mineral waters. There exist marked variations in the activity of these cold waters. The activity of deep-well waters as a rule falls below that possessed by spring waters.

ELECTROLYTIC METHODS IN ORGANIC CHEMISTRY.

A paper by Dr. G. A. Roush gave an account of a successful method of preparing electrolytically iodoform from acetone. It is possible to get a current efficiency of about 95 per cent and acetone yields of about 75 per cent. The best composition of the electrolyte is 20 grams KI, 300 c.c. water and 1.5 acetone.

ELECTRIC RESISTIVITY OF IRON.

The last paper presented at the meeting was a note by Mr. G. Gin on the electric resistivity of iron and steels at high temperatures. A certain kind of cast iron was found to have a resistivity of about 16×10^{-5} microhm-centimeters for temperatures between 1,280° C. and 1,340° C. In the discussion Prof. Richards welcomed this paper as one which should be followed by a great many others, since for metallurgical calculations nothing is more needed at present than such data.

Prof. Burgess proposed and Mr. Hering seconded a vote of thanks to the local committee and to the various authorities which had made this meeting so very enjoyable and successful in spite of the inclement weather. A great part of this success was due to the very effective work done by the local committee with Dr. W. J. Richards and Mr. Landis as chairman and secretary, respectively.

The excursion to Mauch Chunk which had been arranged for Wednesday afternoon had to be given up on account of the rain, but those who remained in Bethlehem either paid a visit to the Dexter Portland Cement Company at Nazareth, Pa., or participated in the impressive ceremony of the opening exercises of Lehigh University in the university chapel.

Telephone Capitalization.

Telephone companies to the number of 247 have made returns to the Indiana Tax Board. Their reports are more or less interesting, as many of the companies are overcapitalized, and their service rates are so low that it is becoming a question whether they are earning sufficient money to pay general and operating expenses, depreciation, and a reasonable profit on the investment. A comparison of the capitalization of the twelve largest independent companies in the State with that of the Central Union Telephone Company shows the average capitalization per telephone of the independents to be $172 to $91 per station of the Central Union. It is claimed that this shows a large overcapitalization of the independents. Another significant feature is the low estimate of the cost of the plants of the independents, figuring depreciation at 7 per cent, allowing 6 per cent interest on the real cost of the plant and using the companies' sworn figures as to gross earnings and operating expenses, eleven out of the twelve companies showing a deficiency in earnings. The Bell people say these facts become all the more interesting when compared with the report of the secretary of internal affairs for the State of Pennsylvania, which places the average Bell capitalization per telephone in the state at $93, and that of the independents at the enormous figure of $347.

Another significant condition existing in Indiana is the alleged fact that of the 247 companies listed, 70 are sub-licensees of the Bell company, and are, for all practical and comparative purposes, a part of the Bell system.

A Home for Science in New York.

The scheme of the Scientific Alliance of New York to raise $500,000 for a building for the use of the allied scientific societies of New York will be actively pushed this autumn. Charles F. Cox, treasurer of the Michigan Central Railway Company, the president of the Scientific Alliance, announces that about $100,000 has been subscribed, contingent upon the Alliance raising $250,000. Of that amount J. Pierpont Morgan had subscribed $25,000, and it was hoped that he would considerably increase the sum. Another subscriber was Mr. D. Adams, and Mrs. Esther Hermann had paid in $10,000.

Mr. Cox said the city would be asked for a site, as it was proposed to found an institution for New York which should combine the objects of Burlington House and the Royal Institution of Great Britain, with the addition of a department for the issue of a series of works similar to those published by the Royal Society and other learned bodies abroad.

It had been suggested that a wing be added to the American Museum of Natural History or the New York Public Library as a home for the Alliance. The latter proposition, Mr. Cox said, had been advocated not only by the late Andrew H. Green, but by Morris K. Jesup and Andrew Carnegie. Mr. Cox said there were about 1,200 members of the Scientific Alliance waiting to be housed, and half a dozen other scientific societies that would be glad to have a central home. At present these bodies enjoy the hospitality of Columbia University.

George Washington University.

The George Washington University, Washington, D. C., has enlarged its educational work very materially in the establishment of another division in its department of arts and sciences, to be known as the College of Engineering. To this college has been assigned the supervision of the courses of study and technical training required for the degrees in civil, electrical and mechanical engineering; and for the accommodation of its work the old Van Ness mansion, around which the main group of new buildings for the university will be erected, is being fitted up.

The adaptation of the Van Ness mansion for purely technological educational work is a very important and significant step in the rapid and broad development of the university that has characterized the administration of President Needham. Those who for years have been identified with the formulation and development of the engineering courses now offered express great satisfaction at this early provision for the greater future of the university in its engineering departments.

The structural arrangement of the building lends itself admirably to the new service. The architectural features of the building will not be altered; the improvements will be in the nature of restoration. The foundations and walls are intact and well fitted to withstand the vibrations of the machinery that will be installed. Its interior arrangement will provide amply for the several branches of the engineering courses. The basement will be used for heavy machinery, such as engines, dynamos, lathes, construction appliances, etc.

On the first floor the lighter machinery, testing apparatus, mechanical and electrical measuring instruments, laboratories, etc., will be placed. The draughting rooms and class rooms will be located on the second floor. The engineering work of the university will be centered in this building, but the general university subjects will, as heretofore, be taught in the class rooms of the administration building, the class rooms in the Van Ness building to be used for strictly engineering courses.

CURRENT NEWS AND NOTES.

WIRELESS IN FLORIDA.—Messages are now being exchanged between Pensacola and Key West, a distance of 460 nautical miles. The only obstacle to prevent continuous communication is the strong and constant "static," a condition peculiar to these latitudes. During the summer months long distance communication can be carried on only between 6 and 9:30 a. m., it is said. It was found that a 2¼-in. spark was necessary to transmit signals over this distance, with 25,000 volts on the secondary of the transformer. The length of wave used is assumed to be about 700 meters.

INSTRUCTIONS BY WIRELESS TO SHIPS AT SEA.—The United States cruiser *Columbia* has gone to sea to find and destroy the abandoned lumber-laden schooner *Edward L. Warren,* which has been bothering navigators from Southern ports since last May. Commander Boyer, of the *Columbia,* which is fitted with wireless, made arrangements with the Navy Yard at Brooklyn to have the latest report about the location of the derelict sent to him while he was searching for her. The steamship *India* passed the *Warren* about 110 miles east by south of Sandy Hook on September 21. This information was telegraphed to the branch Hydrographic Office at New York. Capt. A. J. Keegan, in charge of the office, notified the Navy Yard and a wireless message was sent to the *Columbia,* then about fifty miles off the Hook. She acknowledged the receipt of the message, and doubtless will find and blow up the hulk. This is the first time that wireless has been used to locate a derelict, and this use of it illustrates the many possible special adaptations of the system.

WIRELESS MIX-UP IN CHICAGO.—A Chicago dispatch, dated September 22, says: "Two of Chief Collins's detectives went to Buffington, Ind., last night where they were arrested by a score of constables and held in a cell until to-day. The detectives belong to the gambling squad and were experimenting with a wireless instrument in an attempt to intercept messages for the floating poolroom. Chief Collins will protest to Governor Hanly against the conduct of the constables."

LOCKOUT IN GERMANY.—A cable dispatch from Berlin of September 21 says: "It is learned to-night that the Allgemeine and Siemens-Halske electrical companies have decided to lock out about 10,000 of their employees to-morrow. This lockout will affect the cable works of the Allgemeine Company on the Upper Spree and the dynamo works of the Siemens-Halske Company at Charlottenburg. Trouble between the great electrical companies of Berlin and their employees has been brewing for some time. The workmen in several departments of the two chief companies have already gone on strike. The men say that living has grown so expensive owing to the high price of wheat and other articles that their wages are insufficient. The electrical companies of Berlin employ at least 60,000 men."

INDEPENDENT TELEPHONE MAPS.—The National Interstate Telephone Association has begun the preparation of maps, showing the independent telephone development throughout the country. These maps are being made up by states, and only data which is absolutely reliable is being used in their preparation. When completed they will be an accurate record of the existing independent lines through the country, and will be constantly kept up to date, new lines being added as rapidly as completed and reported. Every indedependent telephone company in the country has been requested to send to Cleveland a map of all toll lines which they operate, dividing their lines into two classes: A, copper lines of No. 10 gauge or heavier; B, copper lines of No. 12 or No. 14 gauge, and all iron lines. Long distance companies especially are urged to furnish maps and data regarding their through lines and connections.

PATENT LAWS.—The following comment is from the *Electrical Times* of England as to some recent correspondence in our columns: "There is always a great deal of discontent with the patent laws and their administration. There is good reason for it; patent laws are never satisfactory, at least to inventors. Mr. Ludwig Guttman has written giving his views to the *Electrical World and Engineer* of New York. One of his main contentions is that a patent case should be tried before experts, not before an untechnical judge. It sounds very well to say that an impartial and qualified expert would be the best judge. But how are we to get him? If you ask anyone with those notions whom he would recommend, you find he really means himself, and has no one else to put forward. If you take a concrete example the difficulty is more easily realized. Suppose there had been an action on the multiphase patents, who would have been a good expert? You want a man who would understand the subject thoroughly, of course, and who has no personal, professional, or trade connection with either side, or preferably with even the experts on each side. But this is not all, by any means. He must understand the rules of evidence, he must be able to deal with two teams of barristers, and he must be well versed in patent law; itself a pretty big subject. In Germany the patent office often gets what it thinks is assistance from various university professors. This is a great hardship to inventors. They find they have to deal with men who start with the idea that practical men know nothing, and never know or invent anything, and they are unable to see the difference between a chance reference to a fact in a theoretical book and a worked out invention. In addition to this they think they know all about the subject *ex officio*, and absolutely refuse to be taught anything. Anyone who has had experience with the German office has found all this out to his cost. In this country either side can ask for an expert to sit as assessor with the judge; but I believe no side has ever done so yet. Twice or thrice a judge has asked for an assessor. One reason for this is that the best experts are already retained by the litigants, but the real cause is distrust of the mind that is untrained judicially, and is ignorant of law."

A SMOKELESS PITTSBURG.—It is stated that Messrs. A. J. Warner, H. C. Frick and George Westinghouse, Jr., are interested in a plan to make Pittsburg smokeless. It is proposed to erect a large power plant about twenty-five miles out which will furnish light and power to Pittsburg and surrounding towns.

THE PHOSPHORESCING DIAMOND.—According to Sir William Crookes, the most remarkable diamond in the world is owned by Mrs. George F. Kunz, of New York. The gem in question is a "phosphorescing diamond," and, according to Sir William, it will phosphoresce in the dark after being exposed to a small pocket electric light, and if rubbed on a piece of cloth leaves a long streak of phosphorescence. This diamond was exhibited by Dr. Kunz, the gem expert, at the New York Electrical Exhibition of 1896, with the aid of an arc light, which stimulated the phosphorescent effect very markedly.

UNIVERSITY RAILROAD COURSE.—The University of Chicago has established a four-year course in railway education. An advisory board, composed mostly of railroad men, has been established, with F. W. McKenna, assistant to President Earling, of the Milwaukee & St. Paul, as chairman, and Daniel Willard, second vice-president of the Burlington, as vice-chairman. These men will shape the courses and will themselves deliver lectures. The first year's course will be devoted to railway conditions in the United States, the second to freight service, railway transportation, railway law and rate regulation; the third to passenger service, statistics and geography of railways, signaling and train service, railway auditing and finance and terminals; the fourth to motive power, car equipment, track, railway development abroad and the economics of railway locomotion. This is something like the transportation course started by Dr. Sheldon at the Brooklyn Polytechnic Institute

RECENT NIAGARA FIRE.—Mr. John L. Hooper, chief engineer of the Niagara Falls (N. Y.) Hydraulic Power & Manufacturing Company, writes us as follows with regard to the recent fire there: "I would say that the fire was entirely upon the wires owned and operated by one of our customers, namely, the Pittsburg Reduction Company, and that the only effect upon our company was that these wires passed through a gate house over one of our waterways, and although this gate house was to some extent damaged by the burning of the insulation of these wires of our customer, no damage was done in the power station of this company; nor did the fire extend to that building, nor were any conduits or works of the Niagara Falls Hydraulic Power & Manufacturing Company, outside of the gate house mentioned, affected by this fire. The power was temporarily removed from the other lines operated by this company, merely for the safety of the firemen engaged in extinguishing the burning insulation, and all power delivered to the other customers of this company was at once established upon the firemen leaving the building."

CENTRAL STATION ADVERTISING.—President Blood, of the National Electric Light Association, has appointed Mr. Paul Spencer, of Philadelphia; Mr. John F. Gilchrist, of Chicago, and Mr. Joseph E. Montague, of Niagara Falls, as a committee to cooperate with the advertising committee of the American Association of Incandescent Lamp Manufacturers in the matter of assisting central stations in the adoption of advertising methods that will result in increased business. The lamp manufacturers' association made an offer to the national association at its Denver meeting of $10,000 to be expended for the above purpose, and the offer being accepted this committee has been appointed to complete plans for the work. One of the most important discussions at the Denver meeting was that upon advertising and general methods of getting new business, and it was pretty well shown that this part of the central station management was about the most important of all, yet in the majority of cases the most neglected, or the most imperfectly carried out. The papers and discussions on the subject created great interest and enthusiasm among the representatives of the smaller stations, and many of the suggestions made in the papers and discussions were at once acted upon when they returned to their homes, and in several cases most gratifying results have been reported. The work of the present committee will undoubtedly be one of the most helpful things ever done for the members of the association.

ELECTRICITY IN WASHINGTON.—Mr. Walter C. Allen, the electrical engineer for the District of Columbia, has asked for $464,000 for 1906-7 as compared with $379,000 in the current fiscal year. The electric lighting needs to be increased, $2,000 is needed for trimming trees around public street lamps and $12,000 is required to put in a central energy telephone switchboard replacing the magneto board.

WIRELESS AND RAILWAY ACCIDENTS.—It is stated that disastrous railway accidents in Germany will probably lead to the general introduction and use of wireless telegraphy on all the State railways. Two years ago experiments were begun on the military railway from Berlin to Zossen. The telegraph stations on the route were each fitted up with a transmitter and receiver, while the trains were equipped with the same apparatus. The ordinary telegraph wires along the track were also used to facilitate the work. The experiments proved conclusively that the different stations could at any time communicate with a train running at full speed and warn it of impending danger. The use of wireless telegraphy in this connection would especially safeguard trains on one-track railways. It is not believed that the expense of supplying stations and passenger trains with the necessary apparatus will be much beyond the budget allowed each year for the purpose of repairing old signals and introducing new appliances and inventions which have for their aim the protection of life and limb in railway travel.

ELECTRICAL EXHIBITION IN CHICAGO.—A company has recently been organized in Chicago to hold an electrical exposition in which will be shown electrical machinery, appliances and apparatus in all branches of the industry. This show will be held in the Chicago Coliseum January 15 to 27, 1906. The exposition will be for the information and instruction of the general public in the various uses to which electricity is applied in which the public is vitally interested, and will also interest and benefit the electrical trade, the engineer, manufacturer, dealer and scientist. The name of the company is the Electrical Trades Exposition Company and includes as stockholders 75 of the leading electrical men of Chicago. It is officered and managed by men well known in the electrical industries of Chicago, the officers being as follows: Mr. Samuel Insull, president; Messrs. E. B. Ellicott, Charles E. Gregory and E. B. Overshiner, vice-presidents; Mr. John J. Abbott, treasurer; Mr. Stewart Spalding, secretary; Mr. Thomas R. Mercein, general manager. The following is a list of the directors: Samuel Insull, Edward B. Ellicott, T. P. Gaylord, James Wolff, H. B. McMeal, C. E. Mitchell, Homer E. Niesz, E. B. Overshiner, G. H. Atkin, Stewart Spalding, Charles E. Gregory, G. Edward Kohler, George B. Foster.

A NEW HUDSON TUNNEL.—Incorporation papers have been filed at Albany and Trenton for another tunnel under the North River, connecting Jersey City and New York. The title of the new corporation is the Interstate Tunnel Railway Company, and its financiers and incorporators are the New York City Railway Company (the old Metropolitan) and the Public Service Corporation of New Jersey. Although the company has been incorporated, it has not yet obtained any franchise or any authority from the State Railroad Commission or the local authorities. The incorporating companies intend to use the tunnel exclusively and as a feeder to their branches and have been organized for the purpose of constructing a tunnel from the terminus in Jersey City, at Erie and Twelfth Streets, to a terminus under Chambers Street, between Broadway and the Brooklyn Bridge terminal, in the Borough of Manhattan. It is intended to provide thereby better means of communication between the business portions of the City of New York and the territory served by the Public Service Corporation, which operates all the surface lines in the counties of Hudson, Essex, Passaic, Union and Middlesex, in New Jersey, comprising about 550 miles of line. The Public Service Corporation proposes to supplement its existing facilities in New Jersey by a new direct high-speed line from Newark, with communication, without changes, to the proposed tunnel in Jersey City, thus affording direct transportation from its terminus in Newark to the City Hall in New York in fifteen minutes. Arrangements have also been made for a joint passenger station at Jersey City, which will enable the Erie Railroad Company to transfer its suburban passengers to the proposed tunnel line. The New Jersey company has an authorized capital of $7,500,000.

GAS IN LONDON.—Figures show that the gas business in London is falling off. No more gas is sold now by the Gas Light & Coke Company than it sold seven years ago, and the quantity was less in the last six months than it was in 1900.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.—Mr. William S. Boyd, secretary of the Western Association of Electrical Inspectors, announces a meeting of this association to be held at 10 a.m., October 5 and 6, 1905, at rooms 1232 4-6, National Life Building, Chicago.

WESTERN SOCIETY OF ENGINEERS.—The first meeting of the season of the Electrical Section of the Western Society of Engineers will be held at the society rooms in the Monadnock Block, Chicago, Friday evening, October 13. Mr. James R. Cravath will give a paper, illustrated with numerous lantern slides, on the subject: "Do We Need Better Illuminating Engineering?"

ELECTRICAL COMMISSION.—At the first public hearing of the recently created New York State Commission of Gas and Electricity, applications from the Palmyra Gas & Electric Company and from the St. Lawrence River Power Company, of Massena, for permission to increase their bonded indebtedness were considered. The Clyde Gas & Electric Company asked for the approval of its certificate of incorporation, with a capital of $25,000. The Wayne Electric Company, said to be a rival of the Clyde Company, telegraphed that it wished to be heard on the subject.

LONG WESTERN TROLLEYS.—Another long stretch of trolley spans the Middle West. With the completion of the Western Ohio Traction Line, from Findlay to Lima, there is an unbroken trolley line from Cincinnati to Cleveland. The route is from Cincinnati to Dayton via the Cincinnati, Dayton & Toledo, from Dayton to Findlay to Pemberville via the Toledo, Fostoria & Findlay, and from Pemberville to Cleveland via the Lake Shore Electric. The distance, 294 miles, can be made with only four changes of cars. Of course the time is much longer than that of the steam roads, but the fare is much less.

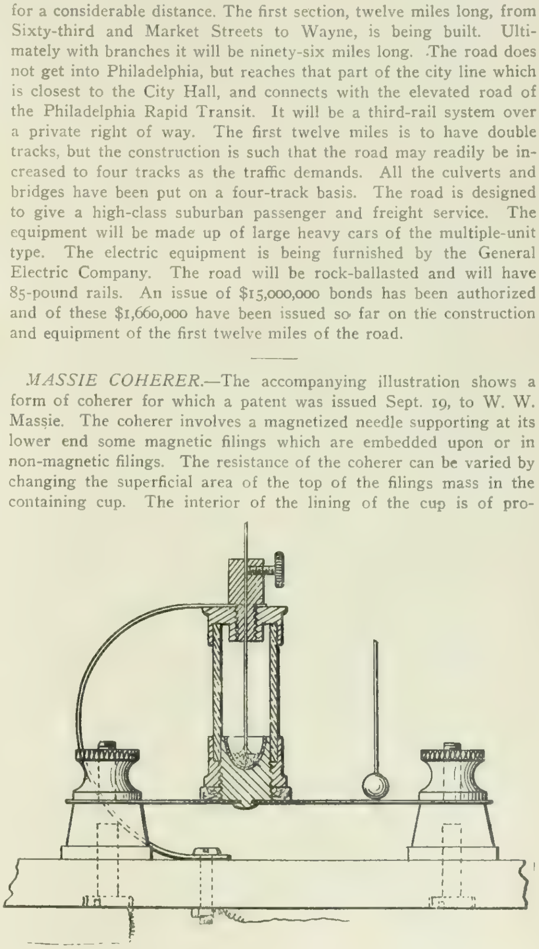
ELECTRICALLY WELDING RAIL JOINTS.—In a patent granted Sept. 19 to Carl Pahde, of Berlin, Germany, there is outlined a method for welding rail-joints which involves the use of the electric arc. The rails are connected with one pole of a source of direct-current, the other pole of which is connected with an arc-lamp carbon. The rail-foot is then lightly touched with the carbon, and there is produced an arc which completely melts the feet of both rail ends. By adding pieces of iron of suitable composition, the melted metal is increased until it fills a form which surrounds the rail ends. This form may consist of fire brick, but the inventor prefers to make it of iron, and to melt it also by means of the arc at its inner surface. It is then rigidly connected with the rail-foot after the welding, and increases the strength of the weld.

ELECTRIC AUTOMOBILES.—A short description was printed last week of a combined engine and motor automobile which had just been patented by H. Lemp. On Sept. 19, another patent was issued to the same inventor for a somewhat similar machine. According to the later scheme, the two driving motors remain at all times electrically connected to a self-excited direct-current generator, the armature of which is mounted upon the shaft of a gas engine. The variation in speed of the motors is obtained by changing the speed of the engine through a limited range above and below the critical exciting speed of the generator. At the lower range of speed, the generator fails to excite itself, and the motors come to rest. On this same date a patent was issued to J. LeC. Davis for a self-propelled vehicle which is a modification of a former invention of Lemp. On a shaft, which serves to drive the automobile, is mounted a motor and one of the outside members of a differential gear, to the other outside member of which is connected a generator, and the central member is connected to a gas engine. The gas engine is run at constant speed, while the speed of the automobile is varied by changing the field strength of the generator, or by varying the electrical connections between the generator and the motor. Both of these patents have been assigned to the General Electric Company.

DEPARTMENT STORE TELEPHONY is a feature now being developed by the New York Telephone Company. The large departmental stores have been installing telephones in large numbers. The idea is to put a telephone on practically every counter. Communication within the store is free and messages are sold at each station. There is, therefore, a pay station at every counter. In New York Siegel, Cooper & Co. have taken 1,000 telephones and Lord & Taylor 500. For the use of Siegel & Cooper 50 trunk lines will be necessary; for Lord & Taylor 40 trunk lines will be employed. In Philadelphia the Bell Company has also entered into a contract with some of the large stores for a service of this character. Gimble Bros. are taking 1,000 telephones, Strawbridge & Clothier have 500. Marshall Field, of Chicago, is said to have been the pioneer in this sort of thing, but the Marshall Field store has only about 300 telephones. In this instance the East has taken up a new idea more eagerly than the West, in which it originated. It is obviously very convenient for people while buying to consult or get in touch with the interested folks at home.

A LONG PENNSYLVANIA TROLLEY.—The Philadelphia & Western is now under construction paralleling the Pennsylvania R. R. for a considerable distance. The first section, twelve miles long, from Sixty-third and Market Streets to Wayne, is being built. Ultimately with branches it will be ninety-six miles long. The road does not get into Philadelphia, but reaches that part of the city line which is closest to the City Hall, and connects with the elevated road of the Philadelphia Rapid Transit. It will be a third-rail system over a private right of way. The first twelve miles is to have double tracks, but the construction is such that the road may readily be increased to four tracks as the traffic demands. All the culverts and bridges have been put on a four-track basis. The road is designed to give a high-class suburban passenger and freight service. The equipment will be made up of large heavy cars of the multiple-unit type. The electric equipment is being furnished by the General Electric Company. The road will be rock-ballasted and will have 85-pound rails. An issue of $15,000,000 bonds has been authorized and of these $1,660,000 have been issued so far on the construction and equipment of the first twelve miles of the road.

MASSIE COHERER.—The accompanying illustration shows a form of coherer for which a patent was issued Sept. 19, to W. W. Massie. The coherer involves a magnetized needle supporting at its lower end some magnetic filings which are embedded upon or in non-magnetic filings. The resistance of the coherer can be varied by changing the superficial area of the top of the filings mass in the containing cup. The interior of the lining of the cup is of progressively-increasing cross-sectional area from its bottom to its top, so that the superficial area will be in accord with the amount of filings in the cup. The needle is contained within a glass tube, the opposite ends of which fit in metallic collars serving as terminals. The coherer is so designed that its parts can be readily assembled to present an operative organization and as easily separated when occasion requires.



IOWA INDEPENDENT TELEPHONE ASSOCIATION.—The Northeastern Iowa Independent Telephone Association held a convention at Waterloo, Iowa, September 15, which was attended by representatives of more than half of the number of independent companies in the district. Among the matters considered at the meeting was the question of organizing the entire State into districts for the advancement of independent interests. Mr. C. C. Deering, secretary of the Iowa Telephone Association, was present and explained the organization of the State telephone clearing house. Mr. Stanley S. Lichty, Waterloo, Iowa, is secretary of the association first named.

TECHNICAL EDUCATION.—Mr. William Barclay Parsons, in a recent address on "The Practical Utility of Technical Training," gave some interesting educational statistics relating to the engineering force engaged in building the New York rapid transit Subway. The staff of engineers numbered about 200 on the average, exclusive of inspectors, and was divided into three classes: The executive, or those engineers holding positions of responsibility, and who were called on for original thought in designing as well as for ability in execution; the assistant engineers, holding positions of less trust, men of less experience carrying out the orders of their superior officers, though still with responsibility; and third, the rodmen, those just beginning engineering work, called on for no originality, but acting entirely under instructions. All of these positions, except those in the first class, were filled after competitive civil service examination. Of the first two classes 86 per cent were college graduates from leading institutions, while of the third, where such education was not in any way a necessary requirement, not less than 58 per cent had passed through some college of recognized standing.

MORAL QUALIFICATIONS OF ENGINEERS.—In an editorial in the September issue of the *Club Journal,* Mr. Charles F. Scott quotes an engineer of wide experience in this country and abroad, now holding an executive position with a progressive company, as saying that in selecting young engineers for specific work he found a greater number were lacking in moral qualifications than in technical ability. He did not restrict the term "moral" to mean simple, common honesty, but used it in a broader sense to include courage, judgment, backbone, moral strength and all those things which make up the complex called character. Commenting on this remark, Mr. Scott says that it is easier to train engineers than it is to develop men. "College courses are apt to give 99 per cent to technical subjects and one per cent to culture studies. Were the divisions 85 per cent and 15 per cent, one would be decreased by only a seventh, while the other would be increased fifteen-fold. When older men talk about the value to an engineering student of a debating society, of familiarity with parliamentary practice, of fluency in composition, of culture studies, of the training in effective co-operation which may be secured through student organizations, of education as a means of forming right habits and developing the faculties as well as acquiring technical knowledge, the student in engineering does not seem to understand what they mean. The development of this broader side of life must be after all a matter of individual choice and effort. Others may counsel and may inspire. The result depends upon the man himself, upon what he chooses to bring within the range of his experience and upon the success with which he assimilates that experience in his growth. No one who has caught the spirit of the modern engineer will think that this applies to school days only. The principle of progress is to keep on. The ideal is not static but kinetic, as well for the individual as in society and science and engineering."

◆

Electrical Engineers of the Times.—XXIX.

MR. A. E. WINCHESTER.

Albert Edward Winchester, of New England and Southern ancestry, was born April 19, 1867, at Marietta, Ohio. His father, Theodore H. Winchester, deceased, was an editor, an artist and an inventor of printing appliances. His mother, Anna Maud Jackson, was an educator and a worker in various lines of literature. His early education was received in Ithaca and New York City. At the age of fourteen he accompanied his mother to Mexico, and there being no suitable schools for an American youth in those days, and having already developed a strong inclination toward constructive mechanics, he became an apprentice in the motive power department of the Mexican Central Railroad, which was then being built to the United States. On completing his term in 1883 he was sent to the United States to qualify for college, and took a preparatory course at the Whitlock Academy at Wilton, Conn. Having become deeply interested in electricity, instead of entering college at the conclusion of his academic career, he became the youngest member of the parent Edison Company's engineering staff, and continued with the various organizations of that company in line of succession from draughtsman to consulting engineer, until the formattion of the General Electric Company, with which he remained until 1893, when he became a member of the Electrical & Mechanical Engineering Company, of New York, and also its superintendent of construction for the three ensuing years.

During 1896-7 Mr. Winchester was on the engineering staff of the New York Edison Illuminating Company. From that time to the present he has held the position of general superintendent of the City of South Norwalk Electric Works, having designed and supervised the construction of this plant back in 1892. From 1892 to 1902 he served as one of the electrical commissioners of South Norwalk, and in the latter year was appointed city electrical engineer, retaining also the position and duties of general superintendent of the municipal plant.

A. E. WINCHESTER.

In the line of invention Mr. Winchester never took out any patents, holding that those who employed him were entitled to his efforts. He is the originator of one of the first practical quick-break switches for heavy currents, the principles of which are in general use to-day. The sectional iron bracket pole for supporting trolley lines was developed by him. He invented an early car motor controller and aided in the evolution of the one that later became standard. He contributed many improvements and modifications to trolley line construction and appliances, to which work he was assigned for a considerable period of time. He was also frequently detailed on special lines of work under the direction of Mr. Edison.

Mr. Winchester's specialty, however, was largely in the line of power station engineering, and he participated in the designing of over one hundred electric lighting and street railway power plants, of which some were erected under his personal supervision. Among the important lighting plants in the designing of which Mr. Winchester took an active part, were the early Edison stations at New York, Boston, Philadelphia, Chicago, Cincinnati, San Francisco, New Orleans, Kansas City, Milwaukee, Detroit, Providence, Paterson and many others. He was one of the engineers connected with the construction of the Richmond Electric Street Railway (the pioneer road of the old Sprague Electric Railway & Motor Company), the Sprague road at Scranton and various others.

Mr. Winchester is a member of the American Institute of Electrical Engineers, and an honorary member of the National Association of Stationary Engineers.

Electric Light, Water Works and Central Hot-Water Heating Installation at Ada, O.

By A. E. Buchenberg.

As plant operating expenses increase and the demand for more perfect and uninterrupted service becomes insistent, it is imperative that the generating and distributing apparatus and appliances of a modern installation be of the best mechanical construction and of the highest possible efficiency under the particular service required. Also that the design of the plant be such as to afford the maximum utilization of the calorific value of fuel with a minimum of condensation, friction and leakage losses. The latter consideration indicates that the different departments of public-service installations, such as light, heat, power and water, should, for economical reasons, be consolidated into one system and under one roof, in this way keeping the unavoidable losses at the lowest point, and affording the minimum cost of operation, maintenance and attendance.

The success of the plant of the Ada Water, Heat & Light Company, of Ada, Ohio, from a financial and engineering standpoint, has led the writer to believe that a general description of this installation would be of interest. The plant was placed in operation in 1902, and has now been in constant service for a sufficient length of time to afford a definite criterion from a financial view of the advisability of a combination of this character in plants of moderate capacity.

The building, shown in Fig. 1, is a brick and stone structure, 113 ft. in length and 74 ft. in width, covered with a slate roof and provided with large ventilators over the boiler room. The engine and boiler rooms are separated from each other by a fireproof brick wall, the only communication between them being a small sheet iron covered door. A portion of the boiler room is partitioned off by dust-proof walls for coal bunkers which face the boilers, making it unnecessary to handle the coal but once after it is unloaded from the side track into the building. One half the engine room is excavated to a depth of 8 ft., and in this concrete lined pit are set all hot and cold water pumps, condensers, feed-water heater, etc.

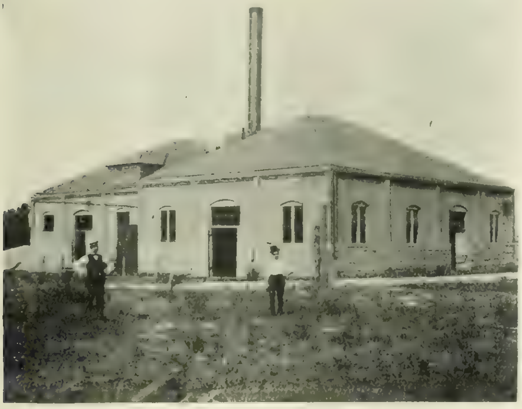


FIG. 1.—VIEW OF EXTERIOR OF STATION.

The boiler equipment (Fig. 5) consists of three 18x6-ft. butt-and-strap triple riveted Brownell tubular boilers with 36x38-in. domes, set in one battery, and equipped with herring-bone grates. Provision is made for a fourth boiler when necessary.

The steel smoke chimney, which is located just outside the building, is 52 in. in diameter and 80 ft. in height, and is mounted on a brick stub 20 ft. high. A large sheet steel smoke connection extends directly from the chimney across and above the front of the boilers. Two of the boilers are arranged with a 5-in. blow-off, and are so connected as to allow their use either for generating steam or as auxiliary circulating boilers for the hot water heating system.

Feed water is supplied by a 6x4x6-in. Smith-Vaile duplex hot-water pump, taking water by gravity from a Hoppes open horizontal heater; and by a secondary arrangement of three Penberthy injectors so connected as to allow any one or all to feed any one boiler or all boilers together. The injector suction line is arranged to take water from a cold water main or directly from a well.

Especial precautions were taken in setting the boilers to obtain the best possible heat insulation, the walls being extra thick and built with a 2-in. air space, and the boilers completely covered with a three brick arch. Where necessary to allow for expansion, shredded asbestos was loosely inserted. All boilers feed into a double 10-in. steam header, and are each equipped with two independent cutout valves in the risers as a safety precaution during cleaning or repairs.

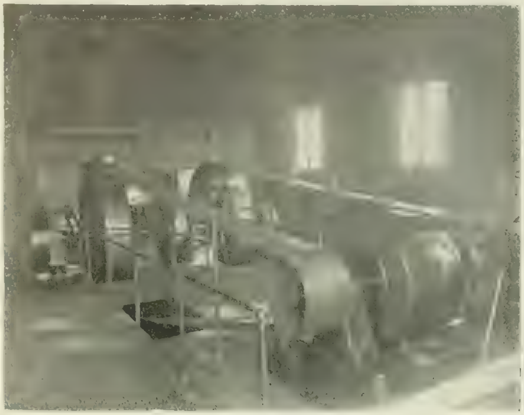


FIG. 2.—VIEW OF DYNAMO ROOM.

The engine equipment consists of two 10x30-in. Lane-Bodley Corliss engines equipped with independent Cochrane vertical steam separators, and set "right and left" with extended shafts in line. Upon the abutting ends of the two shafts is mounted a 36-in. Hill friction clutch for coupling the two engines together. The exhaust steam can be used in the condensers of the heating system, in the feed-water heater, or by a valve adjustment can be proportioned between them. Exhaust to atmosphere is provided through a 12-in. back-pressure valve set at two pounds.

Each engine is belted to a 75-kw, 2,300-volt, 60-cycle, single-phase Warren alternator running at 600 r.p.m. This arrangement of engines and generators while facilitating parallel operation, allows the use of one engine and generator of half the total capacity on light loads, and affords the greatest possible assurance of at least partial operation in case of accident to the engines or generators, by means of cross connecting the engines.

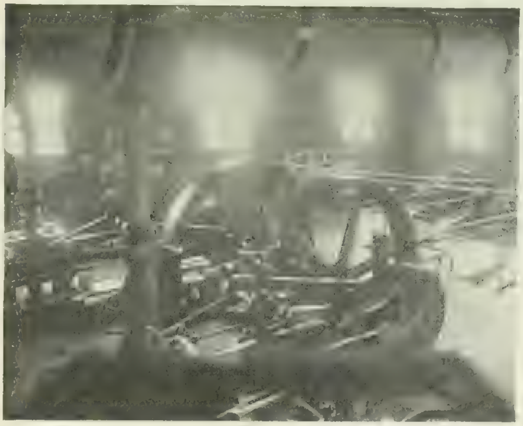


FIG. 3.—ENGINE ROOM, SWITCHBOARD IN BACKGROUND.

The Vermont marble switchboard is built up in three panels with instruments and appliances as follows: On No. 1 panel are mounted a voltmeter, ammeter, and ground detector, exciter and generator field switches, throw-over switch and exciter shunt and series rheostats. Except in the substitution of an integrating wattmeter for the ground detector, machine panel No. 2 is a duplicate of No. 1. On the third or distributing panel are mounted two ammeters, two incandescent circuit switches and the necessary plug switches for two Helios-Upton series arc circuits.

The arrangement of the switchboard wiring is such as to allow perfect flexibility in operating the several circuits from the two machines. Line switches are installed and connected in such a manner as to allow their use on either machine singly, or on the two together when in parallel.

Each exciter is of sufficient capacity to excite both alternators, and connected so as to allow the use of one exciter on either machine, or on both together. The arrangement of engines and generators is clearly shown in Figs. 2 and 3.

The Yaryan central heating system is used. The distribution mains are about three miles in length and vary in size from 2-in. to 10-in. The mains are enclosed in a cypress box, built up with triple air spaces, all openings around and between the pipes being packed with "process" shavings. The insulating boxes are thoroughly underdrained with 3-in. tile, and covered with tarred roofing paper. Expansion and contraction—a most important consideration in central heating underground construction—is taken care of by means of slip expansion joints and U-bends, and anchors located about 300 ft. apart. Slip expansion joints, while expensive in themselves, require a manhole in addition, and have proven unsatisfactory on account of leakage and the tendency to corrode and seize during the summer season. To overcome the above objections a number of sets of U-bends were substituted and are giving the best of satisfaction with a much lower initial cost of installation. Cut-off valves of the gate pattern are installed at frequent intervals in manholes. Under normal operating conditions the temperature loss has been found to be approximately one degree per 1,000 ft. of main.

The station circulating system consists of two duplex Laidlaw-Dunn-Gordon hot-water pumps 10x12x13-in., one of which is built for high-pressure duty, and is so connected as to allow its use as an auxiliary fire pump on the cold-water system in case of accident to the regular pumps. The hot-water pump connections are made to allow either one or both pumps to be used as the service requires. The suction is connected direct to one of the hot-water mains and the discharge pipes are connected to the other main through three Stahl closed condensers, each of 20,000 sq. ft. radiation capacity. Provision is made for the installation of a fourth condenser, and also for a connection through two circulating boilers, allowing one or both to be used as auxiliaries to the condensers when the exhaust steam from the engines and pumps is not sufficient to carry the heating load. A 2-in. steam line, carried from the boilers to each condenser, allows the use of live steam for this purpose when necessary. All exhaust steam is piped to the condensers through a 12-in. catch-all to remove all oil and grease. The condensation is returned by traps to the feed-water heater, and from there to the boilers. A 100-barrel cypress expansion tank is located just outside the building and connected directly to the suction of the hot water pumps.

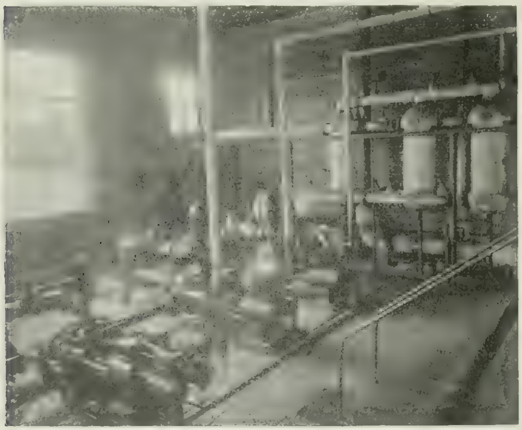


FIG. 4.—PUMP ROOM.

Powers heat regulators are used by consumers to obtain a constant house temperature. To supply the necessary air-pressure for operating this apparatus, a small galvanized-iron air line is laid with the hot-water mains, and a constant pressure of fifteen pounds per square inch is held by locomotive-type Westinghouse air compressor equipped with an automatic governor.

Pipe covering is used on all live and exhaust steam piping, and all hot water piping and condensers. The entire plant has given satisfactory and uninterrupted service, and notwithstanding necessary extensions to the hot and cold water mains, is affording a very nice yearly dividend to the stockholders.

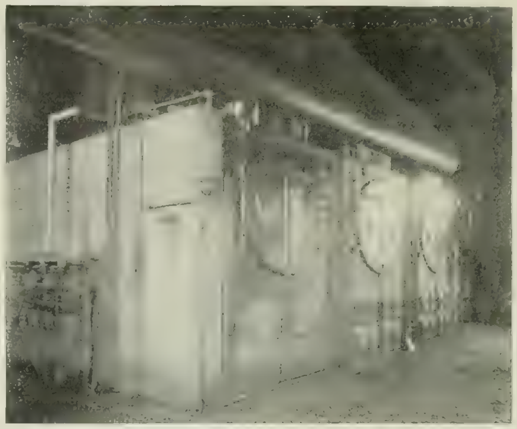


FIG. 5.—BOILERS.

To make a paying proposition of a plant of this description it is essential that a comparatively large day load be carried on the engines and pumps, as it is out of the question with prevailing rates to operate profitably the heating system with live steam or circulating boilers. The working up of a day motor load has been given close attention by Prof. B. S. Young, the general manager. The heating service has in every way been satisfactory to the consumers, and business is only limited by available exhaust steam.

Worm-Gear Traction Motors.

The Maschiner Fabrik Oerlikon has recently carried on an extensive series of tests employing worm gears with traction motors. Earlier experiments in this direction had proved unsatisfactory, principally because the worm gearing available at that time was not sufficiently well made to give a high efficiency, and also because, with the rigid connection between motor and gear which was employed, the shocks and consequent wear proved excessive. These difficulties have been largely overcome in the recent construction, and an experimental car containing two 20-hp, 1,200-revolution, worm-geared motors has given very satisfactory results. The motors weighed only 675 lbs., in place of 1,460 lbs. each, which would have been the case if ordinary single-reduction spur gear and 500-revolution motors had been used. The gear ratio was 12:1, the worm being of hard steel, with a triple thread having a pitch diameter of 3 in. and a pitch of 45 in., while the worm wheel had a cast-iron hub with phosphor-bronze toothed rim attached, a pitch diameter of 18.3 in. and 36 teeth. The motors were rigidly fixed to the car frame in accessible positions, and were connected to the worms through double flexible couplings, which allowed the necessary freedom of motion for the car springs. The worms and worm wheels are arranged on the outside of the car wheels, and run completely enclosed in oil baths. The end thrust is taken up on ball bearings. The gear was found to have an efficiency exceeding 90 per cent for all loads between one-fifth load and full load. The wear and the cost of up-keep proved to be less than with the ordinary spur gear, and the running was practically noiseless and free from shocks.

The Hoho Process of Heating and Working Metals by Electricity.

By Paul Hoho.

The process described in this article was discovered about 12 years ago. Its most striking and almost paradoxical characteristic is that the metal is heated to temperatures corresponding to red heat, white heat and fusing heat while in contact with water. This is accomplished by the action of the electric current operating under specified conditions.

The author has often been called upon to explain why such a promising discovery has made so little progress in the industries as compared with other electric processes. Is this process condemned to remain without application in the industries? The object of this article is to endeavor to demonstrate that the answer to this question should be in the negative.

The process being well known, it is deemed unnecessary to give more than the following outline of its principal characteristics:

1. The electric energy is applied in the form of direct current at from 100 to 250 volts, these being the usual voltages available on commercial networks.

2. Owing to the relatively high e.m.f. as compared with other systems of electric heating, and the correspondingly weak current, this process permits the almost complete conversion of electric energy into heat right at the surface of the metal to be heated.

3. By proper application of suitable insulation, the heating action of the current can be confined to any desired portion of the surface in contact with the liquid.

4. By varying the e.m.f. it is possible to vary and regulate the quantity of heat liberated per second upon a given area. This permits the regulation of the final temperature and the speed of heating and makes it possible to attain excessively high temperatures in an extremely short time.

5. For any metallurgical operation the combination of the above-named properties makes it possible to heat exactly and exclusively any desired portion of the metal in a minimum space of time and consequently with a maximum efficiency.

6. When the metal is connected to the negative pole the electrolytic action of the current causes the deposition of the positive elements of the electrolyte upon the metal, i. e., initially the hydrogen released by the decomposition of water. In fact, the metal is heated in contact with a layer of hydrogen, which at high temperatures protects the metal from oxydation and moreover acts as a reducing agent if the metal was previously oxydized. The importance of this last property is great, especially where certain steels are to be soldered.

7. The rapidity of heating and the localization of the action obtained in this process and which cannot be obtained by any other known process, offers new and special applications; for instance, the surface tempering of steel. We shall return to this subject later.

The above-named properties were the cause of great hopes for the future of this process. A striking analogy may be cited which will immediately explain the situation. About a century ago gas was commercially employed as an illuminant, but it is not 50 years since it was first used in furnaces and it has not been used for heating dwellings for more than 10 or 20 years. The same will be true of electricity and for the same reasons, the chief among which being the cost of electrical energy.

In metallurgy, as in other industries, the cost of heat plays a most important part. We may, therefore, compare the price of one heat unit furnished by coal and by gas with that of one heat unit obtained from electric energy. A little calculation will serve to make the idea clear. In the process of combustion one kilogramme of coal will release about 8,000 calories, or 8,000 × 425 = 3,400,000 kilogramme-meters. When these calories have been transformed into electrical energy by means of the boiler, the engine and the dynamo, scarcely more than one horse-power-hour, or 736 watt-hours, is obtained, assuming a total efficiency of transformation above the average 736 watt-hours = 736 × 3,600 watt-seconds = 2,640,600 watt-seconds = 2,649,600 ÷ 9.8 = 270,300 kilogramme-meters. That is, the electric energy obtained from coal in the ordinary way represents scarcely more than 8 per cent of the original amount contained in the coal.

To this first cause of high price of electric energy must be added the expense which accompanies the transformations, the interest upon the investment, the maintenance, the depreciation, the personnel, etc. The final result is that electric energy is excessively dear, and even admitting a price of 1 cent per kw-hour, or 367,300 kilogramme-meters, or 866 calories, with coal at $3.20 per ton, the price of a calorie at the dynamo terminals is 29 times as dear as that obtained directly from the coal. Evidently these figures have no absolute value, since they depend upon the price of coal and that of electricity, both of which vary between wide limits. In fact, the price of coal varies from $2.40 in France to $5.00 or $8.00 and even more in other countries. The selling price of electricity varies between very large limits. Central stations furnish electricity for use in furnaces at 2 to 10 cents per kw-hour. No matter what source of energy is used, be it coal, gas, water or any other, the price of 1 cent per kw-hour is exceptional, and the proportion of the price per calorie of energy furnished directly by the coal and that obtained from the electric energy remains overwhelmingly in favor of the coal. A similar conclusion is reached when the price per calorie of energy furnished directly by gas is compared with that obtained from electric energy.

At first sight, from the point of view of cost, the competition of electricity with coal and gas seems impossible. However, the electric current possesses certain special qualities and properties, which, at least in many cases, will counterbalance the excessive cost.

Primarily, the electric energy, in the foregoing process, delivers the heat at the desired point and at a maximum efficiency. This is an immense advantage over its competitors, when there is taken into consideration the great masses of metal which are often uselessly heated. A short calculation will again make the point clear. In any operation where metal is to be heated, let the exact weight of the part to be heated, the temperature desired and the number of calories necessary, be given; i. e., the theoretical amount of heat necessary for the operation. Having these data the actual amount of energy consumed in the particular metallurgical operation can be calculated for the case where the heat is obtained directly from coal or gas. By this comparison the true efficiency is obtained. It is a fact that the thermal efficiency of a heating process by means of coal or gas is hopelessly small, oftentimes being less than a fraction of one per cent. For this there are three causes:

1. In order to heat the small portion of metal desired it is necessary to heat masses of metal of a much greater size.

2. In heating the metal by either coal or gas, all bodies which surround the fire must be heated with the metal. The furnace, the chimney and the products of combustion often absorb the major portion of the liberated heat.

3. In heating a few pieces of metal it is necessary that the furnace be hot for some time before and after the actual process.

On the other hand, this electric method permits the attainment of very fair efficiencies, which are vastly superior to those obtained by other processes. This high efficiency is due to the two following causes:

1. The restriction of the heat to the mass which it is desired to heat.

2. The rapidity of the action, which permits the reduction of the losses by radiation and conductivity to a minimum.

The efficiency depends upon the nature of the operation and the rapidity of the heating, and in certain cases an actual efficiency of 30 per cent has been obtained. This figure is unusual, but it serves to show the degree to which the perfection of this process can be pushed as compared with others.

The ratio between the efficiencies obtained by this process and that obtained by other processes varies greatly and depends primarily upon the nature of the metallurgical operation to be performed. It depends again on the kind of furnace used especially, the gas furnaces employed in large enterprises. But in any case this electric process gives an efficiency which vastly surpasses that of any other process. In certain cases it may be several hundred times greater, notably when it is necessary to heat small pieces of metal in furnaces which are ordinarily not in continuous use. On the other hand, there are many cases where the ratio of the efficiencies is not so great, namely, where metallurgical operations are conducted upon a large scale and large pieces of metal are heated in perfected furnaces which are in continuous use.

From that which has gone before it is readily seen that in metallurgical operations on a large commercial scale, the above-described process, as well as other electrical processes, cannot compete with coal or gas, at least in countries where coal is as cheap as in France. However, it has its use, namely, when the three following conditions obtain:

1. Small metallurgical operations, where it is not practicable to

install perfected furnaces and where power is obtainable at a reasonable price.

2. General metallurgical operations in localities where coal is dear and electrical energy relatively cheap.

3. In small installations where electricity is used for light and power, the attractiveness of substituting a vessel of water for the coal or gas furnace with its many disagreeable features will make its adoption a necessity.

Ignoring the possibility of radical discovery in electrical generation, it is a fact that the price of electric energy is continually decreasing, and each diminution in the price will enlarge the field of its application to the heating and working of metals. It should be borne in mind that when electricity has already been installed for other purposes its use for heating will reduce the price per kw-hour of the supplementary energy used in the heating process.

Such is the situation for the metallurgical operations of to-day as far as cost is concerned. It was mentioned above that certain special qualities of this electric process gave it, under certain circumstances, a special value and even new uses, which were formerly unknown.

In the first place, it will be recalled that the metal is heated in contact with a layer of hydrogen, i. e., in the middle of a reducing agent. This fact greatly favors certain operations, especially soldering, and even steels which are difficultly soldered by other methods can be easily soldered.

In the second place we find special uses which result from the localization and the control of the heat. The most important of these is that of surface tempering, which was mentioned above.

It may be assumed that a piece of steel, heated by the process in question, is in a liquid. The quantity of heat released per square centimeter of surface of the metal in contact with the liquid may be regulated at will; i. e., the rapidity of heating to a given temperature may be regulated. The liberation of heat can be so regulated that the steel will be brought to red heat, i. e., the tempering heat, a certain depth from the surface before sufficient time has elapsed to allow the heat to penetrate further into the interior of the piece, which is still cold for the moment.

If, at this instant, the circuit is opened the piece suddenly comes in contact with cold water, i. e., it is tempered, and it should be noted that only that part which was carried to the required temperature becomes hardened, while that part which was not heated remains tough and malleable.

The thickness of the hardened portion, i. e., that part which is brought to the temperature required for tempering, depends evidently upon the intensity and the duration of the heating, both of which may be perfectly controlled.

Any composition which it is desirable to use in tempering may be dissolved in the water. This surface tempering, which should not be confounded with case hardening was unknown until now and cannot be obtained by any other known process. The importance of this appears to be great, especially in the manufacture of rails, axles, shafting, cannons, etc.

At first thought the execution of this operation appears to offer insurmountable difficulties, due to the size of the pieces to be treated, which if tempered in one single operation would necessitate the employment of an enormous current. However, this difficulty is totally disposed of by employing a very simple remedy, which permits at any given instant the release of heat upon the surface of any predetermined portion of the metal in the water. This is accomplished by suitable insulators, in the form of two shields, which limit the action of the current to a sharply defined area on the piece of metal, and which are made to travel along the rail (for example) from one end to the other and expose each part successively to the heating action of the current for a time sufficiently long to allow the metal to reach the proper temperature and then passing on, leaving that part immersed in cold water. In fact it is possible to temper the head of a rail to any desired depth, without in any way affecting the malleability and toughness of the rest of the surface and the interior of the rail.

The surface thus heated, at any given instant, can be reduced to any convenient size, so that the tempering may be done with any desired current strength. It is evident that the time required for tempering the whole rail is inversely proportional to the power used. This same method applied to axles allows the tempering to be limited to the bearing surfaces. It may also be applied when tempering the interior surface of cannons.

The promotors of this process have an operating exhibit at the exposition in Liege, Belgium, where the successive heating and surface tempering of metals is presented to the public for the first time.

* * *

"Welfare Work" of the New York Edison.

The first meeting of the season of the American Institute of Electrical Engineers was held on September 22 at the new assembly rooms of the New York Edison Company on West 27th Street, where, with other technical societies, it will continue to meet until the completion of the United Engineering Building on West 39th Street, donated by Mr. Andrew Carnegie.

The new Edison building is one of the features of that company's "welfare work" on behalf of its employees. The lower portion is occupied as a transforming station, while the upper has been designed as a library and reading room and assembly hall. The hall, holding between 400 and 500, occupies the top floor. The reading room is on the floor below.

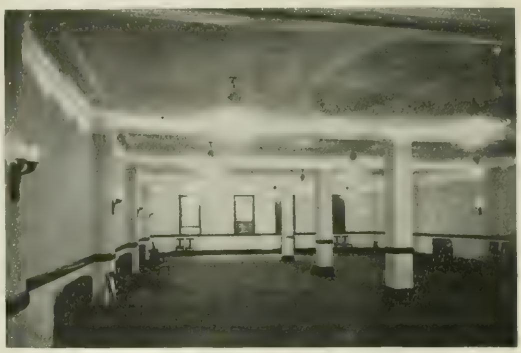


FIG. 1.—READING ROOM.

The library will contain 1,000 volumes on technical subjects, interesting and instructive to the men. The floors are reached by electric elevators, and are equipped with everything that will add to the comfort and welfare of the employees. A striking feature is the method of lighting the rooms. The reading room is illuminated by the indirect arc method in which the light, first projected to the ceiling, is reflected to all parts; the auditorium combines the direct and the indirect, the former by incandescent lamps studding the ceiling and the latter by similar lamps concealed behind the cornice. There is perfect diffusion, without shadows—a near approach to daylight. The auditorium will be open to the various departments of the company for entertainments and lectures. Of the latter a number will be given by experts eminent in the various fields and on subjects in which the men are most interested.

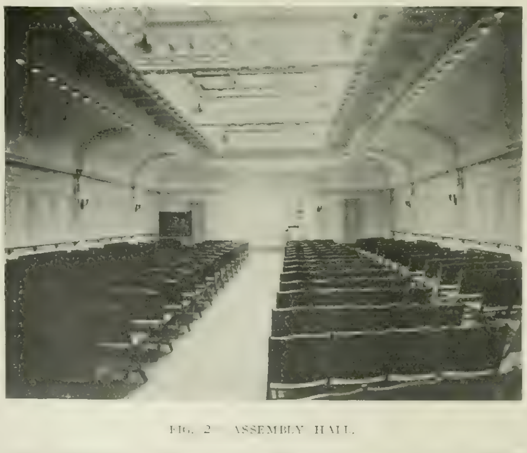


FIG. 2 ASSEMBLY HALL.

Thermodynamics of the Electric Incandescent Lamp.

With the above title, Dr. E. F. Roeber presented a paper at the meeting last week at Bethlehem, Pa., of the American Electrochemical Society, during the reading of which the several new types of incandescent lamps—osmium, tantalum and graphitized filament—were exhibited in operation.

The subject was treated with relation to the thermodynamics of radiation from an incandescent body. A lamp consisting of a conductor of the first class—that is, a filament conducting as a metal—enclosed in an absolute vacuum, was assumed. The following equation connecting the supply of electrical energy to the lamp, with the total radiation was then established, on the assumption of a black radiating body:

$$\frac{e^2\gamma}{2} \cdot \frac{r}{l^2} = K\,(T^4 - T_0^4). \qquad (1)$$

where e = volts at terminals, γ = conductivity, r = radius of filament, l = length of filament, T = absolute temperature of filament, T_0 = surrounding absolute temperature, K = Stefan-Boltzmann radiating constant. This equation enables the temperature of the filament to be calculated if e is known, and if the filament behaves as a black body.

The total radiation consists of electromagnetic waves of an infinite series of different wave lengths, but the physiological effect of light is produced on the normal eye only by those waves the length of which is between 8×10^{-5} and 4×10^{-5} cm., corresponding to a frequency between 39×10^{13} and 76×10^{13} periods per second. The desideratum is such a spectrum of incandescent filament radiation that as much as possible of its area falls within the limits of the wave lengths of visible light. It is shown that a first indication of the degree to which this desideratum is fulfilled is given by Wien's displacement law, according to which the product of the wave length, λm, of maximum energy and the absolute temperature, T, of the radiating source is a constant.

$$\lambda m\, T = \text{constant}. \qquad (2)$$

If the wave length λm is measured in centimeters, the constant is 0.2940 for a black body. If, therefore, the temperature of the incandescent filament increases, the maximum of energy is shifted toward shorter wave lengths. In order to get the maximum energy within the visible spectrum, for instance at the wave length 6×10^{-5} cm. not far from the D line of sodium, the absolute temperature of the black body filament must be 4,900° absolute, or over 4,600° C. This is far beyond anything we can ever hope to reach in incandescent lamps.

The spectral distribution of energy in the radiation of a black body is given by another Wien's law, which, as modified by Planck, is given below, where J is the energy corresponding to the wave length λ in the spectrum, T is the absolute temperature of the radiating black body, ϵ is the base of the natural system of logarithms, and C_1 and C_2 are constants.

$$J = C_1 \lambda^{-5} \frac{1}{\epsilon^x - 1}. \qquad (3)$$

where $$x = \frac{C_2}{\lambda T}.$$

This equation has been found to represent in a most remarkable way the facts throughout the extreme ranges in which it has been tested. These formulas represent the fundamental laws of the radiation of a black body.

It would, of course, be possible to calculate from Planck's law the exact distribution of the energy in the spectrum of a black body at any given temperature, or to calculate from this law the temperature at which the energy within the visible spectrum becomes a maximum. This would give the temperature for which we would get the highest possible efficiency of a black-body filament incandescent lamp. However, no attempt was made to give this calculation, for two reasons: First, from Wien's displacement law it has been found approximately above that this temperature is very high, beyond anything we can hope to reach in practice. Secondly, it will be seen later on that a black-body filament is really not the goal to strive at, in incandescent lighting.

In practice the efficiency of a lamp is not given as the ratio of the energy of radiation within the visible spectrum to the total radiation, but is given by the candle-power which is produced by one watt, or what is the more general, although improper usage, by the reverse ratio, i. e., the number of watts consumed per candle. The rays within the visible spectrum form what we call the flux of light and their energy is sometimes assumed to be measured by spherical candle-power.

The underlying idea is that the spherical candle-power is proportional to the energy of the light emitted. Now, as long as we have to do with light of one single wave length this supposition is correct. But if we compare two composite sources of light, the element of the physiological effect enters into the measurement of the candle-power, since the intensity of the physiological effect depends on the wave length. On the other hand, the energy of light has a distinct value independent of whether it produces any physiological effect or not.

It is, therefore, strictly correct only with monochromatic light to assume the candle-power to be a measure of the energy of visible radiation; and for this reason it is proper only for single wave lengths to try to find a numerical relation between spherical candle-power and the usual units of power—or as we may say, the mechanical equivalent of light.

Since the physiological effect on the normal eye is a function of the wave length, the relation between candle-power and other units of power must also be a function of the wave length. Nevertheless, in practice we compare different sources of light—of different spectral composition—by their candle-power. In such cases we average the physiological effects of the energies of the different wave lengths.

The results obtained by experimental determinations of the mechanical equivalent of light must, therefore, if not limited to a single wave length, be taken *cum grano salis*, although they undoubtedly are interesting as giving a first approximation to the truth.

Experimental researches on this problem seem to have been made first by Julius Thomsen and O. Tumlirz. The result of Tumlirz was 0.188 watt per spherical hefner candle-power. However, his method of measurement was open to objections, since he separated the visible spectrum from the other rays by trying to absorb the latter in a layer of water. This must lead to too high a numerical value of the watts per candle, as was more recently pointed out by Angström, who made another determination of the mechanical equivalent of light. In order to separate the visible spectrum from the balance of the spectrum, he decomposed by refraction the total radiation into the rays of different wave lengths, cut off all rays except those within the visible spectrum and recombined the latter by means of a lens. His result appears to be the best available at present.

Angström found that the equivalent of the light radiation of 1 hefner candle per square cm at a distance of 1 meter (1 candle-meter) is 8.1 ergs per second. This gives as the equivalent of 1 spherical hefner candle 0.102 watt. This is only about one-half the equivalent of Tumlirz.

Now 1 spherical hefner = 0.88 spherical (British) candlepower. We, therefore, get as the result of Angström's determination, for 100 per cent efficiency, 1 spherical candle-power = 0.115 watt; or 1 watt = 8.63 spherical candle-power.

One of the most efficient new types of incandescent lamps, the tantalum lamp, consumes initially 1.99 watts per mean horizontal candle-power, and 2.78 watts per mean spherical candle-power; while the average value throughout life was found as 2.19 and 2.70 watts, respectively, according to recent tests made in a testing laboratory in this country. For the efficiency calculation the watts per spherical cp must be chosen, and if we base this calculation on 2.70 watts and on Angström's equivalent, it follows that the tantalum lamp has an efficiency of 4.3 per cent. An ordinary carbon filament incandescent lamp, if consuming 3.1 watts per mean horizontal cp and 3.9 watts per mean spherical cp, has an efficiency of only 3.0 per cent.

The author referred in this connection to the question of mean horizontal versus mean spherical candle-power. It is still a general rule in this country to rate incandescent lamps (with the exception of the Nernst lamp) by mean horizontal cp, although the impropriety of this method is clearly recognized. The American Institute of Electrical Engineers has already formally declared itself in favor of rating on the basis of mean spherical cp. This is obviously the only proper method of comparing the light given out by different types of lamps with each other.

But even in the test of a single lamp, the curve giving the change of horizontal candle-power during life does not represent a true indication of the performance of the lamp. In testing the horizontal cp one unconsciously makes the supposition that the reduction factor (by which the mean horizontal cp must be multiplied to get the mean spherical cp) remains the same during the whole life. But, as a matter of fact, this is not the case. The distribution of light in a vertical plane changes during life, and with it changes the reduction factor.

This was very clearly shown in the tests of the tantalum lamp above referred to. In this case a black band formed during life on the globe around the sides of the bulb and about an inch wide, which materially decreased the horizontal cp.

As to the problem: What can be done to make incandescent lamps more efficient? One obvious conclusion from the above discussion is, that if we are confined to a black-body filament we must increase the temperature of the glowing filament very materially.

The carbon filament of the old ordinary incandescent lamp has often been assumed to come pretty near a black body. Now, it will at once be seen, that we can easily increase the voltage temperature, *T*, of the filament by increasing the voltage, *e*; equation (1) gives the exact variation of *T* with *e*. If we do this, the maximum of energy in the spectrum will be shifted towards shorter wave lengths according to (2); i. e., the light gets better, whiter, more like sunlight in spectral composition. As a necessary concomitant, the area of the energy curve, which falls within the visible spectrum, increases; in other words, the efficiency increases.

It can be laid down as a general rule that the color effect of the light of an incandescent lamp enables one to judge approximately the efficiency at which it burns. The reason is, that according to the above theory, both the color effect and the efficiency are functions of the temperature. Dr. Louis Bell gives the following color scale of efficiencies of ordinary carbon filament incandescent lamps. Naturally, these are only approximations, since one's judgment is so liable to be warped by the bluish tint of ordinary daylight, owing to reflected sky light that the color values of artificial light are very difficult to judge:

Watts per c. p.	Color.
1.5	clear white
2.0 to 2.5	white, very faintly tinged with yellow
3.0	yellowish white
3.5	yellowish
4.0	yellowish, tinged with orange
4.5	orange yellow
5.0	distinctly orange red

Lummer refers to a test of a lamp of 16 spher. cp which, when burned at 45 volts gave 16 cp, thus consuming 3.5 watts per spherical cp; the voltage was raised, and with it the electrical energy supplied to the lamp to 285 watts; simultaneously, the candle-power increased to 2,000 cp, representing a consumption of 0.13 watt per spher. cp (which is almost the theoretical limit, according to Angström's equivalent). Thus an increase of energy in the ratio from 1 to 5 corresponds to an increase of cp from 1 to 130 and to an increase of efficiency from 1 to 26.

But, of course, the highly efficient state lasts only a moment. This brings us to the point of life. We must make, in practice, a compromise between a reasonably long life and a reasonably high efficiency. There must be an economic relation between life of lamp, cost of lamp and cost of energy.

Moreover, a very important forward step in the manufacture of the carbon filament lamp was the recognition of the importance of differentiating useful life from actual life. This is due to the continual decrease of candle-power of the lamp, setting in shortly after starting, accompanied by an increase in the consumption of watts per cp. It is now considered proper to "oslerize" a lamp when its candle-power has decreased to 80 per cent of its initial value.

The decrease of candle-power at constant voltage which determines the useful life of the carbon filament lamp is known to be mainly due to three causes: First, an increase of resistance, resulting in a diminution of watts; second, a change in the surface activity of the filament, resulting in a diminution of emissivity; third, diminished translucency of the globe, due to the well known black deposit which forms on the globe. A possible explanation of the second effect will be discussed later. Concerning the third effect, it may be said that it is usual to speak of evaporation of carbon. The speaker doubted whether it has ever been proven that such evaporation really takes place. It is quite possible that minute small solid particles of carbon are thrown off from the filament. It is a fact that the carbon is mainly given off near the negative extremity of the filament. Chemical analysis of the black deposit in the case of lamps with flashed filament have shown that the deposit consists partly of carbon and partly of hydrocarbons.

According to Marshall, 16-cp carbon filament lamps can be made according to the following table:

Useful life in hours	28	132	412	1,000	2,005	3,570	6,125
Watts	32	40	48	56	64	72	80
Watts per cp	2	2.5	3.0	3.5	4.0	4.5	5.0

What type to select depends on the relative cost of the lamps and of the electrical energy.

The author then returned to a discussion of possibilities of improving the efficiency. If a black-body filament is to be used, the progress must be looked for in an increase of its temperature. This is the reason of experiments with metals of very high melting points for filaments, such as osmium in Dr. Auer von Welsbach's osmium lamp, since osmium has the highest melting point of any known metal. The same principle was followed in the systematic development of the Siemens & Halske tantalum lamp by Dr. von Bolton, who tried the following metals one after the other: Vanadium, niobium, tantalum. Their melting points are 1,680°, 1,950° and 2,250 to 2,300° C., respectively, and on account of its highest melting point tantalum was finally chosen. The underlying idea is that a filament made from a material of very high melting point will stand without injury a high temperature during a reasonably long life. In this connection it is important to use pure materials, since any small addition of a foreign material lowers the melting point. Thermo-dynamically this is the same effect as the lowering of the freezing point of water, when salt is added. The necessity of using both high temperatures and pure materials indicates the need of employing electrochemical methods.

However, by simply increasing the temperature we cannot get very far towards the realization of the ideal if a black body filament is used. We saw before, that according to Wien's displacement law, we would need to use a temperature of more than 4,600° C., i. e., more than 8,000° F. to get the maximum of energy at 0.6 μ. There is no hope of coming near such a temperature in present practice.

But, fortunately, there is no necessity whatever to use a black body filament. A black body is an ideal case in thermodynamics; it is nowhere strictly realized in practice, but it is now absolutely within the grasp of the mathematical physicist. But the black body is not at all the ideal thing for the lighting engineer. On the contrary, we will see the further we can get away from the black body, the better for us.

The above discussion was based on the consideration of the black body filament because on this matter we can speak with certainty and without vagueness. The discussion of filaments departing from black-body radiation can be carried out only in special cases with similar mathematical exactness. In general, we must be satisfied to indicate the direction in which the results will vary from black body radiation.

At a given temperature the total radiation from a non-black body is less than from a black body. Hence, if we substitute a non-black-body filament for the black-body filament, leaving everything else unchanged, the fundamental equation (1) will no longer be valid. The stationary condition, represented by the equality of radiation energy and electrical energy supply, necessitates now a higher temperature, *T*, than with a black-body filament.

Of greater importance, however, than the total radiation is the distribution of the energy of radiation over the whole spectrum. Non-black body radiation is essentially selective radiation. The real ideal thing about the black body is that, according to definition, its radiation is not selective, since it absorbs all rays of any wave length and, therefore, according to Kirchhoff's law of the parallelism between radiation and absorption, it also radiates all of them.

The ideal filament for the lighting engineer must be one which absorbs only rays within the visible spectrum, while it either perfectly reflects all other rays or is perfectly transparent for the same. Such a body would then emit a radiation completely within the visible spectrum.

It serves no useful purpose to speculate, whether we have any prospects to realize such an ideal filament body. Instead, the author briefly stated what we know concerning polished platinum, which is one of the bodies which of all those tested show the greatest departure from a black body.

In Wien's displacement law (2) $\lambda m T =$ constant, the constant is 0.2940 for the black body and 0.2626 for polished platinum (Lummer and Pringsheim), when the wave length is measured in cm. Hence the absolute temperature, T, at which the maximum of energy lies at a certain wave length, is less by about 10 per cent with polished platinum than with the black body. This means that heated to the same temperature, a polished platinum filament will have a spectrum with its maximum of energy nearer to the visible spectrum than a black-body filament. Nevertheless, polished platinum is still very far from the ideal material which the lighting engineer must aim at.

No rule can be laid down how to select or devise such an ideal material, except to determine empirically the absorption of all possible substances for all different wave lengths. However, the degree of departure of a body from black-body radiation does not depend solely on its material, but also depends to a certain degree on the condition and the configuration of its surface. The more porous the surface the more will it behave like a black body.

The realization of the black body in practice is based upon Kirchhoff's fundamental rule that the radiation inside an inclosure all points of which are kept on uniform temperature is absolute black-body radiation. The black body with which the laws of radiation have been experimentally established is such a hollow enclosure, the walls of which are kept on uniform temperature but contain a small opening through which the radiation is observed. The presence of the opening represents a negligible departure from absolute black-body radiation. Further, in pyrometric practice, "If a porcelain tube with closed bottom be immersed into a lead-hardening bath, the radiation coming from the bottom of this tube will be a close approximation to that of a black body, especially if the inside of the tube is blackened with iron or nickel oxide, for example." (Waidner and Burgess.)

Now it is evident that any pore in the surface of an incandescent filament, whatever it is made of, will cause a behavior more or less like black-body radiation. Hence, we get the important result that the ideal filament must have a polished surface without pores. Blau has called attention to this point in connection with the osmium lamp.

In the case of the osmium lamp it has been noticed that the initial increase of cp after the current is turned on, which is observed with almost every filament, continues for an unusually long period, somewhat like 200 hours. This is said to be due to a continuation of the formation of the filament, the particles being better fused together and the surface getting more polished. It is quite possible that in the case of the new graphitized carbon filament of the General Electric Company something similar goes on, since the treatment is essentially an external surface treatment, although the material of the filament itself is changed.

While speaking of the ordinary carbon filament it was noticed above that two of the reasons of the ageing of the lamp were decrease of surface emissivity and a throwing off of carbon particles from the filament with a resulting blackening of the globe. These two effects have generally been considered to be independent of each other, although in the light of the above discussion it may be that the decrease of emissivity is due to the formation of pores or minute holes in the surface of the filament, as a result of the throwing off of small carbon particles. If this is true, the negative terminal of the filament (from which the carbon particles are mainly thrown off) should lose more in emissivity than the other terminal. To test this suggestion it would be necessary, of course, to separate carefully the effect of change of emissivity from the effect of blackening of the globe. For this reason the globe would have first to be uniformly cleaned, before the emissivity of the two ends of the filament should be compared.

Dr. Roeber then showed, connected in circuit, the several new types of incandescent lamps—the tantalum and osmium lamps and the graphitized carbon filament lamp made by the General Electric Co. and invented in its research laboratory under the direction of Dr. W. R. Whitney.

Concerning the manufacture of the tantalum lamp Dr. von Bolton gives the following information: He first mentions the experiments of Berzelius and Rose. They produced tantalum by heating the potassium and tantalum fluoride (K_2TaF_7) with potassium, and extracting the potassium fluoride with water; this method, however, does not yield pure metallic tantalum, but a product containing only about 5 per cent of the pure metal. Moissan described in 1902 the production of tantalum in the electric furnace by reducing the oxide with carbon; but the product contained about 0.5 per cent carbon and was, therefore, either a carbide (0.5 per cent C. being a pretty large quantity in view of the high atomic weight of tantalum) or it was an alloy of the metal with carbide. Von Bolton describes briefly two methods of producing pure metallic tantalum.

The first method is electrolytic reduction of one of the oxides in the incandescent state in a vacuum. He formed filaments of brown tantalum tetroxide and placed them in vacuum. By passing the electric current through, they were caused to glow slightly, whereby much air was driven out of the porous filaments. Evacuation was then continued and the temperature of the glowing filament was increased until, at beginning white heat, several points of the filament showed strong incandescence. These points gradually extended to longer and longer lines, until the filament was incandescent uniformly along its whole length. During this reaction much gas was given off, which was identified as pure oxygen. The brown color of the original oxide had changed into pure metallic gray, and the wire had become flexible after several hours of strongest white incandescence, like a wire of copper.

The second method, which is the most practical one, is to produce tantalum by the method of Berzelius and Rose, mentioned above, and then to purify and refine the metal in the vacuum under the action of the electric arc. This method is based on the fact that the oxides of tantalum melt more easily than the tantalum itself, and on the other fact, that they are much more easily volatilized in a vacuum than the metal, so that the metal can be completely separated from the oxide.

Concerning the manufacture of the filament of the osmium lamp the latest information is given by Blau. The raw material is very finely divided osmium, which is mixed with organic binding materials so as to form a thick, tough paste, which is pressed under very high pressure through an aperture. A thread is thereby obtained which is formed into loops. The threads are then dried and are heated in the absence of air in order to carburize the binding material, and then subjected to the most important process, which is called formation. The threads which now consist of porous rough osmium with a high content of carbon are heated for a long time by means of an electric current gradually to a higher and higher temperature up to white heat in an atmosphere which contains very much steam and smaller or larger quantities of reducing gases. The carbon is removed by the same reaction which takes place in the production of water gas, and the filament thus becomes pure porous osmium of a far greater density than the former rough thread. During the first period of the use of the lamp the osmium surface becomes gradually smoother and more polished; this accounts for an increase of the light given out by a lamp during this period.

Concerning the manufacture of graphitized carbon filament of the General Electric Company, the fullest information is contained in the paper of John W. Howell, Electrical World and Engineer, June 24, 1905. The main point is an external surface treatment of the filament in an electric tube furnace.

It will thus be seen that in the development of all three new lamps. electrochemical methods have proven of enormous importance. The speaker pointed out that it would be extremely interesting to know how far the progress achieved by the new lamps is due to the increased temperature and how far to a greater departure from black body radiation. We know of all three lamps that their filaments are at higher temperature than the ordinary carbon filament. Concerning the question, however, how far the three new filaments (in comparison with the ordinary carbon filament) depart from the black body, no information of an exact nature has apparently been published.

A complete investigation of these problems would involve not only a determination of the actual temperatures and of the "black body temperatures" of the filaments, but the actual distribution of the energy within the spectrum.

This would give us directly the absolute efficiency of the three lamps as the ratio of the area within the visible spectrum to the area of the total spectrum of the energy curve. It is quite possible that the numerical value of the efficiency, thus determined, may differ essentially from the efficiency, as determined from the cp per watt on the basis of the mechanical equivalent of light.

The first definition is absolutely physical and leaves the physiological aspect of the problem out of consideration; in this definition each watt corresponding to one wave length within the visible spectrum is considered as perfectly equivalent to one watt corresponding to any other wave length within the visible spectrum, although the physiological effects may be very different. The second definition of efficiency, on the other hand, is essentially based on the physiological effect. According to the second definition the efficiency of the osmium lamp is about twice that of the ordinary carbon lamp; but this does not necessarily mean that the efficiency according to the first definition has also been doubled. For the actual efficiency the loss of heat by conduction through the leading-in wires is also a factor; this has not been considered in the above discussion.

The speaker concluded that, in spite of what has already been accomplished, we are still far from finality, and he expressed the hope that the progress made in electrochemical methods during the last decade will continue to react on the invention of incandescent lamps in an encouraging and helpful manner, as has already been the case with the osmium, tantalum and graphitized filament lamps.

Recent Electrochemical Development.

ELECTROLYTIC PROCESSES.

It is generally very easy to arrange an electrolytic cell so that at the moment when operation is started exactly those products are obtained which are wanted. But in very many cases difficulties arise afterwards. These are due to the fact that by the electrolytic action the constitution of the system itself is changed. Such an effect may manifest itself in various ways. For instance, as a result of the electrolytic action some new material may get into the electrolyte and then act as an impurity; it may participate itself in the electrolysis, and produce new undesired effects. To prevent this, a patent, recently granted to Carl Hering, proposes to remove such "objectionable" elements by catching them as insoluble compounds formed with one or the other electrode. The material of the electrode must be chosen according to the nature of the objectionable element to be removed. It may be that this element is objectionable only in so far as it would produce undesired effects if left in the electrolyte, but it may be otherwise valuable. In such a case it may afterward be recovered by removing the electrode with its insoluble salt from the cell and using it as an anode in another cell if previously it was the cathode in the first cell, or using it as a cathode in the second cell if it had been the anode in the first cell.

As an instance, the electrolytic recovery of zinc from zinc sulphate may be mentioned. If this is carried out with an inert electrode, sulphuric acid is formed at the anode This will then participate in the electrolysis with the result that hydrogen is set free at the cathode, and the efficiency of the deposition of zinc is decreased more and more the further the electrolysis proceeds. To prevent this it is evidently sufficient to catch the SO_4 ions when being discharged in the form of an insoluble salt at the anode. This is possible by means of a porous lead anode which changes into lead sulphate according to the reaction well known from the lead accumulator. Another application described in the patent of Hering is the recovery of both zinc and acid from discharged primary cells. The free acid is first extracted by using a sponge lead anode and a lead peroxide cathode. Then the solution is electrolyzed between a cathode of mercury, zinc, etc., for receiving the zinc and an anode of spongy lead.

In a patent recently granted to Carl Kellner attention is called to the fact that in certain cases solid metallic plates as electrodes may have an unnecessarily large surface. This large surface may have the disadvantage of unduly accelerating undesirable secondary reactions; thus, in the electrolytic production of bleaching liquor, all particles of hypochlorite in contact with the cathode are again reduced. For such purposes Kellner uses electrode plates of glass or celluloid around which a helix of platinum wire is wound. Any number of such plates are placed one after the other in a cell. The portions of wire on one side of the glass plate act as anode, those on the other side as cathode.

G. J. Atkins has recently patented details of construction of an electrolytic cell, in which the cathode is a revolving drum, while the anode is the concentric carbon lining of the trough. This carbon lining forms an almost closed cylinder around the drum. The revolving drum is completely immersed in the electrolyte.

A recent patent of C. F. Blacklidge relates to electrotyping. The mold of wax is first coated with an alcoholic substratum of collodion on which a film of silver is precipitated. This is then plated electrolytically with nickel.

C. von Portheim has recently patented a method of obtaining glyoxalic acid, its esters and anrids from compounds containing the radical oxalyl (C_2O_3) by cathodic reduction.

A recent patent of L. Potthoff refers to mechanical details of construction of a tank for electroplating bars, tubes, and in general, such articles which are too large to be shaken up, as is done with small nails, etc. The tank contains a traveling band with a series of cathode tormisants adapted to move the articles to be galvanized, while means are provided for automatically changing the point of contact between the articles.

STORAGE BATTERY INVENTION.

W. Gardiner has recently patented the following construction of the grid for lead accumulators. A sheet of lead is rolled down very thin and thoroughly perforated. It is then folded transversely into a great many plates and is afterwards formed electrolytically. A recent patent of A. E. Knight relates to mechanical details of construction of storage battery plates, the main object being to prevent buckling or warping.

MISCELLANEOUS.

The extended researches which have been made in recent years on electric discharges through gases, especially through air, have resulted in several interesting industrial developments. While the most-talked-of problem, that of producing nitric acid from air, is still decidedly in the experimental stage, yet there are now industrial uses of similar processes in connection with sterilization of water by ozone and with bleaching flour, etc. A recent patent of A. Johnson is an indication of the activity in the last line. It refers mainly to details of construction. The main point is that air is sucked into the "generating chamber," and through continuous electric arc, by which "it is decomposed and converted into gases suitable for use in bleaching flour."

A recent process of J. F. Lester for the purification of water is a combination of electrolytic purification, with sterilization by means of ozone. The apparatus contains an electrolytic chamber (in which the electrodes act simultaneously as baffle plates), an ozonizing chamber, and a filter in a single casing. The electrolytic chamber and the ozonizing chamber are totally surrounded by water to prevent the heating of the water being treated.

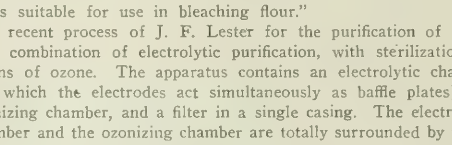
In straining certain liquids it is desirable to heat them while they are passing through the strainer. For this purpose W. J. Morrison uses a strainer made up of a series of contiguously arranged sections of non-absorbent insulating material in which a suitably-controlled electrically-heated conductor is embedded.

New Telephone Patents.

FOUR-PARTY SELECTIVE SYSTEM.

A new four-party selective system has been invented and patented by O. M. Leich, of Chicago. This, like many of its predecessors, makes a distinction between the two sides of the line, all ringing being done with earth return. This method reduces the required number of types of station to two.

Mr. Leich bases his selection entirely upon the counteracting effects of capacity and inductance. To this end he makes one station insensible to ordinary alternating currents and the other sensible to them. This result is accomplished by using an ordinary winding for one station and for the other an inductance such that the usual alternating current is effectually blocked off.


LEICH SELECTIVE SYSTEM.

In order to ring this latter station the inductance must be neutralized. This is accomplished sufficiently by placing at the central office associated with the proper ringing key a condenser, through which the current must pass. The leading current from this circuit combined with the lagging effect produced by the high inductance, leaves a current sufficient to produce results at the bell. As thus far explained it would in fact affect both stations and means must therefore be provided to render the regular bell insensible to this current. This locking is accomplished by an armature extension which moves in the magnetic influence of an auxiliary coil. This coil is in series with a high inductance, the whole being in parallel with the ringer. A light pull on the armature extension will lock a considerably stronger pull from the ringer coils. The leading current in the high inductance lock circuit exerts the required pull, while the phased current does not.

PARTY-LINE KEY.

Mr. M. Setter has invented a new four-party line switching key, the patent for which he has assigned to the American Electric Telephone Company, of Chicago. With this type of key each elemental key should lock after depression until released by the depression of one of the other elements. This has heretofore been successfully accomplished by magnetic means, but Mr. Setter's arrangement is wholly mechanical, a series of latches being provided beneath the plungers, all linked together to act synchronously. If any key be depressed, the latches are tilted to release position first and then, as the actuating element is pushed home, the latter snap back under spring pressure to "locking" position.

SWITCHBOARD.

A return to first principles has certainly been made by E. H. Strauss, of Chicago, who has patented a plug and bar switchboard for telephone work which is not far different from the old telegraph type boards which telephony originally fell heir to. It is difficult to see what is to be done with it at this late date.

REPEATER.

Mr. D. H. Wilson, of Chicago, has devoted his energies to a repeater which he has recently patented. In this the circuit is led through a split-wound coil, whose core is confronted with two diaphragms, one at each end. These actuate transmitters whose common circuit includes reinforcing winding laid over the split receiving winding.

Letters to the Editors.

The Use of the Third Person in A. I. E. E. Discussions.

To the Editors of Electrical World and Engineer:

Sirs:—I have read with interest the communication of Mr. Behrend in your issue of Sept. 9 regarding the use of the third person in the discussions of the A. I. E. E. as they appear in print. Also your editorial explanations of the reason for this usage, and Dr. Hutchinson's further communication on the subject in your issue of Sept. 23.

That this method of reporting the discussions of the Institute was adopted for reasons which appeared wise at the time, no one questions. That whatever these reasons might have been, the method has failed obviously and deplorably is equally beyond question. The advantage of the adoption of the third person, is, apparently, to shorten the printed discussions. That the two words "The speaker" are shorter than the good old pronoun "I" is still a source of wonder to me, and the way in which brevity is served by the change is not manifest. Its ambiguousness is further a reason for its unsuitability. "The speaker." What speaker? The one presenting the paper under discussion; a previous speaker in the discussion or the speaker then expressing his views and experiences? Whatever may have been the reasons for the adoption of the third person, to the casual observer, it looks like an affectation that borders on cheap pedantry. These views are expressed the more unhesitatingly because of their having been so frequently and forcibly—indeed profanely—confirmed by numerous members, officers, and associates of the Institute. Indeed there are some members, whose sensitiveness in the matter of being represented as reasonable and logical humans, in printed documents which may come under observation of scientists and litterateurs, is such that they refrain from participating in discussions, which may after appear in such public form as to lead to the belief that they were really guilty of expressing themselves in so ridiculous a manner. Dr. Hutchinson states, in effect, that about 90 per cent of the discussions should be suppressed, being useless and irrelevant. If any discussion come in this class it should, of course, be deleted, but just what bearing the use of the third person has on the suppression of discussions is a little difficult for the ordinary intelligence to fathom. The essence of Dr. Hutchinson's statement is, that the use of the third person would be proper and helpful, if the Institute had at its command sufficient money and assistants to properly edit the papers, and the present similarity of the printed discussions to a joke book, he attributes to the inability of the Institute to properly handle this cumbrous pronominal. In other words, the Institute has attempted to do something which it has neither the means nor ability to accomplish; a serious reflection on a body of engineers. Our curiosity is greatly aroused over Dr. Hutchinson's statement that only one member of the Institute utters remarks that are fit for print without revision. We wonder who it can be and are now lost in speculation.

The general sentiment of the Institute, so far as I have heard it expressed, is, that the use of the third person is objectionable, and it should be abandoned forthwith. I, for one, desire to express my unalterable opposition to it, and trust that a rational method of editing, the successful execution of which is within the means and power of the Institute, may be substituted for the present practice.

New York City. Lamar Lyndon

[That objection to the use of the third person in editing discussions, which is based upon the literary difficulties involved can be dismissed with the remark that other societies have overcome these difficulties, and that editors the world over constantly practice the art of condensation in the third person with no thought that they are performing a literary feat. The issue thus appears to resolve itself into whether the *Transactions* of the Institute shall be held to their proper function of recording technical information, or only partly devoted to this object and partly given over to the exploitation of individualities—or persons, to use a plainer term. We fear that Mr. Lyndon has taken for the "general sentiment of the Institute" the sentiment of those whose remarks have been edited, which may easily differ widely from the sentiment of the 3,500 or more members of the Institute who merely read the *Transactions*.—Eds.]

"Made in Germany."

To the Editors of Electrical World and Engineer:

Sirs:—On page 489 of your issue of Sept. 16, under the heading of "Electricity in Agriculture," Mr. E. W. Baker, of Barry, Ill., directs attention to the slow progress in the United States in the adaptation of electricity to agriculture, while in other countries, notably Germany, rapid advances have been made. Mr. Baker states that from 1893 to 1901 he has searched the index of the Electrical World and Engineer for notices of electric plowing, and found many references, but all to "trials made in Germany," and concludes: "I think it is high time that this odious German label should be removed in a branch of applied science where otherwise we Americans stand first."

Mr. Baker seems to be not well acquainted with what is going on in the technical world, as otherwise he would have discovered that these machines are all made in Germany, and while I appreciate the work and pains he has devoted to looking up the subject, I do not know of any branch where the "odious phrase" "made in Germany" is more appropriate than in applied science. This is not only true of electric agricultural machinery, but it has long been known by many engineers, although not generally recognized, that much of modern machinery where science is applied is invented or developed by the Germans, though not bearing this label. It will probably surprise Mr. Baker to be informed that alternating-current railroading, high-speed electric traction, high-tension oil switches, superheated steam practice, the newer type of large gas engines, reinforced concrete, steam turbines, etc., all emanate from Germany. It will probably be quite a surprise to Mr. Baker to learn that the very type of water wheel by means of which he proposes to harness the western waters is also a German invention, although it also does not bear the "odious" label.

That Germany is a country of pioneers in applied science may be largely due to the patience and thoroughness with which her engineers experiment. To this must be added credit to the German government which supports them generously. Mr. Baker is certainly on the right road in criticizing the government—that is just what Bismarck taught the Germans to do—but the German government adopted a better scheme than that suggested by Mr. Baker, some dozen years ago when America was ahead of Germany in agricultural machinery. Germany opened its doors for the importation of this machinery and at the same time its engineers were sent to this country, receiving government assistance, to study American industrial methods. Who knows but that Mr. Baker is of the same opinion, as a worthy cousin of Germany who once said, "When Germany is destroyed and its commerce killed, every Englishman will be one-third richer than he is now."

New York City. Franz Koester.

Central Station Rates.

To the Editors of Electrical World and Engineer:

Sirs:—I have read with interest, in your issue of Sept. 9 last, the editorials entitled "The Small Power-User" and "Central Station Rates," but do not think I can agree with you that "there has been in recent years a growing disposition to make rates for the benefit of the large user," nor that the Central Station "often arranges so-called service charges or maximum demand charges in a way to still further aggravate the difference between the small and large consumer."

On the contrary, I believe the tendency has been recently, and still is, to discard the system of a certain meter rate with discounts for quantity only, and to adopt instead some form of demand system, which system does not favor the large consumer, but instead gives the low rate to the long-hour consumer, whether he be large or small. The "Readiness-to-Serve" system, which you mention, is a demand system, and has been adopted much more with a view to securing long-hour customers than, as you suggest, with a view to securing merely the large customers.

Both the object and justification of the "Readiness-to-Serve" system, as well as of the other demand systems, is excellently expressed in your own words, as follows:

"It is a system of logically reducing rates to those customers to which the company can afford to give better rates, without letting the bars down to such classes of customers as are unprofitable even at existing rates."

Boston, Mass. J. S. Codman.

Submarine Boats.—The Compass.

To the Editors of Electrical World and Engineer:

Sirs:—I have lately had occasion to look through the "Mathematical Magick" of Bishop Wilkins, when I came across a chapter with the caption: "Concerning the possibility of framing an ark for submarine navigation: the difficulties and conveniences of such a contrivance."

The difficulties minutely enumerated are three: (*a*) The letting out or taking in of anything without admitting water; (*b*) directing the boat when running submerged, and (*c*) the supply of air needed for respiration.

The conveniences stated are: (*a*) That one may go to foreign ports unmolested and unknown; (*b*) that one is independent of tides and storms as well as secure against icebergs and pirates; (*c*) that one may undermine and blow up ships of the enemy; (*d*) that one may relieve a besieged stronghold by the sea or surprise any place accessible by water, and (*e*) that such a mode of navigation may be of unspeakable benefit for submarine experiments and discovery.

The "mariner's needle," adds the author, would be useful in directing such an ark when running below the surface.

The first edition of this quaint book appeared in 1648. The one from which we quote is in the Wheeler collection of the Library of the American Institute of Electrical Engineers, and is dated 1680.

John Wilkins, Bishop of Chester, was a man of considerable mathematical ability: b. 1614; d. 1672.

In connection with the above, it may be said, following John P. Holland, that the Spanish Armada was probably responsible for the first suggestion of a submarine vessel; also that the first design for such a boat was made by William Bourne in 1604 and that the first submarine vessel constructed and propelled (on the Thames) was by one Cornelius Van Drebble in 1624, just 24 years before the publication of Wilkins's book. Unfortunately, Van Drebble came to be looked upon as a sorcerer, in consequence of which he was compelled to abandon his subaqueous experiments.

Manhattan College, New York. B. Potamian.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Induction Motors.—Welsh.—An article giving some points about the induction motor and the effect of variation in the supply circuit. The slip varies approximately as the inverse square of the applied e.m.f. Greater relative changes in speed occur when the voltage is below normal than when it is above normal. This is shown by the following table, which refers to a normal slip of 1 per cent at 100 per cent voltage:

Per cent. voltage applied..	80	90	100	110	120	130	140
Approximate per cent slip	1.5	1.25	1.0	0.8	0.7	0.6	0.5

The torque developed by the motor varies as the square of the applied e.m.f. As a rule the starting torque with the short-circuited type of motor secondary is equal to one and one-half or two times the full-load torque on full voltage, or it is equal to the full-load torque with 82 to 71 per cent of full voltage. The pull-out or maximum torque which the motor can develop on full voltage is commonly two or three times its full-load torque. Roughly the torque is proportional to the inverse square of the frequency; therefore, a decrease in the frequency will increase the maximum torque developed by the motor. The maximum torque of a given motor is a constant, within certain limits irrespective of the slip. If a motor is run at a frequency different than that for which it was designed, the voltage may be changed in the same proportion. The results of an actual test on a 30-hp, two-phase, 400-volt, eight-pole, 60-cycle motor run on 60 and 25.8 cycles are:

Frequency.	Volts.	Amp.	Real Watts.	Torque.	r.p.m.	Slip in r.p.m.	Real efficiency.	Power factor.	Horse power.
60	400	73.5	26400	185	850	50	84.8	89.7	30.0
25.8	170	78.3	12000	185	335	55	73.3	90.3	11.8

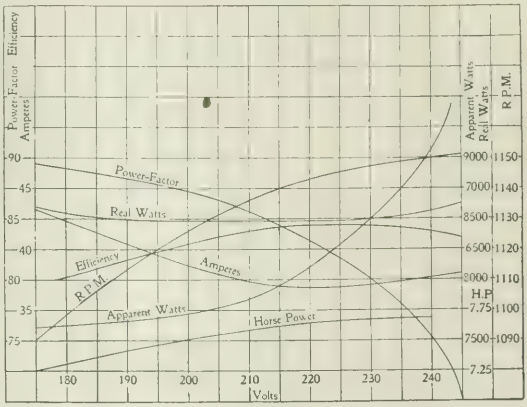
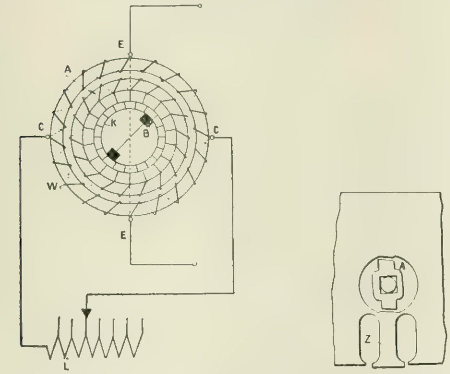


FIG. 1.—PERFORMANCE OF INDUCTION MOTOR AT CONSTANT TORQUE.

The torque was held at 185 pounds in both cases, and the voltage applied in the second case was 25.8/60 of 400 = 170, approximately. In order to develop the same horse-power when a motor is not run at its designed frequency, the voltage should be changed in proportion to the square root of the frequency. For example, a 200-volt, 25-cycle motor may be operated on a 50-cycle circuit with approximately the same performance if the voltage is increased to 283. In this case the torque has one-half its normal value and the motor runs at double speed. The percent slip is less since but one-half the torque is developed, and the starting torque is less since the voltage is not increased in proportion with the frequency. The performance of a motor at a constant torque at various voltages is illustrated in Fig. 1. The curves were taken by brake test on a motor with a squirrel-cage type of secondary. This motor runs normal at the point on the saturation curve rather high as compared with the usual induction motor. The following peculiarities are mentioned concerning induction motors with a wound secondary. With one leg of the three-phase secondary winding open it pulls in at half speed and continues to run at the same rate. This does not affect the balancing of the current in the primary phases. If the open leg is closed the motor will come up to full speed. Opening one leg again will not cut the speed in two unless the load is too great, in which case the motor will pull out. The pull-out in this case has the same value as with one leg of the primary open, (secondary all closed) about 40 per cent of normal pull-out.—*Elec. Jour.*, September.

Compensated Repulsion Motor.—REYVAL.—An illustrated description of a compensated repulsion motor, built according to the principle of Lehmann by the Société Alsacienne and exhibited at the exposition at Liege. In the ordinary repulsion motor the component of the secondary field, in quadrature with the primary field, produces no useful inductive effect on the primary circuit and acts, therefore, as a self-induction proper. The characteristic feature of Lehmann's compensated repulsion motor is that the transversal flux, in quadrature with the primary field, is partially damped in the stator. This result is obtained by means of the use of an adjustable induction coil, *L*, as shown in Fig. 2., for a bipolar motor. The two points, *C C*, of the primary winding, *W*, are connected to this induction coil, *L*, while the points *E E* are connected to the supply circuit. The winding of the rotor, *A*, is analogous to that of the armature of a direct-current dynamo with respect to the symmetrical distribution of the coils and the commutator, *K*. The latter is provided with two short-circuited brushes, *B*. In such a motor the supply current and the torque vary inversely as the inductance, *L*, and decrease with increasing speed. The phase difference of the supply current decreases constantly with increasing speed, becomes zero at synchronism and changes its sign if the speed is further increased. Another special device, as shown in Fig. 3, permits the suppression of any e.m.f. below the brushes and thus assures perfect commutation. Its feature is that the flux which passes through the teeth of the stator situated in the line of the brushes is influenced by a change of the magnetic reluctance in these teeth. In our special case the reluctance of the teeth, *Z*, is varied by the change of the air-gap between *A* and *Z*. This device has the effect that it suppresses the static tension below the brushes by producing an opposite and equal tension. The tests with this type of motor are stated to have given the following results: At starting one obtains the normal torque without the supply current having more than its normal value. With double the normal current, the starting torque is four times the normal torque. In the neighborhood of synchronism the phase difference of the supply current is practically zero. The reversal of the direction of rotation is obtained by exchanging the terminals, *C C*, with reference to the terminals, *E E*. It is further possible to start with any torque by simply changing the position of the brushes. Finally it is possible to maintain the motor at constant speed either at synchronism or at a multiple of synchronism by short-circuiting the armature and removing the brushes, but in this case the motor is no longer compensated.—*L'Eclairage Elec.*, September 9.



FIGS 2 AND 3.—COMPENSATED REPULSION MOTOR.

LIGHTS AND LIGHTING.

Efficiency of Incandescent Lamps.—A summary of recent tests made in Paris by Lauriol and Janet for a special purpose of comparing 110-volt and 220-volt incandescent lamps. The results of these tests support the contention that 110-volt lamps are better than 220-volt lamps in point of efficiency (average difference about 20 per cent in favor of 110-volt lamps), useful life and similarity in illuminating power. A great many diagrams are given, one of which is reproduced in Fig. 4, which shows the comparative illumination and efficiency tests of one type of French make of 110-volt and 220-volt incandescent lamps. The shaded portions between each two corresponding curves in the diagrams indicate the limits within which the results of the ten lamps tested in each case varied. The full lines refer to 110-volt lamps, the dotted lines to 220-volt lamps. The arrow heads point to the time at which lamps failed. The candle-powers are given in "bougies decimales," being nearly the same as English candle-powers. The curves point to very irregular individual behavior of the lamps. The ratio of mean spherical candle-power to maximum candle-power (in the direction at right angles to the lamp axis) varied from 0.95 to 0.70. In no case did the mean spherical candle-power equal or exceed the candle-power marked on the lamp, and in many cases even the maximum candle-power of the lamp did not equal its supposed candle-power. Tests by Janet gave the average results shown in the following table:

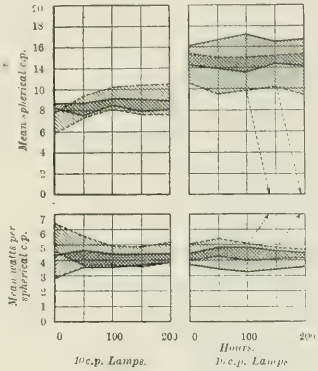


FIG. 4.—EFFICIENCY CURVES.

	5 c.p.		10 c.p.		16 c.p.	
	Max. illum. c.p.	Watts per c.p.	Max. illum. c.p.	Watts per c.p.	Max. illum. c.p.	Watts per c.p.
110 volts.	6.34 (0.71)	3.52	10.5 (0.73)	3.58	16.2 (0.81)	3.66
220 volts.	7.43 (0.69)	3.82	9.2 (0.71)	4.54	14.0 (0.75)	4.57

The figures in brackets in this table are the ratios of the main mean spherical candle-power to the maximum candle-power. It is mentioned that this ratio is largest in the lamps with four spirals and smallest in lamps having two horseshoe filaments. If the aggregate hours of burning of a group of five lamps of one type be divided by 1,000, a figure is obtained which Janet calls the "durability coefficient," and which is to some extent an indication of the durability of the lamp. The 220-volt lamps deteriorated more rapidly on the whole than the 110-volt lamps. After 200 hours the average consumption of the 220-volt lamps tested was 34 per cent higher than that of the 110-volt lamps. Janet finally points out that the use of 220-volt lamps is only now becoming common in France and that it would be unfair to form final conclusions as regards 110-volt lamps versus 220-volt lamps from the figures quoted. Bainville has made some tests to determine the approximate degree of blackening which may take place in incandescent carbon lamps. He took some old lamps, measured their illuminating power, cleared the lamps inside, replaced the filaments, exhausted the lamps and measured their candle-power again. The results obtained with three lamps are given in the following table:

		Cleaning		
		Before.	After.	
25 volts	0.24 amp.	7.7 c.p.	10.77 c.p.	20.6 per cent.
[illegible] volts	1.33 amp.	13.1 c.p.	44.0 c.p.	70.0 per cent.
[illegible] volts	0.78 amp.	22.7 c.p.	47.86 c.p.	54.0 per cent.

The accuracy of these figures cannot be very high, since the vacuum presumably differed in the two cases. The influence of a variation of voltage on the specific consumption of normal 110-volt lamps is shown in the following table:

Specific consumption.	Watts per c.p.			
Normal consumption	3.5	3.0	2.5	2.0
Consumption for voltage 5% below 110	5.9	3.5	3.1	2.7
Consumption for voltage 5% above 110	2.7	2.4	2.0	1.65

Bainville also compared the effect of small and large globes for 106-volt, 100-cp lamps. He found that lamps with large globes are much more constant in illuminating power and efficiency than lamps with small globes.—Lond. *Elec.*, September 1.

Osmium Lamp.—An account illustrated by diagrams of tests of osmium lamps recently made in Vienna. The lamps tested were six 35-volt lamps giving 16 cp and six 35-volt lamps giving 25 cp. One 16-cp lamp gave initially 15.1 candles, with a consumption of 1.68 watts per candle; after 400 hours the candle-power increased to 17.3; at 2100 hours it had decreased to 15.6, the consumption of watts per candle-power at the same moments being 1.46 and 1.58, respectively. One 25-cp lamp began with 22.35 candles, was at 600 hours at 24.6 cp and at 1700 hours at 23.7, the consumption in watts per candle-power being 1.65, 1.51 and 1.56, respectively. The mean total life of the 12 lamps tested was 2,220 hours, the limits being 1,793 and 3,036 hours, respectively. Of the 12 lamps only three lost 10 per cent of their initial candle-power during their total life; one after 1,750 hours, the second after 940 hours and the third after 820 hours. If the "useful life" is considered as the life down to 90 per cent of the initial candle-power, the mean useful life of the 12 lamps was 1,985 hours with a mean consumption of 1.60 watts per candle-power for the 16-cp lamps and of 1.80 watt per candle-power for the 25-cp lamps. (In this article candle-power evidently means Hefner candle, which is equal to 0.88 cp in this country).—*Zeit. f. Elek.* (Vienna), September 3.

Carbon Arc.—BECKNELL.—Experimental researches as to the phenomena in the intensely heated region between the electrodes of a carbon arc immediately after its interruption. A current which may be called residual current can be observed for more than 10 seconds after the interruption of the arc. The residual e.m.f. is counter to that of the dynamo and reaches a maximum value of more than one-half a volt. It seems not to be a case of ordinary electric conduction but probably one of electric convection. Ohm's law does not hold for the residual current. A possible explanation of the phenomena is given on the basis of the ionic hypothesis.—*Phys. Rev.*, September.

Energy of Visible Spectrum.—NICHOLS.—An account of experimental investigations with a summary of results obtained by other authors on the distribution of the energy in the visible spectrum of various sources of light.—*Phys. Rev.*, September.

POWER.

Transmission Troubles.—APPLER.—Some illustrated notes on transmission troubles in the far West. The greater number of the troubles encountered are due to climatic and physical conditions of the country rather than of the apparatus. Several cases are mentioned in which troubles were experienced at times of unusual high water in hydraulic stations. At the power house at Volta, Cal., the exciter unit has a separate pipe line, and it was found necessary to provide some device that would automatically remove the leaves which are in the water in times of heavy rains before entering the penstock. In another plant at Kilarc water is taken from the main pipe line, driving the exciter with the same water pressure as used on the big wheels, and this has proven a more reliable method.—*Elec. Jour.*, September.

Electric Power in German Coal Mines.—BROWN.—An abstract of a paper read before the Mining Institute of Scotland. In nearly all German mines three-phase currents are used with rare exceptions for general power purposes. "At coking colleries there is a tendency to take gas from the coking ovens, which after purification is used to drive gas engines; and it is stated that the power generated by this method, as compared with that of burning the gas under boilers and generating electricity by the steam so raised, is rather more than double." Electric power is used for pumping and ventilation, winding, haulage, coal cutting and air compressing. Some information is given on electric winding engines.—Lond. *Elec. Rev.*, August 25.

Boiler-Feeding Apparatus.—HUBBARD.—A short illustrated article describing the operation of the injector for boiler-feeding purposes.—*Am. Elec.*, September.

Open Feed-Water Heaters.—EDWARDS.—An illustrated article pointing out the advantages possessed by the open type of feed-water heater, and describing its various applications.—*Am. Elec.*, Septembee.

Piston Rod Packing.—STROHM.—An illustrated article describing the various forms of packing used for piston rods.—*Am. Elec.*, September.

TRACTION.

Corrugation of Tramway Rails.—An illustrated note on the trouble of the corrugation of tramway rails. Fig. 5 shows a photograph from a suburban line where the corrugation is pronounced and causes a serious amount of noise. In an editorial note attention is called to the lateral spreading of the rail table at the high parts until met by the wheel flanges. The consequent burnishing furnishes the quickest method of picking out corrugated rails by sight, with a good side light. This trouble never seems to have occurred upon either steam or horse tramways, but on cable tramways it has been known for some time. It has been claimed that vertical springing of the rails starts the corrugations, and that it can be prevented and cured by "anchor plates," but the writer says that this explanation does not fit, since some of the systems which are free from the trouble use no anchor plates, even at the rail joints, while cable and conduit lines, both of which have suffered, have a certain amount of anchoring from the yokes. Some relation between wheel gauge and rail gauge seems a more likely cause, and the lateral spread noticed lends force to this suggestion.—Lond. *Elec.*, September 1.

FIG. 5.—CORRUGATIONS

Electric Transportation of Mail and Express Packages.—A fully illustrated article on trials, recently made in Paris on high-speed transportation of letters and packages. A speed of 250 km. or 155 miles per hour is contemplated. The difficulties of construction at curves are discussed. Four-pole, three-phase induction motors are used with a voltage of 1,000 and a frequency of 40. The vehicle is adapted to carry a weight of 500 kg. (about 1,100 pounds); its length is 25 ft., its width 3½ ft. and its height above the rails 4⅓ ft. The space for the freight is about 70 cu. ft.—*L'Industrie Elec.*, August 25.

British Tramway.—An illustrated description of the new tramway system of Erith with a track of 8.4 miles. Erith already has a municipal electric light and power supply which was the first public three-phase plant in the United Kingdom. To supply current for tramways, two rotary converters of 150 kw each and a 75-kw negative booster have been installed.—Lond. *Elec. Rev.*, September 1.

Couplings.—MYKISCH.—An illustrated description of various types of couplings of electric cables between motor cars for trunk railroads. —*Elek. Bahnen*, August 14; from *Glaser's Ann.*, No. 670.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Starting Rotary Converters.—WAGNER.—The conclusion of his serial, illustrated by detailed diagrams, on different cases of starting rotary converters. The case discussed in the present installment refers to the starting of a three-phase rotary converter operating from direct current to alternating current with direct-connected exciter.—*Elec. Jour.*, September.

ELECTROPHYSICS AND MAGNETISM.

An Experiment in Electricity.—WORTHINGTON.—A description of "a fundamental experiment in electricity." The object was to ascertain whether any difference can be detected between space at a high electrical potential and space at a low potential, quite irrespective of the existence of any electric field in the space in question." He examines whether any difference could be detected in the velocities of light passing through two tubes, the interior of one of which was at a high, and of the other at a low potential. The result was negative. The difference of potentials was 60,000 volts. In a length of 152 cm. of air this does not produce a measurable effect under the conditions of experiment. If there is any difference in the velocities it is less than 1/53 of one-millionth of the whole.—*Phil. Mag.*, September.

Production of Radium from Uranium.—BOLTWOOD.—The hypothesis that radium is a disintegration product of uranium has been greatly strengthened through the demonstration of the fact that in radioactive minerals the quantity of radium is directly proportional to the quantity of uranium present. Soddy has recently claimed to have shown by direct experiment that radium is produced directly from uranium by atomic disintegration. The present author has made an analogous investigation using the very greatest precautions. His results are negative. He states positively that in 390 days the quantity of radium formed from 48 grams of uranium in a uranium nitrate solution must be less than 1.7×10^{-11} gram. This would be less than 1/10th of the quantity assumed by Soddy to have been formed from an equal quantity of uranium of his solution during an interval of 18 months. It is, therefore, concluded that Soddy's results are without significance and that one or more products of a slow rate intervene between uranium and radium.—*Am. Jour. of Science*, September.

Radium.—RUTHERFORD.—A full account of an extended experimental analysis of slow transformation products of radium.—*Phil. Mag.*, September.

Electromagnetic Screening Effect of Metallic Conductors.—KUNITO OGAWA.—A note giving in tables and diagrams the results of experiments concerning the screening action of simple metallic loops and thin metallic foils.—*Memoirs College Sc. & Eng.*, Kyoto Univ., Vol. I, No. 2.

ELECTROCHEMISTRY AND BATTERIES.

The Space Occupied by Atoms.—TRAUBE.—A summary of the investigations of T. W. Richards and J. Traube on the space occupied by atoms. Traube distinguishes three volumes—internal, external and "co-volume"—the latter being the space within which the atoms are free to move. The space occupied by an atom changes from one compound to another; it is the smaller the greater the affinity of the atom in question for the neighboring atoms with which it is combined. There is an intimate connection between the molecular volume and the thermochemical constants, especially the heat of formation. A far-reaching parallelism exists between heat of formation and atomic contraction and the heat of reaction is, as a first approximation, equivalent to the work represented by the contraction of the atoms. When we consider that the electrical energy which a galvanic cell is capable of generating may, as a first approximation, be equated to the heat which under ordinary circumstances the reactions taking place in the cell are capable of developing, it necessarily follows from the relation of this heat development to the dynamical contraction energy, that the electric energy of a cell is to be attributed to the mechanical work accompanying atomic contraction. The various properties of matter are related to the atomic volumes much more simply and directly than to the atomic weights. The numerical relations among the atomic spaces are likewise simpler than those among the atomic weights. The properties of the elements and their compounds are primarily functions of the atomic and molecular volumes and possible shapes. The author discusses the points of agreement as well as of disagreement between the views of Richards and Traube.—*Phil. Mag.*, September.

Absolute Potentials.—GOODWIN AND SOSMAN.—An account of an experimental investigation of Billitzer's method for determining absolute potential differences. This method is based on the observation of deflections of a minute metallic electrode, suspended in various solutions, under the influence of an electric current. The results obtained by the present authors have failed completely to confirm the measurements obtained by Billitzer, and they are forced to the conclusion that the method proposed is not to be relied upon for the purpose for which it was developed. This is further strengthened by the results on the migration of colloids obtained by Blake, who has also failed to confirm Billitzer's measurements using the colloid method. So far as the experiments go, it would seem that most of the phenomena observed may be explained on the assumption of the negative migration of gaseous particles in the liquid, as first demonstrated by Quincke in 1861. The authors believe, therefore, that the results obtained by Billitzer by the above described method afford as yet no sufficient grounds for rejecting the generally adopted values for the potential of the normal (or tenth normal) calomel electrode.—*Phys. Rev.*, September.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Reichsanstalt.—An abstract of the recent report of the German Reichsanstalt for 1904. This is the last report signed by F. Kohlrausch as president, who has resigned during this year and is succeeded by Warburg. The report covers work on specific heat of gases and of water vapor; the determination of the mean value of a calorie in electrical units (the resulting mean calorie being 4.19 watt-seconds at 15° C., and its temperature coefficient being —0.0038 per degree C. for the range from 5° to 25° C., which agrees with Barnes); physical properties of metals (with respect to the electron theory); the expansion coefficients of metals at low temperatures; the internal friction of liquids; the setting of masonry foundations for astronomical instruments; standard cells (the troubles caused by mercurous sulphate do not all appear to have been overcome); conductivity of salt solutions; temperature radiation (the energy curves of the black body radiation agree entirely with Planck's theory). An account is then given of the apparatus and instruments which were tested. The investigation into the constancy of electricity meters for central stations is nearly completed. A number of instruments have been carefully tested, then distributed over various works and have been retested at intervals. These tests of 154 instruments have extended over two or three years. Results will be communicated to the respective firms, but will not be published in detail. The work is said to have been most instructive for both sides. Alternating-current instruments have, on the whole, proven superior to direct-current instruments. The e.m.f. of the Weston cadmium cell was found to be 1.0189 in 5 cells, 1.0190 in 5 cells, 1.0191 in 26 cells and 1.0192 in 4 cells. The Reichsanstalt declares its preference for the Weston cell over the Clark cell, but it regrets that water can evaporate in these cells as furnished by the Weston company, although the modification devised by the Reichsanstalt is free from this effect. Considerable work has been done on the testing of the magnetic properties of iron as has already been noticed in the Digest. An important result is that for permeability tests the direct-current method gives the same results as the less convenient and reliable method of testing with the aid of alternating currents. Iron is not magnetically less soft to rapid current alternations than to direct current, and the permeability does not become smaller at higher frequencies. There is a slight difference in the sense indicated for periods up to 50, and for inductions below 12,000. The watt-metrical method seems, on the whole, to be most suitable for the determination of hysteresis losses. One point requires further elucidation, however. The initial permeability values, i. e., the permeability in very weak fields, as determined by different methods (commutation curves and ballistic yoke methods) were not found identical.—Lond. *Eng'ing*, September 8.

Measuring Mean Spherical and Mean Hemispherical Intensities HYDE.—A discussion of the theory of the Matthews and Russell-Leonard photometers for the measurement of mean spherical and mean hemispherical intensities, and their applications both to arc lamps and incandescent lamps. The paper is chiefly mathematical and relates to the number and location of the mirrors employed.—*Bull. Bureau of Standards*, No. 2.

Absolute Measurement of Inductance and Capacity.—ROSA AND GROVER.—Two very long and detailed accounts of experimental investigations on methods of absolute measurement of inductance and capacity.—*Bull. Bureau of Standards*, No. 2.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Central Battery System.—JACOBS.—A long and fully-illustrated description of the central battery system in the telephone exchange of Wuerzburg, Bavaria.—*Elek. Zeit.*, August 31.

BOOK REVIEWS.

RADIOACTIVE SUBSTANCES. By Madame Sklodowska-Curie. Reprinted from the *Chemical News.* New York: D. Van Nostrand Company. 94 pages. Price, $1.

This work of the distinguished Polish lady was prepared and submitted by her for the degree of Doctor of Science of the University of Paris. It embodies the extensive researches into the new phenomena of radioactivity which were discovered by herself within the past few years.

It was by the study of phosphorescence due to uranium, a discovery of Henri Becquerel, that Madame Curie was led to recognize an order of phenomena hitherto unknown to science, the very subtlety and complexity of which served only to stimulate her interest and to intensify her powers of patient analysis. Facts accumulated by degrees, and it was only when assurance had become doubly assured that the announcement was made to the world of the discovery of a new elementary form of matter. Its peculiar behavior, and above all, its irrepressible emissivity, secured for it the apt name of radium. The various and laborious steps leading up to its detection, its activity, its emanations and astounding properties are successively described in the present classical thesis, which, while revealing a new world of physical wonders, has given a powerful impetus to research, rare material to the framers of theories and much concern to the sober thinker and sedate philosopher. Our views of matter are undergoing a rapid process not of evolution but of revolution; the element of the chemist is no longer that of the physicist; the one-time indivisible entity is now mercilessly shattered into fragments in order to satisfy the requirements of (peace to the shades of Dalton!) and the stability of the atom as well as the permanence of the various forms of matter are beginning to disappear from the articles of our scientific creed.

Of course, the Curies are not the only pioneers in the new physics of our planet. Becquerel must not be forgotten no more than Crookes, W. Konrad, Röntgen or Philipp Lenard. Their splendid work prepared the way, it is true, but it required that infinite ability of looking after minutiæ, frequently called genius, to pass from the domain of such recondite researches into the promised land of radioactivity. The merit of Madame Sklodowska-Curie has been rewarded by the Doctorate of the French University and also by the admiration of the whole scientific world.

RADIOACTIVITY. By Charles R. Stevens. New York: Broadway Publishing Company. 108 pages.

The title of this book does not indicate the purport or the scope of the work. One would naturally think of it as a comprehensive treatise on the engrossing and fascinating subject of the hour, whereas radioactivity is not seriously considered until the tenth and last chapter. The other nine deal with such a variety of subjects as the Permanence of Force, the Permanence of Matter, the Infinity of Matter, Motion, Form, Immutability of the Natural Law, Energy and the Ether. These captions will at once suggest that the book was not written for the student in the class room, but rather for the philosopher in his study. And indeed the treatment is anything but elementary and didactic. It is not the tyro that can read these pages intelligently; indeed their perusal by one not well up in physics and metaphysics would be attended by serious intellectual risks and dangers. The author is affirmative and dogmatic, never discussive nor argumentative. He states his views upon all points with absolute confidence as to their finality. It is just as he puts it and could not be otherwise. The philosophy of the book may be judged from the following: "Ether is matter and is subject to all the laws which govern matter" (p. 9); "force and matter have always existed" (p. 15); "An elemental atom is an immortal being uncreatable and indestructible" (p. 17); "ether is a material substance just as much so as iron" (p. 61); "the lines of force surrounding a magnet are ethereal waves that move in the path of least resistance from pole to pole" (p. 62); "since ether is matter, therefore it is ponderable" (p. 9); "gravity is motion of matter" (p. 52); "the infinity of space is axiomatic" (p. 19). Again: "The supposition of a first cause is idle and preposterous" (p. 15); "the conception that the universe has always existed is a basis on which theories may safely and reasonably be built" (p. 15); "the mind of man is not simple, neither is it immaterial" (p. 81); "that which cannot be destroyed cannot have been created" (p. 15).

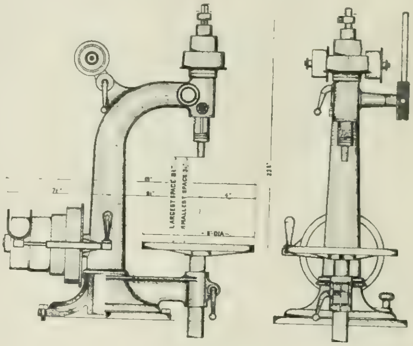
The facts contained in this discussive little book are many; they must be accepted; but the views of the author, especially his philosophical views, are debatable and unsafe.

BOOK RECEIVED.

WIRELESS TELEGRAPHY. Its History, Theory and Practice. By A Frederick Collins. New York: McGraw Publishing Company. 299 pages, 332 ills. Price, $3.00.

Sensitive Bench Drill.

The accompanying illustrations show a new 10-in. sensitive bench drill which is particularly adapted for various electrical manufacturing purposes. The principal features of the new drill are a revolving base and table, crucible steel spindles and bronze sleeve for the spindle shaft. Particular attention has been paid to the matter of interchangeability of parts, every part being made to jigs and accurate gauges so that no trouble will be encountered in replacing worn-out or broken parts. In the design of the machine careful attention has been paid to proportioning the metal, which is so distributed as to make the machine uniformly stiff to withstand drilling strains. It will be noted that the limit of drilling height is unusually large for a machine of this type. The matter of finish has also received careful thought to the end that a customer will not only have a well-proportioned, well-made and well-fitted machine, but one good looking in every respect. This drill is made by the McGeorge Manufacturing Company, Cleveland, Ohio.



BENCH DRILL.

◆

Electrical Equipment of the B. F. Sturtevant Company Works.

BY HOWARD F. KNOWLTON.

One of the most recent industrial plants to be completed in the suburbs of Boston, Mass., is the large establishment of the B. F. Sturtevant Company, formerly of Jamaica Plain, Mass. The growth of the old plant as far back as 1901 demonstrated the need of a new location, and a fire in that year which destroyed a large amount of valuable machinery naturally hastened the development of a new factory. This is now located about three-eighths of a mile north of the Readville station in the town of Hyde Park, and the plant comprises a group of buildings thoroughly representative of the latest ideas in production economy. The company manufactures heating and ventilating apparatus, engines, dynamos and motors, economizers, forges, exhaust heads, general factory equipment, etc.

The site consists of about 20 acres of land, with a frontage of 1,300 feet along the N. Y., N. H. & H. freight yards near Readville, occupied by about a dozen buildings with an aggregate floor area of 9 acres. These are mainly as follows:

Building.	Length, inches.	Width, inches.	No. stories	Class of Work.
A	125	45	4	Office.
B	250	80	3	Testing and electrical mfg.
C	500	80	3	Fan and heater shop.
D	500	120	3	General machine shop.
E	150	80	2—4	Patterns and storage.
F	350	170	1	Foundry.
G	100	40	2	Lockers and work rooms.
H	100	40	2	Blacksmith shop.
I	80	80	2	Power house.
J	25	20	1	Pump house.

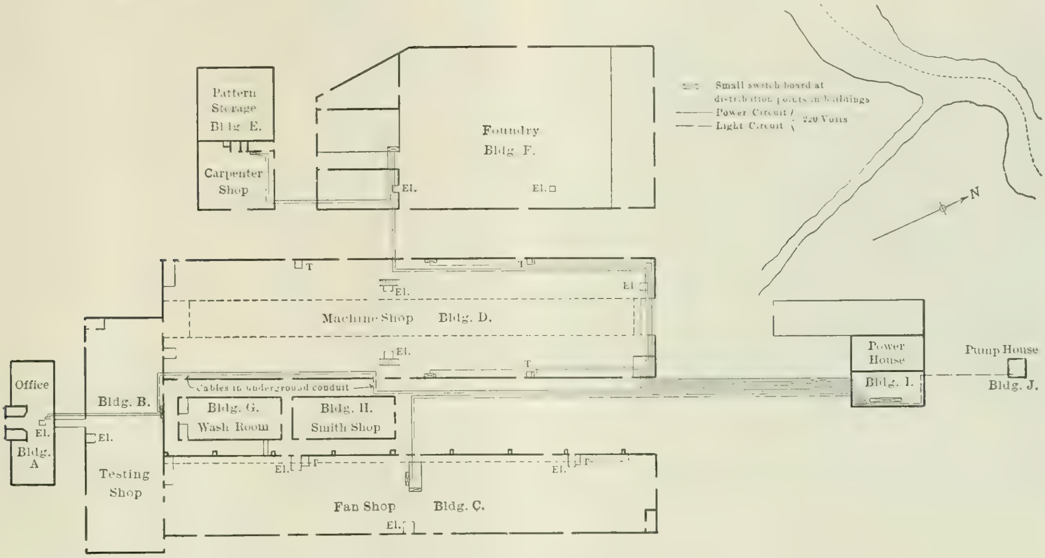


Fig. 1.—Plant of Sturtevant Works.

The arrangement of the buildings is such as to limit as far as possible internal transportation to straight line movements. A complete industrial railway system of 2 ft. gauge connects all departments; spur tracks from the New Haven yards facilitate the movement of raw material and products; traveling cranes, pneumatic, electric and manual hoists and electric elevators are scattered throughout the works and all machinery is motor driven with the exception of the ventilating fans and air-compressor equipment. The building construction is of composite character, consisting of steel interior columns and main steel girders, with brick walls, timbered floors and plank roofs. Ribbed glass is used in all windows except in the lower sashes, and the natural lighting is remarkably effective, especially in the machine shop, which is supplied through a series of crosswise saw-tooth skylights with the glass facing due north. Fire protection conforms to the New England Factory Mutual standards or their equivalent. About 3,800 Grinnell automatic sprinklers are in service; fire hose is stored in red-painted boxes for emergency use; self-closing fireproof doors are installed between many of the departments; fire pails are frequent in conspicuous places, and a night watchman service is maintained. Water at 90 lb. per sq. in. is available from the Hyde Park system, and a 1,000 gal. per min. Blake Underwriter's Fire pump is installed in a house near the power plant.

The power plant was located about 250 ft. north of the shop buildings, so that the latter might be amply extended, with the former still near enough to reduce to a minimum the expense of conveying condensing and other water, transmitting steam, electricity and compressed air. The boilers are of Stirling make, with a total rating of about 1,000 hp, and the plant naturally contains mechanical draft apparatus and a Sturtevant economizer. The generating sets were built by the company and are at present two in number, 100 kw and 250 kw. The engines are of the vertical, cross-compound type and are operated condensing. A concrete tunnel 6 ft. 6 in. high and 5 ft. wide connects the power house with the various shops, and it contains all piping and transmission circuits. It is lighted by incandescent lamps controlled from the power house end—a point of considerable convenience when inspection and repairs are desired. The power house supplies all the steam used in the different buildings through an 8-in. 160-lb. line which branches to a minimum diameter of 2 in. in the pattern building with 2½ in. in the office building, and a 14-in. pipe carrying 5 lb. pressure to the various heating coils. The high-pressure steam is reduced to 80 lb. for the operation of fan engines, and the latter exhaust into the heating system, which is a typical Sturtevant installation. The testing department uses 160 lb. steam in its work upon compound, direct-connected sets.

All the electrical distribution is carried out upon the two-wire plan at 220 volts direct current for both power and lighting. The largest cable used in the ducts is 1,500,000 c.m. A maximum drop of 2½ per cent was figured between the power house and the load. General illumination is supplied by General Electric 110-volt enclosed arc lamps run two in series, and all special lighting is by 16-cp, 220-volt incandescents. The air compressor in the power house is a Laidlaw-Dunn-Gordon machine with compound steam and compound air cylinders, distributing air at 100 lb. pressure throughout all the shops. Junctions in the main 6-in. supply pipe provide for the different buildings, which are supplied by 3-in. pipes. Tools are supplied through 1-in. pipes and the air is widely used in drills, hoists, riveting hammers, chisels, snaggers, for blowing out generators, motors and cylinders.

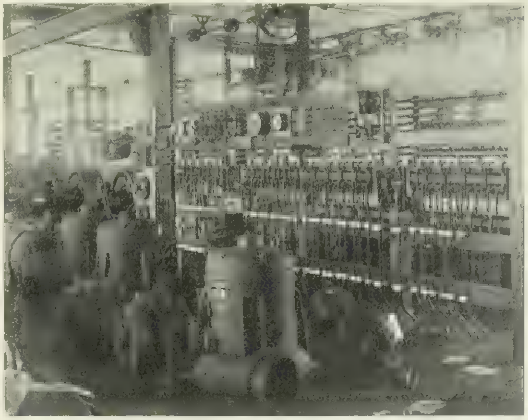


Fig. 2.—Switchboard and Motors in Testing Department.

There are about 100 electric motors in the plant, varying in size from ¼ to 40 hp, all being of the company's own make. Both group and individual driving of machines are in use. The tools are in general arranged to facilitate the direct progress of the work from the receiving ends of the shops toward the finished stores, erecting, testing and shipping departments. Machines, group driven, are as a rule operated in sets requiring about 20 hp, and a motor of this capacity is assigned to all such groups. The machines are as far as possible arranged in duplicate and space is left for additions in supplementary parallel rows. All motors above 10 hp are equipped with General Electric circuit-breakers, enclosed fuses being used in smaller sizes. Starting boxes and controlling switches are located either on posts close by the machines, or in the case of some connected motors, upon the machine frames. Practically all the motors used in group driving are hung from the ceilings. The starting boxes are equipped with self-closing doors lined with asbestos. The bench lighting is arranged so as to give each employee as far as possible left shoulder illumination. Incandescent lamps for this work are hung from porcelain rosettes attached to a horizontal wooden strip suspended upon wall brackets. The strip is about 10 ft. above the floor and the lamps, with attached downward reflectors, are about 1 ft. above the average man's head. At various points in the factory where power is required for testing or other temporary purposes, plug boxes are installed upon certain of the vertical columns within easy reach of the floor. These boxes are fitted with one jack on each side and with fuses or other circuit-breaking devices inside, self closing doors and asbestos lining.

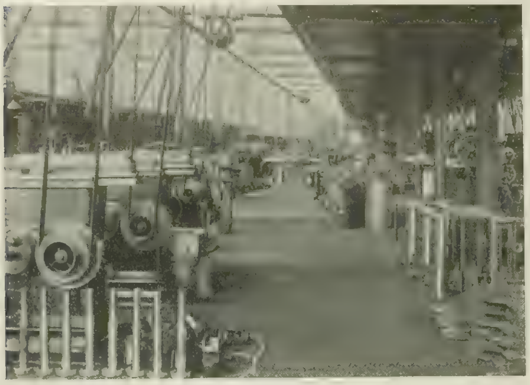


FIG. 3.—GROUP DRIVE IN MACHINE SHOP GALLERY.

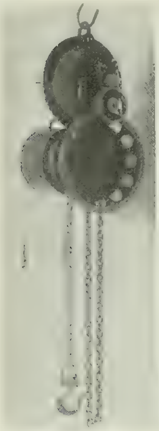


FIG. 4.—1-TON ELECTRIC HOIST.

Several motors are effectively used in the pattern shop and foundry. In the former, the flask shop band, cross-cut and splitting saws, boring drill machine and lathe are all driven by a 10-hp motor, while the carpenter shop or pattern-making division proper is equipped with two 10-hp motors which operate two band saws, a buzz planer and a double surfacer, five lathes, a drill press, core box machine and wood trimmers. Both these motors are required in ordinary work, one serving as a possible relay in case of accident. In the foundry, a 15 and two 20-ton Whiting electric traveling cranes are in regular use upon the two runways, and the floor between the runways is served by a number of 1½-ton electric traveling hoists with 10 ft. span, built especially for the work by the company. The cupolas are two in number, of Whiting make, 56 in. and 72 in. in diameter. The former is supplied with air by No. 8 Sturtevant pressure blower driven by a 30-hp motor, and the latter by a No. 10 blower driven by a 40-hp motor. In the brass foundry, blast for the furnaces is supplied by a No. 3 Monogram blower, and the entire machinery, consisting of a sprue cutter, a magnetic separator, a tumbling barrel and emery wheels, is driven by a 5-hp motor attached to the wall. A 5-ton three-motor electric Whiting crane serves the principal portion of the floor in the cleaning room. In the core department is a Blake wire straightener, driven by a 5-hp motor.

The more important direct-connected tools are located in the machine shop and fan and heater building, first floors. In the former, the principal machines direct-driven are:

1 Dietrick and Harvey 60 in., open side, 16-ft. planer, belted to 15-h.p. motor.
1 Dietrick and Harvey 72 in., open side, 18-ft. planer, belted to 20 h.p. motor.
1 Baush vertical boring mill, 6 ft. swing, back geared, belted to 1½ h.p. motor.
1 Baush vertical boring mill, 8-ft. swing, plain, belted to 10-h.p. motor.
1 Beaman and Smith horizontal boring mill, 5-ft. swing, geared to 2-h.p. motor.
1 Johnson lathe, 48-in. swing, geared to 7½-h.p. motor, speed variable.
1 Cincinnati planer, 60 in. x 48-in. x 16-ft., four heads, geared to 20-h.p. motor.
1 Landis grinder, driven by a 15-h.p. belted motor, with mechanical rheostat and control from working centre.
1 Bullard 76 in. boring mill, belted to 5-h.p. motor.
1 Chucking lathe, 3-h.p. geared motor.
1 Niles 60 in. boring mill, 2 heads, belted to 7½-h.p. motor.
1 Niagara circular shear, geared to 10-h.p. motor.
1 Bliss gate shear, geared to 15-h.p. motor.
1 set Hilles and Jones bending rolls, geared to 15-h.p. motor.

The latter machines and rolls will cut and fold plates up to 120 in. in length and width, and from ¼ in. to ½ in. in thickness.

All the elevators in the works are electrically driven by Sturtevant motors. Those in the shops and testing building are:

No. Maker.	Lftg. cap, tons.	Travel, feet.	Speed feet p. min.	Platform.	Motor. h.p.	Drive.
Fan Shop 2, Salem	3	32	50	7'3"x12'3"	10	belt.
Fan Shop 1, Morse	5	32	50	9'6"x12'8"	20	flex. coupl'g.
Mch. Shop 1, Morse	3	32	50	9'0"x12'8"	15	chain.
Mch. Shop 3, Morse	2	17	50	9'0"x10'4"	10	chain.
Test Bldg. 1, Morse	2	32	50	8'6"x8'4"	10	chain.

The principal travelling cranes are all of Whiting make, with Sturtevant motors. The machine shop is served by a 10-ton crane, span 37 ft. 7¾ in., lift 23 ft. 0 in., speed, motor hoist, 15 ft. per min., bridge travel, 350 ft. per min., trolley travel 120 ft. per min., motors, trolley travel 15-hp., hoist 15-hp, bridge travel 2½-hp. This crane serves the entire floor, handling large castings and forgings at one end, and at the other end depositing the substantially completed engine or generator upon a transfer car which passes through to the testing building, where a 15-ton crane picks up the machine, drops it upon the testing plate and subsequently carries it forward to the shipping department. The crane on this floor has a 36-ft. 7⅞-in. span, a 21-ft. 3-in. lift, main hoisting speed, 10 ft. per min., bridge travel 275 ft. per min., trolley travel 120 ft. per min., two 15-hp motors on the hoist and trolley travel, and a 2½-hp on the bridge. The fan shop is served by a 5-ton crane, which travels half its length, the floor height throughout the area being 32 ft., to provide for the construction of very large steel plate fans. This crane has a 36-ft. 11⅛-in. span, lift 23 ft. 4 in., speed 15 ft. per min., on main hoist, 7½-hp motor, 250 ft. per min. bridge travel, 2½-hp motor, trolley travel, 120 ft. per min., 7½-hp motor. An interesting feature of the fan shop is the storage of nearly 1,000 tons of plate iron on edge in diagonal alcoves just outside the building. By means of a small two-wheeled truck, built especially for this work, one man can easily handle plates of sheet iron 120 in. x 64 in. x ¼ in., weighing some 320 lbs., when formerly the plates had to be dragged about the shop by sheer force of muscle.

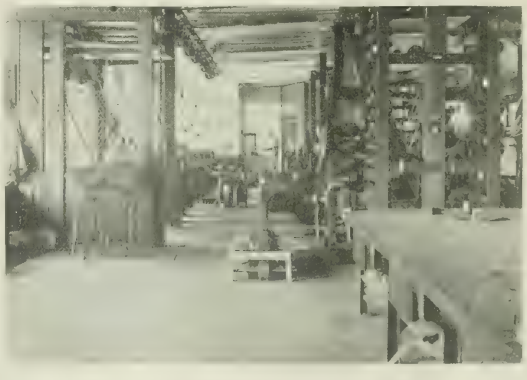


FIG. 5.—GENERAL VIEW OF WINDING DEPARTMENT.

Armature punchings and commutators are built up in the uppermost floor of the fan and heater shop, adjoining the testing building. The storage of commutators and parts is effected on divided pigeon holes, numbered according to the shop scheme for quick reference. The armature baking room is 40 ft. square, entirely fireproof, and it contains two steam heated baking ovens, fitted with sheet iron doors and discharge ducts. At the other end of the building is the special store room for electrical supplies. The balance of this floor and of the intermediate floor below is devoted to winding, assembling and testing. The electrical designs are worked out in the office building, and a remarkably complete card catalogue system of filing machine data is in service in that department. Cross references are liberally included so that any machine sent out can be at once identified, no matter how meagre may be the information returned by the correspondent. The essential data of the machines are filed in this manner, but the final detailed particulars are kept in a fireproof vault.

Heavy testing is mostly carried out upon the first floor. Here is a testing plate 30 ft. x 60 ft., completely equipped with steam and electrical connections; engines may be run condensing or non-condensing, and efficiency tests, compounding tests and heat runs conducted. Flexible and rigid pipe sections, portable belted tachometers, steam trap and electrical testing connections, movable racks of lamp banks, scales and water rheostats complete the equipment.

The winding department on the third floor is arranged conveniently with bench scales, reel frames, magnet connections at intervals of 20 ft., lamp banks and armature racks. The latter are group-driven, and the daylight supply is admirable. The testing magnet is mounted on a bracket attached to an upright column and is permanently driven by belting from an overhead line shaft. The special trucks used in handling armatures also deserve mention. Small travelling cranes and hoists are constantly in use on this floor, which is equipped with a floor plate for testing motors and blowers. A complete permanent switchboard forms part of the testing room equipment and all direct-current voltages from 80 to 550 are available for testing, as well as alternating voltages up to 2,500, the latter being used in insulation breakdown tests. On the rear of this board are circular bus-bars, to which flexible cables may be clamped as may be convenient. The variation in voltages is obtained by operating the motor generator sets shown at the left of the switchboard in the illustration. Portable test tables and lamp banks are available; a water rheostat plant is located on the roof, and instruments are stored in the office, which is being equipped for B-H curve tests upon samples of iron used in the machines. The foundry of the company supplies this material, which runs evenly most of the time, but which needs checking magnetically now and then.

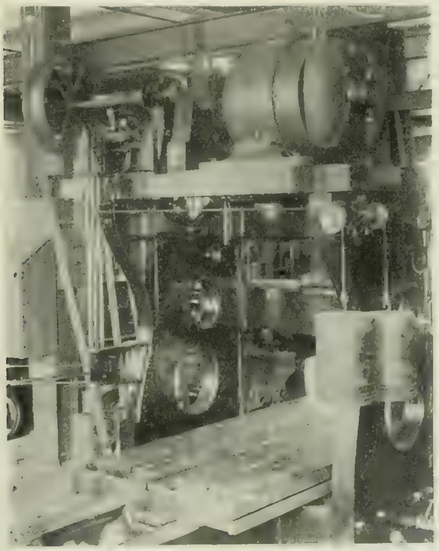


FIG. 6.—LARGE MOTOR-DRIVEN PLANER IN MACHINE SHOP.

The tests performed upon the equipment vary according to the specifications of the purchaser, but all the generating sets and motors are built to withstand the severe requirements of the U. S. Navy. All apparatus sold to the government is subjected to the exhaustive tests which the departments specify; but even commercial apparatus is put through heat runs, insulation, mechanical balances, frictional and commutating tests at the proper loads.

The requirements of the Bureau of Equipment, Navy Department, in regard to engine regulation, illustrate the severe conditions which have to be met in the construction of generating sets. The speed variation must not exceed 2½ per cent when the load is varied between full load to 20 per cent of full load, gradually or in one step, the engine running with normal steam pressure and vacuum. A variation of not more than 3½ per cent will be allowed when full load is suddenly thrown on or off the generator with constant steam pressure, either normal or 20 per cent above normal; a variation of not more than 3½ per cent will be allowed when 90 per cent of full load is suddenly thrown on or off the generator, with constant steam pressure at 20 per cent below normal; exhaust in both cases to be either into condenser or atmosphere. No adjustment of the governor or throttle valve shall be necessary during the above test to insure proper performance under any of the above conditions. The maximum weight of generating sets allowed varies from 560 lbs. in the 2.5 kw size to 22,000 lbs. in the 100 kw size. The water consumption must not exceed per kw-hr. at full load 105 lbs., 2.5 kw sets, and 31 lbs. 100 kw sets. The maximum allowable temperature rise in degrees C. above a room temperature of 25° is:

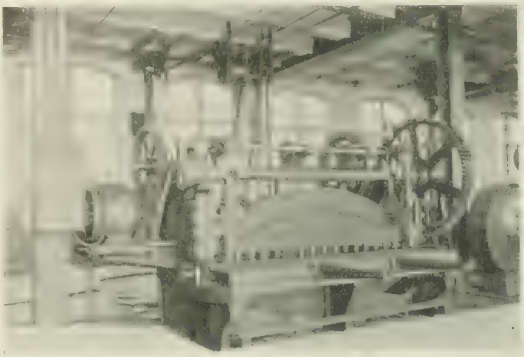


FIG. 7. MOTOR DRIVEN BLISS SHEAR.

Armatures, electrical measurement	33⅓ degrees
Commutator, thermometer measurement	40 degrees
Field coils, electrical measurement	33⅓ degrees.
Shunt rheostat, electrical measurement	75 degrees.
Series shunt, thermometer measurement	40 degrees

The minimum allowable generator efficiencies vary as follows, from the 2½ to 100 kw sizes:

K.W.	50% load.	75% load.	Full load.	1⅓ load.
2½	73	76	78	78
100	87	89	90	90

The Bureau of Construction and Repair of the Navy has recently issued complete specifications covering electrical appliances on shipboard, and a noteworthy feature of these is the new shop test of motor-driven fans, which is, of course, in use at the Sturtevant works. This test provides that in shop tests the set shall be erected with free inlet to the fan. To the fan outlet must be attached a pipe the size and shape of the outlet, whose length shall be not less than 20 diameters of the outlet for fans with round outlets or 20 times the average breadth and depth for fans with rectangular outlets. A double Pitot tube, designed to indicate the pressure produced by the impact of the moving air and the actual pressure in the moving air shall be inserted in the center of this pipe at about ½ its length, with the axis of the tube in the center line of the pipe. An adjustable throttling device shall be fitted to the end of the pipe and adjusted with the fan running at its normal speed, with motor fields hot, until the pressure of motor, in inches, shown by a manometer connected to the pressure side of the Pitot tube is not less than 13.4 times the weight per cu. ft. of the air in lbs. When this condition is obtained, the head of water in inches shown by the manometer connected to the impact side of the Pitot tube shall not be less than 17.4 times the weight of the air per cu. ft. in lbs. (as given by Bureau's tables). The wet and dry bulb thermometer must be placed in the current of air approaching the fan inlet. The object of this test is to show that the fan at full speed is capable of discharging air through a pipe the full outlet size against a pressure of 5 lbs. per sq. ft. with a minimum velocity of 2,200 ft. per min. at the center of the discharge pipe. The apparatus to record pressure direct, a pressure of 5.2 lbs. per sq. ft. is to be taken as equivalent to 1 in. of water. An 8-hr. heat run and 48 hr. endurance test follow.

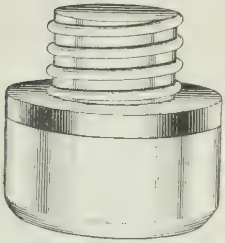
The architects and engineers for the B. F. Sturtevant Company were Messrs Lockwood, Greene & Company of Boston. The construction of the plant, including the design of the entire industrial equipment, the purchase of all building material, the hiring of all labor, was carried out by the Sturtevant company.

Eastern Hydro-Electric Plant.

The Chittenden Power Company's hydro-electric plant at East Pittsford is nearly completed. It will be one of the most complete stations of this class in western New England, and will cost $4,000,000. Three large turbines will be operated under a head of 208 feet and will drive three 40-kw. revolving field generators. The voltage will be 13,300. The Chittenden Power Company is allied with the Rutland Street Railway Company and one-third of the power developed at the new plant will be used in operating railway system, the remainder being available for commercial purposes. The system will include two sub-stations, one situated in East Pittsford, and the other at Castleton Corners, 12 miles away. At each substation the high-tension current will be reduced to 600 volts direct for the use of the railway. A Gould storage battery of 288 cells is also being installed in the sub-station in East Pittsford. The main generating station is a fireproof structure and is situated five miles east of East Pittsford. Each of the turbines is 72 horse-power, running at 500 r.p.m. Each is fed by a 30-in. penstock leading to a 5-ft. penstock from the dam. Pressure in the long penstock is hydraulically regulated by a cylindrical tank 15 ft. in diameter and 50 ft. long, situated on a steel tower 250 ft. high. The General Electric Company furnished all of the electrical apparatus.

The dam built at Chittenden, 15 miles east of East Pittsford, in connection with the plant, furnishes a head of 486 ft. The reservoir covers 800 acres, drains 15 square miles of territory, and has a capacity of 435,000,000 gallons. The masonry is 40 ft. high and has a spillway 100 ft. wide.

Weather-Proof Socket Plug.



WEATHER-PROOF SOCKET PLUG.

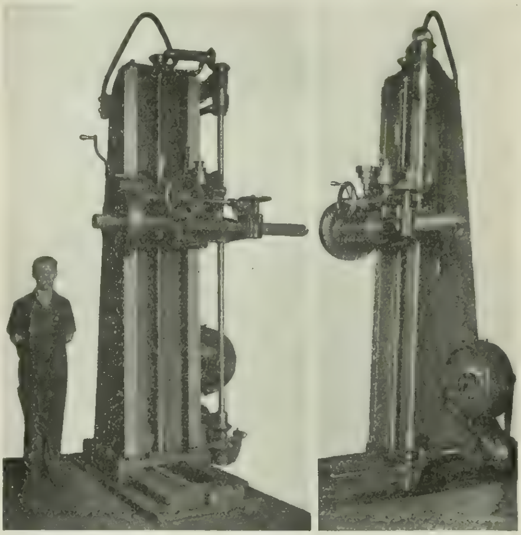
The socket plug shown in the accompanying illustration, has been designed as a substitute for an incandescent lamp in places where light is not needed throughout certain portions of the year, as in parks, summer resorts, and for sign work. Under ordinary circumstances when the lamps are removed, the sockets, which are left exposed to the elements, become badly corroded and cracked. The breakage resulting from this cause frequently amounts to a very large proportion of the total installation of sockets and receptacles, and the cost of new ones, together with the price of labor, necessary to replace them, forms a considerable item of expense. The socket plug illustrated is thoroughly weather-proof. A soft rubber gasket is interposed between the plug and socket, thus making an absolutely water-tight joint. These plugs are manufactured by the Weather-Proof Socket Plug Company, 1229 Real Estate Trust Building, Philadelphia.

Expansion Connection Carbon Brush.

Attention has recently been called to an improvement in carbon brushes, which is being introduced by the National Carbon Company, Cleveland, O. It is known as an expansion connection brush, and consists of a carbon brush, of any size, having a hole drilled into it, penetrating about one-half of the length of the brush. A piece of plaited flexible wire, terminating in a cable shoe, is unraveled at the end opposite to the cable shoe, and this miniature wire net is formed cylindrically around a little brass sleeve. This sleeve is of the same length as the hole in the carbon brush, and is slotted over two-thirds of its length. The slot is tapped so that the closing screw fitting into the slot is forced into a tapering hole. The resistance with which the screw meets on account of this tapering is overcome by the sleeve expanding, so that the whole appliance acts as a wedge when the screw is inserted, making a very close and rigid contact between the flexible wire and the interior of the brush, which is even increased through expansion of the metallic parts, should the brush become slightly heated while in use. This flexible connection is very easily detached, and can be connected to a new brush, simply by use of a screw driver, obviating the necessity of attaching by means of the soldering process. This connection is so arranged that the distance between the commutator surface and the terminal connection is reduced to a minimum, thereby reducing the carbon resistance between these points, resulting in obtaining a higher efficiency and a lower loss between the commutator surface and the end of the connection.

New Portable Boring, Milling and Drilling Machine.

The Espen-Lucas Machine Works, Philadelphia, have just put on the market several portable machine tools for use in large electrical manufacturing plants, one of which, a 72-in. portable boring, milling and drilling machine, is shown herewith. It is a very rigid and heavy tool, built to carry an 18-in., high-speed, steel, inserted-tooth cutter head. It has a very large range of speeds covering all the needful feeds for drilling small holes as well as boring large ones. The spindle, which is made of hammered crucible steel, is 4 in. in diameter and feeds through a gun metal sleeve, having 24 in. of feed. It has a No. 6 Morse taper hole in the end, and also a pin hole for retaining the bars and milling tools in place. The head has a vertical adjustment of 72 in. and can be securely clamped in any position for milling. The column carrying the spindle head has feed in both directions, giving 24 in. to the spindle-head for milling. The spindle has feed in either direction for boring and counterboring, and is very powerfully geared for heavy work. The machine shown in the cut is driven by a 3 to 1 variable-speed Crocker-Wheeler motor. The gearing is made of hammered crucible steel cut from the solid and the bearings are all lined with bronze.



PORTABLE BORING, MILLING AND DRILLING MACHINE.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Most favorable reports were made from all sections, and the sentiment in jobbing trade and the industries was more uniformly favorable than during any previous week this year. Crop reports are reassuring, the absence of frost being the favorable feature. Fall trade is now well under way and mercantile payments are unusually prompt for the season. Manufacturing plants in the leading industries are receiving large orders, a heavy tonnage of iron and steel business being placed, and machinery houses make very cheerful reports. As grain comes to market more freely there is difficulty in averting freight blockades, and railway earnings thus far available for September exceed last year's by 2.5 per cent. Foreign commerce at the port of New York for the last week showed a gain of $532,846 in imports, but a loss of $4,068,163 in exports. Bank exchanges at New York were 21.6 per cent larger than a year ago, and at other leading cities the gain averaged 10 per cent. Building material, particularly lumber and hardware, still reflects unprecedented activity for this season of the year. Labor is well employed, and reports of a scarcity of help come from widely separated points. Chicago had the banner week of the year in jobbing trade; St. Louis reports trade exceeding that of last year, and at Indianapolis the outlook is reported as highly satisfactory. On the Pacific coast trade is at its best, and the activity in railroad building in that section stimulates demand for labor. The copper market is still dull and without animation, but some brokers were able to secure fair size contracts at the ruling figures of 16 to 16½c. for Lake and electrolytic, and 15¾c. for casting stock. The business failures for the week ending September 21, according to *Bradstreet's* figures, were 173 against 188 the week previous and 203 in the corresponding week last year.

OCEAN SHORE RAILWAY.—The Ocean Shore Railway Company, which recently let contracts to C. E. Loss, of New York, for the construction of its 81-mile double track electric railway, connecting Santa Cruz with San Francisco, is in the market for the electric equipment of its initial installation. The call for proposals issued by Sidney Sprout, the company's electrical engineer, includes 40 car equipments of four 125-hp direct current motors each, multiple control system. The sub-stations call for ten 500-kw, 25-cycle, rotary transformers, 550 to 650 volts on direct current side, and thirty 250-kw static transformers. Eight of the sub-stations will be located at points on the line according to the load, while two will be mounted on cars so as to be portable. One rotary and three static transformers will occupy each sub-station. The main power station will be erected at Balboa, a new town, one mile north of Halfmoon Bay, near the water, so that a salt water pumping system can furnish condensing water for the engines. Two 2,000-kw, three-phase, 2,300-volt, 25-cycle generators are called for, each to be direct-connected to a vertical condensing engine. Seven step-up transformers, to 30,000 volts, will be required, three to each generator and one extra. There is an alternative of three 1,500-kw generators with three engines, and ten 750-kw transformers. Switchboards for generating and sub-stations are to be included in the proposals, as well as exciters and auxiliaries. Water-tube boilers are specified, equipped for burning oil fuel. The company's capital stock is $5,000,000, and the road when completed and fully equipped will represent an expenditure of nearly $6,000,000, it is said. W. E. Dean is president and A. D. Bowen, general manager of the company, which occupies an office building at 561 California Street, San Francisco.

CHICAGO PNEUMATIC TOOL.—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has returned from Europe. He states that the foreign business promises, during the next few years, to rival the American business. The American factories are all running to their maximum capacity night and day, and although a number of the latest improved automatic machines have recently been installed at each factory, they are unable to keep pace with the business offering, and further improvements are to be made at an early date. Mr. Duntley brought home with him orders for several hundred air cooled Duntley electric drills. The bulk of the orders for electric drills are coming from fields heretofore impossible to interest in the air tools. While he was in England and on the continent several tests were made with the result that the sample tools demonstrated by Mr. Duntley accomplished the work in a satisfactory manner. Domestic inquiries are extremely heavy for all classes of tools and appliances, as well as compressors, as many as forty compressors being quoted upon in a single day. Several large orders for compressors and tools have been received recently.

RUSSIAN ELECTRICAL TRADE.—The removal of retaliatory duties on American imports has already proved a great stimulus to American trade here. The agents of American houses have wired directions for the shipment of engines, pumps and other machinery. This prompt action of the agents is necessary in order to land goods at Cronstadt before the close of navigation, so as to avoid the heavy costs of railroad trans-shipment from the ice-free ports in the southern Baltic, and also in order to take advantage of the favorable rates under existing treaties, as before navigation is reopened the new and higher scale of duties based on the treaty recently made with Germany will be in effect. This treaty provides increases ranging from 10 to 20 per cent on machinery. The manufacturers of electrical machinery, expect that export business will be greatly benefitted by the recent order of the Czar. An official of the Westinghouse Electric & Manufacturing Company states that the return of peace will allow a large number of Russian projects, which were on foot before the war, such as the electrification of the St. Petersburg street railways, to be renewed, and that American concerns should get a large share of the business. Heretofore, German and Swiss firms have been generally the successful bidders in this field.

EQUIPMENT FOR APARTMENT HOTEL.—A twelve-story annex, 64 ft. front by 100 ft. deep, is to be built to the Hargrave Hotel, 104 West 72d Street, New York City. The Oak Realty Company is the owner; Frederick C. Browne, 145 West 125th Street, is the architect. Percival Robert Moses, electrical engineer, 320-322 Fifth Avenue, has been retained as consulting engineer. The present steam, electric and refrigerating plant of the Hargrave will be reinstalled in a central location to supply the two buildings, and additional equipment of one 100-hp boiler, one 13 in. x 12 in. simple automatic high-speed horizontal engine, direct-connected to a 60-kw compound-wound multipolar direct current, 240-volt generator, with 50 amp. shunt-wound motor-dynamo balancer, and two passenger elevators will be installed.

CHARLES E. DUSTIN COMPANY, dealer in electrical and steam machinery, 11 Broadway, New York, with storehouses located formerly at Orangeburg, N. Y., has secured the large works formerly occupied by the Spiral Riveted Tube Company, Fiske and Mallory Avenues, Jersey City, N. J., together with all the buildings. It has moved all its material from Orangeburg, the new works having been fully fitted for the purpose of handling and storing electric generators, steam engines, boilers and all forms of electrical and steam machines. There are four buildings and about 1½ acres of land, reached directly by a side track of the Central Railroad of New Jersey.

ELECTRICALLY DRIVEN PUMPS.—Chief Engineer De Verona of the Department of Water Supply has reported to Commissioner Oakley in favor of the D'Olier Engineering Company, which was the lowest bidder for the eight electrically driven pumps for the high-pressure fire service stations in course of construction in Brooklyn. Five of the pumps are for the station at Joralemon and Furman Streets and three for the station at Willoughby and St. Edwards Streets. A protest against the award on the ground that the D'Olier Company is a foreign corporation was overruled.

NEVADA MINING POWER PLANT.—The Allis-Chalmers Company will supply two 750-kw three-phase generators and direct-connected engines; also a large blowing engine to supply air to the roasting furnaces for the boiler plant of the Nevada Consolidated Copper Company's electric mining installation at Ely, Nevada. Chas. C. Moore & Company, of San Francisco, have secured the contract for four 400-hp Babcock & Wilcox boilers, with condensers, economizers and superheaters.

TELEPHONY IN NEW YORK.—The increase in the number of stations which the New York Telephone Company had in use or under contract for the month of August was 4,456. The total number of stations in use in the five boroughs of New York was 220,155. This gives about 55 telephones to 1,000 inhabitants. The average for the country is about one telephone per 34 persons.

THE COLUMBIA BATTERY COMPANY has recently been organized at Milwaukee, Wis., to manufacture storage batteries, by a new process. The batteries have been in use in Milwaukee for some little time and have given such excellent service that it has been determined to exploit the cell. The office of the company is at Third and State Streets, the capital stock being $10,000.

APPARATUS FOR CHILI.—The Compania de Luz Electrica de Concepcion, of Concepcion, Chili, Arturo Lotzin, manager, wishes to get catalogues, price lists and discount sheets of electrical apparatus, fittings, machinery, turbines, carbons, etc.

DEMAND FOR MECHANICAL STOKERS.—That the mechanical stoker has reached such a state of perfection as to be considered indispensable in the equipment of most modern boiler plants is indicated by the large number of orders booked by the Westinghouse Machine Company for the Roney stoker, a type of its exclusive manufacture. In ten years this company has developed the Roney stoker by successive improvements until it has become capable of meeting successfully all the requirements of heavy modern service. During the past month orders have been received for no fewer than 51 Roney mechanical stokers, ranging in size from 54-in. x 20 grate to 132-in. x 26 grate, the largest of the orders being that of the Pennsylvania Railroad for six 132-in. x 26 grate stokers and five 100-in. x 20 grate stokers. A large order from the Ohio Hospital for Epileptics at Gallipolis has also been received; and others from the American Bridge Company, Ambridge, Pa.; National Tube Company, Pittsburg, Pa.; Detroit United Railway Company, Detroit, Mich.; York Engineering Company, York, Pa.; Proctor & Gamble Company, Cincinnati; the Union Rolling Company, Cleveland, O.; Gulfport & Mississippi Coast Traction Company, Gulfport, Miss.; United Presbyterian Board of Publication, Pittsburg, Pa.; Indiana Boys' School, Plainfield, Ind.; B. & O. office building at New York City, and the Railway Exchange Building at Chicago, Ill.

BIDS FOR NAVY SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until October 10, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., dynamotors, motors, conduit, testing sets, electrical supplies, rheostats, etc.; also October 17 at the navy yards at Mare Island, Cal., and Puget Sound, Wash., motor, electric wire and fittings, conduit cable, motor drive outfit, electric traveling hoist, air hoist, steam separator, windlasses, etc.; also October 31 at the navy yards at Mare Island, Cal., and Puget Sound, Wash., motors, wattmeters, electric traveling crane, electric traveling hoists, pumps, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

THE BARRIETT ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has been incorporated to manufacture all kinds of electrical machinery and apparatus. The officers are: E. Shideler, president; E. N. Laralde, vice-president; L. K. Behrens, secretary and treasurer, and C. H. Haddrell, general manager. The Barriett Electric Manufacturing Company has succeeded to the business of the Barriett Electric Company, and will continue the manufacture of motors and generators. The business will be considerably extended. Direct coupled motor-driven blowers and buffing lathes have now been added to the standard lines manufactured.

CALIFORNIA TRANSMISSION.—H. H. Sinclair, of the Edison Electric Company, of Los Angeles, has gone East and will make a tour of the leading manufacturing plants before closing contracts for the long transmission line from the Kern River to Los Angeles. It is proposed to have about 1,100 steel towers, many of which will be 60 feet in height, to support the wires. Thirty thousand horsepower will be developed, there being a head of 825 feet at the power house site.

UNDERGROUND CABLE BIDS.—Bids will be received by the Committee on Electricity of the Common Council and Board of Aldermen, Lynchburg, Va., until October 9, for the manufacture and delivery of underground, alloy-covered cables for the electric signal circuits of the fire department and police patrol systems. For further particulars apply to W. L. Kent, city electrician.

LAVA INSULATORS IN CANADA.—The D. M. Steward Manufacturing Company of Canada, Toronto, has been incorporated with a capital of $40,000, to manufacture gas burners, electrical insulators, crayons etc. The provisional directors include C. S. Steward, of Chattanooga, Tenn.; W. H. Frazier and S. L. Ezell, of Toronto.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for telephone exchange switchboards for the following places: Marathon, Wis.; Rose Hill, N. Y.; Watson, Mo.; Tolo, Oregon; Niagara Falls South, Ont., Can.

THE SOLVAY PROCESS COMPANY, Syracuse, N. Y., is to install a unique air heater in the form of a special economizer built by the B. F. Sturtevant Co., of Boston, Mass. This is designed to heat nearly a million cubic feet of air per hour from about 70° to 600° F.

LAMP BIDS.—Bids will be received until October 5 by M. C. Martin, chief quartermaster, U. S. A., for furnishing and delivering at Chicago 55,000 incandescent electric lamps.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was generally strong under bullish manipulation, the leading railroad shares showing decided strength. United States Steel stocks were active and were freely bought. The actual developments of the week, apart from the additional gold importations, did not have any particular influence on prices. There was little disposition to take up the railroad specialties and that portion of the list suffered somewhat from such neglect. The electric securities received little attention and were quiet throughout the week. Brooklyn Rapid Transit was the only exception in point of activity, 104,800 shares having changed hands at prices ranging between 68⅜ and 71¾, the closing price being 70½. This is a net gain of 1⅛ points. Metropolitan Street Railway fluctuated between 126¾ and 129, closing at 128⅜, a net gain of ½-point, while Interborough Rapid Transit declined a like amount, closing at 213½ ex-div. Allis-Chalmers common made a net gain of ½, closing at 17¾, but preferred is unchanged at 58. General Electric touched 183 during the week, but lost some of the gain and closed at 179½, which represents a net loss of ⅜-point. Westinghouse common is at 170, an increase of 4 points. Western Union is a shade lower and American Telephone & Telegraph 2½ less than a week ago, the closing prices being 93¼ and 140, respectively. American Telegraph & Cable sold at 93, a net gain of 3¾. Prices on the "Curb" were generally higher compared with the week before. There was a break in Chicago Subway due, it is supposed, to efforts to distribute stock for which there is apparently not much public demand. Following are the closing quotations of September 26:

NEW YORK

	Sept. 19	Sept. 26		Sept 19	Sept. 26
Allis-Chalmers Co	17¾	18⅝	General Electric........ ...	180¼	182
Allis-Chalmers Co. pfd.. .	59⅛	58¾	Hudson River Tel...... ...	..	..
American Dist. Tel.........	30	30	Interborough Rap. Tran...	215	212
American Tel. & Cable....	92	92	Mackay Cos......	41⅛	43
American Tel. & Tel... ...	139	138	Mackay Cos. pfd....... .	74⅛	74¼
Brooklyn Rapid Transit....	68⅝	72	Marconi Tel................	..	..
Electric Boat...............	30	30	Metropolitan St. Ry........	126⅞	125⅝
Electric Boat pfd.	70	70	N. Y & N. J. Tel....	..	..
Electric Lead Reduction. .	..	..	Western Union Tel.........	94½	93¼
Electric Vehicle.	18	17	Westinghouse com.	167	169¼
Electric Vehicle pfd........	23	22	Westinghouse pfd.....	..	..

BOSTON

	Sept. 19	Sept. 26		Sept. 19	Sept. 26
American Tel. & Tel	139	140⅛	Mass. Elec. Ry. pfd........	58½	56
Cumberland Telephone.. .	120½	119⅛	Mexican Telephone.........	1⅛	1¼
Edison Elec. Illum.........	250	247⅛	New England Telephone...	134⅛	136
General Electric....	179	181	Western Tel. & Tel.........	*18	16
Mass. Elec. Ry.............	15⅛	14	Western Tel. & Tel. pfd...	97	97

PHILADELPHIA

	Sept. 19	Sept. 26		Sept 19	Sept. 26
American Railways...	52	52½	Phila. Electric........... .	8¾	8⅞
Elec. Co. of America . .	11	11	Phila. Rapid Trans....	28	27½
Elec. Storage Battery......	85	85	Phila. Traction.	..	100¾
Elec. Storage Battery pfd...	.	..			

CHICAGO

	Sept. 19	Sept. 26		Sept. 19	Sept. 26
Chicago City Ry............	190	195	National Carbon............	60	60
Chicago Edison.............	..	..	National Carbon pfd.......	115⅛	114½
Chicago Subway..	..	..	Union Traction.......	..	..
Chicago Tel. Co	..	..	Union Traction pfd........	..	..
Metropolitan Elev. com....	25	25¼			

* Asked.

INTERBOROUGH INCOME.—The Interborough Rapid Transit Company, which operates the subway and the Manhattan elevated lines in New York, has issued its report for the year ended June 30, at which time the subway had been in operation eight months and five days. The net earnings for the year were $9,439,986, an increase of $1,098,352 as compared with last year, when only the elevated lines were operated. The gross earnings were $16,837,370, an increase of $2,649,685; operating expenses, $7,379,384; increase, $1,551,333; net earnings, $9,439,986; increase, $1,098,352. Other income amounted to $491,040, an increase of $149,536. Expenditures for interest and rentals aggregated $2,443,371, an increase of $621,191. The dividends of $2,362,500 on Interborough stock for 1905 showed an increase of $1,662,500. Operating expenses increased from 41.20 per cent to 43.93 per cent.

NILES-BEMENT-POND.—Negotiations have been carried through for the acquisition by the Niles-Bement-Pond Company of the plant and business of the John Bertram & Sons Company, Limited, of Dundas, Ont. About $300,000 will be spent in improvements to the property. The common stock of Bertram & Sons, as increased from $200,000 to $400,000, will all be owned by the Niles-Bement-Pond Company. The 6 per cent cumulative preferred stock will be increased about October 1 from $100,000 to $200,000, and, it is understood, will be held by the public, the new shares, of a par value of $100, having all been subscribed.

INDEPENDENT TELEPHONY.—A certificate showing increase of capital stock from $500,000 to $50,000,000 by the New York Independent Telephone Company has been filed at Albany. The stockholders signing the certificate, which is acknowledged in Monroe County, are Harrison C. Durand, Harry C. Sickels, William F. Dwyer, J. Henry Howe, Arthur C. Frith, George S. Bixby and George R. Fuller.

INDEPENDENT TELEPHONE CONSOLIDATION.—In connection with the tour of independent telephone men, an account of which was given in last issue, comes the statement from Rochester, N. Y., that the consolidation of independent telephone interests from the Atlantic to the Pacific is practically assured. Rochester men will take a prominent part in the deal, and the Stromberg-Carlson factory in that city, it is stated, is to be the headquarters for their apparatus for the entire country. Circulars have been mailed by the Alliance Bank, Rochester, to all the stockholders of the Stromberg-Carlson Company and of the Rochester Telephone Company, outlining the plan of consolidation with the United States Telephone Company of New Jersey, which has been organized as the "holding company," to take over control of all of the independent telephone companies in the United States. The capital stock of this company is stated to be $50,000,000. Bonds will be issued to cover the cost of every independent plant in the United States included in the scheme. Information comes from St. Louis to the effect that the consolidated interests will establish a factory plant in that city similar to the one in Rochester, from which the Western section of the United States will be supplied with apparatus, the Rochester factory taking care of the supply in the Eastern section. The St. Louis company, it is stated, will have a capital of $5,000,000.

NEW HAVEN RAILROAD BONDS.—The New York, New Haven & Hartford Railroad stockholders of record on Dec. 1, 1905, will have the right to subscribe to an issue of convertible debenture certificates amounting to $30,000,000 in the ratio of $37.50 par for each share of stock held by them. Payments are to be at the rate of 35 per cent, beginning Jan. 1, 1906, and 25 per cent at the end of each nine months thereafter. The debentures at a par of 150 will be convertible five years from the date of issue for stock of the company at a par of 100. The purpose of the plan is to retire temporary obligations of the company and to absorb the outstanding securities of subsidiary lines. As a result of this new issue of debentures the stock of the company, five years after the issue, will be raised from $80,000,000 to $100,000,000. Among the improvements recently undertaken by the New Haven is the electrification of the New York end of its main line in connection with the similar improvement undertaken by the New York Central. Much work has also been done on the New Haven's main line between New York and New Haven. Practically all the bridges on this section of the road are being reconstructed. It was found that the bridges were unable to bear the heavy traffic carried over the road, and heavier steel bridges are being substituted. The New Haven has spent recently large sums in the purchase of electric lines which at many places competed with it for local traffic.

SAN FRANCISCO GAS & ELECTRIC.—The directors of the San Francisco Gas & Electric Company have undertaken to place all of the shares of that company with the Union Trust Company, to be held in escrow until the purchase is completed. The purchasers, who are said to be connected with the Rockefeller group of interests, have deposited $500,000 with the Trust Company as a guarantee that they will carry out their part of the contract. The price to be paid is said to be $25 cash and $65 in 5-per cent bonds for each share of the gas company's stock. At the rate of $90 per share, the purchasers will pay for the 158,484 shares $14,263,560, of which $3,962,100 is in cash and $10,301,460 in bonds. When the negotiations were commenced the shares were selling at about $54 and the price steadily advanced until it reached $80 recently. There were some sales at $80.75. By placing the stock in escrow the necessity of holding a special meeting of the stockholders and securing a two-thirds vote in favor of the sale is obviated. What position the Mutual Electric Light Company will take cannot be stated yet, although the advance in its shares has led to reports that some of its stockholders were in favor of taking up a merger proposition.

DIVIDENDS.—The Central & South American Telegraph Company has declared the regular quarterly dividend of 1½ per cent. The Mexican Telegraph Company has declared the regular quarterly dividend of 2½ per cent. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred and the assenting and non-assenting stocks, payable October 10. The directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable November 1. The American Telephone & Telegraph Company directors have declared the regular quarterly dividend of 1½ per cent, payable October 16. The regular quarterly dividend of 1¼ per cent on the preferred stock of the United Railroads of St. Louis has been declared, payable October 10. The directors of the Electric Storage Battery Company have declared the regular quarterly dividend of 1¼ per cent on both stocks, payable October 2. The Union Switch & Signal Company's directors have declared the regular quarterly dividends of 2 per cent on the common stock and 2½ per cent on the preferred stock, both payable October 10.

HUDSON RIVER TUNNEL RAILWAY.—The Newark & Hackensack River Railway Company and the Hackensack River Railway Company, each affiliated with the scheme to tunnel the Hudson River between New York and Jersey City, have been incorporated. Each of the companies has an authorized stock of $1,000,000 and the incorporators of each are the same. They are Thomas N. McCarter, president of the Public Service Corporation; Charles A. Sterling, East Orange; Albert H. Charlton, Elizabeth; John J. Burleigh, Merchantville; Anthony R. Kuser, Bernardsville; Thomas C. Barr, Orange, and Mark T. Cox, East Orange. The Newark & Hackensack River Railway Company is to construct a trolley line from Park Place, Newark, to the Hackensack River. The Jersey City & Hackensack River Railway Company is to continue the line from that point to the intersection of Erie and Fourteenth Streets, Jersey City, where it is to connect with the proposed line of the Interstate Tunnel Railway Company, which in turn is to construct the tunnel to the middle of the North River connecting with the affiliated company incorporated in New York State. Lew Bloom and Jane Cooper, presenting their original playlet, "A

ANNUAL REPORTS.—Following are condensed reports of three of the Stone & Webster properties for the year ending July 31, 1905: Edison Elec. Illum. Co., of Brockton, Mass.; gross earnings, $134,493.71, increase, $22,965.89; operating expenses, $93,033.32, increase, $130,730.07; net earnings, $41,460.39, decrease, $7,764.18; interest charges, $8,651.52, decrease, $4,855.15; net profit, $32,808.87, decrease, $2,909.03. Lowell Electric Light Corporation, Lowell, Mass.: Gross earnings, $248,127.24, increase, $14,939.50; operating expenses, $146,738.80, increase, $4,602.73; net earnings, $101,388.44, increase, $10,336.77; interest charges, $11,333.66, decrease, $5,074.54; net profit, $90,054.78, increase, $15,411.31. Minneapolis General Electric Company, Minneapolis, Minn.: Gross earnings, $695,825.11, increase, $97,059.68; operating expenses, $346,405.01, increase, $31,849.44; net earnings, $349,420.10, increase, $65,210.24; interest charges, $112,823.27, decrease, $3,583.51; net profit, $236,596.83, increase, $68,793.75.

ELECTRIC REFINING DEAL.—It is stated from Philadelphia that the reported lease of the copper plant of the Lake Superior Corporation to the Canadian Nickel Company, a concern organized for the purpose of refining copper and nickel by electricity, has been confirmed by Francis B. Reeves, a Philadelphia director of the corporation. Regarding the lease Mr. Reeves said: "While the corporation should have really received $2,000,000 from the Canadian government it really received but $1,000,000. Although the credit of the corporation is excellent it did not seem wise at this time to take money from the steel and pulp mills which are doing excellently to develop the copper and nickel refining process, and it has closed a lease with the Canadian Nickel Company, made on favorable terms for the Lake Superior Corporation."

BOSTON EDISON REPORT.—The Edison Electric Illuminating Company, of Boston, has filed its annual report with the gas and electric light commissioners. The financial operations for the year ended June 30, with comparisons, are here given:

	1905.	1904.	1903.
Gross	$3,346,027	$3,125,517	$2,667,809
Expenses	2,177,974	2,055,756	1,418,456
Net	1,168,052	1,069,761	1,249,353
Other income	100,876	138,325	35,549
Total net	1,268,928	1,208,046	1,284,962
Charges	182,824	203,338	188,554
Balance	1,086,104	1,004,708	1,096,348
Dividends	1,070,770	973,405	804,667
Total surplus	67,508	71,934	352,632

BELL TELEPHONE BONDS.—It is stated from Boston that President F. P. Fish, of the American Telephone & Telegraph Company, and Robert Winsor, of Kidder, Peabody & Company, have been together in London and that this conference has some connection with the future financing of the American Telephone Company. It will be recalled that when the company issued its $25,000,000 4 per cent bonds last March, $10,000,000 of these bonds were sold abroad and they have not been resold to this country. Europe will be looked to in the future to help finance the telephone company's development, which is now taking place at a greater rate than ever.

CAMBRIDGE, MASS., LIGHT.—The report of the Cambridge Electric Light Company for the year ended June 30, compares as follows:

	1905.	1904.	1903.
Gross	$233,108	$225,510	$198,062
Net	112,061	97,978	55,185
Dividends	56,000	36,000	31,500
Surplus	56,061	61,970	23,685
Charges	22	42,140	13,254
Surplus	56,039	19,830	10,431

INVESTMENTS IN JAPAN.—According to reliable statistics, the amount of foreign capital invested in Japanese industries at the beginning of the war was only $1,000,000. The Tokio Electric Light Company and the Hokkaido Colliery & Railway Company have respectively successfully negotiated foreign loans of $1,500,000 and $5,000,000.

General News of the Week

The Telephone.

NEW CASTLE, ARK.—The Mercantile Telephone Company, of New Castle, St. Francis County, has been incorporated with a capital stock of $17,000. The names of the officers are: President, F. J. McDougal; vice-president, W. J. Dillon; secretary and treasurer, E. L. Horton.

TEXARKANA, ARK.—The Southwestern Telegraph & Telephone Company at a meeting of the City Council on the Arkansas side formally accepted the franchise granted by the city for operating and extending its business in this city and vicinity. One of the specifications in the franchise is that all wires in the business part of town must be put underground.

CALISTOGA, CAL.—A telephone franchise has been granted to C. M. Hoover.

SONORA, CAL.—The Standard Lumber Company has decided to install a dynamo to supply the town with electric light during such time as the water power may be shut off.

SAN FRANCISCO, CAL.—The consideration of the Alameda Home Telephone Company's application for a franchise has been postponed until Sept. 25 by the City Council of Oakland. A committee will be sent to Los Angeles to look into the operation of the Home Telephone Company's automatic system there before that date. Attorney J. J. McDonald, representing capitalists of other cities, has filed an application for a franchise, offering to invest $900,000 within three years and agreeing to pay to the city 3 per cent of the gross receipts after three years.

EAST ST. LOUIS, ILL.—The Bell Telephone Company has started excavating for the foundation of the new telephone exchange and office building at Eighth street and Missouri Avenue. This will be the second building to be erected by the Bell company in East St. Louis.

AURORA, ILL.—At the annual meeting of the Interstate Telephone & Telegraph Company, held Sept. 11, the seventeenth regular, quarterly dividend of 1 per cent was declared on the entire capital stock. The report for the fiscal year ending June 30, showed an increase of nearly $20,000 in the surplus over and above fixed charges, including interest and dividends.

SHIRLEY, IND.—Elam Leary, of this city, and others have purchased all the property and rights of the Shirley Telephone Company.

SOUTH BEND, IND.—The City Attorney has brought suit against the Independent Long Distance Telephone Company and the Western Union Telegraph Company to enforce an ordinance requiring all wires to be placed underground and to collect a penalty of $25 to $100 per day since June 1. It is claimed that all other telephone and electric light companies have complied with the ordinance.

DARLINGTON, IND.—The Cooperative Telephone Company, of Franklin and Sugar Creek townships, has consolidated with the Home Telephone Company, of Darlington. The latter is supposed to be owned by the Bell interests. This will give the Bell subscribers access to the Cooperative, but for the present at least the Home Telephone Company, of Crawfordsville, will continue to connect with them also.

INDIANAPOLIS, IND.—Three new telephone companies have filed articles of incorporation with the Secretary of State. The Home Telephone Company, of Flora; H. E. Soesbe, H. E. and Joseph Studebaker are the incorporators. The Home Telephone Company, of Hancock County. The headquarters will be in Greenfield. A. T. Reevey, M. E. Dobbins and S. A. Wray are the incorporators. The Citizens' Telephone Company, of Shirley; W. B. Thompson and Harry Griffith are the incorporators.

KOKOMO, IND.—The Citizens' Telephone Company has endeavored for some time to get its franchise amended so as to remove the prohibition to enter into a combination with the Bell Telephone Company. Failing in this the company has served notice of an increase of 25 cents a month on resident telephones; also that subscribers will be required to pay quarterly in advance. The rate on residence telephones has been $1.25 a month ever since the system was installed. The franchise under which the company operates grants the right to charge $1.50 a month for residence telephones, and this may have to be submitted to, but the payment quarterly in advance will be bitterly oposed.

FORT WAYNE, IND.—Following out the plan of organization adopted at the Winona meeting, July 12, when the Indiana Independent Telephone Association was organized, several districts have held meetings. The representatives of this, the Second district, held a meeting here on Sept. 12, the Tenth district at New Albany on Sept. 18, and the Ninth district at Princeton on Sept. 20. These meetings were all well attended and much interest manifested in the plan of organization. The meeting of the Seventh district will be held in Indianapolis, Sept. 27, and that of the Eighth district at Cambridge City, October 12. The State Association has eleven vice-presidents, each one of whom is president of his district association. George W. Beers, of Fort Wayne is president, and C. S. Norton, of Indianapolis, secretary of the State Association.

MARION, IND.—There was formed in this city on Sept. 21 a new combination of independent telephone interests, including the Converse Telephone Company, Winchester Telephone Company, Delaware & Madison County Telephone Company, of Muncie, and the Home Telephone Company, of Fort Wayne—four of the strongest telephone companies in Northeastern Indiana. Some of the most prominent men of the State are interested in the new combination. It is the purpose of the new organization to ask a franchise in Marion and to establish a plant here in opposition to the Central Union and United Company now operating under the Bell management. The Converse company has a toll line reaching Marion and maintains a central office, but has no general franchise in the city. A new copper wire circuit is being put up between Converse and Indianapolis at the present time, and the Converse Company has connected up Wabash, Peru, Greentown, Sims and other cities with copper circuits. These developments coupled with the purposes of the new combination is regarded as the beginning of a lively telephone war against the Central Union by the independents in northern Indiana.

BARNUM, IA.—The Barnum Telephone Company, capital $10,000, has been formed by P. T. Burke and others.

ARDMORE, I. D.—The Sulphur telephone system has been sold by C. J. Webster and J. D. Kirby to W. N. Hayes, of Norman, Okla., and J. F. Rumley, of Chicago.

FENTON, MICH.—Propositions from two telephone companies for the purchase of its system are being considered by the Fenton Mutual Telephone Company.

BRISTOL, MICH.—The Osceola-Lake Co-operative Farmers' Telephone Company has been organized. C. M. Van Antwerp is president; M. O. Stroud, secretary; Fred Darlington, treasurer.

BATTLE CREEK, MICH.—The Michigan State Telephone Company has nearly completed its rural telephone service out of this city. The company has placed 300 telephones in farmers' houses, making in all 500 instruments on the rural lines covering the country within a radius of eight miles. Free service is established between the city and the country subscribers.

NORTHVILLE, MICH.—The Northville Telephone Company at its annual meeting elected the following officers: President, Dr. J. M. Burgess, vice-president, F. S. Neal; secretary and manager, M. A. Porter; treasurer, R. C. Yerkes. A dividend of 10 per cent was declared. The company has over 200 telephones and more than 150 miles of line. It gives long-distance connections with all parts of the State.

LANESBORO, MINN.—The Northwestern Telephone Company is contemplating the installation of a local exchange here.

MINNEAPOLIS, MINN.—The Tri-City Telegraph and Telephone Company has asked the City Council for a franchise to construct a telephone exchange in this city.

ST. LOUIS, MO.—The approximate number of subscribers to the Bell Telephone service in the city of St. Louis is now put at 25,000, which is the largest in the history of the company. Despite sharp opposition on the part of the local independent, there has been a considerable gain right along in the amount of business done by the local Bell corporation.

SKILLMAN, N. J.—The State Village of Epileptics is having installed a complete telephone system connecting the administration building with the cottages and farm buildings.

JAMESTOWN, N. Y.—Thad S. Lane, of Jamestown, N. Y., has secured a controlling interest in the stock of the Home Telephone Company of this city. This company was organized about three years ago by Warren people. The controlling interest has since been held in Warren, but it is understood now passes into the hands of a syndicate which has invested several millions in independent telephone properties.

ASHEVILLE, N. C.—A. Wynne, of Raleigh, N. C., has secured a franchise to install and operate an independent telephone system.

BISMARCK, N. D.—The Capitol Telephone Company has been formed with a capital of $100,000, by I. P. Haker, Alexander, McKenzie and others.

FLORA, OHIO.—The Home Telephone Company has been formed with a capital of $5,000 by H. E. Soeshe and H. E. Studebaker.

ELMIRA, OHIO.—The Northwestern Mutual Telephone Company has been organized with a capital of $10,000, by J. H. Ferrel and J. F. Reeves.

TOLEDO, OHIO.—The directors of the Toledo Home Telephone Company have decided to increase the wages of all its operators about 10 per cent. The directors also declared the customary 1 per cent quarterly dividend.

CHARTIERS, PA.—The Chartiers Telephone Company is arranging for the construction of a new line from Buffalo village to Taylorstown, where connections will be made with the Claysville Telephone Company's lines. The same company is also arranging for the construction of a new toll line between Canonsburg and McDonald. Connections will be made at Canonsburg with both the State Mutual and Wheeling and Pittsburg Telephone Companies.

PIERRE, S. D.—The Great Western Telephone Company, of Chamberlain, has been formed with a capital of $25,000, by Warren Young and David Henry.

PIERRE, S. D.—The telephone trouble which has been on at Pierre some time between the local exchange and the Dakota Central has been ended by the purchase of the local exchange by the Dakota company. The purchase is made to secure better local service for the Dakota Central, and to give it a base for western extensions. The two systems have been reconnected.

BEAUMONT, TEX.—Judge W. H. Pope has appointed John W. Mackey, of this city, temporary receiver for all the properties of the Beaumont Northwestern Telephone Company.

PRICE, UTAH.—The Eastern Utah Telephone Company has been formed with a capital of $50,000. Reuben G. Miller, President.

ABINGDON, VA.—The East Tennessee Telephone Company contemplates building a metallic line between Abingdon and Bristol.

CHIPPEWA FALLS, WIS.—The Yellow River Telephone Company has been formed, with a capital of $10,000, by D. McElmurry, of Colburn, and others.

Electric Light and Power.

MENA, ARK.—The Mena Light, Heat & Power Company has been incorporated with a capital stock of $250,000.

UKIAH, CAL.—A franchise for an electric transmission line from this city to Potter has been sold to the Eel River Power and Irrigation Company, for $50, this being the only bid.

HANFORD, CAL.—It is stated that arrangements have been made with the San Joaquin Power Company to extend its electric transmission line down to Corcoran. The line will be 17 miles in length.

OAKLAND, CAL.—The Oakland Gas, Light and Heat Company has given notice that it is securing rights of way to skirt the city with its 40,000-volt transmission wires, instead of carrying the high current through the streets, as at present. Plans of details for putting other overhead wires in conduits are being rapidly shaped.

ROCKVALE, COL.—The Council has granted the Arkansas Valley Electric Light Company a franchise to construct and operate an electric light plant.

WINDSOR LOCKS, CONN.—The Windsor Locks Electric Lighting Company is to increase its water power by lowering the tail race between the wheel pit and the river. The effective fall at the wheel will be increased by nearly eight feet, and this will give about 50 more horse-power. New transformers for house and store lighting will be put in at once in order to utilize the power thus gained.

KEY WEST, FLA.—An ordinance has passed first reading, granting to Messrs. Ladd, Larkins and Jerguson a franchise to furnish electric light to Key West.

ROCKMART, GA.—The Rockmart Electric Light, Power & Water Company has decided to petition council for a franchise to construct an electric light plant. A. H. Graefer is secretary.

WASHINGTON, GA.—The Anthony Shoal Power and Mill Company has been bought by John H. Fitzpatrick, of Washington, who propses the immediate development of the same and possibly the later construction of an electric railway from Washington to Elberton, Ga. The power will be used for manufacturing purposes.

LA GRANGE, GA.—Contracts for constructing the municipal electric light plant have been awarded as follows: Two boilers and stack, to the Lombard Iron Works, Augusta; two engines, to the Ball Engine Company, Erie, Pa.; two generators, to the Crocker-Wheeler Company, Ampere, N. J.; switchboard and arc lamps, to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., and the pole line and wiring to the Ryan Construction Company., of Indianapolis, Ind.

BOISE, IDA.—Articles of incorporation of the Pend d'Orielle Electric Company, of Spokane, have been filed with the secretary of state. It is the intention of the company to install an electrical power plant at Sandpoint, this State.

LEWISTON, IDA.—It is reliably stated that should funds not be forthcoming from other sources, the Commercial Trust Company, through W. P. Hurlbut & Co., of New York, is prepared to construct the Lewiston & Southeastern Electric Railroad. The Commercial Trust Company is already promoting an immense irrigation project in the region which will be traversed by the proposed line.

WEISER, IDA.—Plans are being perfected for putting in an electric power-house at Ox Bow on the Snake River, for developing 8,000 horsepower to be transmitted to Caldwell, Idaho, and Baker City, Ore., and all intermediate points. It is estimated that over 30,000 acres of land along the Snake River will be watered by pumps driven by the electric power generated. Ten large tunnels will be run, but only one at first, which will be eight feet high and 20 feet wide.

HILLSBORO, ILL.—The Hillsboro Electric Light and Power Company has increased its capital stock from $25,000 to $50,000.

ISHER, ILL.—A franchise has been granted to the Wardlow Electric Lighting Company of this village to carry on and maintain an electric light plant here.

BREESE, ILL.—The Breese Water & Light Company is preparing to install a central lighting plant, and will receive bids on the entire equipment until Oct. 9. Wm. H. Bryan, St. Louis, Mo., is the engineer.

COLLINSVILLE, ILL.—Charles E. Slocum, of Belleville, has organized the Collinsville Gas, Electric and Refrigerator Company, which has been incorporated at Springfield, Ill., with $50,000 capital stock. The incorporators are Charles E. Slocum, John H. Seigel and W. E. Hadley.

CRAWFORDSVILLE, IND.—The contract for repairing the municipal electric light plant has been awarded to J. F. Davies, of Toledo, O., for $7,438. The work is to be done under the supervision of an engineer and is to include the installation of two new boilers of 250 horse-power each, making the pipe connections, the erection of two smoke stacks and various changes about the boiler room and plant.

MONTICELLO, IND.—A big undertaking near this city is suspended because the dam of the Tippecanoe Hydraulic Company, which was to have been finished Oct. 1, will not be completed until next year. The company has ceased building operations and will do nothing more this year. The plant is to cost $1,000,000 when it is finished. It is understood that the company is desirous of purchasing all the land likely to be flooded by backwater.

AFTON, IA.—The Council is considering the question of constructing a municipal electric light plant, or of granting a franchise for the plant.

HOPKINSVILLE, KY.—John H. Bell, Jr., of Hopkinsville, has secured a franchise for the construction and operation of an electric railway and electric light plant.

BOWLING GREEN, KY.—The County Commissioners are considering the best means of heating and lighting the county buildings, and it is quite probable that plans already in hand for a new power plant will be given to the contractor and the court house and jail heated and lighted from their own power department.

EASTPORT, ME.—The service furnished by the Eastport Electric Light Company has been considerably improved. It is the purpose of the company to make such immediate additions and improvements to the works that satisfactory service will be given in the future. An option is held on the water front property at the old Iron Works dam in Pembroke, now owned by the Sprague estate, and there is in contemplation the establishment of a power house at that place for generating the electric current to be used in Eastport. In the meantime Mr. C. E. Capen, a former owner of the electric light property here, is active in a purpose to build a new electric light plant in this city. He is negotiating with the Dennysville Lumber Company for a water power privilege at that place, by which a night and day service can be furnished in Eastport.

PLYMOUTH, MASS.—The Plymouth Electric Light Company has been awarded the contract to wire the new central fire station.

AMESBURY, MASS.—George E. Gale, of Boston, has been at work buying up the stock of the Amesbury Electric Light Company. It is said he is trying to get control, with an idea of reorganizing the business.

FOXBORO, MASS.—The committee on the expenditure of the appropriation of $100,000 made by the last legislature for the construction of a central heating, lighting and power plant and additional buildings at the State hospital here, has practically decided upon plans and specifications for the enlargement of the institution. Work will be begun immediately after the awarding of the contract.

TAUNTON, MASS.—The Taunton Knitting Company's new mill on Ingell street will be run by power furnished by five motors. A new 25-horse-power motor is also to be placed in the White Warner plant on Tremont street to be used by the Huber-Hodgman Press Company, to be run by special power provided by the city, although there will be several other motors run by the company's own engines.

L'ANSE, MICH.—Plans have been completed for the construction of a municipal electric light plant.

SAGINAW, MICH.—The Rifle River Power Company, of Saginaw, has employed H. von Schon, Detroit, to examine and report on the development of Rifle River power.

MUSKEGON, MICH.—The Grand Rapids & Muskegon Water Power Electric Company has secured a franchise to erect poles and string wires through Muskegon Heights.

NASHVILLE, MICH.—The Thornapple Gas & Electric Company is preparing to make several improvements. Among other things will be the changing of the transformer station here to the south side of the river and the installation of an extra transformer for use in case of accident.

MASS CITY, MICH.—Arrangements have been made with the Mass Consolidated Mining Company to supply the village with lights. The company operates for its own use a dynamo with a capacity for 2,000 lights, but is using only 500. A new Corliss engine will be installed to operate the dynamo.

LANSING, MICH.—The Piatt Power & Heat Company has secured flowage rights on Grand River and will build a large dam six miles below Grand Ledge, which, with what it now holds, will develop 10,000 horse power. The company will erect a steam plant at Lansing to protect its customers against low water or floods.

SEBEWA, MICH.—Messrs. Mudge and Ewing, of Grand Ledge, have secured from several land owners options on land along Grand River, the land to be used for overflow for a site for a dam and power house. They have secured the options for Eastern capitalists. It is intended to build a 22-foot dam across the river near Sebewa and generate power for an electric railway.

STURGEON, MO.—Sturgeon's new municipal electric light plant was formally opened Sept. 15.

ST. LOUIS, MO.—Sharp rivalry has recently developed between the Laclede Power Company and the Union Electric Light & Power Company. Price cutting has been resorted to and it is seemingly apparent that each concern is making sharp concessions where it has been necessary to keep the rival company from securing new business.

MEREDITH, N. H.—The directors of the newly organized Meredith Electric Light Company have decided to increase the capital stock of the company from $9,000 to $16,000, and to change the system to an alternating one. The power house here will be done away with and power will be brought from Laconia.

BROAD ALBIN, N. Y.—The Broad Albin Electric Light & Power Company has been incorporated with a capital of $50,000. The directors are: W. P. Judson, H. C. Finch and Anna L. Judson, Broad Albin.

SOUTH GLENS FALLS, N. Y.—The Board of Village Trustees has awarded the United Gas, Electric Light & Fuel Company the contract to light the village streets for 5 years with 2,000-cp. arc lights, at $50 per light per year.

ROCHESTER, N. Y.—A certificate of incorporation of the Clyde Gas & Electric Company has been filed at the office of the county clerk. The company is to replace the old company of the same name and is capitalized at $25,000. There are three directors elected for the first year: Thomas W. Summers, of Ithaca; George S. Sheppard and William T. Morris, of Penn Yan.

AUBURN, N. Y.—At a hearing of the State Commission of Gas and Electricity the Citizens' Light and Power Company of Auburn asked to be allowed to increase its capital stock $175,000 and the Auburn Gaslight Company petitioned to issue bonds for $600,000 and to increase its capital stock $250,000 in order to absorb the property of the Citizens' company. Mayor T. M. Osborne, of Auburn, opposed the application of the Auburn company.

LOUISBURG, N. C.—The question of constructing a municipal electric light plant is under consideration here.

CANTON, OHIO.—The Best Light Company, capital $25,000, has been incorporated by C. V. Best, J. G. Best, H. G. Best, C. C. Best, R. G. Best and B. W. Best

SALEM, OHIO.—E. E. Beam, of Cleveland, and S. D. Gilbert, of Cincinnati, have purchased the plant of the Salem Light & Power Co. and will rebuild and enlarge the plant.

PAWHUSKA, OKLA. The Pawhuska Electric Light, Ice & Water Company has been incorporated with a capital of $25,000, by J. W. McCloud, of Little Rock, Ark.; W. C. Tucker, of Pawhuska, and others.

CHILLICOTHE, OHIO.—Five stockholders in the Chillicothe Electric Light & Power Company have sold their stock to G. A. Vaughters, president of the Citizens' Bank. This gives Mr. Vaughters control and there will be a change of management.

LAKEWOOD, OHIO. Bids will be received until Oct. 3 by the Board of Trustees of Public Affairs for furnishing materials and building a brick addition to the electric light station and for installing complete, ready for piping, one new boiler at the Lakewood electric light plant.

LOUDONVILLE, OHIO.—The electric light plant was damaged by fire to the extent of about $3,000, Sept. 17. The fire is supposed to have originated in a pile of waste in the engine room. It is thought that it will require at least a month's time to put the machinery of the plant in running order.

TOLEDO, OHIO. Mr. F. W. C. Bailey has filed a report to the effect that under very favorable conditions a municipal plant might be able to furnish arc lights to the city at $58 per year for 1,500 lights. Apparently this does not include, among other things, the taxes lost by the city on private enterprise doing the same work.

ALBION, PA.—Albion Council is considering the question of installing an electric light plant and water works.

WERNERSVILLE, PA.—The Wernersville Electric Light Company will soon start on its plant. It will be installed by Mr. C. S. Bomberber, Swatara Station, Pa.

GREENCASTLE, PA.—The Greencastle Light, Heat & Power Company has been incorporated with a capital of $10,000. Harry C. Hollinger, of Philadelphia, is treasurer.

READING, PA.—The ordinance granting a franchise to the Reading Illuminating Company has been defeated. Its aim was to introduce electric light competition in the city.

LANCASTER, PA.—The directors of the Edison Electric Illuminating Company and the Lancaster Gas Light & Fuel Company have awarded to the Providence Engine Company, of Providence, R. I., the contract for enlarging the electric light plant at Engleside for $165,000.

HUNTINGDON, PA.—The Juniata Water & Power Company has been incorporated, with offices at Huntingdon and Philadelphia. The company has purchased property for the erection of a hydro-electric power plant in Warrior Ridge Gap. The cost of the proposed plant will be about $1,000,000 and power will be transmitted to Huntingdon, Tyrone, Altoona and other towns in this vicinity. S. L. Brumbaugh, Philadelphia, is president.

BAMBERG, S. C.—This city will receive applications for a franchise for the construction of water works and an electric light plant.

BAMBERG, S. C.—An election will probably soon be held to vote on issuing bonds for an electric light plant and water works at a probable cost of $25,000. G. Moye Dickinson is the mayor.

BELTON, S. C.—The Belton Power Company has completed a big dam on Saluda River where electrical energy will be developed for running the Belton Cotton Mills, for street lighting in the town and for other purposes. The company has a capitalization of $300,000.

PIERRE, S. D.—The City Council has decided to install an incandescent electric light plant.

HURON, S. D.—The municipal electric light plant at Huron has run behind financially every year for six years. A deficit of $3,000 now exists.

CHATTANOOGA, TENN.—The plans for the lock and dam and the power plant of the Chattanooga & Tennessee River Power Company, to be constructed at Hales bar, in the Tennessee River, at a cost of about $3,000,000, are now ready for the inspection of contractors at the office of the U. S. Engineer here. Bids will probably be called for at once. John Bogart, of New York, is consulting engineer.

FORT WORTH, TEX.—A charter has been issued to the Consumers' Light & Heating Company; capital stock, $100,000.

BAY CITY, TEX.—The plant and property of the Bay City Ice, Light & Power Company is to be sold to the highest bidder by order of court. The plant cost about $40,000.

AUSTIN, TEX.—George B. Evans, representing Stone & Webster, of Boston, Mass., is here investigating the situation with reference to rebuilding the dam across the Colorado River. He says that if the project of utilizing the water power for generating electrical energy is deemed feasible and practicable Stone & Webster will take hold of the enterprise. The city stands ready to lease or sell the dam, part of which is standing. It is said to be the purpose of Stone & Webster, should Mr. Evans' report be favorable, to restore the dam and establish a large electric power plant here which is to form the basis for a new system of street railway, as well as one or two interurban lines out of Austin.

PROVO, UTAH.—It is proposed to construct an electric light plant and water works at a cost of $91,000. Frank C. Kelsey, Salt Lake City, is the engineer.

SALT LAKE CITY, UTAH.—The Telluride Power Company is contemplating the early construction of a power plant on Battle Creek, near this city. It will have a capacity of 25,000 horse-power.

OGDEN, UTAH.—A company will shortly be organized by Utah capitalists for the construction of a power plant at a point on the Blackfoot River, near Blackfoot, Ida. It is the design to supply Idaho Falls and Blackfoot and the intervening towns with electrical energy. The cost of the proposed plant is estimated at $100,000. E. W. Wade, of this city, is promotor of the enterprise.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Inter-Mountain Power Company will shortly be filed in this city. The company will have a capitalization of $1,500,000, and the chief stockholders will be Ohio capitalists who are at present represented here by J. J. Chambers of the Buckeye State. It is the intention of the company to establish four separate power plants, which will furnish a vast amount of electrical energy for mining and smelting purposes. Reservoir and power sites have already been acquired, and one of the company's first plants will be established in Cottonwood Canyon. Frank C. Kelsey of this city is the company's chief engineer.

BURLINGTON, VT.—The Plummer Electric Company, of Boston, Mass., has secured the contract for the conduit and wiring system for the U. S. Post Office for $1,813.

MANCHESTER, VT.—The manufacturing plant of the Vail Light & Power Company, at Manchester Depot, operated by the Hadley Manufacturing Company, was destroyed by fire a few days ago. The loss is estimated at $35,000.

CASHMERE, WASH.—F. C. Barnum, of Cashmere, is endeavoring to obtain a franchise to erect an electric light plant here.

CHINOOK, WASH.—The Chinook Light, Power & Water Company has been incorporated, with a capial of $10,000, by Albion L. Gile and others.

SEATTLE, WASH.—The city officials are considering the installation of another unit at the municipal electric light plant, at a probable cost of $15,000.

SPOKANE, WASH.—The Spokane Palouse Light & Power Company has been incorporated with a capital of $100,000 by W. E. Goodspeed, B. H. Kiser, and others.

PORT TOWNSEND, WASH.—The City Council has received an application from W. A. Pfeiffer for a franchise to construct and maintain an electric light and power plant in connection with a gas plant.

TACOMA, WASH.—The Westinghouse Electric & Manufacturing Company is preparing plans, specifications and estimates for a municipal steam-power electric-generating plant, to be established within the city limits of Tacoma, with a maximum capacity of 12,000 horse-power.

PORT WASHINGTON, WIS.—The citizens have voted to issue $75,000 electric light and water works bonds.

MILWAUKEE, WIS.—The Finance Committee of Council on Sept. 13 adopted a resolution providing that $60,000 be set aside from the water fund to purchase a site for the municipal lighting plant.

VANCOUVER, B. C.—The estimated cost of constructing a municipal plant has been placed at $500,000.

METEPEC, MEX.—The City Council of Metepec has taken preliminary steps looking to the installation of an electric light and power plant for the city.

CHINIPAS, MEX.—E. T. Hovelman, of Chinipas, will establish an electric power plant on the Chinipas River for the purpose of operating mining machinery and reduction works.

TEXMELUCAN, MEX.—The Mexican Government has granted a concession to Andres Matienzo to establish an electric power plant on the Atoyac River, near the town of Texmelucan. The power will be transmitted to a number of towns in this region.

GUADALAJARA, MEX.—It is reported that the electric light and power plant of the Compania Industrial de Guadalajara is about to be sold to Canadian capitalists, who are largely interested in the Mexican Light & Power Company, of the City of Mexico.

SAN DIMAS, MEX.—Colonel Daniel M. Burns, of San Francisco, owner of the Candelaria mines, will erect a large hydro-electric plant for the purpose of supplying electric power for the operation of his mines and other mines and reduction plants in the San Dimas district.

MAZATLAN, MEX.—The Guadalupe de los Reyes Mining Company will install an electric power plant on the Piaxtla River at Los Barras, near this city. The electric power will be used to operate the machinery in the mines. The proposed plant will cost about $100,000.

XICOTLACOTLA, MEX.—Andres Lefebre is having the surveys made for a large electric power plant which he will establish at Xicotlacotla. Transmission lines will be built to towns of Guerrero and the state of Morelos, and the electric power used for operating industries and furnishing lights.

ZACATECAS, MEX.—The Compania del Alumbrado Electrico del Comerico de Zacatecas has been organized for the purpose of constructing and operating a large electric light and power plant in the city of Zacatecas. The company has a capital stock of $100,000, and is composed of local business men.

MICOS, MEX.—A company has been organized for the purpose of establishing a large electric power plant at Micos. The proposed plant will be located at the water falls, where it is estimated that not less than 10,000 horse-power can be generated. It is proposed to build transmission lines from the main generating plant to the cities of San Luis Potosi, 75 miles distant, and Tampico, about 150 miles distant.

TORONTO, ONT.—The Georgian Bay Power Company, of Toronto, has engaged H. von Schon, Detroit, Mich., to plan the development of Eugenia Falls on Beaver River, Ont., where a head of about 400 ft. will be available.

KINGSTON, ONT.—The city of Kingston, Ont., has conducted its electric and gas plants as a municipal utility for a year, and has a surplus of $15,000 after spending some $6,000 on needed repairs. The works are to be much extended and improved, when it is expected cheaper light can be provided at a good profit.

The Electric Railway.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company announces that an electric car line will be built to Boyles, four miles from the city. The estimated cost of the line will be about $40,000, and will be constructed in the nature of an extension of the Gate City line.

WOODLAND, CAL.—The Board of Supervisors at Woodland has granted J. Reith, Jr., a franchise to build electric railway lines along the country roads of Yolo County. W. F. Forsman, a rival promoter of railways, objected, through his attorney, to the granting of the franchise on the ground that it would conflict with a franchise granted to N. A. Hawkins. A damage suit will be filed. The Northern Electric Company, which has closed a contract with the Westinghouse Electric & Manufacturing Company for three 400-kw. motor-generator sets for its sub-stations on its new electric railway connecting Chico and Oroville, Cal., is in the market for three 55-ft. electric cars of standard passenger type, which are to be run 60 m.p.h. Four 50-hp. motors will be placed on each car. Sub-station No. 1 will be located at Chico, No. 2 at Durham, 9 miles south, and No. 3 at a point 5 miles northwest of Oroville. There will be three 150-kw. step-down transformers and one spare transformer at each sub-station. This company has purchased the Chico Electric Railway and has placed Frank Ross in charge as manager of the local system. Mr. Ross was formerly with the California Gas & Electric Corporation at Sacramento.

NAUGATUCK, CONN.—It is understood here that the new company which has a charter for an electric railway from Waterbury to Woodbury, has completed its purchases of property for a private right of way for a considerable portion of the line where it leaves the highway.

NEW HAVEN, CONN.—President Mellen, of the New York, New Haven & Hartford Railroad Company, denies that that company has made an offer for a controlling interest in the Boston & Worcester Street Railway Company, and states that the company will buy no more electric railways at present.

ROCKFORD, ILL.—The Rockford, Beloit and Janesville electric railway, connecting this city and Janesville, has been sold to a party of Cleveland capitalists.

EVANSVILLE, IND.—The directors of the Evansville & Princeton Traction Company have elected the following-named officers: President, Joseph Heston; vice-president, J. G. Lagrange; secretary, H. C. Redman; general manager, W. P. Larcey.

WABASH, IND.—The Indiana Northern Traction Company has financed the interurban line connecting Wabash and Warsaw. The Indiana Central Traction Company has filed a mortgage for $800,000 to protect a bond issue for a line between the same cities.

EVANSVILLE, IND.—Articles of incorporation have been filed by the Indianapolis, Vincennes & Evansville Electric Railway Company, with home office in this city. It is proposed to connect Evansville, Vincennes and Indianapolis and intervening towns.

INDIANAPOLIS, IND.—The Randall Morgan interests are combining under one management, the Indianapolis & Eastern, the Richmond Street & Interurban and the Martinsville and the Indianapolis & Plainfield companies, with headquarters in the Terminal Station.

SOUTH McALESTER, I. T.—The Washita Valley Interurban Electric Company, of Tishomingo, has been incorporated with a capital of $12,000,000 by W. T. Croslan, J. G. V. Redmon and M. R. Morris. The company will build an electric interurban railway from Shreveport, La., through Texas, Indian Territory and Oklahoma to Anadarko, O. T., together with branch lines in these states and territories.

HOPKINSVILLE, KY.—The 20-year franchise for an electric street railway system and electric light plant offered for sale some days ago was purchased by John H. Bell, Jr., of Hopkinsville.

LEXINGTON, KY.—Official announcement is made that negotiations have been closed by which the owners of the Lexingon Street Railway Company system, including the gas, the electric light plant, two ice factories and the street car system, is acquired by a syndicate of Philadelphians, at the head of which are J. Levering Jones and Chandler Brothers. In addition to the public utility companies of Lexington, the syndicate has purchased the Blue Grass Traction Company, owning the interurban lines from Lexington to Paris and to Georgetown, the Central Kentucky Traction Company, owning the interurban lines from Lexington to Versailles, and the Frankfort Power & Light Company. The amount involved in the purchase of the properties is $8,000,000.

WARE, MASS.—The auction sale of the property of the Hampshire & Worcester Street Railway by the receiver has been postponed from Sept. 16 to Sept. 30.

TREMONT, MASS. The statement is given out that the incorporators of the proposed electric railway from Wareham to Plymouth, the Plymouth, Carver & Wareham Street Railway Company, have secured sufficient money to assure the building of the road, and work upon construction will be begun as soon as practicable.

DULUTH, MINN.—The first long-distance electric railway out of Minneapolis promises to be built northward to this city. C. C. Cokefair, of the Great Northern Power Company, is interested.

ST. LOUIS, MO.—The St. Louis, Vandalia, Terre Haute & Eastern Traction Company has been formed with a capital of $1,000,000, by Lewis H. Bissell, Effingham, Ill., and George D. Steinhauser, Vandalia, Ill.

CAMDEN, N. J.—The Camden, Gloucester & Woodbury Railway Company has accepted ordinances of townships along its proposed route.

HOBOKEN, N. J.—The Jucaro and San Fernando Railroad and Transportation Company has been formed here with a capital of $500,000. Incorporators: George G. Schreiber, George W. Ireland, J. W. Rufus Besson, Francis A. Stevens and Leonidas H. Besson.

ALBANY, N. Y.—The Manhattan & Long Island Railroad Company, of New York City, has been incorporated with a capital of $10,000,000, to operate an electric railway 80 miles long in Greater New York and on Long Island. The road is to run from Long Island City to Northport. The directors are: Edward Mackey, D. T. Meyer, H. H. Bowtell, Samuel Y. Sauber, Franklin M. Walter and George E. Macardle, of New York City; Robert M. Stockwell, of Yonkers; A. Paroutaud, of Brooklyn, and Henry Guinard, of Watchung, N. J.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company will build an addition to the brick power house on Washington Street and Cuyahoga River, to cost $25,000.

ALLIANCE, OHIO.—The Alliance, Akron & Cleveland Railway Company has organized with High Bleakley, president; G. L. King, vice-president; R. S. Keyler, secretary-treasurer.

STEUBENVILLE, OHIO.—The Steubenville & Wellsburg Traction Company has been incorporated with $10,000 capital stock by J. Dunbar, M. Keane, D. J. Sinclair, Robert McGowan and others.

SANDUSKY, OHIO.—The Sandusky, Fremont & Tiffin Traction Company has been incorporated with $100,000 capital stock by Charles Thompson, W. H. Gilcher, John G. Dorn, D. B. Sharp and others.

WAPAKONETA, OHIO.—A special meeting of stockholders of the Sandusky Southwestern Railway Company will be held Oct. 2 to vote on an increase of the capitalization from $1,000,000 to $2,000,000. The road is in the hands of a receiver and the court has been petitioned to allow the increase.

HAMILTON, OHIO.—At the annual meeting of the Cincinnati, Dayton & Toledo Traction Company the following officers were elected: President, George B. Cox; vice-president, C. C. Richardson; second vice-president, J. B. Foraker, Jr.; secretary-treasurer, F. R. Williams; general counsel, W. C. Shepard.

DAYTON, OHIO.—The project known as the Cincinnati, Dayton & Fort Wayne Railway, which was promoted by Dr. Samuel F. George, of Dayton, three years ago, is being revived. A meeting will be held at Fort Wayne this month. It is stated that New York capitalists have been interested.

CLEVELAND, OHIO.—The Cleveland, Berea & Southern Railway Company has been incorporated, with $10,000 capital stock, by C. C. Downs, W. S. Mitchell, W. G. Benedict, Frank Cowdry, and others. The company expects to build from South Brooklyn, the terminus of the Pearl Street line of the Cleveland Electric Railway, to Berea, 12 miles.

HARRISBURG, PA.—At last week's meeting the directors of the Central Pennsylvania Traction Company decided to install reciprocating engines and direct-current equipment in the new $250,000 power house to be built on the site of the present main power plant on South Cameron Street.

EPHRATA, PA.—There is a movement on foot among the people of the northern section of Salisbury township, to build a trolley line from the New Holland line at Groffsdale to White Horse. Estimates place the cost at $150,000.

PITTSBURG, PA.—Private right of way has practically been secured for the Shenango Street Railway Company. This line will be 65 miles long and will connect New Castle, Sharon and other Shenango Valley points with Conneaut Lake, Meadville and Cambridge Springs and will form the connecting link between Pittsburg and Erie, a distance of 150 miles.

POTTSVILLE, PA.—The Council of Frackville has granted to the Tamauqua & Pottsville Electric Railway, one of the allied interests of the Pottsville Union Traction Company, a franchise through the town. A new branch between Pottsville and Shenandoah, fourteen miles long, is about to be started. This, with an eight-mile road to be built from Middleport to Tamauqua, will be the connecting link to afford electric railway travel from Pottsville to Scranton.

IRWIN, PA.—Application for a charter will be made for the Greensburg and Sewickley Street Railway Company. The road will tap an entirely new country, extending from the new Stanton road in Hemphill Township to the coal towns of Arona, Madison and Herminie. It will be mainly over private right of way and at various points will connect with existing and contemplated lines. Congressman George F. Huff, his son, Colonel Lloyd Hull, Richard Coulter and H. F. Bovard are among those interested.

STROUDSBURG, PA.—The Stroudsburg & Wind Gap Trolley Company has been reorganized. The company was originally organized May 4, 1903, and the charter provides for the building of an electric railroad from Stroudsburg to Wind Gap, via Kellersville, Sciota and Saylorsburg. Consent was obtained from all municipalities between the two towns prior to May 4, 1905, for the use of streets. The following are the new officers: President, J. B. Williams; vice-president, Joseph Shiffer; treasurer, G. A. Schneebeli; secretary, E. P. Arbogast.

PITTSBURG, PA.—Charters have been granted in Harrisburg to three street railway companies to construct lines which will connect Ambridge, Baden, Economy and Freedom, and which will be a portion of the long-distance trolley line to be constructed between Pittsburg and Beaver for which surveys have already been made. The companies are the Freedom & Baden Street Railway Company, capitalized at $6,000; president, John H. Park, Beaver. The Economy & Harmony Street Railway Company, capital, $16,000; president, William A. Park, Rochester. The Ambridge & Baden Street Railway Company, capital stock, $12,000; president, W. E. Guy, Pittsburg.

SAN ANTONIO, TEX.—A movement is on foot in Campbellton to build an electric railway to run in this city. For further information address W. A. McCoy, of Campbellton.

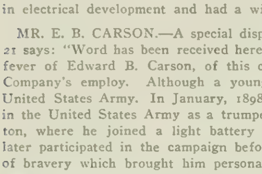
FORT WORTH, TEX.—The Fort Worth & Mineral Wells Electric Railway Company has been chartered, with a capital stock of $250,000. Its principal office is at Fort Worth. The board of directors is composed of Cicero Smith, D. M. Howard, H. N. Frost, E. J. Waldron and Albert Stevenson, all of Mineral Wells.

Obituary.

DR. L. H. LAUDY.—We note with great regret the death of Dr. Louis H. Laudy, late professor of chemistry in Columbia University, New York. The cause of death was apoplexy. Mr. Laudy's father, a man of great wealth and political prominence in the French Republic and who had represented his government as Minister at Madrid, came to this country and settled in Gouverneur, N. Y., where his son, Louis, was born. Dr. Laudy was a member of the Alumni of Cooper Union, a fellow of the New York Academy of Science, and of the Association for the Advancement of Science, member of the New York Electrical Society, life member of the American Institute and vice-president of the Henry Electric Club. For a long period he was secretary of the American Institute and was president of its polytechnic section. He was in his sixty-third year. He leaves no children. Dr. Laudy took a deep interest in electrical development and had a wide circle of electrical friends.

MR. E. B. CARSON.—A special dispatch from Newport, R. I., of September 21 says: "Word has been received here of the death in New Orleans of yellow fever of Edward B. Carson, of this city, an electrician in the Westinghouse Company's employ. Although a young man, he had a notable career in the United States Army. In January, 1898, although but 16 years old, he enlisted in the United States Army as a trumpeter, and in April was sent to Washington, where he joined a light battery and went with it to Tampa, Fla., and later participated in the campaign before Santiago. There he performed deeds of bravery which brought him personal thanks from President McKinley. He was next transferred to the Signal Corps, and assigned to the School of Instruction at Fort Meyer, Va., from which he was sent to Manila, remaining in that vicinity until the expiration of his enlistment. While on duty with a party in Manila Carson received a Filipino bullet in the arm. For rescuing a detachment of soldiers in Southern Luzon he received a medal of honor and an appointment as an electrician sergeant."

Personal.



MR JAMES R THOMPSON.

MR. JAMES R. THOMPSON, a young man who has made a conspicuous success as chief electrical engineer of the Lewis and Clark Exposition, at Portland, Ore., is a native Portlander. He was born in that city Feb. 11, 1871. He received his education in the grammar schools, and served three years in a broker's office before entering the electrical business. From 1891 to 1892 he was in the employ of the Willamette Falls Electric Company. The following year he attended Stanford University, and then returned to electrical work in the employ of the Portland General Electric Company, which had become the successor of the Willamette Falls Company. He remained with this company until 1904, serving in various capacities, and left the service of the company to become electrical engineer for the exposition in 1904. He designed and superintended the construction of all the electrical illuminations at the fair. Personally he is a quiet, modest man, easily approachable, well liked by all those who serve under his directions, and is not in the least spoiled by the enviable success he has so early attained. The details of the electrical work and illuminations have already been given in these pages.

PROF. A. H. FORD has been elected to the chair of electrical engineering at the University of Iowa, Iowa City.

MR. C. A. TERRY, secretary of the Westinghouse Electric & Manufacturing Company, has just returned to New York from a European trip.

MR. CARL B. AUEL, assistant general manager of the Trafford Park Works of the British Westinghouse Company, has arrived in the United States for a short visit.

DIRECTOR F. A. SPIECKER, of the Siemens & Halske Company, of Berlin, accompanied by Dr. O. Feuerlein, manager of the incandescent lamp department of the same organization, is due to arrive in New York City from Europe about October 1.

MR. R. S. HALE, of Boston, has been appointed general agent of the Edison Company of that city, in charge of the commercial department. He has resigned his position as engineer of the Mutual Boiler Insurance Company, and will devote his entire energies to the new work.

MR. D. W. ROPER has been appointed assistant chief operating engineer of the Chicago Edison Company, succeeding Mr. W. G. Carlton, who has resigned to become superintendent of power for the New York Central Railroad Terminal in New York. Mr. Roper, who was formerly electrical engineer of the Missouri Edison Company, at St. Louis, has been on the engineering staff of the Chicago Edison Company for about two years.

DR. WYSSLING, professor of electrical engineering in the Polytechnic Institute at Zurich, Switzerland, and Charles Wirth, also of Zurich, inspected the line of the Indiana Union Traction Company, and the company's powerhouse in Anderson, Ind., during the past week. Dr. Wyssling and Prof. Wirth are members of a commission appointed to make a report to their home government on electric railway development in America.

MR. GEORGE P. LOW, of San Francisco, has severed his relations with the *Journal of Electricity, Power and Gas,* and is now engaged in the specialization of engineering work, from its literary side more particularly. Mr. Low has for some years done a great deal of work in the field of technical literature, and will now be free to devote his energies to the description of engineering installations and properties, the prospectuses of new industries, etc.

PROF. L. I. BLAKE.—Prof. L. I. Blake, head of the department of electrical engineering at the University of Kansas, has been granted a year's leave of absence. He has been appointed chief engineer of the new submarine signal company, which handles his invention for telephoning between ships, using the water as a medium. The system is already being used on American warships, and has recently been adopted, it is said, by the German government.

MR. J. F. WITMER.—J. G. White & Co., of New York, have secured the services of Mr. J. F. Witmer, B. A., C. E., of Buffalo, N. Y., who will assume charge of special work bearing on hydraulic engineering in foreign fields. Mr. Witmer is a specialist of many years standing with offices at Buffalo, N. Y., and during the last ten years has designed and superintended the construction of water works systems at upwards of 30 different towns and cities in the United States.

MR. A. W. LEONARD, manager of the Houghton, Mich., lighting and trolley interests, denies the report that he has been appointed manager of the General Electric Company of Minneapolis. He says that the rumor may be due to the fact that he was recently in Minneapolis for about three weeks on special work connected with the development of Taylor's Falls water power. The manager, for many years past, of the Minneapolis company is Mr. A. M. Robertson.

MR. GEORGE A. DAMON, managing engineer of the Arnold Company, Chicago, has been awarded the Chanute medal for 1904 by the Western Society of Engineers for the best paper on an electrical engineering subject presented to the Society during that year. This paper, which was on the subject: "The Opportunities in the Electrical Business," created wide-spread comment at the time it was presented and resulted in the most crowded house the Society ever had on the evening it was discussed.

MR. FRANK HOOKER ALFRED has been appointed general manager of the Canadian J. G. White Company, Ltd. Mr. Alfred was born December 24, 1866, and educated at the University of Michigan and the Ohio State University. From 1887 to 1890 he was engaged successively as rodman, transitman and resident engineer on railroad construction. From 1890 to 1894 was with the Norfolk & Western Railroad, during which time he had charge of the field work on the construction of their terminals at Columbus, Ohio. From 1894 to 1896 was with the engineering department of the Hocking Valley Railroad. From 1896 to 1899 was engineer of maintenance of way of the Cleveland, Akron & Columbus Railway, and from 1899 to 1900 held the same position with the Wheeling & Lake Erie Railway. From 1900 to 1902 was division engineer of the Pere Marquette Railway, and from 1902 to the present time chief engineer of the same road. During this period the railroad was reorganized and extended into Chicago and Buffalo, involving the construction of new lines and terminals. New shop buildings and yards at Grand Rapids, Mich., and new shops at St. Thomas, Ontario, have just been completed under his supervision. Mr. Alfred is a member of the America Institute of Electrical Engineers.

MR. KENNETH B. THORNTON, of Montreal, has been appointed operating engineer of the Canadian J. G. White Company, Ltd. Mr. Thornton was born at Montreal, June 23, 1873, and was educated in London, England. After taking a three years' course in electrical and mechanical engineering at the Central Technical College, South Kensington, London, England, he returned to Canada in June, 1893, and entered the Royal Electric Company, Montreal, working in the several manufacturing departments and also in the testing and drafting departments. In September, 1895, he was transferred to the operating department of the Royal Electric Company, which at that time was supplying light and power in and around Montreal. From that time to August, 1905, Mr. Thornton has been intimately associated with the construction, operation and engineering details in connection with the generation and distribution of light and power for the Royal Electric Company, and latterly for the Montreal Light, Heat & Power Company, which company finally secured a monopoly of all the electric companies in Montreal in 1903. During this period the amount of power generated increased from about 7,000 hp in 1895 to over 30,000 hp in 1905. Mr. Thornton is a member of the American Institute of Electrical Engineers, the Canadian Society of Civil Engineers and past-president of the Canadian Electrical Association.

MR. F. S. DICKSON.—Mr. Frederick S. Dickson, president of a number of independent telephone companies in Ohio, has written a book on "Telephone Investments—And Others," which will be published about October 1. This volume deals with the various forms of investment now offered to the public in America, and compares them one by one with the telephone. He considers government bonds, real estate, bank and trust company stocks, industrials, mines and public service corporations. The latter are divided into those supplying water, power, light, heat, transportation and communication, and the latter subject considers mail, telegraph, and telephone. Mr. Dickson's experience in the telephone field and on the directorate of various manufacturing and transportation companies in Philadelphia qualifies him to speak with authority on his chosen subject. He is not unknown in the literary field, as his out-of-door book, "And the Wilderness Blossomed," was highly commended on its appearance a few years ago. He contribuated lately to the extensive bibliography to General Wilson's book on "Thackeray in the United States," so his last volume promises something of a literary as well as a business flavor. The volume is illustrated and with large type, good paper and bound in limp art linen, makes an attractive appearance. It is issued by the Publication Department of the Cuyahoga Telephone Company, Cleveland.

Trade Publications.

REFRIGERATING MACHINES.—A recent catalogue of the York Manufacturing Company, York, Pa., presents in an attractive manner the advantageous features of the vertical single-acting ice and refrigerating machines.

WATTMETERS.—The Gregory Electric Company, 54 Clinton St., Chicago, in addition to its regular monthly publication has issued a flyer calling attention to a special sale of wattmeters. Although these meters have been in use, the company states that they are in all respects equal to new.

TELEPHONES.—The Dean Electric Company, Elyria, O., has issued folders No. 4 and No. 8, dealing, respectively, with magneto local-battery telephones and common-battery switchboards. In folder 4 are shown numerous diagrams of telephone circuits for the various uses to which telephones may be put. Folder 8 shows front and rear views of the internal mechanism of common-battery switchboards and also illustrates the apparatus used in the switchboards.

WIRING SPECIALTIES.—Supply catalogue No. 7590 of the General Electric Company, Schenectady, N. Y., treats of fuses and enclosed fuse cut-outs which have been designed to conform to the requirements of the Underwriters according to the specifications for the National Electrical Code Standard. Price list No. 5140 of the same company, refers to braided and lead-covered varnished cambric insulated cables for working pressures of from 125 to 15,000 volts.

AIR BRAKES.—The National Electric Company, Milwaukee, Wis., has just issued bulletin No. 357, dealing with Christensen air-brake equipments. The Christensen system is described fully, the various mechanical details being illustrated. The air compressor is driven by electric motor, governed by the pressure of the air. These equipments have been designed especially for use with electric cars. It is stated that more than 15,000 are in successful use at the present time.

OIL ENGINES.—The De La Vergne Machine Company, foot of 138th Street, New York, has issued a neat 74-page catalogue dealing with Hornsby-Akroyd oil engines. These engines are well suited for operating isolated electric plants. A table is given to show that with a certain 125-hp. engine the total cost, including interest on investment and depreciation, at 12 per cent., per brake hp-year of 3,000 hours, was $25.37. It is stated that there are more than 10,000 of these engines now in operation.

DIRECT-CURRENT RAILWAY MOTOR.—The Westinghouse Electric & Manufacturing Company, Pittsburg, has just issued circular No. 1120, describing what is stated to be a motor of the largest capacity which has yet been used on cars for passenger service. This is the Westinghouse No. 113 railway motor, which is rated at 200 horse-power. The general constructional features and the operating characteristics are fully discussed. A description of this motor appeared on page 536 of our issue for Sept. 23.

BELT-DRIVEN DIRECT-CURRENT GENERATORS.—Bulletin No. 355 of the National Electric Company, Milwaukee, Wis., is devoted to type M. B. generators. The pole pieces of these machines are made of steel castings, circular in cross section, and are bolted to the frame. The pole shoes are built up of laminated sheet steel, and are bolted to the pole pieces. These shoes aid in a better distribution of the magnetic flux in the air gap, secure sparkless commutation under widely varying loads, and in addition serve to hold the field coils in place.

LIGHTING SPECIALTIES.—The General Electric Company, Schenectady, N. Y., has recently issued several diminutive bulletins called "Fliers" dealing with lighting supplies. No. 2163 treats of standard key and keyless sockets, No. 2164 describes concentric diffusers for incandescent lamps, while No. 2165 is devoted to sockets of the key and keyless types for electroliers; 3329 tells of the advantageous features of the G. E. incandescent lamps, and 3361 serves to show why the electric cigar lighter, which might now be considered a luxury, will soon become a necessity.

FLEXIBLE METALLIC CONDUIT.—The Sprague Electric Company, 527 West 34th Street, New York, has just issued a handsome illustrated bulletin, designated as No. 422, which serves to show that its flexible metallic conduit and flexible steel-armored conductors are used successfully in finished buildings, and in new structures under construction, for almost every class of electric wiring. The bulletin contains numerous illustrations of buildings in which its metallic conduit is used. These buildings represent every type of modern fireproof structure, as well as some of the best-known older buildings of the United States. Several views are given of some of the most modern and best-equipped steel ships, on which the flexible steel armored products are used.

STORAGE BATTERY FOR VOLTAGE REGULATION.—The Gould Storage Battery Company, Depew, N. Y., has issued a well-illustrated bulletin, designated as No. 6, which contains an article descriptive of the storage battery installation of the Edison Electric Illuminating Company, of Topeka, Kan. This installation consists of 280 elements, each having a capacity of 640 amperes for one hour, and a booster-set which controls the operation of the battery so that the generator load does not vary, even under extreme conditions, more than 2.5 per cent from any mean valve for which the booster may be adjusted. This battery was installed to equalize the load on the railway generators and to insure good voltage regulation on the various supply circuits.

PREPAYMENT WATT-HOUR METERS.—Circular No. 1123 of the Westinghouse Electric & Manufacturing Company deals with a new type of single-phase prepayment watt-hour meter for two-wire and three-wire circuits. This meter is built on the principle of an induction motor, with a light rotating secondary whose speed is determined by the value of the power being used upon the circuit to which it is connected, and is similar in general to the Westinghouse type B watt-hour meter, with the addition of the prepayment feature. The addition consists essentially of a circular dial and pointer, a coin slot and a circuit-closing mechanism. When a quarter is inserted in the slot, it strikes a wheel releasing a spring which closes the circuit through the electromagnet of a switch connected to the main circuit.

POLYPHASE INDUCTION MOTORS.—Bulletin No. 1068 of the Fort Wayne Electric Works, Fort Wayne, Ind., describes a line of polyphase induction motors recently placed upon the market. The lamination for the stator of the machine is held in a skeleton frame which gives maximum surface for cooling without sacrificing rigidity. For constant-speed work, the machine is provided with a squirrel-cage secondary winding and is started by means of a "compensator," which consists of two auto-transformers for a two-phase motor or three auto-transformers for a three-phase motor. For variable-speed work, or where a large starting torque is required, the secondary is coil-wound, and provided with extra resistance which may be placed external to the machine, or mounted directly on the shaft of the rotor. The several types of motors, indicated above are illustrated and described at length.

A HANDSOME SOUVENIR EDITION.—*The Street Railway Journal* has been making a practice of issuing souvenir numbers on the occasion of the annual conventions of the American Street Railway Association. This year's number surpasses all of its predecessors in every respect, and represents the highest development of the printer's art. Its design is artistic and harmonious throughout, and yet it is intensely utilitarian. It is replete with practical articles on street railway progress, the principal one being devoted to a complete description of the transportation facilities in and about Philadelphia, where this year's convention is held. The book contains 184 reading pages, over 200 pages of advertisements and about 60 pages devoted to a dictionary of electric railway material, supplies and apparatus. This dictionary gives definitions for practically everything used by an electric railway, and its publication is an entirely new departure in technical journalism. The cover design of the Convention Souvenir issue has for its central idea an artistic presentation of the Liberty Bell, with a conventional reproduction of Independence Hall and an old stage coach at the left, and the Philadelphia City Hall with a modern electric railway car at the right. The illustrations are of the highest order and very effectively arranged, and all together this number would seem to justify the belief of the publisher that it is the most elaborate edition of a technical periodical ever published.

News of the Trade.

MR. LOUIS G. SEDBERRY has been made superintendent of the Wetumpka, Ala., municipal light plant and water works. He desires to receive trade literature relative to the lines of work indicated.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, now located at 2017 Locust Street, St. Louis, has purchased a tract of about ten acres, adjoining the right of way of the Wabash Railroad near Page Avenue.

TOLEDO TRANSFORMERS.—The F. Bissell Company, Toledo, O., has been awarded the contract by the Toledo Gas, Electric & Heating Company for the transformers for the new plant. The transformers will aggregate 600 horse-power.

MR. V. C. GILPIN, who has a most extensive acquaintance among electrical people, has finished the special work in which he was engaged with the Perkins Electric Switch Manufacturing Company, and will open an office at 39 Cortlandt Street, New York City, for the representation of electrical manufacturers.

THE WILLARD STORAGE BATTERY COMPANY has been awarded the contract, through the Union Switch & Signal Company, for all of the storage batteries for the Lake Shore & Michigan Southern Railway signal system, comprising several thousand cells. The Willard Company has entirely recovered from the fire which recently destroyed its works, and is now turning out batteries in the usual quantities.

DULUTH AERIAL BRIDGE FERRY.—The Keelyn Electric Company, of Milwaukee, Wis., write us as follows: "We did the work at the Ferry for the Modern Steel Structure Company, of Waukesha, Wis., and our electrician was on the job six weeks. The writer laid out the work and ordered the material. We have informed several parties that we had furnished this equipment and propose to use this job in getting other work in this line."

MACHADO & ROLLER, of New York City, have just opened a branch office in the Monadnock Building, Chicago. It is in charge of Mr. H. I. Shire, formerly of their New York office, and will carry a large stock on hand of the standard Whitney instruments, so as to be able to make prompt deliveries to the local trade. A portion of the stock has already been made available in Chicago, where secondary standards will also be kept for comparison purposes. Repairs will also be made there. Machado & Roller were led to make this new departure by the rapidly increasing popularity of the instruments and other lines handled by them in that section of the country.

MADISON SQUARE GARDEN ELECTRICAL SHOW.—The managers of the Madison Square Garden Electrical Show report that they are meeting with very gratifying and substantial co-operation from the electrical industry. Since the announcement of the broad-gauge plans which have been developed for insuring a great popular success at the Garden next December, a great many new contracts for space have been received. Among others the following well-known firms have selected their space and are busy preparing attractive exhibits: National Carbon Co., Harry M. Stevens, Eastern Carbon Works, Joseph Goldfinger, New York Telephone Company, Chicago Pneumatic Tool Company, Electro-Dynamic Company, General Storage Battery Company, G. M. Gest, Ovington Manufacturing Company.

DOBLE LABORATORY WATER WHEELS.—The Abner Doble Co., of San Francisco, announces that the University of Michigan has purchased the tangential water wheel which it exhibited at the St. Louis World's Fair, and for which the company was awarded the grand prize. This wheel is to be installed in the hydraulic laboratory of the new Engineering Building at Ann Arbor, Mich., where it will be mounted in connection with a duplex pump for experimental purposes, its output being 100 hp when operating under a head of 580 feet. The 12-inch laboratory water motors which the Abner Doble

Co. builds for technical schols and universities have attracted considerable attention among the engineering faculties of the leading educational institutions, and the interest shown in these small water wheels has resulted in an increasing demand for them, orders having recently been received from the University of Wisconsin, the Michigan School of Mines and the University of Toronto.

THE PERU ELECTRIC MANUFACTURING COMPANY has opened an office in New York City, at 39 Cortlandt Street, in charge of Mr. Robert J. Mulligan, who is well known to the New York trade. Mr. Mulligan will be pleased to furnish prices, samples and literature to anyone interested in the line of switches, sockets, rosettes, etc., made by this company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 19, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

799,658. TELEPHONE SIGNAL APPARATUS; David Frame Laughlin, Clyde, Kan. App. filed June 13, 1905.

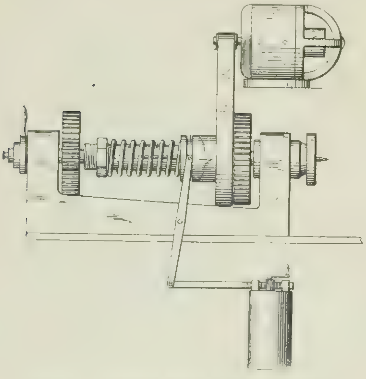
799,684. ELECTRIC FUSE; Henry N. Snyder and Lewis A. Hardison, Santa Paula, Cal. App. filed Aug. 8, 1904. A fuse wire is supported within a protecting tube by a zig-zag insulating strip having aligned holes for the wire. The zig-zag strip serves as a support, and prevents the formation of an arc.

799,704. ELECTRIC RAILWAY SIGNAL; Joseph Bartl, Chicago, Ill. App. filed Feb. 26, 1904. An alarm circuit designed to notify a train of the presence of another train on the same block, is completed by staggered rail sections along the track which make a circuit with trolleys on the trains when both lie between the insulated sections.

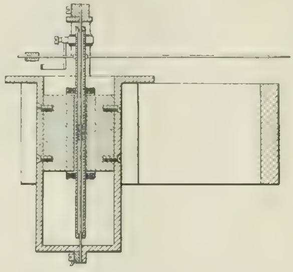
799,717. VARIABLE SPEED DRIVING MECHANISM; Howard A. Coombs, Washington, D. C. App. filed Jan. 30, 1905. In order to accord the motive power with the load requirements in a machine tool, the torque is effective to displace a cam which turns on more current at the motor controller.

799,720. ELECTROMAGNETIC CLUTCH; Henry H. Cutler, Milwaukee, Wis. App. filed Sept. 22, 1902. The clutch members are arranged with an intervening spring which exerts a yielding pressure to throw the members out of contact and insure the disengagement of the clutch regardless of residual magnetism. A special form of controller reverses a portion of the operating current through the clutch to further deenergize its residual magnetism.

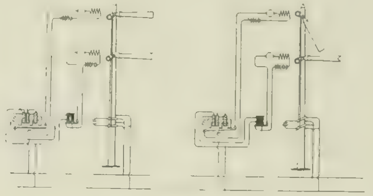
799,721. MULTIPLE SWITCH; Henry H. Cutler, Milwaukee, Wis. App. filed Mar. 24, 1905. A motor starter in which the component contactor switches can only be closed in a predetermined order, and all of which must be closed in order to be retained in closed relation. This is accomplished by making the retaining mechanism dependent upon the closure of the last switch in the series.



799,717.—Variable Speed Driving Mechanism.



799,733.—Means of Supporting Movable Elements of Electrical Instruments.



799,816.—Block Signal System.

799,722. PORTABLE SUPPORT FOR TELEPHONES; Augustus G. Davis, Baltimore, Md. App. filed Jan. 5, 1905.

799,726. INSULATOR; Ernest J. Foreman, Trinidad, Col. App. filed Mar. 16, 1905. A telephone insulator comprising a porcelain tubular shell with overhanging surfaces which act to shed water away from the interior parts.

799,733. MEANS OF SUPPORTING MOVABLE ELEMENTS OF ELECTRICAL INSTRUMENTS; Eugene Hartmann, Frankfort-on-the-Main, Germany. App. filed Jan. 3, 1903. The movable part has a central tube with a jewel eye at each end through which is stretched a wire constituting a stationary spindle. This wire is made one terminal of the armature circuit, the other terminal being formed by a tortion spring secured to the tube.

799,748. CONNECTING WIRE TO BINDING POSTS; William Mills, Elizabeth, N. J. App. filed Dec. 27, 1904. A terminal fixture for connecting wires composed of sheet metal stamped and drawn in a special way. A disk of rubber is clamped into the structure so as to exert a constant yielding pressure to make a good contact at the binding post. This prevents the connection being broken by vibration in gas engines, etc.

799,780. SELF-PROPELLED VEHICLE; Joseph Le Conte Davis, Schenectady, N. Y. App. filed April 9, 1904. (See Current News and Notes.)

799,790. ELECTROMAGNETIC LOCK FOR AUTOMATIC CIRCUIT BREAKERS; John D. Hilliard, Jr., Glens Falls, N. Y. App. filed Nov. 17, 1902. A circuit breaker arranged to operate only for the load for which it is designed. For this purpose a special quick acting locking magnet is located in series with the circuit breaking magnet, and locks the circuit breaker against action in case of an excessive overload.

799,798. LIQUID HEATER AND STRAINER; William J. Morrison, Nashville, Tenn. App. filed Nov. 7, 1904. (See page 570.)

799,807. BLOCK SIGNAL SYSTEM; Henry N. Sporberg, Schenectady, N. Y. App. filed Apr. 24, 1902. Tappets adjacent to the rails open a local circuit and display danger signal. A mechanical connection retains such circuit opened until it is closed through a shunt circuit made by the actuation of the succeeding semaphore. The first signal then returns to normal position.

799,816. BLOCK SIGNAL SYSTEM; Harold E. White, Schenectady, N. Y. App. filed Feb. 11, 1904. The track rails are charged in each block by a local battery with a polarity which is determined by a pole changing switch mechanically operated from the caution signal of that block.

799,817. TELEGRAPHIC TRANSMITTER; Richard Wolters, Dusseldorf, Germany. App. filed Sept. 20, 1904. A Morse code transmitter operable by a typewriter keyboard in which the contacting sliders describe a four-motion path so as to make contact only on the up-stroke.

799,851. MOTOR VEHICLE; Ralph O. Hood, Danvers, Mass. App. filed Nov. 11, 1904. The longitudinal shaft of an automobile is provided with a magnetic clutch having an external gear with which meshes an electric motor. The vehicle includes storage batteries and a controller which can be manipulated to make the motor start the vehicle or to assist the engine in hill climbing. At other times the engine may drive the motor as a generator.

799,887. PARTY-LINE TELEPHONE SYSTEM; Mary A. Breadheft, Indianapolis, Ind. App. filed Feb. 24, 1903.

799,896. ELECTRIC CONTACT DEVICE; Robert W. Farrington, Buffalo, N. Y. App. filed Sept. 23,1904. The trolley wheel has its bearing surface formed by a series of pivoted shoes which are designed to successively make contact with the wire on their flat faces in order to secure a greater contact area than would be obtained by the plain surface of the wheel.

799,934. PROCESS FOR ELECTRICALLY WELDING RAIL-JOINTS; Carl Pahde, Breslau, Germany. App. filed June 30, 1904. (See Current News and Notes.)

799,957. HANGER FOR CABLE HEADS; Frank M. Winn, Des Moines, Iowa. App. filed Nov. 2, 1904. Comprises side bars having parallel portions from which the bars diverge so as to embrace and be secured to a telegraph pole. The opposite ends are bent to embrace the cable and have a bolt to connect the parallel portions and a stay-rod extending therefrom to the pole.

799,989. OUTLET BOX; Charles J. Klein, New York, N. Y. App. filed Sept. 23, 1904. A stamped sheet steel member has spring arms with teeth adjacent to the openings of the outlet box which engage the cables and prevent their withdrawal from the box.

800,022. TRAIN OPERATED TIME SIGNAL SYSTEM FOR RAILWAYS; William B. Severance, Manchester, N. H. App. filed May 29, 1905. The semaphore is operated by a time relay so as to be displayed for a certain predetermined period after the passage of a train.

800,052. CONDUIT FOR ELECTRIC WIRING; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. A sheet metal conduit for interior wiring and designed to form an ornamental moulding. A three-sided sheet metal trough has a corrugated cover secured thereto by screws which engage cross braces within the trough.

800,053. ANGULAR CONDUIT FOR ELECTRICAL WIRING; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. An L-shaped sheet metal trough has its third side formed by an S-shaped strip which slides endwise over the trough so as to interlock therewith and at the same time present an ornamental appearance.

800,054. CONDUIT FOR ELECTRICAL CONDUCTORS; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. A U-shaped sheet metal trough has ears thereon with which to engage corresponding projections upon the cover.

800,055. COVER FOR ELECTRICAL CONDUITS; Henry C. Ayres, Greenville, Ohio. App. filed Mar. 13, 1905. A still different form of conduit moulding in which the cover is very narrow and spring pressed into the longitudinal recess which it is designed to close.

800,084. ELECTRIC WATER HEATER; William C. Dice, Seattle, Wash. App. filed Dec. 6, 1904. A portable arrangement in which the heating coil is wound on a porcelain block within a perforated casing. The device is plugged to an ordinary lamp socket and immersed in a pail of water.

800,114. REGULATOR FOR ELECTRIC CURRENTS; Patrick Kennedy, New York, N. Y. App. filed Nov. 12, 1904. Especially designed for regulating dynamos geared to car axles. The controller arm is stepped around by a pawl and ratchet operated from a magnet which receives current intermittently under the influence of a rotating cam. The direction of the stepping movement is dependent upon a lever whose position is controlled by the intensity of the current.

800,117. ELECTRICAL INDICATOR; Hermann Lemp, Lynn, Mass. App. filed May 5, 1903. The steam from a flash boiler passes through a thermostat on its way to the engine including a steel rod within a copper tube. The relative movement closes one or the other of a pair of alarm circuits which notify the operator of the temperature.

800,118. CONTROL OF AUTOMOBILES; Hermann Lemp, Lynn, Mass. App. filed Jan. 13, 1905. (See Current News and Notes.)

800,119. COHERER; Walter W. Massie, Providence, R. I. App. filed March 27, 1905. (See Current News and Notes.)

800,128. GRID OR ELEMENT FOR SECONDARY BATTERIES; William Gardiner, Chicago, Ill. App. filed Aug. 22, 1904. (See page 570.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, OCTOBER 7, 1905. No. 15.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.................................1139 Monadnock Block
PHILADELPHIA OFFICE.................................929 Chestnut Street
CLEVELAND OFFICE.................................402 Cuyahoga Building
EUROPEAN OFFICE........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen moths from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **14,500** *copies are printed. Total circulation for 1905 to date,* **553,500.**

NEW YORK, SATURDAY, OCTOBER 7, 1905.

CONTENTS.

Editorial 599
Completion of Hudson River Tunnels of the New York and New Jersey R. R. Company........ 602
The Indiana Municipal Code........ 602
Large Independent Telephone Plants........ 602
The Struggle for Independent Telephony in New York........ 603
Metering the Flow of Water in Rivers........ 603
The American Street and Interurban Railway Association........ 603
Instruction of Station Employees........ 605
Central Station and Refrigeration........ 606
Current News and Notes........ 606
Electrical Engineers of the Times.—XXX. Prof. Harold B. Smith........ 608
Electric Operations about Massena........ 609
Armature Reaction in Rotary Converters. By C. J. Fechheimer and H. A. Berthold........ 611
Dynamo Iron Loss Increment on Full Load. By A. Press........ 612
Demonstration Apparatus for Wireless Telegraphy. By A. Frederick Collins........ 613
Relation of Pull to Diameter of Solenoids. By Charles R. Underhill........ 615
Electric Railway Equipment........ 617
New Telephone Patents........ 618
LETTER TO THE EDITORS.
Pressure Due to Radiation. Aerial Navigation. By B. Potamian........ 619
Digest of Current Electrical Literature........ 619
Absorption of Light by Dust. By Van Rensselaer Lansingh........ 623
"National" Induction Motors........ 623
Galvanized Chain for Arc Lamps........ 624
"American" Arc Lamp........ 624
Power Development in Wisconsin........ 624
Thomson High Torque Induction Test Watt Hour Meter........ 625
Extension of Acheson Graphite Works........ 626
Ball Side-Crank Automatic Engines........ 626
The Advantages of Mechanical Draft........ 628
Industrial and Commercial News........ 629
General News of the Week........ 632

MORE ATLANTIC CABLES.

The Commercial Cable interests are completing this week their fifth cable across the Atlantic, and are pushing onward with work on the Pacific. A fair inference from this would be that not a great deal of Mackay capital has been invested in wireless systems, and that the owners of these and other cables have serene confidence in the permanent value of their investment. In some places there are wireless systems working to-day that would appear to have usurped the functions hitherto attributed to the cable; but when long distances, such as those of the Atlantic are considered, the cable still holds its own, and these newer investments would imply that it is expected to hold its own indefinitely.

We do not say that it is "up to" the owners of the wireless systems to explain this state of affairs. Many reasons can be imagined for delay in establishing steady continuous wireless service across wide reaches of ocean. But the general public will wonder why such brilliant promise has so long an intervening period of negation; and the technical public can only wait in patience without being able to offer or receive much information on the subject. As for shorter distances than the width of the Atlantic there is much encouragement. For example, to take one authentic record, the Signal Corps system up in Alaska has been in operation thirteen months, without a single break or interruption of any kind, and without an error having been checked against the St. Michael's and Fort Davis stations, 123 miles apart, although about a million words have been transmitted, many of them in cipher. If wireless telegraphy must "walk" before it can "run," it seems certainly to have passed through its first stage.

CENTRAL STATION CURRENT FOR REFRIGERATION.

On several occasions we have pointed out the possibilities of power load from refrigerating plants of small capacity, which class of service furnishes an almost ideal means of smoothing out the load curve. Formerly the absence of refrigerating apparatus of proper kind and capacity projected into the future the realization of the obvious advantages, but it seems that the stage has now been reached which makes the subject one that no central station can afford to overlook. Refrigerating apparatus is now offered which has been developed especially for operation from central stations, which is automatic in regulation and which does not require expert attendance. Elsewhere we print an abstract of a paper read at the recent meeting of the Edison Illuminating Association, which gives the result of experience in Philadelphia with this kind of service. This experience has extended over a period of more than a year and covers a great variety of applications, and in every instance the results have been satisfactory, both to the central station and to the user. While the convenience of this kind of refrigeration in itself would in very many cases more than make up for a considerable excess in cost over icing, figures given in the paper show that the new method is decidedly the more economical, the saving in some cases being astonishing. For example, in the case of a drug store doing a large soda-fountain business, total cost chargeable to icing of $1,538.46 was reduced by mechanical refrigeration to $953, this sum including interest on investment and an allowance of 10 per cent for depreciation. With economy thus also in its favor, the prospect of a rapid development of this method of local refrigeration from electrically-driven apparatus appears to be excellent. As to the field offered, it is pointed out that in Philadelphia alone there are no less than 10,000 retail dealers whose business necessitates artificial refrigeration; and as the system is also adapted for household purposes the prospect opened up to central stations by this new development is most engaging.

◆

Armature Reaction in Rotary Coverters.

An investigation of the magnetomotive forces of the currents in the armature of a polyphase alternator reveals the fact that if the reluctance were uniform around the air gaps there would be produced a revolving field similar to that of a polyphase induction motor. This field rotates synchronously in a direction opposed to the motion of the armature, and hence it occupies a relative constant direction in space. The magnetism fluctuates in value with a frequency equal to the product of the circuit frequency and the number of collector rings, and the resultant flux oscillates slightly around a certain mean position in space. In a commercial alternator the air gap is not uniform around the circumference of the armature, but the conclusions with reference to the backward rotation of the flux on the armature core and as to the fluctuations in its value and the vibrations in its position in space are directly applicable to a commercial machine.

It can be shown that the actual mean mechanical position of the armature flux with reference to the field poles depends directly upon the power factor of the delivered current. When the power factor is unity, the flux due to the armature current occupies a mean position midway between the field poles, while, when the power factor is zero, the flux is in a position directly to assist the field magnetism if the current is leading, or directly to oppose the field if the current is lagging. As is well known, the above remarks are equally true when applied to a synchronous motor. In the latter case, however, a leading current (so-called) tends to decrease the field magnetism, while a lagging current produces the opposite effect. In a synchronous motor the power factor of the current is determined by the field excitation, so that the mean position of the flux due to the armature current can be varied within wide limits by alternating the strength of the exciting current. It is interesting to observe in this connection that, neglecting minor modifying influences, the amount of distortion of the flux from the field poles is in no wise altered by changing both the value and position of the armature flux due to a variation in the exciting current. This fact is indirectly implied in the discussion given by C. J. Fechheimer and H. A. Berthold on page 611 when dealing with the armature reaction in rotary converters.

As these writers show, the alternating current can be resolved into two components, one in phase with the electromotive force, due to the load on the machine, and the other in quadrature with the electromotive force, due to the excess or deficiency of the exciting current. In a rotary converted the former of these components is more or less fully counterbalanced in magnetomotive force by the direct-current on the delivery side of the machine, so that the distortion due thereto is represented by the amount caused by the current to supply the losses of the machine. The latter component, which is in a mechanical position directly to assist or oppose the field magnetism, can have no effect in skewing the flux from the poles. Since the magnetomotive force of the quadrature component of the current is always in a direction to oppose any change in the field magnetism from its normal value, it would seem that with an armature having negligible local impedance the total flux in line with the field poles is not changed by altering the exciting current. It is evident that this statement applies equally well to synchronous motors as to rotary converters. As the writers of the article referred to have shown theoretically and verified experimentally, however, the change in the power factor of the supply current results in a variation in the distribution of the flux across the circumferential area of the pole faces.

◆

The Alternating-Current Railway Situation.

Mr. Scott's convention paper brings the alternating-current railway question vigorously to the front. For many months it has been in committee, as it were, with frequent and somewhat fervid argument going on, and much waiting for evidence. It must now be regarded as fairly before the house with a favorable, if somewhat guarded, report behind it. We have published from time to time various reports from foreign alternating roads. The evidence is upon the whole favorable, in fact, most encouraging; and with the announcement that the N. Y., N. H. & H. R. R. stands committed to the new system, we must regard the alternating-current railway as fairly out for business on a large scale. Until recently it has often looked as though its supporters were somewhat half-hearted, recommending it in the abstract and side-stepping the issue in the concrete, but to-day the alternating-current motor must be reckoned with as a serious competitor in any large railway proposition. Undoubtedly there will be many improvements made and the system as it exists to-day cannot be considered a finality, but it has certainly won the right to most respectful consideration.

We have consistently held for a long time past that only by using high voltage on the working conductors can heavy electrical railway operation over considerable distances be successfully accomplished. We have been called down in the name of uniformity, standardization, and the third rail "system," whatever that may mean, and have still cheerfully harped away on the high-voltage string. There is no dodging the issue, and the alternating motor in whatever form meets it squarely. The experiments of the past few years have gradually shown that alternating motors of several types can be made to meet the severe requirements of electric traction, and their record up to the present has been at least encouraging. Engineers have been divided, as in the good old times, into opposing camps on the frontier, and more than a little of the old-time acrimony has appeared in their discussions. Some have sturdily and some weakly supported the newcomer, and many have damned it with faint praise. In the meantime it has worked out of the realm of argument into that of reality, and it must be admitted from now on as a genuine competitor in electric railway work. What the future of the alternating-current traction motor, in its present form, may be we hesitate to predict, but it can no longer be put aside with a superior smile, as of possible practical usefulness in some other case than the present. It is interesting to note, too, that the bow trolley, which everyone who has followed foreign practice has known as particularly well adapted to collecting heavy currents at high speed, has at last won a right to a hearing in this country. In fact, a modification of it has already been in successful use on the Coast, which has served as a trial horse for so many improvements.

Another suggestion in Mr. Scott's paper is his discussion of variable-speed control, pointing out that the ordinary direct-current motor is not well adapted to operation at a wide range of speeds, and that in fact the controller for an alternating system is the simpler and more effective. It must not be supposed that at this early stage of the fight the direct-current motor is "down and out" by any means, but it is long past the point where it can conduct its battle on paper. To take a conservative view of the case, the time has now arrived in which a judicious engineer in planning any considerable electric road must consider the alternating system strictly upon its merits, not as a theoretical improvement, but as a practical reality. Its general advantages are manifest. It is a clear gain to do away with the costly and somewhat inefficient rotary converter sub-station, and the tons of feeder copper required to distribute 500-volt current. It is also a gain to get away from the serious difficulties entailed by the distribution of enormous currents on the working conductors, and to come back to a simple overhead construction. That these gains will be made without some sacrifice is hardly in the nature of things to be expected, and the next step is to determine how great is the price which must be paid for the gain and in what currency it must be settled. This is the problem for the traction engineer to-day. The result will determine the status of alternating-current traction. Something will depend on the facility with which a single equipment can be made to play the double rôle required in passing from alternating-current to direct-current conductors. Mr. Scott does not seem to be unduly optimistic upon this particular point. Even so, there are numerous cases in which this condition does not seriously enter the problem, and there will be the first battleground of the respective systems. The vital point is that the plain issue can no longer be dodged and that the fight will be to a finish.

◆

International Electrical Engineering Standardization.

One of the greatest services which the American Institute of Electrical Engineers has done for the electrical engineering industry has been the formulation and adoption of a set of rules for the standardization of certain details of electrical machinery and apparatus. These rules have come into almost universal use in the United States, to the great benefit of all parties concerned. The manifest design of a set of standardization rules is to simplify the classification and testing of machinery, by the recommendation of a rational system of sizes, and other characteristic properties for the various machines ordinarily used. The general adoption of standard definitions, ratings and methods of testing is of enormous advantage to the electrical engineering public. The opportunity for misunderstanding in contracts and specifications is minimized by conformity to standard rules. Moreover, if the methods of rating and testing are clearly defined, the manufacturers are better able to judge in advance of the precise behavior of apparatus under construction. They have less need for a margin of extra security owing to uncertainty of testing methods, and they are thus enabled to reduce the cost of the machines, the purchaser in many cases benefiting from such reduction. Standardization rules in general use in electrical industry have saved, and are saving an enormous amount of waste material, time, labor, uncertainty, vexation and litigation. Other countries also have undertaken the formulation and adoption of electrical standardization rules. England, France, Belgium, Germany, Italy and Switzerland in particular have taken action in this direction. It would seem probable that before long every civilized country will adopt such rules. It is manifest that the advantages which are secured in any one country, such as the United States, by these rules, would be sought for in each and every other country by similar means.

It is, of course, inevitable that the standardization rules independently adopted in different countries should differ. The manufacturing and economic conditions differ materially in different countries, and these alone would tend to determine variations in standardization rules. It is, therefore, very doubtful whether uniform rules should or could be adopted internationally in such matters as relate merely to conditions of manufacture. International uniformity of standardization rules is, however, most to be desired in matters of definition, rating and testing. There seems to be no reason why a dynamo which is rated as of one hundred kilowatts power in one country should become rated as of eighty kilowatts under the rules of another country, or of one hundred and ten kilowatts under the rules of a third country. The conditions which determine the rating are heating, regulation, sparking and mechanical strength. These conditions are physical and mechanical. They are not local exigencies of manufacture. It is true that a motor which is operated in the tropics may have a lesser safe output than a similar motor operated in the arctic zone; but such modification of rating as may be applicable to local temperature conditions should also be determined and adopted internationally. It is generally admitted that all electrical machinery should have the same classification, rating, and methods of determining the rating, all over the world. These matters should not be questions of latitude and longitude. Nothing is needed to establish international standardization on these points except international discussion and compromise.

The international electrical Congress of St. Louis last year took this matter under consideration and adopted a resolution in favor of the plan. It was proposed that the various national societies of electrical engineers should communicate with one another with a view to taking steps towards the accomplishment of this desired result. Two consequences should follow upon the successful adoption of even the most elementary foundations of electrical engineering standardization. The first would be the advantages to international commerce in electrical machinery, by the elimination of uncertainty, misunderstanding and cause of dispute. This would be a universal commercial advantage. Any electric machine which had its rating correctly established in one country would thereby have its rating at the same time established for all other countries. The second advantage that might be expected to follow in the wake of international standardization would be less demonstrable from a utilitarian or commercial standpoint but might nevertheless be of considerable indirect international value to electrical workers. It should result from the closer association of the national electrical engineering bodies that would inevitably be brought about by their co-operation upon an international set of electrical standardization rules. This co-operation should increase the cordiality, respect and mutual good will of electrical engineers in all parts of the world and pave the way for their harmonious international co-operation in other directions. It is high time that steps were taken to carry out the suggestions of the International Electrical Congress of St. Louis in regard to international standardization. It is to be hoped that the American Institute of Electrical Engineers may take this matter up at an early date.

There can be no doubt that if the American society were to communicate with its sister societies abroad, interest in this subject would be cordially reciprocated. The first step taken might be to determine by correspondence the precise status of national electrical standardization in each country. Then discussion might be taken up by correspondence between committees of these national societies in regard to the possible unification of the simplest physical and mechanical definitions of rating. After the practicable matter has been sifted from the impracticable in this way, a meeting of delegates from the societies might be called at some convenient time and locality in Europe to discuss the matter and arrive at a tentative international understanding, subject to the ratification of the governing bodies of the societies represented. In such a manner the first steps towards international electrical standardization might be completed in a single year at a very small cost and with great mutual advantage.

Completion of Hudson River Tunnels of the New York & New Jersey R. R. Company.

An important event in the history of New York City's traction facilities was witnessed Friday, September 29, in the completion of the tunnel system of the New York & New Jersey Railroad Company under the Hudson River between Hoboken and New York. The uncompleted south tube of this tunnel system, which has been under construction from the Jersey side of the river, a few days ago reached the wall of the working shaft on the New York side, at Morton Street and the river front, and this wall was forced through Friday afternoon in the presence of the officials and directors of the above company and also of the Hudson Companies, the construction company directly in charge of the prosecution of the work. The event was attended with considerable ceremony, marking the entire and successful completion of the under-river portions of this tunnel project. The officials, together with a party of invited guests, entered the south tube through the entrance shaft near Fifteenth Street, Jersey City, from which all of the work of construction has been carried on, and rode through to the barrier wall at the New York end, where Mr. W. G. Oakman, president of the Hudson Companies, operated the hydraulic jacks which forced the final opening through the wall and permitted the party to make the first complete trip through this tube.

Among those present in the party representing the New York & New Jersey Railroad Co. were W. G. MacAdoo, president; E. F. C. Young, director; C. W. King, secretary, and A. B. Conger, treasurer. The Hudson Companies, the construction company, was represented by W. G. Oakman, president; Pliny Fisk, director; W. N. Barnum, director; W. C. Kinney, treasurer; William H. Barnum, assistant treasurer; Charles M. Jacobs, chief engineer; J. V. Davies, deputy chief engineer; G. D. Snyder, principal assistant engineer; H. M. Sperry, consulting signal engineer; R. S. Courtney, works manager; F. K. Hilt, division engineer, and Dr. A. J. Loomis, medical director at the tunnel. Mr. L. B. Stillwell, consulting electrical engineer, was represented by Mr. H. Hazleton, his assistant.

The completion of these tunnels is of interest in that it marks the culmination of an enterprise that was projected over thirty years ago and, although regarded at that time as an impossible undertaking, was carried well along toward completion before being compelled by engineering difficulties and lack of financial support to be abandoned. At the time work was stopped in 1881, the north tube was nearly half completed and work had been begun on the south tube. Work was again taken up by the present company in 1902, after a delay of eleven years, and has been pushed to completion in record time. The north tube was completed in March, 1904, and the work of lining with concrete and of installing the cable ducts at the sides is well advanced. Now that the south tube is completed and the air pressure used with the shield method of construction is removed, similar work will be vigorously prosecuted there also. Work is progressing so rapidly upon the approaches that it is confidently expected that cars will be running upon the system early in 1907.

The length of the tunnels between the shafts at Fifteenth Street, Jersey City, and Morton Street, New York, is 5,780 ft., the interior of each of the tubes being 15 ft. 3 in. The tubes are laid nearly parallel, separating only about 50 ft. toward the middle of the river, and have no cross communication at any point between the shore shafts. The greatest depth below mean tide is near the middle of the river, where the tubes are 15 ft. below the bed of the river, the depth of water at that point being 65 ft. Each tube will provide for a single track, the north tube carrying west-bound traffic and the south tube the east-bound.

The plans for the terminals upon the New Jersey side of the river have not been definitely determined, but it is probable that connection will be made with the principal ferry terminals, so that incoming passengers may have the advantages of direct connections with the principal points of the city without the dalays and inconveniences of the present ferry accommodations.

The New York approaches to the tunnels have been carried to some distance eastward from the Morton Street shaft. Construction upon these is being carried out upon the shield and hydraulic jack method, similar to that for the tubes beneath the river, the shields for the approaches having now reached Christopher Street. The present plans for the New York terminal call for a line running up Fourth Avenue as far as Thirty-second Street, with stations at Fourteenth, Eighteenth, Twenty-third and Twenty-eighth streets, and a branch through Ninth Street to make connection with the Interborough subway at Astor Place.

The Indiana Municipal Code.

Mr. H. O. Stechhan, in the October-December *Forum* has an interesting article with regard to the new Indiana municipal code. He says:

"Uniform government in all the cities and towns of Indiana is the end which the new municipal code enacted by the General Assembly this year seeks to achieve. It marks a distinct step forward in city government, and is intended to work a number of important reforms in the general conduct of municipal affairs, placing them on more of a business basis.

"The code repeals all so-called individual city charters and separate incorporation acts, with special grants, under which the different municipalities of Indiana have been organized heretofore, and extends the same broad principles of local self-government to all. Owing to the varied systems of management that these cities and towns have had in the past, the experience of one contributed but little to the well-being of its neighbor, each being compelled to learn the same lesson for itself. This fact inspired the code, and it was drafted for the express purpose of meeting the wants of all similar communities within the confines of the State. Indiana's municipal code is constructed after the pattern of the city charter that prescribed the government of Indianapolis, the State's capital city, from early in 1891 until the middle of April, 1905, when the new law went into effect. Thoroughly tried and tested during the fourteen years that it was in force, the Indianapolis charter came to be regarded as one of the best to be found in our country.

"In some quarters, what is known as the 'city-made charter' is the most approved form of municipal law at the present time. This means a body of law that has been made and adopted by the people themselves for whom it is intended, after which it has been ratified by the legislature of the State, as distinguished from a code of laws originating in the General Assembly, as most city charters do. Constitutional provisions in Missouri and California authorize 'city-made charters' for cities having more than 100,000 population. Kansas City, Mo., is the latest municipality to make its own government. Fourteen years ago Indianapolis, through a committee of public-spirited citizens, built for local needs the body of law which the Indiana legislature approved at the time; and so satisfactory has been its operation in the interim that this year's assembly saw fit to apply the provision of this organic law, 'city-made' according to the latest meaning of the term, to all the cities of the State. For the larger cities the same machinery of government employed in Indianapolis for fourteen years has been adopted, though minor modifications have been made to adjust it to the varying needs of the smaller ones. Where a sort of governmental chaos has existed in the local affairs of municipalities within the State, this act is expected to bring about systematic regularity."

Large Independent Telephone Plants.

Following is a list of the approximate number of independent telephones in use in some of the larger cities of the country:

Philadelphia	17,000
Los Angeles	16,000
Pittsburg	15,000
Cleveland	15,000
Minneapolis and St. Paul	14,000
St. Louis	13,000
Kansas City	11,000
Chicago (business telephones only)	10,000
Indianapolis	9,000
Louisville	8,000
Buffalo	7,600
Rochester	7,500
Seattle	6,500
Grand Rapids	6,200
Columbus	6,000

In the State of Pennsylvania there are more than 30 cities having over 10,000 population each, in which there is an independent telephone company.

By some authorities it is figured that there is $250,000,000 capital invested in the more than 5,000 independent companies in the country at the present time.

The Struggle for Independent Telephony in New York.

A large number of applications are on file in the New York Board of Estimate and Apportionment for telephone franchises in the greater city and environs. Each of the applicant companies agrees to give the city the use of six hundred telephones.

The applications now on file with the Bureau of Franchises, pending final disposition by the board and the aldermen, are as follows:

Atlantic Telephone Company: Joshua D. Powers, president; home office, Louisville, Ky. Petition received June 2, 1905.

The Atlantic company asks for a franchise in New York City only

The Atlantic company proposes to charge five cents a call and $66 a year for unlimited service for private residence telephones and $108 for unlimited service in business places. The franchise is for twenty-five years and the rental to be paid the city is a sum equal to 1 per cent of its gross earnings for the first two years, 2 per cent for the next three years and 4 per cent for the remaining twenty years, the city to have the free use of five hundred instruments.

Star Telephone Company; Richard J. White, president; home office, New York City; capital, $1,000,000. Petition received June 30.

The Star company's application covers New York State and the Middle and New England States.

The Star company's rates are five cents a call for messages and slightly lower yearly rates than those named in the Atlantic company's application.

Commonwealth Telephone Company; Edwin M. Brooks, president. Petition received July 14.

The Commonwealth company states that it expects to operate in New York, New Jersey, Pennsylvania, Delaware and Maryland.

The Commonwealth proposes to charge five cents a call, $90 a year for business telephones in Manhattan, $75 in Brooklyn and The Bronx and $60 in Queens and Richmond.

◆

Metering the Flow of Water in Rivers.

In a paper read before the Boston Society of Civil Engineers, Mr. H. K. Barrows described an electric meter for determining the flow of water in rivers as used by the Hydrographic Branch of the United States Geological Survey. There have been many forms of flow meters used by the Survey in one way or another, but it has been found that the Price electrical meter gives, in general, the best results for river work. This meter is made in two sizes, the smaller size for use at ordinary and low-water stages, and the larger size, which is built stronger, for use when the velocity is high and the number of revolutions of the smaller meter would become too great for counting. The meter is suspended by a double-conductor cable which is heavily insulated. When this cable is new and in good condition it will safely carry a lead weight of 35 or 40 pounds for holding the meter in place.

The meter proper consists of cups of peculiar shape, mounted upon a shaft which revolves with a speed proportioned to the velocity of the water. In the Price meter, the shaft is vertical, and the greater part of the weight of the moving parts comes on the lower bearing which is adjustable by means of screws. The top end of the shaft of the meter is bent slightly so as to give it an excentric motion as the cups revolve, thus making and breaking an electric circuit as each revolution is made.

The primary cell used is small and compact in form, and is the result of a great deal of experimentation. It consists of a hard rubber cell with a cylindrically shaped carbon which is connected with a platinum wire extending through the bottom of the cell. The other pole is of zinc extending through a rubber stopper which closes the cell. This cell fits in a case, and is connected in circuit with a buzzer through the contact device of the flow meter. This form of apparatus gives more or less trouble, owing to the various parts of the buzzer getting out of adjustment, but so far it is the most satisfactory form devised. It has, at least, the advantage of being exceedingly compact in form, and can be placed at the end of the cable near the observer. Experiments have shown that with the smaller Price meter, measurements of velocities less than about 4 ft. per second are not reliable, the chief reason being that the friction of the meter on its bearings grows relatively greater as the velocity decreases. Two important improvements which are now being considered are the use of ball bearings which should make the low velocity readings much more reliable, and the use of some device whereby, when desirable, only every fifth (or tenth) revolution of the meter will be recorded. This latter improvement will enable the small meter to be used for high velocities, and will result in a greater field of usefulness for it.

At the present time there are some 20 metering stations in Maine maintained by the Geological Survey, and covering most of the principal rivers of the state. Throughout the other New England states there are 23 additional stations, distributed as follows: New Hampshire, 13; Massachusetts, 5; Vermont, 3; Rhode Island, 1; Connecticut, 1.

Besides the matter of obtaining estimates of flow of rivers, the Hydrographic Branch is devoting some time to the procuring of river profiles, and such data as will be of value in pointing out to capitalists suitable sites for power development.

◆

The American Steel and Interurban Railway Association.

During the Philadelphia meeting of the American Street Railway Association and affiliated societies last week, the plans for reorganization were carried through, a new constitution being adopted and the name of the combined societies being selected as "The American Street and Interurban Railway Association." The following officers were elected: President, W. Caryl Ely, Buffalo; first vice-president, John J. Beggs, Milwaukee; second vice-president, Calvin G. Goodrich, Minneapolis; third vice-president, James F. Shaw, Boston. Under the new plan of organization, the members of the executive committee are made up of the presidents of the affiliated organizations. The executive committee is as follows: H. H. Adams, Baltimore, of the Mechanical Association; S. L. Rhoads, Philadelphia, of the Claim Agents' Association; W. B. Brockway, Nashville, of the Accountants' Association.

Four papers were read before the American Street Railway Association. Two of these by Arthur West and J. R. Bibbins, who dealt with gas engines, were printed in abstract in our last issue. The other two papers treated of single-phase and direct-current railway equipments. The paper by Charles F. Scott, on "The Single-Phase Railway System," was abstracted on page 596 of our issue for September 30, while a review of the paper by W. B. Potter on "Electric Railway Equipments," may be found on page 617 of the present issue. A digest of the discussion which followed the reading of these papers is given below.

GAS ENGINES.

In opening the discussions of the papers dealing with gas engines, Mr. C. O. Mailloux stated that he had called attention last year to the fact that evidence at hand went to show that with coal at $2 per ton the steam plant and the gas plant were about equal as to the cost of producing power. Mr. Bibbins, however, showed that the two should be on an equality when the coal costs $1 per ton. He wished to know why such a change had taken place within one year. Mr. Bibbins replied that he was not familiar with the assumptions made the year previous, but the greatest item in determining the price for coal at which the two plants show equality is the load factor. In his own paper he had assumed a load factor corresponding to an average railway plant, which is 66 per cent. If the load factor is that of an electric lighting plant, barely 25 per cent., the results would be quite different.

Mr. Charles Hewitt questioned the accuracy of the figures used by Mr. Bibbins. Whether the comparisons made between the particular gas and steam plants were correct he could not say. But he was sure that steam plant selected was very uneconomical. Anthracite buckwheat coal contains between 11,000 and 12,000 heat units per pound of coal. The figures given indicate that this coal would run from 6.5 pounds to 8 pounds per kw-hour. The poorest plant with which he was personally familiar showed better results than that. He was familiar with plants running non-condensing which showed 4.5 pounds of coal from year's end to year's end. The consumption will run as low with good coal as 4¼ pounds, seldom over 4¾ pounds, and the average for the year will be 4.4 pounds to 4.5 pounds. Running condensing with the same quality of coal, it is perfectly possible to run at 3.5 pounds of coal. Mr. Bibbins said that figures given referred to a non-condensing plant. He thought it was safe to say that the relative coal consumption between steam and gas plants would be about two to one.

In reply to a question by Mr. Mailloux, Mr. Bibbins said that a smaller plant will cost more per kilowatt than a larger one even though the same number of units were instilled. The small gas engines, however, will show an efficiency quite comparable with a large one, while the relative efficiency of the steam plant will decrease much more rapidly with small units, and this item might readily more than balance the increased capital cost.

Mr. W. E. Winship related the experience with the gas engine plant installed for the Gould Coupler Company, at Depew, N. Y. This plant consists of three Westinghouse vertical gas engines, rated at 235 horse-power each, with the Loomis-Pettibone gas system. The plant cost almost exactly $115 a brake horse-power to install. It was estimated that it would have cost $90 per horsepower for a steam plant, equivalent to the gas plant, excepting as regards coal consumption. In regard to the overload capacity, it was estimated that by installing a storage battery the same overload capacity could be gotten out of the plant. After the batteries are installed the plant will have cost about $130 per brake horse-power, and for the same overload capacity as the steam plant. The coal consumption, based on coal containing 13,400 B. T. U. per pound, has been on a monthly average 2.26 pounds per kw-hour at the switchboard, with a load factor on the plant of roughly 50 per cent for twenty-four hours' operation. On a series of 65 days when the load factor was approximately 65 per cent, the coal consumption went down to 2.02 lbs. as an average. The lowest record for twenty-four hours' period of operation, when the load was especially good, was 1.79 pounds of coal for a kw-hour on the switchboard. That load is very similar to what is used in street railway work. The peaks, when the load is heavy, are fully 60 per cent above the average, and when the peaks are lighter, they are fully 100 per cent above the average load. The conclusions were that with coal at $2.30 per ton, and with the plant operated for about fourteen or sixteen hours a day, the steam plant and the gas plant would have just balanced each other, but that with the twenty-four-hour operation the gas plant is more desirable. In regard to the reliability of the plant, he could state that it has been fully as reliable as any steam engine plant that could have been put in.

Mr. Hewitt remarked that it might be of interest to some of the members to know the latest results in steam turbine plants, which he had received only a few weeks ago from New England. As opposed to the 2.26 pounds of coal, which Mr. Winship gave as the average for thirty days, the results show 2.4 pounds to 2.6 pounds per kw-hour with bituminous coal. The average is 2.5 pounds for turbines as against 2¼ pounds for gas engines. One of these plants has five units of about 1000 kw; the other has two units, and he thought in the latter case there were about 1500 kw using superheated steam.

ELECTRIC RAILWAYS.

The papers of Messrs. Scott and Potter were discussed together.

At the conclusion of the reading of his paper, Mr. Scott remarked that the single-phase system and its apparatus must be developed in the course of a few months or a few years, not only to equal, but to more than equal the result of the development of the direct-current system during the past dozen years. A great deal of that development can be done by the designing engineers in the factory, but, as we all know, the service test is the final test, and a great many of the practical points as to control the interworking of various parts, the best forms of apparatus must come from experience. The experience has been begun, but just as with the direct current after its fifteen years, so the alternating current after as many months has not reached perfection, but the manufacturers have reached that point where they feel that with the knowledge of the apparatus and with the experience which has been secured, it can now be presented to the operating street railway man as a perfectly feasible and practicable system.

W. E. Goldsborough stated that he did not believe that any designer of electrical machinery to-day is satisfied in his own heart with the single-phase commutator motor. He felt confident that in time, through insistent and persistent work on this problem, there will be produced a single-phase motor which will be more nearly analogous to the multiphase motor and which will not have a commutator.

C. O. Mailloux said that while he had much faith in the single-phase system, he did not believe that the direct-current system would be discarded immediately. In many cases of long-distance traction to-day the single-phase system, even in its present state, will be more practicable than the rotary converter sub-station system. It may be alleged as an excuse for this latter system that it was introduced at a time when it would have been impossible to have gone very long distance without it. There are doubtless many cases in the Middle West where the system is eminently practicable, and where it is to-day the very best. These cases are found where the traffic is very frequent and where there is sufficient mean power distribution over the whole line to warrant the use of such stations. He said that his criticisms refer particularly to the cases where the cost of operating sub-stations is so great that the engineers are trying to find employment for the men who run the sub-stations, by making them wind armatures or field coils, so as to justify charging the larger part of their time to the mechanical and repair department. Some of these cases are sad, and would have been prevented by a little discretion or discrimination in the selection of the system. That there are to-day two good single-phase systems, both of them sufficiently good for the great majority of these cases just noted, is significant. The single-phase alternating-current motor will greatly enlarge the field of operation of the companies employing the direct-current motor system, by enabling them to extend their lines in the suburbs. Such companies should run the lines in the city with the direct current as they have been doing. They can, if necessary, buy a few new single-phase equipments for the suburban lines; then run with direct current inside of the city limits, and even for some distance beyond, use the alternating current (single-phase) to operate the longer suburban lines. There will, doubtless, be a very large field for that sort of work, and we are apparently on the point of realizing it practically.

In response to the request of Mr. Scott, G. D. Nicoll, chief engineer of the Indianapolis and Cincinnati Traction Company, related the experiences of his company with the single-phase railway. Operations were begun on the first day of January of this year. On the first day of April the cars ran within four miles of Indianapolis, all of the operation being on alternating current. Difficulty was experienced in getting into the city of Indianapolis on account of two overhead bridges which were so low that the cars could not pass under them. These were raised, and on the 1st of July cars began to run into Indianapolis. The line then was 41 miles in length, 37 of which was on alternating current, and the remaining 4 miles on direct current in the city of Indianapolis. Up to the time of beginning operating into the city, there had been no trouble with the motor insulation. The worst trouble was the question of the transformer ventilation. This was overcome, but on operating the motors in the city of Indianapolis defects developed in the motor windings. These were also overcome, and there has been no further trouble. The company is operating the highest schedule that is maintained in the State of Indiana, collecting the current by means of a bow-trolley. No trouble whatever has been experienced with the bow-trolley. He was not able to give any data as to the car mileage or the life of the shoe of the trolley, which is composed of wood plated with aluminum, but stated that the cost of operation and of renewing the shoe is not more than would be the case with the ordinary trolley. The company has been well pleased with the operation of the equipment. Some minor changes have been made in the apparatus, but on the whole it is very satisfactory.

John J. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, requested some information concerning the advisability of installing single-phase motors upon a certain interurban route. There are now being built three 12-mile extensions, the farthest point of which will be 33 miles from the center of operation. It is the intention to continue these extensions to 75 or 80 miles, possibly 100 miles, in the development of that section of the country. It is a serious question whether to adopt the composite motor; and if it would be equally effective with the direct current as it would be with the alternating current in the more sparsely settled sections of the State, on many of the lines a car operating only once every 2 hours. Representatives sent to investigate the various lines operated with alternating curent have given very conflicting reports concerning them. One of the most recent reports was to the effect that the system was so unsatisfactory that it was to be abandoned. In reply to Mr. Beggs' question, Mr. Potter said that there is no doubt that the alternating-current motors can perform any service now done by direct-current apparatus. The selection of the type of motor is mainly a financial and not strictly an enginering proposition.

Both of these factors are, however, closely related, and while it is the latter which determines the former, it is the former, giving due consideration to all incident advantages, which should govern. The alternating-current motor when running on direct current will do even more work than it will on alternating current. A good alternating-current motor in a general sense is a most excellent direct-current motor with respect to acceleration and heating. On a road of, say, 50 miles in length, employing few cars, the saving secured by the use of a high-potential trolley would be so much greater than the additional cost of the alternating car equipments that there would be little question but that alternating-current apparatus would be more suitable for such a proposition. On a road of a few miles in length and having a number of cars per mile the relative cost of the alternating car equipment would be a much larger proportion of the total cost, and whatever saving could be made in the trolley conducting system would be relatively small. It is not, however, wholly a question of initial cost, but it may be said in general that where the initial cost for alternating-current and direct-current installations are about equal, the choice should be for direct-current equipment, owing to the lower probable maintenance of the installation as a whole.

In reply to a criticism by Mr. Hall as to the relative acceleration of direct-current and alternating-current motors, Mr. Scott said that the rate of acceleration in the motor depends upon the rate of application of higher voltage to the motor; in other words, upon the rate at which the controller is thrown on. The rate of acceleration on the alternating-current motor in some cases has been slow, because the controller was thrown on slowly. For example, on the Indianapolis road, if the controller handle, which is adapted to both direct and alternating current, should be turned at the same rate, it happens to give a much lower rate of acceleration on alternating current than on direct current. In order to get the same acceleration in the case of alternating current the controller should be moved faster. Some of the earlier motormen, who were accustomed to operate on direct current, operated in the same way with the alternating current, and got a slower acceleration for that reason. When the rate of the movement of the controller was increased the rate of acceleration of the car was increased also.

◆

Instruction of Station Employees.

Mr. W. F. Wells, superintendent of the Brooklyn Edison Company, at the Lake Champlain convention of the Association of Edison Illuminating Companies, read a paper on "Instruction of Men Operating Interconnected High and Low-Tension Systems, with Reference to Safety of Employees, Reliability of Service, and Resumption of Same after Partial or Total Interruption." The paper deals with the experiences of the New York Edison Company, and presents in complete form the instructions which are given to the employees at the various stations, feeder sections and substations.

As the Edison system increased in size and complexity, and the service from each station became more and more dependent upon what occurred elsewhere, it was found necessary to broaden the organization and to raise the intellectual standard for the station operating men. For operating the steam plant of the generating station, the high-speed stationary engineers and assistants were replaced by men trained and disciplined on the Atlantic steamships. These men quickly learned that a signal from the electrical switchboard to start or stop an engine was as imperative as an order from the pilot house, and they soon realized that when required, engines must be kept running at all hazards. They were accustomed to the operation of engines with heavy parts, were self-dependent and have been found capable of acting promptly and with good judgment when the situation demanded it.

For the electrical operators the proposition was entirely different; the equipment being installed was of a new type, the details of which had not been fully developed, and consequently there were no men trained in its manipulation. Nor had any instruction books been printed, describing the construction of the apparatus, or its operation in connection with an electricity supply system, in a manner that would be comprehended by the men best fitted to operate it. Experience has shown that the best men for this service were those who had some mechanical training and who possessed a technical knowledge of electrical apparatus about equivalent to the steam knowledge required for licensed engineers. These men submit to the discipline and monotony of the position, by education and training become quickly acquainted with all the details of the station equipment and outside system, and in case of trouble quickly ascertain the cause and then act coolly and promptly. Their interest in the work is increased and the men induced to study and improve their condition by promoting from time to time those capable of filling positions of increased responsibility, this being partially determined by periodical examination. As a rule graduates from the technical schools have been found unsatisfactory for this class of work. As soon as they had mastered the details of the position the monotony of it would become irksome and they would secure employment elsewhere.

In the instruction of new men they are first given to understand that they are assuming certain responsibilities, that they must comply with all the rules and be conversant with all instructions issued for their guidance, and further, that if rules are not observed, action will be taken. It is only by maintaining strict discipline that best results can be obtained.

The method of instructing electrical operators varies with their positions, which, in the New York Edison Company are graded as system operators, foremen, regulators, and various assistants.

With the system operator, experience is the teacher, and the text-books are the load curves and reports from the entire system. These are made the subject of exhaustive study and from them are deduced plans of action for the future. In order to be prepared to meet exceptional emergencies, which it is hoped may never occur, conditions are assumed, and operators in all stations trained and drilled in executing a carefully prearranged plan. As an instance, twice each month the steam engineers at the generating station and the foremen and electrical operators in all stations are drilled under the direction of the system operator in starting engines and rotaries from rest, as would have to be done in case of total shut down on the system. This drill, which consists in starting one and additional rotaries in the various sub-stations, one and additional engines in the generating station, and synchronizing both rotaries and engines at low voltage and frequency, has brought out many details, such as methods of starting engines, low voltage synchronizing devices, field excitation most suitable on generators and rotaries, the use of batteries, etc. By such means the men are trained to think and at the same time become familiar with what may be expected of them in case of serious disturbance.

A man becomes a foreman only after he is thoroughly acquainted with all the known details of the construction, operation, and repair of the apparatus. His instruction, therefore, is on the broad lines of discipline, methods of handling and educating men, thoroughness in investigation of trouble with apparatus or employees, and clearness, accuracy, and conciseness in making reports. He must maintain a certain dignity with the men, and guard against familiarity or favoritism. He should instruct the men to perform all operations and never personally operate a switch unless absolutely necessary.

For the regulators, assistant regulators, switchboardmen, brushmen, etc., it is customary to employ men for the lower grades and promote them to better positions when warranted. Each man is thoroughly trained and drilled by the foreman in the operation of the apparatus under his care and becomes perfectly familiar with all its connections before he is called upon to work on other apparatus.

As the apparatus in the stations increased and the connections became more complicated, various methods were developed in the different stations for accomplishing the same purpose. In order to avoid confusion and establish uniformity it was found desirable to issue rules and instructions for the electrical operators. In some cases it was possible to make these rules inflexible, but in other cases broad and general instructions were issued as to the methods to pursue under given circumstances, and the man depended on to use his judgment. The rules for all employees handling high-tension cables and apparatus, and detailed instruction for operating men as to the best methods to be followed in both generating and sub-stations in case of serious disturbance to the system have been issued in booklet form to the men and their receipts taken so that no excuse can be given for ignorance. The rules and instructions for the operating men in the generating station have been collected in the form of a rule book very similar to that used on the large railway systems of the country. These are issued in a loose-leaf book, and when existing rules cannot be enforced by reason of later experience, or further developments in the apparatus, necessary changes or modifications are made, as a single obsolete or illogical rule tends to nullify the importance of all the others. In general this book defines the position, responsibility, and duties of each class of electrical operators; it contains concise, yet complete detailed instructions for the men in the different positions so that the substitutes are fully prepared to take the place of absentees; it contains general and detailed instructions for the operation of all apparatus and for the safety of all employees working around high-tension apparatus.

It is impossible with a rule book, by education, or by any other means, to make a good man out of poor material, but by placing rules and instructions of this sort in the hands of intelligent men to be used as a guide by requiring of them complete observance of the rules, and by questioning them as to their understanding of the various instructions an organization may be developed which will successfully cope with any operating problem.

◆

Central Station and Refrigeration.

Among the papers read at the recent meeting at Lake Champlain of the Association of Edison Illuminating Company was one by Mr. G. W. Goddard, entitled "Relation of the Central Station to the Motor-Driven Refrigerating Machine." Mr. Goddard pointed out the growing use of refrigeration in towns and cities, and as electric power has particular advantage in driving refrigerating machinery, the situation is one that should not be overlooked by central station men. He advised the study by these of the processes of refrigeration and the looking up of electric power business in this field. Twenty years ago artificial refrigeration was in its infancy, and yet to-day it is making the entire ice output of the Southern states, supplying the ice to refrigerating cars from the west and south, and preserving and regulating the delivery of meats, fruits and other commodities. Through refrigeration millions of dollars worth of perishable goods are stored for any desired length of time for supply to the smaller dealers; and it is this latter class who can derive a particular benefit by use of the smaller refrigerating machines now made and arranged to be driven by the electric motor.

About 18 months ago the Philadelphia Electric Company added a refrigeration department to its business, putting into effect at the start a system of publicity through illustrated pamphlets and following up by a personal call. As a result of this work, plants have been installed in dairies, dry goods stores, grocery stores, residences, restaurants, saloons, office buildings, apartment houses, etc. The paper gives descriptions in detail of several typical plants installed for different refrigerating purposes, together with data of tests and cost of refrigeration.

In the case of a dairy the cost of ice refrigeration was $779.25, and of an electrically-driven refrigerating plant $735.75, this latter figure including cost of electric power, water for condensing and fixed charges. The electric system, in addition, demonstrated its great advantage in regulating temperature at will under sanitary conditions and regulating refrigeration to the amount of material to be cooled. In a grocery store the cost of ice refrigeration had been $92.20, and of mechanical refrigeration $42.21, giving a saving of $49.99 in favor of the latter. In addition to interest on investment, all of the costs given in the paper include an allowance of 10 per cent for depreciation and repairs. The greatest difference was found in the case of a drug store, where the cost of ice refrigeration was $1,538.46 and the cost of mechanical refrigeration $953, making a saving of $585.46. In the case of a restaurant the corresponding figures were $640.50 and $414.86, the saving thus being $225.64. Data are also given of a plant in a butcher shop and in a saloon, there being a saving also in both of these cases. Data are also given of the results of operation of an installation in a residence. In this case the machine was under the care of the butler, who had little trouble in learning to operate it.

In conclusion, Mr. Goddard stated that the demand for a refrigerating machine of a capacity of from 500 pounds to 3 tons of ice is an unquestioned fact; the practicability of such machines now in the market has been demonstrated, and there is no doubt that a large and profitable load for the operation of such machines can be secured by central stations. In Philadelphia alone there are more than 10,000 retail stores which could use small refrigeration machines with an advantage and profit to themselves.

CURRENT NEWS AND NOTES.

THE NEW ATLANTIC CABLE.—A special dispatch of October 2 from Canso, Nova Scotia, says: "The steamship *Colonia*, which is laying the new transatlantic cable of the Commercial Cable Company, reported to-day that about four-fifths of the entire distance had been successfully covered. Up to noon to-day, 1,778 miles of cable had been paid out, although the steamship was only about 1,500 miles in a straight line from her starting point at Canso. The *Colonia* then had more than 300 miles to steam before reaching the coast of Ireland, where the European end of the cable will be landed. Fine weather and a westerly breeze were reported by the *Colonia*."

WIRELESS TELEGRAPHY FOR SURVEY WORK.—To facilitate the survey work of the Grand Trunk Pacific Railway, now in progress in northern Ontario and Quebec, it has been decided to utilize wireless telegraphy for the purpose of communicating with the survey camps. At the present time it takes five or six weeks to send a communication to some of the engineering parties in the field and receive an answer from them. The first wireless station will probably be erected at New Liskeard and another in the vicinity of Lake Abitibi. From the latter point, east and west, there will be wireless offices established at distances of forty or fifty miles apart.

NEW YORK LIGHTING.—Some idea of the expected rapid development of electric light and power on Manhattan Island may be formed from the fact that even before its big Waterside Station No. 2, recently described in these pages, has gone into operation, the New York Edison Company has bought a tract of land at the upper northern extremity of the Island. The land includes 30 lots and is bounded by Academy Street, Two Hundred and First Street, and the Harlem River. This is a splendid strategic location for a new power plant in the future, to supply the territory now developing so rapidly along the banks and bluffs of the Harlem, and shows how closely the energetic management of the company is studying its problems not merely of to-day but those of five and ten years hence.

WIRELESS IN WEST INDIES.—U. S. Vice-Consul Mitchell, of Georgetown, Trinidad, writes that the people in the island are dissatisfied with the present methods of transmitting cable messages. He says: The West India and Panama Telegraph Company, which is paid an annual subsidy of $21,600, subject to deductions pro rata for interruptions, keeps this colony in telegraphic communication with the outside world by means of a cable between here and Trinidad, but this line has become unserviceable, and is so often broken, sometimes for weeks together, that the business community has become intolerant of the uncertain service. The feeling is therefore strongly in favor of any system of wireless telegraphy that would be "fairly reliable," and it is the intention of the Government to offer a reasonable annual subsidy to any one who will undertake such a service.

ELECTRICAL CONVENTION.—In Kansas the eighth annual convention of the Kansas Gas, Water, Electric Light and Street Railway Association will be held at Kansas City, Kan., at the Mercantile Club House, on October 13 and 14. Mr. R. C. Johnson, of Lawrence, is president, and Mr. J. D. Nicholson, of Newton, is secretary-treasurer. The programme prepared is as follows: President's address, R. C. Johnston; "The Tantalum Lamp," Prof. B. F. Eyer, State Agricultural College; "Producer Gas," R. M. Sutton, Wichita, Kan.; "The High Efficiency of High C. P. Lamps," J. F. Schaefer, Kansas City, Mo.; "The Need of Sewage Disposal Plants in Kansas," R. E. McDonnell, Kansas City, Mo.; "Co-operation in Management of Gas, Water, Electric Light and Street Railway Companies," C. R. Maunsell, Topeka, Kan.; "Public Utilities and Municipalities," Prof. E. H. S. Bailey, University of Kansas; "Purification," E. S. Springer, Leavenworth, Kan.; "Relative Heat Producing Values of Natural Gas, Oil and Coal," Prof. Erasmus Haworth, University of Kansas; Report of Committee on Revision of Constitution and By-Laws.

STATUE OF GRAMME.—A statue of the late Zenobe Gramme will be unveiled in Liege Oct. 7. Commemorative addresses will be delivered in the afternoon in the Festival Hall of the Electrical Exhibition now in session at Liege.

ELECTRIC LAUNCH FOR NAVY YARD.—An electric launch is being built at the Charlestown Navy Yard, Boston, Mass., for experimental purposes and for practical work. The launch is 28 ft. long and will derive its power from storage batteries. Its speed will be 9 miles per hour.

THE MEXICAN TARIFF.—Many articles of American manufacture are affected by the increase of import duties made by the Mexican government, and which became effective September 1. The duties are based upon the weight per kilo of 2½ pounds. The gross kilo includes the entire packing or casing, and the legal kilo is that prescribed in the traffic act. The rating on electric lamps per gross kilo is 11 cents.

ELECTRIC SMELTING IN CANADA.—The Dominion government is making preparations to conduct experiments at Sault Ste. Marie in electric smelting of ores and the making of steel rails. The furnace is already constructed, and the transformer ordered from the Westinghouse Company for transforming the high voltage current to one of low voltage, is already on the way. The electrodes have been purchased in Sweden.

MORE PACIFIC CABLE.—Mr. George G. Ward, vice-president of the Commercial Cable Company, sailed for New York last week on the White Star steamer Cedric, having completed arrangements for extending the Pacific cable to China and Japan. Clarence H. Mackay, president of the Commercial Cable Company, states that the new cables, both to China and Japan, will be laid and in operation on or before April 1, 1906.

INDEPENDENT TELEPHONE OFFICIAL SHIELD.—The National Interstate Telephone Association has arranged to handle the standard toll sign and other supplies bearing the official shield in order to furnish the same to independent telephone people throughout the country at the lowest possible prices. It is the desire of the association to educate telephone users, and the public generally, to the significance of the official shield as the emblem of independent telephony.

THE DENVER CONVENTION.—Although the entertainment and hospitality extended to the National Electric Light Association last June at Denver and Colorado Springs was most lavish, and left nothing wanting, it is interesting to note that Mr. R. B. Sullivan, chairman of the local finance committee, has returned to the contributors to the fund, 15 per cent of their subscriptions. This is much better than the usual shortage.

LONG-DISTANCE TELEPHONY.—Advices from Boston say: "The American Telephone & Telegraph Company is laying a hundred-pair underground cable between New York and Philadelphia. The underground cable system will in the near future be put in from New York to New Haven and from Boston to Providence. Electrical conditions may soon be overcome that will permit the use of underground cables all the way between Boston and New York. Telephonically speaking, the new telephone repeater of the American Telephone Company will bring Chicago 500 miles nearer to New York."

INDIANA INDEPENDENT TELEPHONE ASSOCIATION.—This association, through its secretary, Charles S. Norton, has just issued a pamphlet describing the plan of organization, giving the operating rules adopted and some gratifying facts and figures on the independent telephone companies of Indiana. The pamphlet shows that there are 368 independent telephone companies in the State, 15,000 stockholders, 175,000 subscribers, 30,000 miles of toll line, 1,560 toll offices, $15,000,000 of capital invested, and that the gross earnings of last year were $3,500,000. The uniform system of accounting is explained and the objects of the organization now being perfected are set forth as being the improvement of the service, standardization of equipment, unification of operating methods, the harmonizing of interests, decrease of expenses, and the increase of the value of telephone securities

TRAIN LIGHTING SYSTEM.—In order to prevent the electric lamps of a single car of a train from being extinguished when the trolley conductor of that car loses contact due to coming upon a dead section, Sigvald Krohn, of Berlin, Germany, according to a patent issued September 26, would arrange the lighting circuits of a train so that at least a portion of the lights upon each car may receive current from the trolleys of a plurality of cars. The lights of each car are divided into independent groups, one of which is connected to the local trolley conductor and another to the trolley conductor of an adjacent car. By this means, failure of current upon one car operates to extinguish only a portion of the lights of any one car, or a portion of the lights on several cars.

POWER OF NIAGARA FALLS.—In a recent ruling in favor of the right of the Niagara, Lockport & Ontario Power Company to acquire certain lands, Referee Love, of Buffalo, made some interesting statements about the effect on the cataract of power development. He says that the development of 200,000 horsepower at Lockport will not endanger the Niagara River. The diversion of 4,500 cubic feet of water every second by the Lockport company, at the point where it proposes to divert the water would not lower the level over the American falls to exceed one inch; and that the diversion of 9,000 cubic feet every second would not lower the level over the American falls to exceed three and one-tenth inches. He adds that the lessening of the depth of the Niagara River from three to six inches would have no injurious effect upon its navigation, as the shifting winds often produce equally as great, if not greater, diminution of its depth.

NO CONFISCATION.—An interesting instance of protecting a corporation is thus noted by the *Wall Street Journal:* "The railroad commissioners of Massachusetts have authorized the Boston & Northern Street Railway Co. to abolish the giving of transfers in five towns and cities along its route. The commissioners in reaching this decision acted upon the principle that the doing away of these transfers was necessary to enable the company to earn fair dividends. The Boston & Northern earned last year only 2 per cent on its stock. This is a notable instance of action by a government board in behalf of vested interests. It stands out in striking contrast to the policy of the Texas Railroad Commission. Government control of railroads ought never to mean confiscation, either direct or indirect. It ought never to result in regulations regarding either rates of transportation or methods of operation which would involve the sacrifice of the capital vested in the enterprise. The ideal government regulation will stand, not for the railroads as against the people or for the people as against the railroads, but for both the railroads and the people, so that each may have fair play."

GERMAN LOCKOUT.—A cable message from Berlin, of September 30, says: "A lockout in three of the largest electrical companies in Berlin began this afternoon. It affects all the factories of the Allgemeine, the Siemens-Halske and the Siemens-Schuckert companies, except one lamp factory, and throws about thirty-three thousand workmen out of employment. As yet the trouble has not affected the entire electrical industry, but it shows signs of spreading. The employes of the Berlin Electrical Works, which generates nearly all the electricity consumed for power and traction purposes in Berlin, met this evening to consider a sympathetic strike, but deferred action until Sunday night, in order to await the result of a conference to be held on Sunday morning between the three companies affected and their employes. This conference will be presided over by Herr von Schultz, president of the Government Arbitration Bureau, but will have no official character, as the companies refused to take part in the appeal for arbitration. They agreed, however, to meet the labor representatives. The engineers of the Berlin Electrical Works, fearing a sudden strike, are spending their entire time in the shops. The office force is also being held in order to operate the machines in case of emergency. Suspension of work in these shops would stop every street car line in Berlin, and the authorities are taking precautions. It has already been arranged to bring a detachment of machinists from the navy yard at Kiel. .The lockout this afternoon was effected in good order. The police department offered to increase the police force about the shops, but the managers declined the offer. The companies desired to retain 10 per cent of the workmen in order to complete pressing contracts, but the men refused to stay."

NEWFOUNDLAND TELEGRAPHS.—The premier of Newfoundland, Sir Robert Bond, has made arrangements for a loan of $2,000,000, the proceeds of which are to be paid to Mr. R. G. Reid for the telegraph lines of the colony. The rate of interest on the loan is to be 3½ per cent.

THE TROLLEY IN MANILA.—Secretary of War Taft in his report on the present conditions in Manila, says: "The most noteworthy change is the construction of the electric street railway along thirty-three miles of the streets of Manila. It is a paying property, greatly patronized by the natives, and has revolutionized living in the city."

A CORRECTION.—In the review notice of the book on "Radioactive Substances," by Mde. Sklodowska-Curie, printed last week, an omission by the printer partly destroyed the sense of a sentence. The sentence should have read as follows: "Our views of matter are undergoing a rapid process, not of evolution but of revolution; the element of the chemist is no longer that of the physicist; the one-time indivisible entity is now mercilessly shattered into fragments in order to satisfy the requirements of $\frac{e}{m}$ (peace to the shades of Dalton!), and the stability of the atom as well as the permanence of the various forms of matter are beginning to disappear from the articles of our scientific creed."

LOWER TELEPHONE TOLLS.—Following their reduction of rates in Manhattan and Brooklyn last spring, and more recently in The Bronx, the New York Telephone Company and the New York and New Jersey Telephone Company now announce that a new schedule of discounts is to go into effect on October 1, 1905. The discount will be allowed on toll messages when contracted for in advance, sent from any subscriber's station, in any exchange district of the city of New York, which includes all the boroughs, to all other stations in any other designated station in the city of New York. The subscriber may also select not more than three stations in the exchange district so designated, and all messages sent from them to his station will be subject to the discount which is as follows: On a guarantee of 25 messages a month, 10 per cent.; 50 messages, 20 per cent.; 100, 30 per cent., and 200, 40 per cent.

EVERY HOTEL LIGHTED.—It was, of course, quite impossible for a man like Elihu Thomson to escape an interview on his return from Europe, and thus the *Boston Herald* has secured some interesting comments from an acute and sympathetic observer of progress. He is quoted as follows in regard to his visit to Spain to see the sun's eclipse, and then to Switzerland: "I did not go out of my way to see or inspect anything electrical, but I was surprised to find such advancement in its application as I observed in Spain. I was not prepared to find obscure and remote points of that country using it to the extent they are. In Switzerland, by reason of the immense natural water power, they have made wonderful strides, and are using it extensively in all its various channels of adaptiveness. The railroads are utilizing electricity generally for passenger transportation. I did not visit a hotel during my trip that was not using electricity." When asked for his views on the electrical status, he said: "Electrical people are not disturbed by any contest with gas; our field is so illimitable, discovered and undiscovered. It may be put in this way: The foundation is laid and upon this the structure must be built, rising stone by stone; some have been fitted and laid, some have been quarried and must be dressed and fitted for their places in the structure, while doubtless, others still must be uncovered and blasted out. It is a proposition of dig, and judging from the accumulation of mail you see here, I shall have to take a hand at it, but that may be counted as part of the price one must pay for a vacation."

Electrical Engineers of the Times.—XXX.

PROF. HAROLD B. SMITH.

Harold Babbitt Smith was born in Barre, Mass., May 23, 1869. His ancestors on both sides were among the early settlers of New England, some being among the earliest graduates of Harvard, and members of the family for over a century and a half have, with occasional interruptions, been engaged in educational work. With the exception of about a year spent in California in 1885, Prof. Smith's boyhood was passed in Barre, where he graduated from the high school and passed a year in the office of his father, a wholesale lumber manufacturer, prior to entering Cornell University in 1887. He was graduated from Cornell with the degree of M. E., in June, 1891, and returned for graduate study the following fall. At graduation he was on the honor list of his class, and while a student was a class officer and editor of *Sibley Journal of Engineering*.

In March, 1892, he entered upon the duties of adjunct professor of electrical engineering at the Arkansas State University and had charge of the development of this new department of the university. From this position he resigned in January, 1893, to join the Elektron Company at Springfield, Mass., where he occupied successively the positions of draughtsman, chief designer and electrical engineer. In the fall of 1893 he again returned to educational work as director of the School of Electrical Engineering of Purdue University, Lafayette, Ind. This position he occupied for three years, during which period the scope of the department was much enlarged, the number of students in electrical engineering more than doubled and the corps of instructors and the equipment greatly increased. In 1896 he was appointed to his present position, that of professor of electrical engineering at the Worcester Polytechnic Institute, Worcester, Mass., where as director of the electrical engineering department he has organized this branch of instruction of the Institute.

PROF. HAROLD B. SMITH.

While Prof. Smith's work has been principally that of an educator, and his abilities as such have been made evident in the organization and conduct of the electrical departments of Purdue and Worcester Polytechnic, his activities have extended to other fields. During the past twelve years he has served as consulting engineer for a number of clients, in several cases being retained over a period of years. He has also devoted considerable time and thought to experimental investigations with alternating currents of high potential. In 1898 he built a transformer for 175,000 volts, in 1901 one for 500,000 volts, and in 1904 another of 300 kw capacity, which has been operated at over 400,000 volts; this latter was probably the largest high-voltage transformer built up to that time.

Prof. Smith is the author of over forty monographs and contributions to engineering societies and technical journals, and was the revising editor of the electrical terms in the last edition of the "Century Dictionary." At the meeting last year of the International Electrical Congress he presented a paper on high-voltage transformers, and was chairman of the International Group Jury of Awards on Electric Lighting at the St. Louis Exposition. He is a member of the American Institute of Electrical Engineers, the British Institution of Electrical Engineers, the American Society of Mechanical Engineers, the American Electrochemical Society, the National Electric Light Association, the Society for the Promotion of Engineering Education, the American Association for the Advancement of Science, etc.

Electric Operations About Massena.

SAINT LAWRENCE COUNTY, New York, the largest in the State, is second only to Niagara in its water power resources, and probably leads all others in the extent of its mineral deposits. Along the northern boundary of this county the St. Lawrence River flows for 73 miles, passing down Galops, Du Plats and Long and Little Sault Rapids in its course. These last named rapids represent a fall of nearly 50 ft. in the river along 10 miles of its course, which could be developed, but by a curious geographic formation it is practicable to utilize nearly all of this fall by discharging water from the St. Lawrence into La Grasse River through a canal about three miles long. Massena is the site of an electric power plant of 20,050 kw capacity, operated with water from such a canal, as has already been described in our columns.

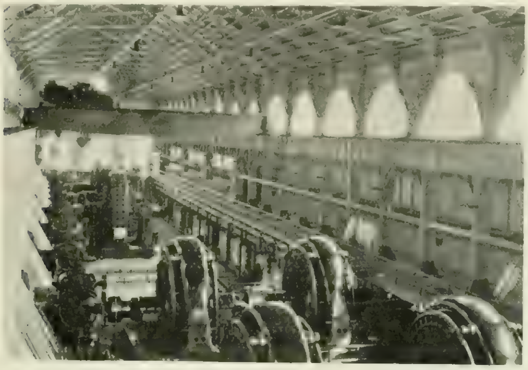


FIG. 1.—INTERIOR OF POWER HOUSE, SHOWING ALUMINUM CONDUCTOR UNDER GALLERY.

This interesting plant is owned by the St. Lawrence River Power Company, which has kindly made it possible to present here some facts as to its recent extensions and operations. As the plant is located more than a hundred miles from any of the larger cities of the State, and is in the midst of a territory rich in natural resources, the company has chosen to build up a manufacturing center about it, and to supply energy at attractive rates to industries only a few miles distant, rather than to undertake long transmissions of power. Some of the reasons for this policy may be found in the fact that St. Lawrence County offers an attractive field for the manufacture of paper from wood pulp, and contains large deposits of magnetic and hematite iron ore, and of white and blue marble. In accord with the policy just noted, nearly one-half of the present capacity of the electric station is devoted exclusively to the development of energy for the nearby works of the Pittsburg Reduction Company. Four Bullock generators each rated at 2,200 kw and 500 volts, direct current, supply energy for the company just named, and are kept in operation 24 hours per day and seven days per week with very short intermissions for inspection and repairs. Each pair of these generators is direct-connected to the shaft of a single set of horizontal turbine water wheels, as indicated in Fig. 1.

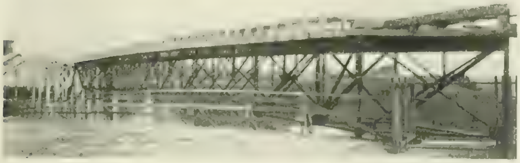


FIG. 3.—ALUMINUM LINE TO PITTSBURG REDUCTION CO.

The output of 8,800 kw from the four generators is transmitted from the water power station to the works of the Pittsburg Reduction Company over conductors that have a single length of about 1,500 ft., and are probably among the largest in the world (see Fig. 2). Each side of the two wire, 500 volt circuit that carries this current of 17,600 amp. is composed of a number of large flat bars of aluminum until a point a little outside of the power house is reached, and then it changes to 250 round aluminum wires, each having a dimeter of ⅜ in. For the support of the two conductors like that just described there are two parallel pole lines with cross timbers between opposite poles, and the aluminum conductors lie directly on the wood at every support. An examination at one or two points failed to show any signs of charring in the wood next to the aluminum wires, and it was stated that no trouble had developed from this cause.

In the works of the Pittsburg Reduction Company the greater part of the energy represented by the 500-volt current is used in the production of aluminum, but quite a portion is consumed as power in the wire-drawing mill. Though aluminum is produced at other points by the Pittsburg Reduction Company, it is said that all of the aluminum wire which is made in the United States is drawn at the Massena plant.

Another important manufacturing industry located near the power plant is that of the Indestructible Fibre Company, which uses eleven motors that aggregate 314 hp, and operate at 440 volts. The Massena Mineral Filler Company uses one motor rated at 1,000 hp and 2,080 volts, and the Remington-Martin Paper Company has a motor of like capacity and voltage. One motor of 20 and one of 40 hp operates the plant of the Simpson McIntyre Co., and the Massena Machine Works has a 10-hp motor. The St. Lawrence County Electric & Water Company, which distributes electric light in Massena, uses two 25-hp motors to drive machinery in its station.

The most interesting of these power installations is that of the Remington-Martin Paper Company, which is at Norfolk, about 12 miles from the water power plant. At the mills of the Remington Company a 1,000-hp motor is devoted to the unusual if not unique work of grinding logs into pulp. This class of work is one of the heaviest done about a paper mill and is most commonly carried on with direct mechanical connection between the water wheels and pulp grinders. In the mill of the Remington Company, however, the pulp grinders are direct-connected to an induction motor that operates at 2,080 volts, 25 cycles, three-phase and 214 r.p.m. (see Fig. 3). This motor, which is of the General Electric make, drives four wood pulp grinders, two being connected at each end of its shaft. About this motor there is a housing with removable top. This motor is started with an external resistance connected through collector rings on the rotor, and a hand wheel on the motor short circuits the secondary after the controller is cut out. The grinding of pulp with electric power has been found to be so satisfactory that the paper company is about to adopt it in another mill. It may be noted here that the satisfactory application of electric power to the grinding of wood pulp will result in the location of mills at points where they have not heretofore been thought practicable, because of the lack of cheap power, and will thus materially increase the amount of electric transmission.

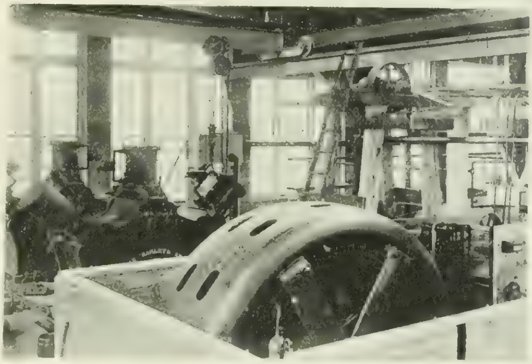


FIG. 3.—INDUCTION MOTOR AT NORFOLK MILL.

In order to economically transmit the energy for this 1,000-hp motor it was necessary to raise the pressure of 2,200 volts generated at the former place to some higher value, and 22,000 volts was selected for the purpose. The 2,200-volt overhead lines run from the generating station to a transformer house a few hundred feet distant, and there connect with three oil-insulated, self-cooling transformers of the Westinghouse make. Each transformer is rated at 375 kw and operates with 1,900 to 2,200 volts in the primary and with 19,000 to 22,000 volts in the secondary windings.

Near the plant of the Remington Paper Company in Norfolk there is a terminal house in which is placed a similar group of transformers which reduce the line pressure to about 2,080 volts for the motor. A single three-phase circuit of aluminum connects the transformers in these terminal houses at opposite ends of the transmission line, which is 11.73 miles long. Each conductor of this circuit is made up of seven aluminum wires each 0.099 in. in diameter, so that the cable has approximately the cross-section of a No. 2 B. & S. gauge wire. These three power cables enter the transformer houses through circular openings fully 12 in. in diameter, which are protected from the weather by a hood in each case. Between the centers of adjacent circular openings the distance is about 4 ft., and this is the standard distance between the three cables along the pole line.

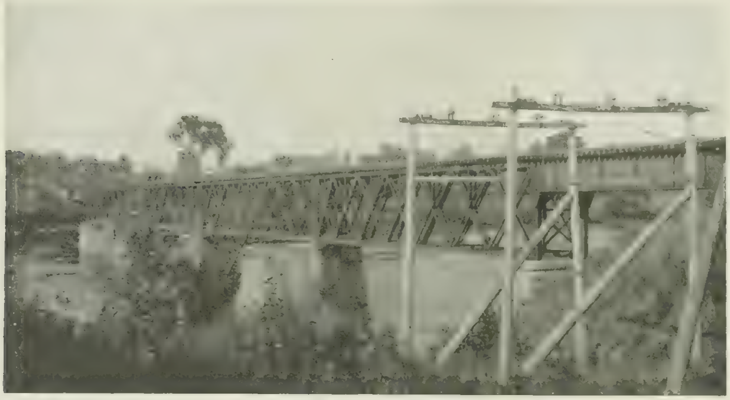


FIG. 4.—RAQUETTE RIVER SPAN ON NORFOLK LINE

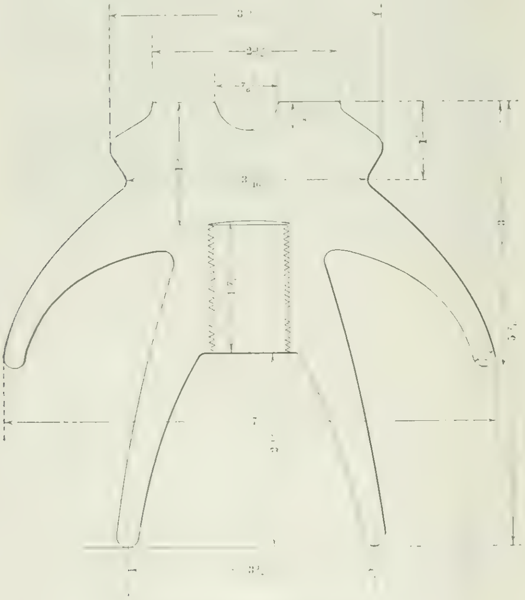


FIG. 5.—DIAGRAM OF INSULATOR.

The pole line is built mainly of Michigan cedar poles, each 30 ft. long and having a 6-in. top. Each pole carries one two-wire cross arm for the power cables and the third cable is mounted at the top. At railway and river crossings special timber structures or long poles take the place of the ones of the regular size. Where the transmission line crosses the Massena Terminal Railway a double-pole structure is used on the one side and a tall pole with a special form of guard irons beneath the conductors on the other side. These guard irons are secured at either end of a horizontal bar that is attached to the pole beneath the conductors and parallel with them. Each guard iron resembles a cross arm with its ends turned up, and it is intended to catch any cable that falls from its insulator. In crossing La Grasse River the aluminum cables make a span of 377 ft. between timber structures, and with the temperature at 28° C. the sag of each cable is 10 ft. At the crossing of the Raquette River the span is 515 ft. between wooden structures, but in this case the aluminum cables are supported by two steel cables, each of which is secured to timber struts and passes over wooden saddles on the fixtures that support the power conductors, as shown in Fig. 4.

Each steel cable contains seven strands of wire 0.160 in. in diameter, has a weight of 0.52 pound per foot, an ultimate strength of 9,800 pounds, and a sag of 22 ft. between supports at 26° C. The pair of steel cables carry four cross arms between supports and the aluminum cables are attached to regular line insulators on these cross arms. One-piece porcelain insulators, which are used to support the 22,000-volt circuit, are giving satisfactory results. Each insulator is 5⅞ in. in height, 7 in. in greatest diameter and has a groove ⅞ in. wide for the cable at its top (see Fig. 5). Of the two petticoats on each insulator, the inner extends about 2⅞ in. below the outer and is 3¾ in. in diameter. The depth of pin hole is 1⅞ in., and from the top of the pin hole to the top of the insulator the distance through porcelain is 1⅝ in. At each insulator the aluminum cable is mounted in the top groove and is held by a solid aluminum tie wire 30 in. long of No. 2 B. & S. gauge.

These facts as to electric operations about Massena are presented through the kindness of Mr. E. B. Bumsted, general manager of the St. Lawrence River Power Company; of Mr. R. D. Pierce, and of Mr. Irving A. Taylor, general superintendent.

* * *

Three-Wire Electric Railway Systems.

A recent issue of the London *Electrician* contains an interesting account of the Nürnberg-Fürth railway which was converted to the three-wire system some time ago. The financial report for 1904, which recently appeared, shows a substantial gain in favor of the three-wire working. Altogether, the system comprises 19 route miles, and 3,950,000 car miles were run in 1904 against 3,540,000 car miles in 1903. In 1904 and 1903, the receipts were 6.4 d. and 6.5 d. respectively. These figures are based on the assumption that two trailer miles are equivalent to one motor car mile. Some 22.6 millions of passengers were conveyed during 1904, against about 20.4 millions in 1903. In 1904, 3,457,209 kw-hours were generated in the power house, against 3,159,100 kw-hours in the previous year, the generating costs being as follows:

Fuel costs	£5.500	in 1904	and	£5,477	in 1903.
Salaries and wages	1.477	"	"	1,432	"
Lubricating material, etc.	194	"	"	204	"
Maintenance, etc.	1,121	"	"	1,056	"
	£8,292			£8,169	

Hence, the generating costs per kilowatt-hour came to 0.60 d. in 1904, against 0.65 d. in 1903. On an average 870 watt-hours were consumed per car mile in 1904 against 892 watt-hours in the previous year. The corresponding figures per ton-mile are 95 and 97.5 watt-hours respectively. At the end of 1904, the rolling stock consisted of 113 motor cars, 97 trailers, 6 snow ploughs, 3 watering cars, 2 cars for transporting rails and 15 horse-drawn vehicles for various purposes. The total capital expenditure on the tramways, including the power house, was £325,931 at the end of 1904. This system was described on page 1186 of our issue for June 24, 1905.

Armature Reaction in Rotary Converters.

By C. J. Fechheimer and H. A. Berthold.

If the excitation of a rotary converter be such as to give a maximum power factor, then, if the losses be negligible, there is absolutely no armature reaction. This statement is, of course, based upon the assumptions that the impressed e.m.f. on the alternating-current end follows a sine wave of time-value, and that the rotary is not hunting. The mathematical demonstration of this fact has been given by Dr. Steinmetz, and it may be found in his "Elements of Electrical Engineering," pages 236 to 239. This condition may be seen to follow from the fact that in a synchronous motor operating at its maximum power factor, the tendency of the cross ampere turns (which are the only ones that exist under this condition), is to skew the field in a direction opposite to the direction of rotation; while in a direct-current generator operating with its brushes neutral, the cross ampere-turns tend to skew the field in the same direction as that in which the armature is revolving. Since a rotary converter is a combination of a synchronous motor and a direct-current generator, and since, under the conditions assumed, the resultant ampere turns are equal in value, but opposite in sign, they neutralize each other, and there is, therefore, no armature reaction.

It has now become standard practice to place inductive reactance in series with the alternating current end leads of a rotary and to cause the field m.m.f. to be varied by causing the generated direct current to flow through a series field coil. In such cases the power-factor varies over a wide range, and the conditions cited above no longer hold. It is sometimes important to know just how the field is distorted or skewed, if at all, with excitations that give power-factors other than unity, if for no other reason than to be enabled to set the direct-current brushes intelligently. The writers believe that the following synopsis of a theoretical and experimental investigation which was carried out in the electrical laboratories of Purdue University, will prove of interest.

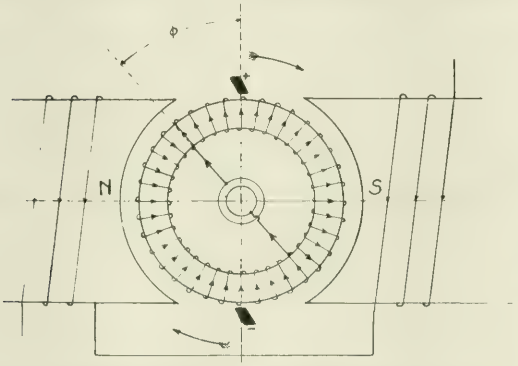


FIG. 1.—ROTARY CONVERTER IN WHICH CURRENT LEADS E.M.F. BY ANGLE φ

The experimental work consisted in taking flux distribution curves on a four-pole, three-phase, 7½-kw rotary converter. These curves were taken by balancing the e.m.f. induced in an exploring coil wound on the armature against the e.m.f. drop in a resistance, a contact maker being used to close instantaneously the circuit at the proper points. These curves were taken at a number of points on the no load, 1-3, 2-3, and full load phase characteristics, the power-factor being varied from 10 per cent lag to 20 per cent lead, the alternating e.m.f. being maintained constant at 60 volts. A few of these curves have been incorporated in this article.

It was shown by Prof. Blondel in his paper on "Armature Reaction of Alternators," read before the Electrical Congress at St. Louis, that "the armature reaction may be considered as the resultant of a direct reaction produced by the wattless current, *I sin φ*, and a transverse reaction due to the watt-current, *I cos φ*." Evidently this statement will apply to synchronous motors as well as to alternators. In a rotary, however, a peculiar condition is met with. If the amperes necessary to overcome the losses be neglected in comparison with the much greater load and wattless currents, then at all times will the energy ampere turns of the alternating current be equal to the ampere turns of the direct current, since, neglecting losses, the same amount of energy is given off at the commutator as is taken in at the collector rings. Hence, as with unity power-factor, the direct current ampere turns neutralizes the alternating-current energy ampere turns, and thus the transverse or cross reaction is reduced to zero. This simplifies the problem a great deal, as only the effect of the back ampere turns producing the direct reaction, due to I sin φ, need to be taken into account.

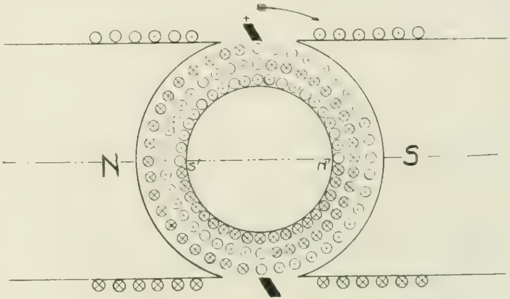


FIG. 2.—LAGGING CURRENT. INNER BELT—*I* SIN φ. MIDDLE BELT—*I* COS φ. OUTER BELT—DIRECT CURRENT.

In a polyphase synchronous motor or generator, the m.m.f. due to the current in the armature revolves synchronously with respect to the armature. This m.m.f. is stationary with respect to the poles, and hence in rotary converters the m.m.f., due to the alternating current, stands still in space. As far as polarity due to armature m.m.f. is concerned, the polyphase rotary may be treated as a single-phase machine.

It is customary in dealing with the power factor of synchronous motors to call the terminal power-factor the power-factor of the machine. Due to the local impedance of the armature, however, the angle between the current and the e.m.f. required to overcome the counter generated e.m.f. is not the same as the angle between the current and the terminal e.m.f. In order to simplify conditions, the cosine of the angle between the current and the e.m.f. which overcomes the counter generated e.m.f. will be considered the power factor of the machine.

Fig. 1 is a bipolar representation of a single-phase rotary converter at the instant when maximum alternating current is flowing, which in this case is leading. The angle φ is the angle whose cosine is the power factor. Consider in Fig. 2 that the wattless current, *I sin φ*, flows in the inner belt of conductors; that the power current, *I cos φ*, flows in the middle belt, and that the direct current, *Id*, flows in the outer belt. It will be seen that, if *I cos φ = Id*, their m.m.f's neutralize each other, so that only the effect of *I sin φ*, as previously stated, need be considered. In the case of lagging current, as shown in Fig. 2, it will be seen that *I sin φ* produces an m.m.f. which assists the field, the poles *S'* and *N'* being produced thereby. Due to the distributed form of winding, this m.m.f. increases as the axis is approached. Therefore, the maximum flux density should be along this axis, or directly at the middle of the pole, as is illustrated in Fig. 3. This was found to be the case in the experiments, as is illustrated in the experimental flux distribution curves of Figs. 4 and 6.

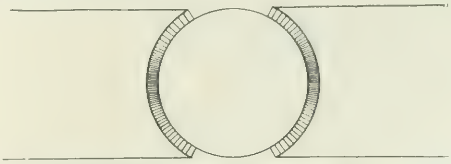


FIG. 3.—DISTRIBUTION OF FLUX IN A ROTARY CONVERTER WITH LAGGING CURRENT.

The conductors shown in Fig. 7 represent those carrying *I sin φ*, which in this case, is leading. Since the armature m.m.f. opposes the field m.m.f. and since this effect is greatest along the axis there should be a smaller flux density at the middle of the pole than at any other point covered by the pole. Since the armature m.m.f. is less at the pole tips than at any other portion of the armature enclosed by the poles, the flux density should be greater at the pole tips than at any other point, as is shown in Fig. 8. Figs. 5 and 10 illustrate this, although not as well as might be desired, as it was found extremely difficult to obtain accurate results under these conditions.

In the experimental curves illustrated there is a tendency to peak at the leading pole tip. This is believed to be due to the cross-magnetizing effect of the current required to overcome the losses, which in so small a machine (7.5 kw) is not negligible.

From Figs. 2 and 7, it will be observed that *I sin φ* has absolutely no effect upon producing greater flux density in one pole tip than in the other. Hence, there is absolutely no skewing of the field, and, therefore, if the direct-current brushes be set neutral or be given a small forward lead, so that the short-circuited coil may commutate in a field just sufficient to reverse the current, the rotary should run sparkless, regardless of load or power-factor. Experimental curves for various conditions are shown superposed in Fig. 6. In every case they intersect the *X* axis in practically the same points. Thus we have experimental proof that the neutral point is not shifted by a change in power factor.

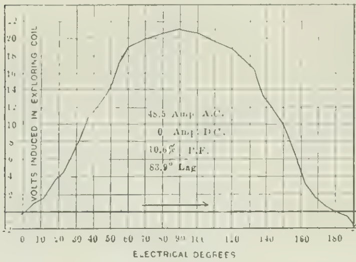


FIG. 4.—FLUX DISTRIBUTION WITH LAGGING CURRENT.

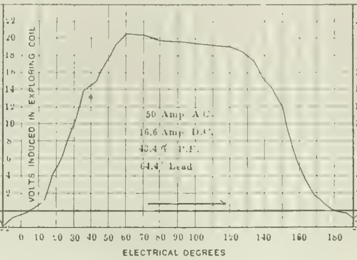


FIG. 5.—FLUX DISTRIBUTION WITH LEADING CURRENT.

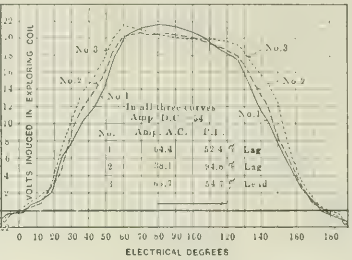


FIG. 6.—EFFECT OF CHANGE IN POWER FACTOR ON POLE FRINGES.

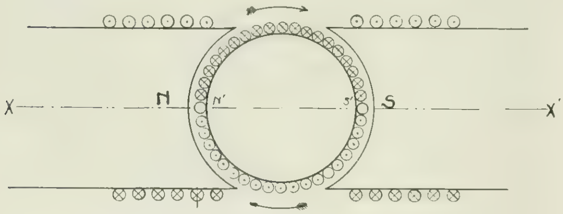


FIG. 7.—BELT OF CONDUCTORS CARRYING *I* SIN *φ*—LEADING.

It may be shown, by means of a vector diagram, that, for the same terminal e.m.f. and frequency, more flux is required to produce the necessary counter generated e.m.f. with leading than with lagging current. The flux per pole is proportional to the area of a distribution curve, and it was found that the areas of the leading current curves were larger in every case than those for lagging current, thus verifying experimentally that which may be shown theoretically.

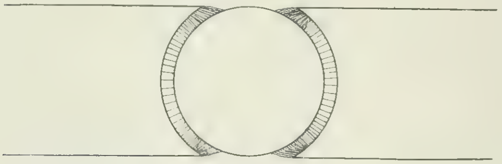


FIG. 8.—DISTRIBUTION OF FLUX IN A ROTARY CONVERTER WITH LEADING CURRENT.

Since there is more flux per pole with leading than with lagging current, and since the maximum density occurs at the pole tips in the former, and at the middle of the pole in the latter, there will be more fringing with leading than with lagging current, as is shown in Figs. 3 and 8. This is also illustrated in Fig. 6, as the sides of the lagging current curve falls within the leading current curve. As a result of this fringing effect with leading current, the range through which the brushes may be shifted without causing sparking, is less with leading than with lagging current.

It will readily be seen that if the rotary be run inverted, the distribution of flux with leading and lagging current will be, respectively, the same as with lagging and leading currents with the rotary running in the ordinary manner.

In case the rotary is used to do mechanical work in addition to its operation as a converter, the flux will be distorted, due to the cross ampere-turns (as in direct-current or synchronous motors) whose value will depend upon the mechanical load applied; and the distribution of flux will depend upon these cross ampere-turns, the back ampere-turns due to I sin φ depending upon the power-factor.

Dynamo Iron Loss Increment on Full Load.

By A. Press.

It is generally conceded that there is an additional iron loss taking place when a dynamo takes on load. The cause of this iron loss is assumed to be due to the flux distortion, in virtue of the armature conductors carrying current setting up a cross flux which compounds with the flux entering from the magnet frame.

Should one investigate the phenomena of superimposition of such fluxes one will arrive at the conclusion that the eddy-current losses can be calculated separately and then added. That is, the eddy-current loss on open circuit of the armature will be ordinary no-load loss; and then, to this should be added the eddy-current loss calculated on the assumption that only the cross flux exists, to give the total iron loss on full load.

The mathematical investigation of this superimposition of eddy-current losses is gone into in a work by the writer on "Dynamo Design," now in course of publication.* The formula, however, for this loss can here be given:

$$\textit{Incremental eddy-current loss} = \frac{262\, f\ (\textit{Volume of teeth})}{(1-f)\ r^2\ \delta^2}\left(\frac{W}{pF}\right)$$

Here the loss is in watts and *f* is the pole-pitch factor, i. e., ratio of pole shoe span to the pole pitch; *r* is the tooth-pitch ratio, i. e., the ratio of the tooth width to the tooth width plus the slot width; *W* is the output in watts; *p* is the number of poles; *F* is the flux per pole in c.g.s. lines; and *δ* is the depth of the air-gap in cms. It will be seen that only the teeth volume is mentioned. Prof. Ernest Wilson (see *The Electrician*, London, February, 1904) has shown that the iron loss in smooth core armatures is practically independent of the distribution of the flux in the air-gap. Since one can apply the same reasoning for the density in the teeth that one can for the density in the air-gap, it can be taken for granted that there is no incremental core loss.

The above formula does not take into account the additional hysteresis loss. This can be allowed for by multiplying the open-circuit hysteresis loss by 1.2 as an average factor. It will thus be seen why taking an open-circuit test and a short-circuit test gives losses when added rather larger than the actual full-load losses. The bearing friction and windage are added twice and the hysteresis loss is only roughly allowed for.

---

* McGraw Publishing Company, publishers.

Checking the above evaluation with an empirical formula used by one of the largest European concerns, it is found that there is quite a substantial agreement in the character of the formulæ. Whereas the one can be reduced to

$$\textit{Incremental loss} = D\left(\frac{W}{pF}\right)^2$$

the theoretical formula is

$$\textit{Incremental loss} = \frac{l\lambda}{r\,\delta^2}\,.\,D\left(\frac{W}{pF}\right)^2$$

Here λ is the depth of slot and l is the length of core. Checking in this way five machines one arrives at the following:

Size of Machine.	$\frac{\textit{Empirically derived loss.}}{\textit{Theoretically derived loss}}$
60 kw	1.64
125 "	2.2
250 "	2.43
500 "	2.65
1000 "	3.32

It is to be noted that the experiments were conducted with a machine of about 50 kw capacity. It was well understood that the above empirical formula was not entirely satisfactory. It gave much too large values for machines of considerable output.

Demonstration Apparatus for Wireless Telegraphy.

By A. Frederick Collins.

During the past two years the advances in tuned and syntonized wireless telegraph systems have been so marked that simple open circuit transmitters and receivers are no longer suitable for demonstration or experimental purposes, and in order to meet the new conditions the Wireless Telegraph Company, Limited, of Berlin, has placed on the market a small model that covers, in an easily comprehensible form, all the latest improvements.

In this miniature apparatus the high-frequency and high-potential circuits are arranged exactly as they are in the commercial installation of the Telefunken System—as the combined Braun, Siemens & Halske and Slaby-Arco equipments are now known—the only difference being that the instruments have been reduced down to the fewest number of parts and hence their construction is not nearly so expensive. The complete set includes a transmitter with a battery for energizing the induction coil and a receptor with relay and tapper, but with a bell or a sounder instead of the usual Morse register, together with the dual aerial wires and artificial earths.

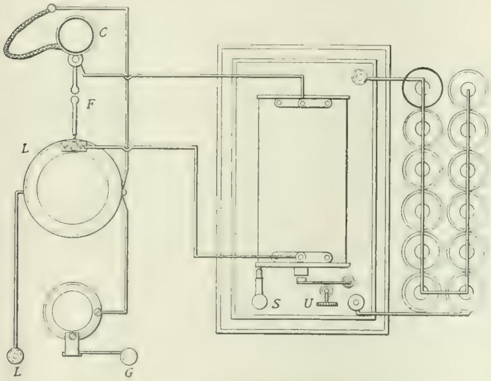


FIG. 1.—TOP ELEVATION OF TRANSMITTER.

By a careful perusal of the following description and a thorough study of the accompanying diagrams a complete understanding of the relations existing between the high and low potential circuits may be obtained. The top elevation, Fig. 1, and the diagrammatic view, Fig. 2, show clearly all the arrangements and various connections of the transmitter and by referring to these it will be seen that the low-voltage direct current from the battery, which gives a current of 1 ampere and 1.5 volts, passes through the primary winding of the small induction coil, *W*, the interruptor, *U*, and the key, *T*, all of which are connected in series.

The terminals of the secondary of the induction coil are connected to the opposite sides of a spark gap, *F*, through a capacity formed of a small Leyden jar, *C*, and these with an inductance coil of fixed value comprise a closed oscillating circuit. The capacity of the jar may be varied within certain limits by changing the relative positions of the inner and outer foils. By this means three different frequencies of oscillations may be set up and, hence, three different wave-lengths sent out.

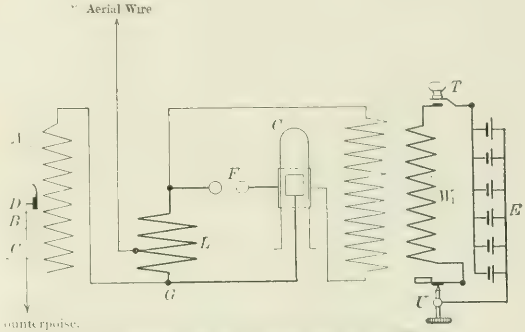


FIG. 2.—OSCILLATOR SYSTEM AND GENERATOR.

When the induction coil is in action electric oscillations of high frequency and potential surge to and fro in the closed circuit, and these are impressed on the aerial or radiating system; this consists merely of a hard copper wire about 2 meters in length and having a sheet of copper wire gauze attached to the top. The wire that ordinarily leads to earth is in this case connected to a square of copper gauze, called, according to the German terminology, a counterpoise; the terminal of this and the lower end of the aerial wire are joined together by an inductance coil, *L*, having three turns of wire, through the medium of a sliding contact.

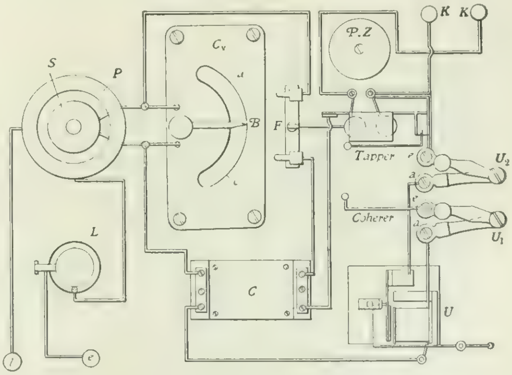


FIG. 3.—TOP ELEVATION OF RECEIVER.

The sheet of copper gauze or counterpoise is connected to the closed circuit at *C* through a variable inductance formed of a large number of turns of wire wound on an iron core and by changing the value of this inductance, a modification in the wave length of the aerial may be had. Of the three wave lengths which it is possible to produce in this manner, the shortest is obtained when the capacity of the jar is given its smallest value; that is, when the jar is raised high for its guide ring to form its sole capacity and to throw it out of contact with the outer tin foil coating of the jar. When this condition prevails the terminal of the counterpoise must make contact with the inductance coil at *A* so that the value of inductance will also be cut down.

These two adjustments having been made, the electric oscillations that surge through the aerial will emit electric waves about 30 meters in length. The longest wave is obtained by giving the Leyden jar its greatest capacity, which may be done by bringing the guide ring into contact with the exterior coating of foil and overlapping it by about 2 millimeters.

By connecting the terminal of the counterpoise with the inductance coil at *C*, the resulting wave length will be about 50 meters.

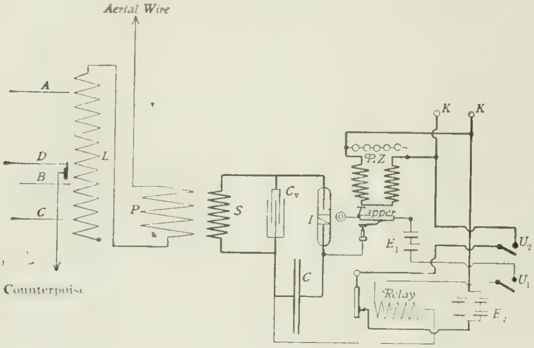


FIG. 4.—RESONATOR SYSTEM AND RECEIVER.

A third and intermediate wave length may be obtained by giving the jar its lowest value and bringing the terminal in contact with the inductance coil at B. Care should be taken that the open and closed circuits are in tune, for the energy propagated by the transmitter is greatest when the oscillating circuits are in resonance.

The receiver shown in the top elevation, Fig. 3, and in the diagram of Fig. 4, utilizes the filings coherer as a detector. When the emitted energy delivered in the form of electrical waves impinges on the antenna or receiving aerial wire they are converted into electric oscillations having the same frequency as those in the sending aerial providing the receiver is in syntony with the transmitter.

Like the open and closed oscillations at the sending station, the receiving resonators consist of a suspended wire with an elevated terminal capacity and of a counterpoise of copper gauze, these being connected through a variable inductance, *L*, and an inductance, *P*, of fixed value, the latter acting as the primary of a small transformer. The primary and secondary of the transformer are wound on a wooden spool, and it is through this mutual induction coil that the open-circuit antenna is coupled with the closed-circuit resonator.

As in the case of the emitting circuits, the maximum energy of the impinging electric waves is greatest when the open and closed circuits of the receiver are in resonance and again when the receiver is syntonized to the transmitter. When these conditions are satisfied the slightest amount of energy suffices to cause the filings of the detector to cohere.

The closed-circuit resonator includes the secondary windings of the transformer, the coherer, *I*, and a fixed capacity, *C*, which is exceedingly large when compared with the inherent capacity of the coherer; the large capacity is introduced so that the capacity of the coherer may be considered negligible when determining the proper oscillation of the closed circuits. Tuning is effected by the variable condenser, *Cv*, which is connected in parallel with the coherer.

The first internal or low-voltage circuit is formed by connecting one side of the coherer to the make and break of the tapper, thence through two small dry cells of 2.6 volts, through the coils of a relay and thence back to the opposite side of the coherer. The second internal circuit includes the armature of the relay, four cells coupled in parallel the terminals leading to *K*, *K*, where either a bell or other indicating device may be connected in; a shunt circuit includes the magnets of the tapper and bridges across the latter is a battery of five polarization cells, which in virtue of their great capacity, prevents undue sparking at the relay contacts. Polarized cells are thus used instead of the choking coils, and these are formed of small glass vessels containing dilute sulphuric acid in which a pair of platinum wire electrodes are immersed.

To tune the circuits and syntonize the receptor with the transmitter, the sliding contacts of the inductance coil, *L*, must be placed at *A B* or *C* as indicated. With this demonstration set, jointed poles that may be easily set up, taken apart and packed in a trunk are supplied; these with their copper gauze capacities may be set in any convenient position indoors, and signals sent and received within the limits of the demonstrating room.

In setting up the apparatus it is only necessary to attach the aerial wires to the terminals marked *L* and the wires from the counterpoises to those marked *G;* but before attempting to transmit signals it is essential that the spark-gap is so adjusted that the discharge will take place when the capacity of the Leyden jar is greatest. The receiver must be adjusted to the highest degree of sensitiveness so that it will respond only to the wave corresponding to the one for which it is tuned. Immediately the operator is through receiving, the switches marked U_1 and U_2 must be thrown open, nor is it advisable for the tyro to make any alterations in the position of the relay or decoherer or to attempt their readjustment.

The theory of syntonization may be beautifully shown experimentally where two sets of demonstration apparatus are at hand, the opposite senders and receivers being tuned to 30 and 50 meter wave lengths respectively. When these sets have been tuned, syntonized and brought to their highest degree of sensitivity, each receiver should respond only to its own transmitter even when the opposing emitter is the nearest.

Where it is desired to send messages to greater distances, an aerial wire at least 15 meters in length, insulated at the top and suspended vertically, must be used, while the opposite terminal may be earthed if a suitable ground is obtainable; or if this is not possible the counterpoise should be used, and in this case it must be in-

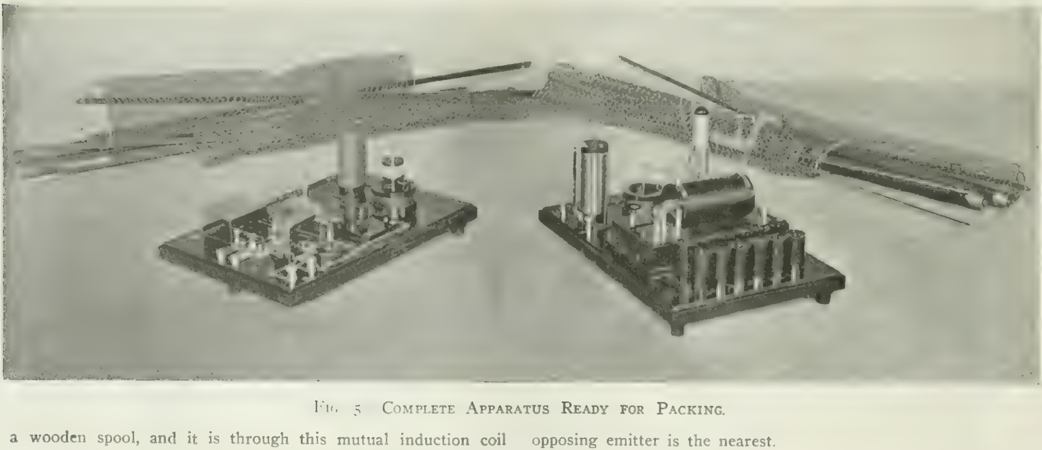


FIG. 5 COMPLETE APPARATUS READY FOR PACKING.

sulated from the earth. The instruments are then adjusted so that the transmitter shall have a small capacity and the inductance an intermediate value, the terminal of the earthed wire forming contact with the turns of wire at *D;* the lever of the adjustable condenser in the coherer circuit is brought to the point, *a*, Fig. 3, while the grounded terminal is set at *P* to correspond with the transmitter.

The receiver is then given its maximum sensitiveness by turning the coherer on its longitudinal axis so that the edge of the V-shaped pocket points downward, and also by forcing the secondary coil of the transformer toward the center of the primary winding when all the turns are cut by the oscillatory magnetic field. It is seldom, if ever, that the transmitter gets out of order, but the receiver is more troublesome.

Should any difficulty be experienced, the receiving circuits may be treated by removing the coherer and bridging the terminals with a bit of wire, when the relay, if it is in fit form, will be set into action. If it operates satisfactorily, then the experimenter may know to a certainty that the coherer is at fault; but if short-circuiting the springs that clasps the coherer does not actuate the relay, then the latter is evidently the source of the trouble and readjustment is necessary.

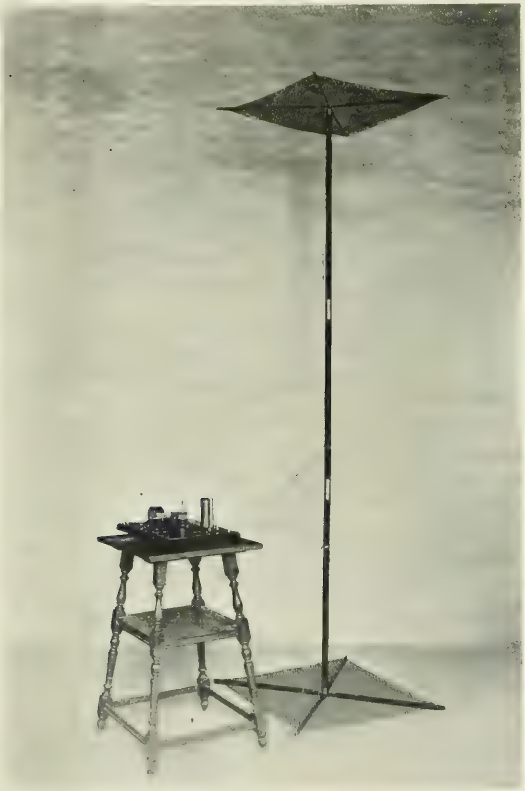


FIG. 6.—DEMONSTRATION RECEIVER SET UP READY FOR USE.

For out-of-door work care must be taken to keep the aerial wire as far as possible from walls of buildings, trees, metallic objects, such as windmill and water towers, etc.; and where the aerial wires are swung from the top of a house, they should be suspended from a pole 3 meters in length projecting horizontally beyond the wall and attached to either the roof or out of the window, with the aerial insulated from it and drawn away at an angle.

Indoors the signal may be sent for a distance of 50 meters with 3 meter aerials, but out in the open messages may be transmitted and recorded a distance of 500 meters if an aerial 15 meters in height is provided.

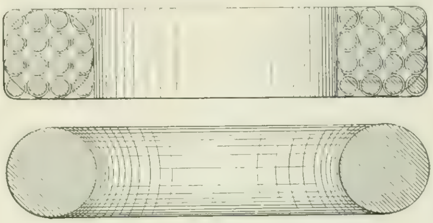
Relation of Pull to Diameter of Solenoids.

By CHARLES R. UNDERHILL.

IT is well known that when an electric conductor is bent into the form of a circle the magnetizing force at the center of the loop is

$$H = \frac{.2\pi I}{r}, \qquad (1)$$

where I = current in amperes and r = radius of the loop in centimeters; and since the magnetizing force is proportional to the ampere-turns, a group of turns, as in Fig. 1, acting together, and having the same general dimensions as a single conductor, as in Fig. 2, produce the same magnetizing force at the center, providing the ampere-turns are the same in both cases. For the group of turns formula (1) would be



FIGS. 1 AND 2.—DIAGRAM OF COILS.

$$H = \frac{.2\pi IN}{r}, \qquad (2)$$

where N = number of turns in the group.

In order to determine the effect due to changing the diameters of solenoids, the writer had two sets of windings mounted on wooden spools, the length L of the windings being 1 inch in all cases. Each set consisted of four windings of different diameters. One of these sets had windings of square cross-section, 1 inch by 1 inch, as in Fig. 4, the mean or average diameters, M, being 4, 6, 8 and 10 in., respectively. In the center of each wooden spool a hole 1 5/32 in. in diameter was bored for the plunger to enter. This set of windings may be called rim windings for convenience.

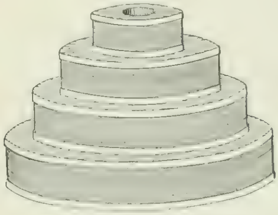


FIG. 3.—THE DISC WINDINGS.

The other set consisted of windings with varying outside diameters, but with fixed internal diameter, which was 1 3/16 in. in all cases (see Fig. 5). The mean diameters were 2.38, 3.63, 4.63 and 5.63 in., respectively. These windings will be referred to as disc windings.

Substituting $\frac{M}{2}$ for r in (2),

$$H = \frac{.4\pi IN}{M_1}, \qquad (3)$$

where M_1 is expressed in centimeters.

In English measure,

$$H = \frac{3.192\, I N}{M} \qquad (4)$$

The tests were made by the method illustrated in Fig. 6. Here *A* is a magnetizing coil to saturate the core, and *B* represents the winding to be tested. The core was of Swedish iron 1⅛ in. in diameter and 1 sq. in. in cross-section.

First the coil *A* was excited so as to saturate thoroughly the iron core, and then a disc winding was placed over the end of the core in the position of maximum pull and excited from a separate source. Each coil had a rheostat and ammeter in series, the two coils being so connected that attraction would result. Coil *A* was rigidly fastened to the iron core, and the test coil, *B*, attached to the scales. After the core was saturated, a change in the strength of the current in coil *A* produced an almost inappreciable change in the pull, which was accredited to the change in *H*; but when the current strength in coil *B* was changed, the pull varied directly with the strength of the current in coil *B*.

Fig. 7 shows the result of a test of the set of rim windings. This test indicates that the pull due to a solenoid is directly proportional to the ampere-turns in the winding after the core is saturated. It incidentally proves the law expressed by (2).

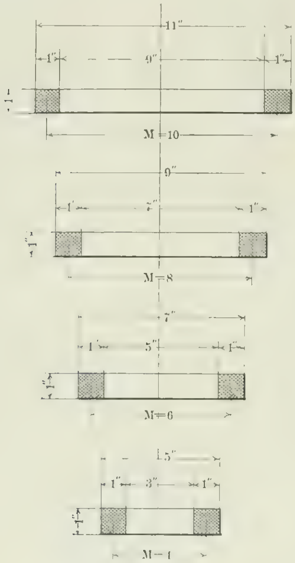


FIG. 4.—DIMENSIONS OF DISC WINDINGS.

When the disc windings were tested under the same conditions as the rim windings, it was found that the pull was not inversely proportional to the mean diameter of the winding, but nearly inversely proportional to the square root of the mean diameter of the winding. Fig. 8 shows the results of the tests of the disc windings. Although the current varied more or less as the test coil heated, or as the line voltage changed, the curves in Figs. 7 and 8 are very accurate, since the turns were known, and hence the ampere-turns varied directly with the strength of the current.

The dimensions of the rim windings are shown in Fig. 4, and those of the disc windings in Fig. 5. It will be noted that the rim windings were so dimensioned that when telescoped together they would form a perfect disc winding.

The curve from *a* to *b* in Fig. 8 is plotted from Fig. 7, the points being taken from the pulls corresponding to the different mean diameters on the ordinate representing 6,000 ampere-turns. Now the mean or average diameter of a disc winding is not the mean diameter representing the mean strength of field, but the latter is equal to the reciprocal of the sum of the reciprocals of the mean diameters of the squares or groups of turns constituting the disc, multiplied by the number of groups. As an example we will refer to Fig. 7 and note the pull for each of the rim windings under test with 1,500 ampere-turns. The pulls are 1.8, 2.3, 3.2 and 4.8 pounds, respectively, making a total of 12.1 pounds pull for the four rim windings, with a total of 4 × 1,500 ampere-turns = 6,000 ampere-turns.

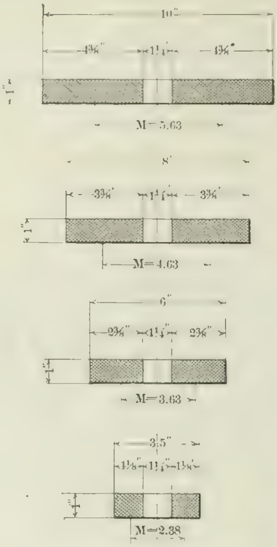


FIG. 5.—DIMENSIONS OF DISC WINDINGS.

Now consider these solenoids telescoped so as to form a disc winding as in Fig. 10. The mean or average diameter of the winding is 7 in., but the mean diameter representing the mean strength of field is

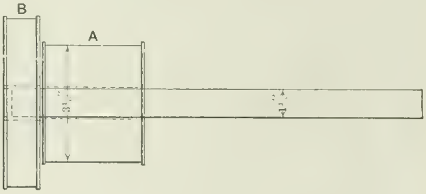


FIG. 6.—DIAGRAM OF TESTING APPARATUS.

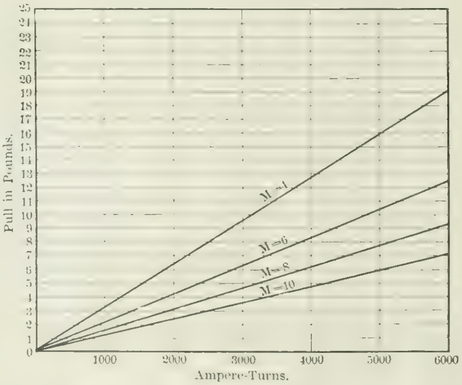


FIG. 7.—TEST OF RIM WINDINGS ON MAGNETIZED BAR.

$$M_e = \frac{n\,(a\,b\,c\,d)}{(a\,b\,c) + (b\,c\,d) + (c\,d\,a) + (d\,a\,b)}, \qquad (5)$$

where n is the number of groups of turns and a, b, c, d the relative mean diameters of the groups.

Therefore, in the case under discussion,

$$M_c = \frac{4\ (4\times 6\times 8\times 10)}{(4\times 6\times 8)+(6\times 8\times 10)+(8\times 10\times 4)+(10\times 4\times 6)} = \frac{7{,}680}{1{,}232}$$

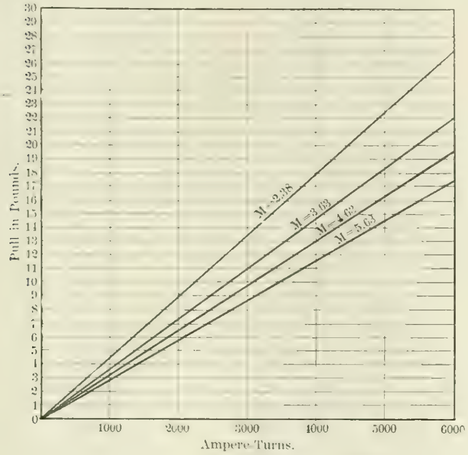


FIG. 8.—TEST OF DISC WINDINGS ON MAGNETIZED BAR.

= 6.23, and hence for a mean diameter of 6.23 in. a pull of 12.1 pounds should be obtained with 6,000 ampere-turns in the entire disc winding, since there are 1,500 ampere-turns in each group of turns, and there are four groups. Referring to Fig. 10 it is seen that this exactly coincides with the curve obtained from separate tests of the rim solenoids.

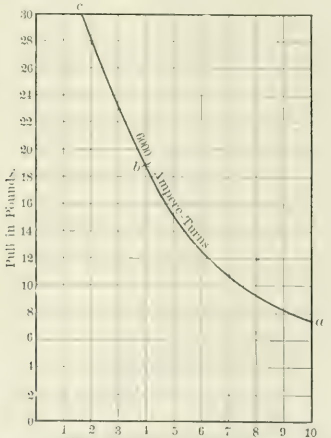


FIG. 9.—COMBINED TEST OF RIM AND DISC WINDINGS.

By calculating the diameters representing the mean field strength of the disc windings after this manner, the rest of the curve a-c is obtained, which coincides with, and forms a continuation of, the curve representing the tests of the rim windings.

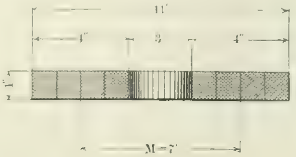


FIG. 10.—RIM WINDINGS TELESCOPED TO FORM DISC WINDING.

The curve in Fig. 11 represents the product of the pull times the mean magnetic diameter. This curve is approximately correct; the products below 2½ in. mean magnetic diameter being assumed from the natural slope of the curve.

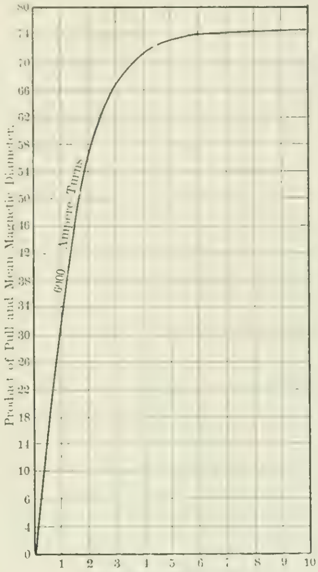


FIG. 11.—PRODUCT OF PULL AND MEAN MAGNETIC DIAMETER.

* * *

Electric Railway Equipments.

The paper by Mr. W. B. Potter on "Electric Railway Equipments," read before the American Street Railway Association at its Philadelphia meeting, dealt with the features relating to the development of the past few years. He discussed first the outlook with reference to prime movers, stating that the extent to which the reciprocating engine is being superseded by the steam turbine is indicated by the sales during the past three and one-half years of one type of machine alone, which amount to over half a million kilowatts, of which about one-third are for electric railway service. These figures are mentioned for the purpose of emphasizing the recognized importance of the steam turbine as a prime mover. While the larger sizes of turbines have been more generally used for driving alternators, they are adapted for direct-current railway generators, and turbine sets of this character have been built up to 2,000 kw. The turbine certainly gives great promise of being the only steam-driven prime mover of the future for producing electric power, and its usefulness is by no means limited to that particular field.

Each year bears evidence of the growing popularity of electric traction, and the increase in traffic has naturally affected both the size and weight of the cars and the schedule speeds. The more onerous conditions imposed on the electric apparatus to meet the ever increasing demand for larger and heavier equipments, and the demand for greater seating capacity on systems already operating at 500 to 550 volts, has led to an increase in the generated voltage. We have been accustomed to consider 500 to 550 as the standard direct-current voltage, but 600 volts is now being used to such an extent that it has really become the standard for the power station. The rôle of the manufacturer is to design and construct such apparatus as will best meet the conditions of the operating companies, and it is, therefore, the requirements of the operator that should be studied rather than the development of any particular idea.

The direct-current railway motor has been greatly improved, and has undergone more changes in detail than is perhaps generally appreciated. The old troubles of sparking and flashing at the commutator have been practically eliminated. Previously it was considered advantageous to shirt-circuit a turn on the field winding to reduce the sparking at the brushes and in the controller, the idea being to restrain the rapidity with which the magnetism of the motor changed, but several years ago it was found that while this provision decreased whatever troubles occurred, due to opening the circuit, it was a positive cause of flashing in case the current was interrupted and suddenly applied. For example, this trouble would occur on passing a section insulator with the controller on, and more especially when operating with sleet on the trolley wire or running over a third rail with an uneven surface.

The field coils as now made not only have no short-circuiting turns, but where metal spools are used, it is customary to split the spool and introduce an insulation into the shell to eliminate every feature of a short-circuited turn. The armature revolutions of a motor as affecting the peripheral speed of the commutator have also an effect on the sparking and wear of the commutator. The armature revolutions further affect the performance of the bearings, and while it would be possible to build a lighter and cheaper motor at higher armature speeds, a maximum of 1,500 r.p.m. appears to be the highest desirable limit as indicated by experience. To meet the requirements of the higher voltage now more commonly used, and to further insure the stability of the motor as regards flashing, it is now the practice to provide a greater number of commutator segments; that is, the voltage difference per commutator bar has been reduced to a lower figure.

The field coils of a motor, although subject to less potential than the armature, by reason of their location in the motor, are more liable to injury from occasional water. A distinct improvement has been made in the construction of the field coils by immersing them in a bath of hot compound under vacuum. The effect of this process is to thoroughly fill all air spaces with compound. This not only renders the coil more waterproof, but also makes it more solid and less liable to injury from mechanical vibration.

The more severe demands of present service have also necessitated changes in the older type of controllers, as well as the development of new types of control and control appliances. The cylinder controllers have been improved by making the arc deflectors of a more vitreous material, less affected by the arc and productive of a much smaller quantity of conducting gas when opening the circuit under abnormal conditions. For the control of equipments aggregating 200 hp and over, the type of control, consisting of electrically operated contactors or switches is being very generally used. It is not only possible to handle heavier currents and a higher voltage by contactor switches, but a further advantage lies in the fact that the master controller occupies considerably less space than a cylinder controller handling the full motor current.

Whether the cars are operated singly or in trains, as the multiple-unit system, the control may be either hand-operated or automatic in its action. In the former case the handling of the master controller is similar to the ordinary cylinder control, and there are controller notches corresponding to each rheostatic step and the series and parallel running points. In the automatic control there are only three positions of the handle, the first one giving slow movements to the car for switching; the other two points are the series and parallel running positions. The intermediate rheostatic points are actuated automatically by a series relay on each car of the train. The automatic form of control is well adapted for services where the rate of acceleration may be predetermined, and need not be dependent upon the judgment of the motorman.

During the past year there have been several installations of alternating railway equipments, and the outlook is very promising for this class of equipment under conditions advantageous to its use. Considered wholly from a technical standpoint, there is no question but that alternating-current motors can perform any service now done by direct-current apparatus, but the choice as between alternating and direct-current should not be made without a full consideration of the direct and indirect expense incident to either type of equipment.

As the street railways and the steam railroads are now becoming so closely identified, a reference to some of the recent tests of the New York Central electric locomotive will not be out of place. This locomotive has now run over 21,000 miles with trains of varying weights. The maximum speed attained with a train weighing 278 tons, including the locomotive, was 71 miles per hour in a distance of about 4 miles. With the locomotive alone, the maximum speed was 85 miles per hour, with the probability that the speed would have been 100 miles per hour had the run been twice the length. The total weight of this locomotive is 97 tons, of which about 70 tons are on the drivers. The nominal rated power is 2,200 hp., although the output during acceleration has often exceeded 3,000 hp.

New Telephone Patents.

NEW SWITCHBOARD APPARATUS.

The design of ringing keys has been revolutionized in the past few years, the old push keys giving way, most generally, to lever keys. The first of these, while gaining much in accessibility of parts, and being well proportioned, occupied far too much keyboard space. Recently all moves have been toward a reduction of this space. In Fig. 1 is shown a good design recently patented by C. M. Hedman, of Chicago, and assigned to the Stromberg-Carlson Co. The operation is self-explanatory. The key shown combines a listening and ringing element. Another device, the patent for which has been assigned to the above mentioned company, is a relay, comprising two elements, the armatures of which are so linked together that the one controls the other. For example, the retractile spring of one armature may hold its own armature in the non-operated position, and the main armature in the operated position. A current in the auxiliary removes its influence from the main, which returns to normal ready to be reactuated by its own coil.

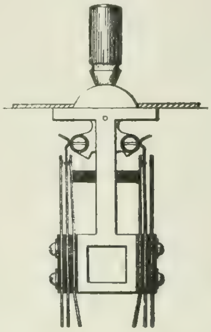


FIG I.—HEDMAN HANGING KEY.

NEW SUB-STATION APPLIANCES.

Yet a third patent assigned to the Stromberg-Carlson Company is one granted to J. A. Birsfield covering a means for fastening transmitter heads upon desk stands and similar sets. In Fig. 2 is given a sectional view, wherein is shown a spherical lug seated upon

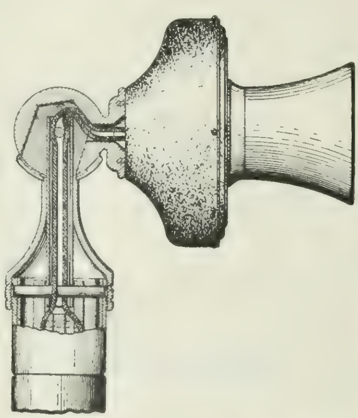


FIG. 2.—BIRSFIELD TRANSMITTER HEAD FASTENING.

a leather cushion on a cup. These parts are held together by a tubular link hinged in an aperture within the sphere.

A. R. Hollander, of Chicago, has invented a metal case hand style receiver, in which a casing and a cup, both of metal, are assembled upon a bridge piece, which supports the magnetic element. This latter is adjustably supported. The diaphragm is clamped by a clamping ring upon which a rubber ear piece is carried.

A pulsating hand generator has been devised by Messrs. E. B. Willix and J. Young, of Mt. Vernon, Iowa, by which either polarity of current may be sent out at will. This is accomplished by a shifting brush which responds to the direction of rotation of the hand crank.

REPEATER.

A new repeater idea has come forward in a patent issued to Béla Gáti, of Hungary, a gentleman who represented the Hungarian government as delegate to the St. Louis International Electrical Congress. In this repeater the arriving currents are made to affect as a slight increment a constant current flowing through a body with a negative temperature coefficient. The increment, if positive, serves to reduce the effective resistance and thus an increase of current larger than proportional is made to flow, thereby giving a multiplied effect which is applied inductively to the transmitting side of the apparatus.

AUTOMATIC SYSTEM CALLING SELECTOR.

Messrs. F. A. Lundquist and J. K. Norstrom, of Chicago, have patented a subscriber's selective calling device for use with automatic systems. The apparatus is too special for detailed description. The claims cover a selector with a number of independently moving toothed discs, all restored by a single common spring.

Letter to the Editors.

Pressure Due to Radiation.—Aerial Navigation.

To the Editors of Electrical World and Engineer:

Sirs:—In a book by "D. L. F.", published in Paris in 1775, under the title of "Le Philosophe sans Prétention ou L'Homme Rare," I found a description of a curious contrivance for aerial navigation which is called, p. 30, "Une machine électrique d'une forme nouvelle," and which is operated by *the impact of light,* "percussion de la lumière."

Says the inventor: "Observez que la percussion de la lumière agit actuellement au-dessous de ma méchanique. C'est elle qui va m'enlever sans beaucoup d'efforts," p. 32.

Like the book itself, the machine is one of pure imagination; but, all the same, the expression "Impact of light" is as bold as it is surprising in a work written 130 years ago.

Manhattan College, New York. B. Potamian.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Compound Alternator.—Reyval.—An illustrated description of a 90-kw compound Heyland three-phase alternator exhibited by the Société Alsacienne at the Exposition at Liege. The principle of the Heyland generator is shown in Fig. 1. The excitation is furnished from the polyphase currents generated in it and supplied to field coils by means of a special commutator. On the other hand the alternator is compounded since the current furnished to the commutator through the brushes is the resultant of the secondary currents furnished by two transformers; the exciting transformer in shunt with the terminals of the machine and the compound transformer in series with it. In the three-phase generator exhibited at Liège these two separate transformers are avoided in the following way: The three-phase exciting currents are produced in three auxiliary coils placed on the stator. In order to realize at the same time the compounding effect, the same slots which hold the auxiliary winding, are also occupied by a part of the main winding which is connected in opposition to the rest of this winding. The arrangement can be seen from Fig. 2 in which *C* is the commutator, *B* the brushes, *s*, the three auxiliary coils placed on the stator and furnishing the exciting current, *S*, the turns of the main stator winding, *S'* that part of the main winding which is placed in the same slots as the auxiliary winding, the windings *S'* being connected in opposition with the rest of the main winding. In this arrangement the auxiliary winding and the part of the main winding placed in the same slots form a compound transformer. As an inductive current has the effect of reducing the field in the main winding its action on the winding *S'* has the inverse sign and increases the voltage of the exciting currents induced in the auxiliary winding *s*. By choosing conveniently the number of the turns in *S'*, it is possible to get the exact compounding. This method of construction is of special interest for machines of medium capacity. It avoids the use of the transformers, the price of which represents a considerable portion of that of the alternator. Moreover, the connections are greatly simplified. The generator exhibited at Liège has a capacity of 38 kilovolt-amperes, and produces three-phase currents at 2,300 volts. For a power factor of 0.8 the current per phase is 22 ampères, which corresponds to a power of 70 kw. The frequency is 50 periods per second for a speed of 750 revolutions per minute. The dimensions of different parts of the machine are given in a table and a detailed drawing of the machine is given.—*L'Eclairage Elec.*, Sept. 9.

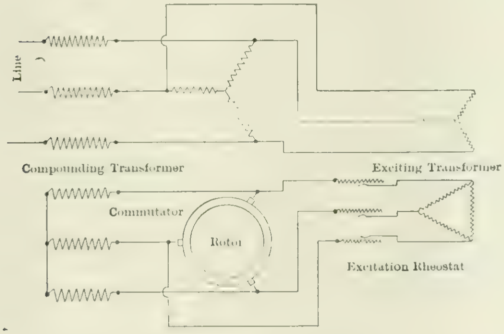


FIG. 1.—COMPOUND ALTERNATOR.

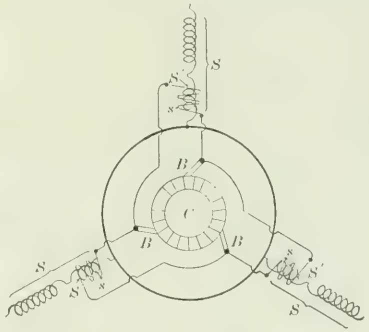


FIG. 2.—COMPOUND ALTERNATOR.

Sparking at Commutators.—Some editorial comments on the recent paper of T. Reid before the Am. Inst. of Elec. Eng. It is pointed out that the belief is still prevalent to-day that it is the spark per se which injures the segment on which it impinges, but others believe that this cannot be the case. It has been noticed that white bright sparks beneath the brushes do not attack the commutator, which still retains its glossy surface; but when the sparks assume a greenish hue the commutator blackens and loses its smooth surface. This latter observation lends color to the theory advanced of late by a few independent workers that the injury to the segments is caused by a volatilization of minute portions of copper, this vaporization being due to an excessive generation of heat in the trailing end of the brushes. Reid's paper shows that the current density may reach enormously high values at certain parts of the rush under favorable conditions. It is assumed by Reid in his deductions that the contact resistance between brush and commutator is constant. This assumption is opposed to the results obtained by a number of experimenters, who found that the contact resistance varied inversely with the current density, so that it was the voltage drop from segment to brush—and not the contact resistance—which remained constant. It must be pointed out, however, that these experiments were made with slip rings, and do not, therefore, apply directly to commutator problems. Considering that carbon has a negative temperature coefficient, it seems likely that the contact resistance is not independent of the current density, but judging from recent researches, it may be reasonably doubted whether it varies strictly inversely as the current.—Lond. *Elec.*, Sept. 8.

Synchronizing Alternators.—Dieny.—An illustrated description of two methods of automatically synchronizing alternators. One method is that of the Westinghouse Company, the other that of Voigt and Haeffner. Both methods have already been described in the Digest.—*La Revue Elec.*, Sept. 15.

Lights and Lighting

Economy of Arc Lamps. Hoppe.—A very long discussion of the economy of various types of arc lamps, with special reference to the number connected in series. The author points out that there are a great many different factors besides energy consumption which must be taken into account in determining the economy of a given type of lamp. The author first gives quite a number of tables and diagrams comparing the economy of the different lamps with respect to energy consumption alone. One of his tables is as follows. In order to get 2,000 hefner candles there are consumed (1) with ordinary carbons:

110 volts, 2 lamps in series, 1250 watts
" " 3 " " 1060 "
220 " 4 " " 1575 "
" " 5 " " 1350 "
" " 6 " " 1350 "

(2) with flame arc lamps:

110 volts, 2 lamps in series, 800 watts
220 " 4 " " 950 "
" " 5 " " 1000 "

The author remarks that this result is of interest when lighting installations are planned for towns of medium size. There will be many consumers who can use two or three arc lamps, but not four to six. At 220 volts it is necessary to use a larger number of lamps, whereby the cost of installation is increased; moreover, with the same consumption of energy less light is obtained. Further, it will be seen that the connection of six lamps in series is in no way superior to five lamps. It may be different, however, if in a larger installation a certain number of lamps is prescribed. If 60 lamps are required it will be possible to get more light by connecting six lamps in series than five in series. For instance, 13.2 kw give in such a case 20.000 hefner candles for 10 circuits each containing six lamps in series and each consuming 1.32 kw. The same energy gives 16,800 hefner candles if 12 circuits each containing five lamps in series and each consuming 1.1 kw are used. With enclosed arc lamps the energy consumption is almost always higher; they are superior only for small intensities of light, for instance, below 300 or 400 hefner candles. However, the whole situation is changed if the consumption of carbons, cost of attendance, interest and depreciation are considered. The author finds that for small intensities of light the enclosed arc may be quite economical. The connection of six lamps in series (at 220 volts) is not at all more economical than a connection of five. For small light intensities and short hours of burning, four lamps in series may be more economical than six lamps. With the flame arc four lamps in series at 220 volts are not less economical than five lamps in series. The flame arc lamp is to be taken into consideration only for greater light intensities, like 1,000 hefner candles at 110 volts and 2,000 hefner candles at 220 volts, but for all practical conditions it is more economical than other types of lamps. The superiority of three lamps in series over two lamps in series appears only at longer hours of burning or at greater light intensity. A voltage of 220 appears to be in every respect more uneconomical than 110 for arc lamp installations. Concerning the comparison between alternating-current and direct-current, there is no difference with respect to flame arcs. Ordinary arc lamps, however, when operated with alternating-current (3 in series at 110 volts) consume about 60 to 70 per cent more energy for the same light than with direct-current, three lamps in series, and 40 to 50 per cent more energy than with direct-current, two lamps in series. —*Elek. Zeit.*, Sept. 7.

Illumination of Rooms.—Meisel.—A mathematical paper describing graphical methods for determining the distribution of illumination in a room with different arrangements of a number of sources of light within it. —*Elek. Zeit.*, Sept. 4.

Power.

Irrigation. Wheeler.—A paper read before the Pacific Coast Eng'ing Congress on the cost of irrigation by electrically driven pumps from transmission service. For small plants capable of irrigating one hundred acres or less, the first cost will usually range from twelve dollars to fifteen dollars per irrigated acre, while the cost of operation will be found to vary from two dollars and seventy-five cents to three dollars and seventy-five cents per irrigated acre. Irrigation by electrically driven pumps is believed to have a very great future.—*Jour. of Electricity*, September.

Textile Mills.—Woodhouse.—A paper read before the Leeds Section of the (Brit.) Inst. Elec. Eng. on the electric driving of textile mills. He first discusses variation of load and gives figures for the power absorbed by various machines. He then speaks in a general way of the advantages of electric driving. For the majority of textile operations constant speed is of vital importance, and it seems that polyphase induction motors are preferable to direct-current machines. The advantages of squirrel-cage motors are many. The only important class of variable-speed machines is found in textile printing.—Lond. *Elec. Eng.*, Sept. 8.

Power Plant Design.—Koester.—A continuation of his illustrated serial on modern power plant design and economics. The author discusses steam engines and steam turbines and the advantages of the latter. He then deals with condensers and auxiliaries.—*Engineering Mag.*, October.

Single-Phase Motors.—Layman.—A paper read before the Pacific Coast Eng'ing Congress. The author gives notes on the latest developments in single-phase motors for commercial power purposes, especially for ventilators, cranes and elevators. The question why a polyphase transmission system should employ single-phase motors is answered by the statement that better combined lighting and motor service can ordinarily be given from local distributing centers over single-phase than over polyphase circuits.—*Jour. of Electricity*, September.

Gas Driven Station.—A fully illustrated description of the electric lighting and traction plant of Walthamstow, which is the largest gas-driven station in England. The engine room at present contains 13 generating sets, each consisting of a Westinghouse three-cylinder gas engine, direct coupled to a direct-current generator. Of this plant, the seven earlier sets comprising four 115-hp and three 250-hp units were utilized solely for lighting purposes; the six latest units are intended three for lighting and three for operating the recently inaugurated light railways. The three traction generators are each for an output of 185 kw at 460 to 562 volts. Gas is generated in 8 producers of the Dowson type.—Lond. *Elec. Rev.*, Sept. 15.

Lignite and Peat for Gas Generators. Zlaman.—A paper on the use of lignite and peat in gas generators for the operation of gas engines.—*Elek. f. Zeit.* (Vienna), Sept. 3.

Fuel Oil.—A continuation of notes on the use of fuel oil on the Pacific coast.—*Am. Mach.*, Sept. 28.

Traction.

Mountain Railway.—Mueller.—An account of a new project of erecting an electric railway to the top of the Zugspitze. The first part of the road has a length of 12.50 km, and is an adhesion railway. The second part is a rack railway. Direct-current at 750 volts will be used. The intention is to arrange the time table so that one car always goes down as another goes up. In this way it will be possible to recover a great amount of the potential energy from the car running down, and the capacity of the generators will be only 60 per cent of what would be required for running single cars up the hill. There will be provided a battery to be used when no cars run down. The third rail is to be used.—*Zeit. f. Elek.* (Vienna), Sept. 17.

Trolley Head.—A description of a new type of trolley head for electric tramways invented by Blaney. Its object is to reduce the shock when the trolley wheel is passing over suspending ears or other solid parts of the overhead system. The trolley head is shown in Fig. 3; it has the socket which carries the trolley fork, B^1, pivoted at *C* in a forked extension, *D*, of the pole socket, *E*, to absorb shocks due to unevenness of the wire and to reduce sparking. Two extensions of the pivoted socket are shown, one being the curved arm, *F*, terminating in a shoulder, *I*, which is in contact with a spring or an air cushion in a chamber, *H*, fixed to the arm, *D*, and the other the curved arm, *M*, which terminates close to the periphery of the trolley wheel, J, and also carries two stops, *O*, normally pressed against the pole socket by the spring, *H*. When the wheel, *J*, meets a joint or any other uneven place in the wire, the wheel moves rearwardly on the axis, *C*, and compresses the spring, while the arm, *M*, moves with the socket and prevents the wire or any obstruction from getting between the wheel, *J*, and pole socket, *E*. The spindle, *B*, is grooved, and engages a pin placed in the hole, *K*, thus permitting the trolley wheel, fork and spindle to revolve, but preventing them from leaving the socket, *A*.—Lond. *Elec. Eng.*, Sept. 15.

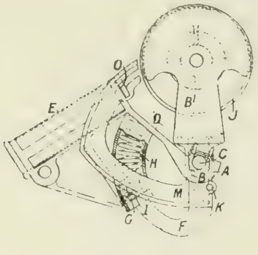


FIG. 3.—TROLLEY HEAD.

Philadelphia.—A very full and profusely illustrated series of articles on the tramway systems of Philadelphia; their history, management and equipment. Since the articles cover not less than 84 full pages it is impossible to abstract them briefly.—*St. R'y. Jour.*, Sept. 23 (Convention Issue.)

Electric Railway Dictionary.—A dictionary covering 48 full pages and giving concise descriptions of a very large portion of the principal types of American electric railway apparatus and supplies.—*St. R'y Jour.*, Sept. 23 (Convention Issue).

Automatic Regulator.—An illustrated description of the Thury automatic regulator which is primarily intended to keep the voltage of electric generators constant by regulating the field resistance. Fig. 4 is a diagrammatic sketch of the voltage regulator for alternating-current systems, which is practically identical with that used in continuous-current installations. *H* is a toothed wheel keyed to the shaft, *L*, which carries the switch arm of the rheostat *D* is a casting, which is rocked to and fro about the shaft, *L*, by a small electric motor of 1/20 hp. The pawls, *I* and I^1, are attached to *D* in the manner shown, but are held off the toothed wheel by the spring-actuated levers *K* and *K'*. Each of these two levers carries a projection at its upper end; the projection on *K* passes normally above the blade *C*, while that on *K'* rocks to and fro underneath this blade. Consequently, when the blade *C* is lowered or raised in the manner to be described, it will strike against *K'* or *K*, respectively, thus permitting pawl *I'* or *I* to drop into the teeth of the wheel *H*. The latter is now rotated in the one or the other direction, thus cutting in or cutting out field resistance, until the blade *C* regains its horizontal position, when it no longer strikes against *K* or *K'*. Pawls *I* and *I'* are then drawn by spring action out of contact with the teeth of the wheel *H*. The electromagnet mechanism for controlling the position of the blade *C* is as follows: *P* is one of the limbs of the laminations which constitute part of the magnetic circuit through which a flux is maintained by the coil *F*. A very light coil, *B*, connected across the bus-bars whose voltage is to be controlled is free to move up or down above *F*, the movement being limited by adjustable stops, *b* and *b'*. When the voltage of the supply is normal, the current through *B* is such that the lever, *E*, carrying the blade *C* is in a horizontal position and nothing happens. But when the supply voltage is higher or lower than the normal, then a correspondingly larger or smaller current flows through the shunt coil, *B*, which rises or falls in consequence and causes the blade *C* to move into the way of the oscillating levers, *K* and *K'*, thus actuating the rheostat. The coil *B* moves against the tension and compression of the two springs, *A* and *R*, the latter being, in its turn, attached to the free end of a flat spring, *O*, fixed at *S*. The free end of *O* is also in connection through the intervention of a dash-pot, *N*, with the pivoted lever, *M*, which takes up a position in accordance with the position of the switch arm by means of the gearing shown. This arrangement tends to steady the movement of coil *B* and to bring it back speedily to its horizontal position after having been deflected. In order to prevent vibrations of the blade *C* in regulators for alternating current or where the regulation is required to be unusually sensitive, a dash-pot, *Q*, is also provided.—Lond. *Elec.*, September 15.

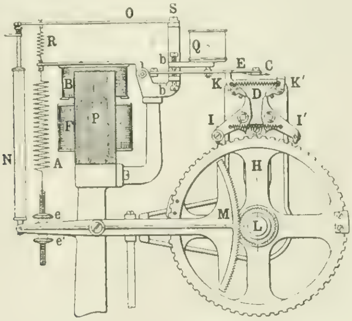


FIG. 4.—AUTOMATIC REGULATOR.

Lightning Arresters.—BALLOIS.—The conclusion of his long illustrated serial giving descriptions of some new types of lightning arresters; most of them have already been noticed in the Digest.—*L'Eclairage Elec.*, September 2.

ELECTROPHYSICS AND MAGNETISM.

Evolution and Absorption of Gases by Electrodes.—SKINNER.—The author has recently carried out investigations concerning the rate of evolution of hydrogen from the various metals when used as cathodes in an atmosphere of helium, and also its rate of absorption by the anode when the gas filling is hydrogen. It was found that a fresh cathode gives off hydrogen at the same rate as a water voltameter conceived to be placed in series with the discharge tube; that is, the rate of evolution follows Faraday's law for electrolytes. This held with pressures of helium varying from 1 to 3 mm., with currents varying from 1 to 3 milliamperes, and finally with current densities varied from one to six times the normal value for the cathode, and with which also was associated a change in cathode fall of about 100 volts. Then assuming that the evolution in hydrogen was the same as in helium results were given showing that, with the hydrogen filling, the anode absorbs gas also at a rate following Faraday's law. After the current has passed for a time the rate at both cathode and anode falls below Faraday's law. It appeared remarkable that the gas given off by the various cathodes was in all cases hydrogen. Only occasionally was the presence of nitrogen also noted. The author has now investigated if other gases possess in this respect the same properties as hydrogen and he describes experiments showing that nitrogen plays the same part in carbon electrodes that hydrogen plays in the metals. In addition, observations are given showing that a metal as anode also takes up nitrogen.—*Phys. Rev.*, September.

Heat Developed in Dielectrics.—GUYE AND DENSO.—The conclusion of their article in which they describe measurements of the energy dissipated in the form of heat in paraffin when subjected to an electrostatic field revolving with a high efficiency. The results are given in diagrams and it appears that the heat is proportional to the frequency.—*L'Eclairage Elec.*, September 16.

ELECTROCHEMISTRY AND BATTERIES.

Production of Ozone from Oxygen.—FISCHER AND BRAEHMER.—An account of an experimental investigation on the ozonization of oxygen by ultra-violet light (as given out from a quartz-tube, mercury-vapor lamp). It is necessary to keep the temperature low. At temperatures above 270° C., the reaction changing ozone to oxygen by heat takes place at a greater speed than the reaction changing oxygen to ozone by ultra-violet light. It seems that in the production of ozone by "silent discharges" through air it is really the ultra-violet light produced by the silent discharges which makes the ozone. —*Phys. Zeit.*, September 15.

Alternating-Current Electrolysis.—Wilson.—An account of experiments on alternating-current electrolysis between lead electrodes in sulphuric acid, zinc electrodes in sulphuric acid, zinc chloride, zinc sulphate and sodium sulphate, between iron electrodes in ferrous sulphate and sodium chloride. Some experiments were also made with copper, tin and aluminum electrodes.—*Transactions* Faraday Society, August.

Units, Measurements and Instruments.

Testing High-Tension Insulating Materials.—Kinzbrunner.—An illustrated account of an investigation in which he determined the conditions for the testing of insulating materials. He investigated especially the shape of the electrodes and the time of the electrification. Fig. 5 gives a time curve for presspahn. It will be seen from this curve that the material is able to resist, for a short time, a voltage considerably in excess of that which it is able to stand for any length of time. This is of great importance, and any material should be subjected to the voltage for at least such a period after which its time curve becomes asymptotic. In this particular case this time is about 1½ minutes. This is called the "time constant." The time constant varies with the quality of the material tested and, although it does not seem to follow any definite law, it increases with the actual disruptive voltage of the material and consequently with the thickness of the latter. The essential conditions to be observed in the test of dielectric strengths of insulating materials are given by the author as follows: The electrodes used should be flat, with round edges, and the actual touching area should be at least 5 sq. cm. The mechanical pressure on the electrode should be at least ¼ kg. per sq. cm. The shape of the curve of the alternating voltage should be nearly sinusoidal; a slight deviation from the sinusoidal shape has, however, little influence on the disruptive voltage. The frequency of the alternating current should be between 20 and 75 periods per second; wherever possible 35 periods should be used. The test should be made in the normal state of the materials: i. e., at a temperature of about 17°, and at a humidity of the air of about 70 per cent. The time of testing should be fixed according to the quality and thickness of the material. The following tables contain these times for a few of the insulating materials mostly used:

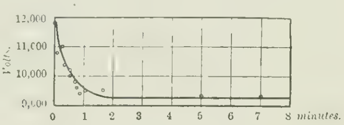


FIG. 5.—INSULATION CURVE.

Presspahn—1 mm. thick, 4 min.; 2 mm., 6 min.; 3 mm., 8 min.
Paper (not treated)—0.1 mm. thick, ½ min.; 0.2 mm., 1 min.; 0.3 mm., 1½ min.; 0.5 mm., 2 min.
Varnished paper (in one or several layers)—0.5 mm. thick, 2 min.; 1.5 mm., 4 min.; 3 mm., 8 min.; 5 mm., 12 min.
Varnished linen (in one or several layers)—0.5 mm. thick, 2 min.; 1.5 mm., 3 min.; 3 mm., 5 min.; 5 mm., 8 min.
Rubber—1 mm. thick, 1 min.; 2 mm., 5 min.; 5 mm., 15 min.
Gutta Percha—1 mm. thick, 3 min.; 3 mm., 10 min.; 6 mm., 15 min.
Pure Para—1.5 mm. thick, 5 min.; 3 mm., 8 min.
Ebonite—0.5 mm. thick, 5 min.; 1 mm., 10 min.; 3 mm., 20 min.

The procedure for testing should be as follows: The voltage should first be raised to the sparking point, in small steps, and at intervals of about 20 seconds. A new piece should then be taken, and the voltage should be reduced to about 70 to 80 per cent of the sparking voltage; the time which passes between the application of this reduced voltage and the breakdown must be measured carefully. Should this time be less than the time constant, another test must be made with a somewhat smaller voltage; if, on the other hand, the material withstands the voltage for a time which is larger than the time constant, the test must be repeated with an increased voltage, and the time measured again. It is advisable, though not absolutely essential, that for each of these tests a new piece of the material should be used.—Lond. *Elec.*, September 8 and 15. The article is the subject of a long editorial in which the author's definition of the disruptive voltage as that voltage which a material will stand for any length of time is not endorsed. It is customary to test with rising pressures applied for a quarter of a minute at a time, and the voltage at which the material is broken down under these conditions is now recognized as the "disruptive voltage." The time chosen is, of course, purely conventional, but a quarter of a minute being that adopted in the tests issued by the British Engineering Standards Committee should be accepted. The time curves given by the author for various materials are believed to be really temperature curves; i. e., these curves show the decrease in disruptive voltage with the increase of the temperature of the material. This explains the increase of the time factor with increased thickness and with increased dielectric strength. Hobart's suggestion that all materials should be thoroughly dried in a vacuum oven immediately prior to the test should be adopted.—Lond. *Elec.*, September 15.

Practical Standards for Electrical Measurements.—The report presented to the British Association by the Committee on Electrical Standards. It deals especially with the work done on the ampere balance and with apparatus for the determination of "g." The resolutions adopted by the Chamber of Delegates at the St. Louis Congress are given and it is stated that the report relating to the summoning of an international congress on electrical units is now under the consideration of the British Government. "Meanwhile a preliminary conference of representatives of standardizing laboratories and others interested in the determination of electrical units has been summoned by the president of the Reichsanstalt to meet in Berlin in the autumn. Lord Rayleigh and the secretary have received invitations to be present. The object of this conference is stated to be that the institutions which are concerned in maintaining the accuracy of electrical measurements in conjunction with those scientists who have devoted especial attention to this field of work should exchange opinions, and, if possible, come to an agreement as to the measures which must be taken in order to obtain the international uniformity in electrical units and measurements which is desired. It is thus preliminary to the more formal consideration of the subject which would be the work of the international congress." As an appendix is given a paper by Smith on the preparation of the cadmium cell.—Lond. *Elec.*, September 15.

Measuring Slip of Induction Motors.—Tian.—A brief discussion of several methods for determining the slip of an induction motor and referring especially to stroboscopic methods in combination with an aluminum rectifier and to another method in which the phenomena of rotary magnetic polarization are made use of.—*L'Eclairage Elec.*, September 2.

Electricity Meters.—Gerhardi.—A continuation of his illustrated serial. He describes the demand indicators of Fricker and of Merz. —Lond. *Elec.*, September 8.

Telegraphy, Telephony and Signals.

Telephone Wires on Power Transmission Lines.—Appler.—On the twenty miles of line from Kilarc to De La Mar in California a special telephone line construction is used which has proven very successful, both in regard to induction and danger of crossing with the power lines. It is shown in Fig. 6. The main power line is transposed every three miles while the telephone line is transposed at every power transposition and once between, and at the same time zigzagged up and down from pole to pole. Reference to the sketch will explain this construction. The wires do not cross each other horizontally but vertically. The wire, *a*, is on the one side, the wire, *b*, is on the other side of the poles, changing from one side to the other at transpositions.—*Elec. Jour.*, September.

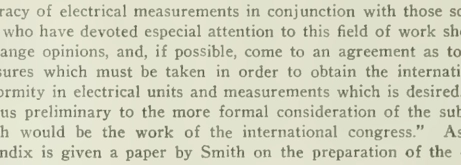


FIG. 6.—TELEPHONE WIRES ON TRANSMISSION LINES.

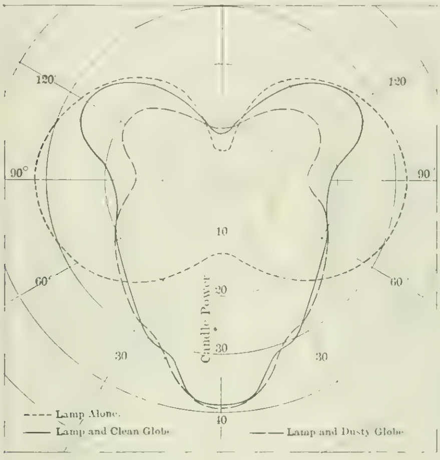
Fire Protection in Telephone Exchanges.—KNOWLTON.—An article giving the various fire hazards encountered in telephone exchanges, what steps are necessary to reduce or eliminate these, and where various fire extinguishing appliances should be located the more readily to be of service in case of need.—*American Electrician,* October.

Absorption of Light by Dust.

By VAN RENSSELAER LANSINGH.

A short time ago an editorial appeared in your columns relative to the effect of dust on "Holophane" globes, in which it was stated that the effect of dust on such globes was to cut down very materially the efficiency of the same. In order to determine whether this statement was correct or not, a series of tests was made at the Electrical Testing Laboratories. I quote from their report:

"Globe No. 3354 used in this test was about 6 inches in diameter and 6 inches deep, and was of the Holophane type. In order to prepare the globe for this test it was hung pendant for several months in the position in which it was to be used, allowing dust to accumulate upon its outer surface, with its opening covered, however, to keep the dust from getting upon the inner surface. When a coating of dust had accumulated on the globe, it was removed from its position and tested with a 32-cp oval-filament incandescent lamp. It was impossible to rotate the globe without disturbing the coating of dust, and therefore measurements were made in various vertical planes at each angle specified. Where the coating of dust was thicker on some parts of the globe than on others, it resulted in variations in the apparent candle-power shown in different planes at the same angle. This variation is shown in columns 4 and 5 of the following tabulation. The globe was then removed, thoroughly cleaned, and measurements of the globe used with the same 32-cp lamp were made in the usual manner. The following results were then obtained:



ABSORPTION OF LIGHT BY DUST.

	Lamp alone.	Globe dusty.	Variation in Apparent c.p. Low.	Variation in Apparent c.p. High.	Globe. cleaned
180° (zenith)	5.4	8.3	...	...	8.1
150°	19.8	12.9	12.4	13.4	15.8
120°	27.5	18.4	10.7	20.2	26.0
90° (horiz.)	32.0	15.1	14.1	16.4	18.2
75°	30.8	18.3	...	...	18.7
60°	28.5	20.4	20.2	20.5	20.8
45°	24.6	24.3	24.0	24.8	23.7
30°	19.5	28.2	28.0	28.6	28.1
20°	16.6	30.4	30.0	30.9	30.5
10°	14.0	36.4	36.0	36.8	36.7
0° (Nadir)	12.9	38.5	...	...	38.2

It will be noticed in examining this test that the light below the horizontal is practically uneffected by the thick covering of dust, and that most of the light absorbed, amounting to 13 per cent, is lost in the upper hemisphere where it is of least value. This is due, of course, to the shape of the globe, as the upper part is where the dust principally rested. The reason that there is so little loss in the lower hemisphere is due to the fact that the upper part of each prism in a "Holophane" globe is mostly a total reflecting surface and on such a surface it is immaterial whether dust collects or not, as far as the reflecting power is concerned. It will readily be seen that such prisms are unaffected, as long as nothing comes in optical contact with the glass, and inasmuch as in the case of dirt, a thin film of air exists between the particles of dust and the glass, the index of refraction of glass and air is unchanged. This is not true of the lower surface of each prism, but on this the dust is much less likely to lodge.

It will be noted in this test that the opening was covered to prevent dust from getting on the inner surface. This should be done in the case of all globes, whether of the "Holophane" type or not, as it is not only a question of dust falling inside of the globe, but also settling on the lamp itself. It may result in a slight decrease in the life of the lamp, but this is more than compensated for by the cleanliness secured.

In a series of tests made by Messrs. Legg & Townsend some years ago at the Chicago Public Library on the desk lamps used there, which consisted of bare lamps with green flashed porcelain shades, it was found that the relative increase of light, after cleaning the shades and lamps, ran in some cases as high as 70 per cent, and averaged 29 per cent. Such tests would show the absolute necessity of keeping the inside of the globes clean (as well, of course, as the outside), and would tend to support the theory that if such a method of procedure slightly shortened the life of the lamp, the increase in illumination gained thereby would more than offset the same. A series of tests is now being made to determine the relative losses in such cases and will be reported upon later.

It will be seen from the above tests that the loss in light, due to dust collecting on "Holophane" globes, is, therefore, a comparatively small amount, certainly not in excess of the loss on ordinary globes. The effect of dust, therefore, on globes is more a question of looks than of efficiency. They should, in common with all globes, be kept clean, which can easily be done by means of a stiff brush. The loss of light, due to such dust, is, however, remarkably low.

"National" Induction Motors.

The National Electric Company, Milwaukee, builders of direct and alternating-current machinery and the Christensen air brake, so well known in the street railway field, is placing on the market a new type of induction motor. The machines are of extremely heavy and substantial construction, and may be installed on the floor, side wall or ceiling by changing the brackets which carry the bearings. Owing to the high speeds at which the machines operate and the small space between stator and rotor, an extremely heavy shaft is used, while the bearings are of large area, eliminating as much as possible any variation in the air gap.

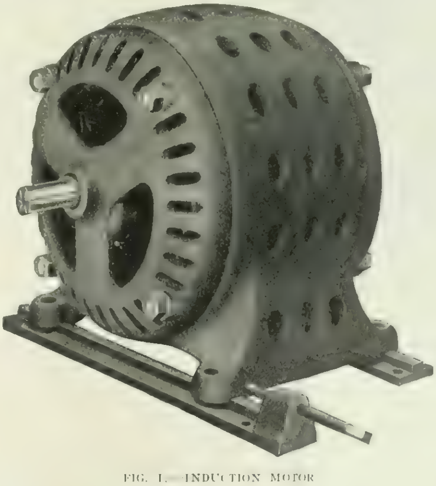


FIG. 1.—INDUCTION MOTOR

The frame is made of cast iron, into which are assembled the laminations. The windings are all form-wound by automatic machinery, and between each coil air space is provided to take care of the heating. The ventilation has also been given careful consideration, there being numerous openings provided in the frame, and also ventilating spaces between the laminations. The rotor is of the squirrel-cage type with copper rods inserted in the slots. This is built up of laminations of mild steel assembled on a spider and held firmly in position by end plates. The bearings are self-oiling and have wearing surfaces of ample proportions.

An auto starter is furnished with the squirrel-cage type consisting of transformers connected across the line with voltage taps suitable for starting the motor under different conditions of load. A switch construction is provided for throwing the motor from one voltage to another. All of this apparatus is immersed in a tank of oil, which makes it sufficiently reliable to operate at high voltages and which takes care of any heating due to starting under heavy torque.

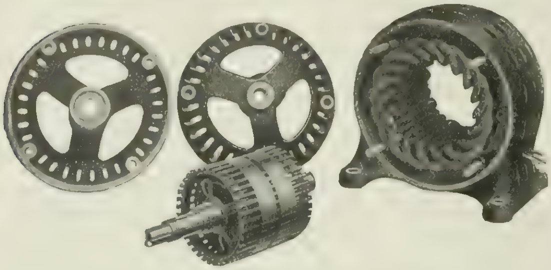


FIG. 2.—PARTS OF MOTOR READY FOR ASSEMBLING.

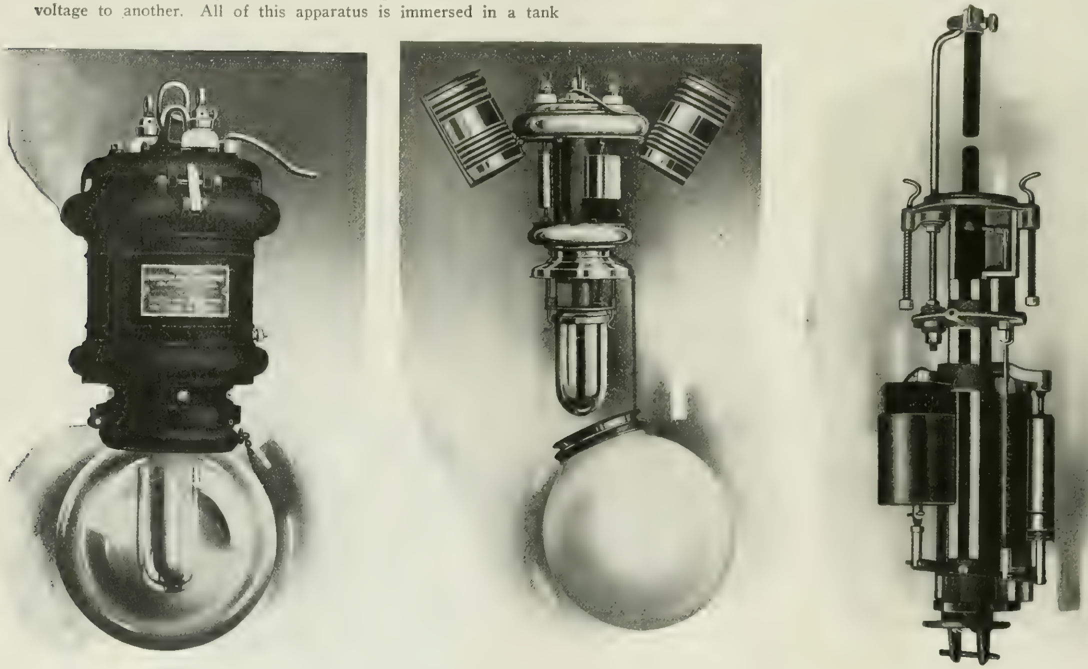
Galvanized Chain for Arc Lamps.

The Oneida Community, Ltd., Oneida, N. Y., is putting on the market a special chain for raising and lowering arc lamps suspended from mast arms. This chain is made in various sizes, to fit any pattern of pulley, and is heavily galvanized. It is claimed that this chain will outwear two or three times any other attachment which has yet been put on the market for this purpose. As the chain is uniform in strength, there is no fear of the lamps falling to the street, as happens so unexpectedly when the strands of a wire cable give way, or a rope has rotted out. The manufacturers state that many central stations have already adopted this system for raising and lowering arc lamps.

“American” Arc Lamp.

The American Arc Lamp Company, of Kalamazoo, Mich., which succeeded to the business of the late Lea Manufacturing Company, of Elwood, Ind., has for the past year been engaged in improving the arc lamp made by the latter company, which had been in successful use for over ten years. For the manufacture of the improved lamp a well-equipped factory has been erected, and is now turning out a large product.

The lamp, which is of the direct-current multiple type, has been especially adapted for use in shops, factories, etc., and its construction is remarkably simple in that there are but five parts. The swinging covers are readily opened without the use of tools and permit access to the interior of the lamp from every side. The magnet coil is practically indestructible, and a self-locking switch is an important improvement. This switch is manipulated by a lever or handle on the top cover as in the Lea lamp, but in the switch itself there is a radical change. When the switch is opened by the ordinary movement of the lever it remains open, locked in position, and no amount of pressure will cause it to fly back or short-circuit. When closed it remains locked in position forming a perfect contact, and is not affected by vibration or rough usage. This overcomes an anoying feature noticeable in the old type of lamp. The difficult problem of great length of carbon life has been solved in a simple manner, the lamps running about 240 hours without trimming. The means employed in securing this result is clearly shown by the cut of interior of the lamp with covers removed.



FIGS. 1, 2 AND 3.—“AMERICAN” ARC LAMP.

Power Development in Wisconsin.

The Western Gas & Investment Co., with headquarters in Chicago, and owner and operator of a number of electric lighting and gas plants throughout the country, acquired some time ago the property of the Stillwater, Minn., Gas & Electric Company. In conjunction therewith it also acquired water powers on the Apple River in Wisconsin, one at Somerset, Wis., approximately 12 miles from Stillwater, the second one at Riverdale, Wis., approximately 14 miles from Stillwater.

At Somerset the water power had been previously developed and there was in operation an electric plant supplying current to a number of surrounding towns. The electric portion of this plant has been entirely remodeled and there are now in operation two 250-kw, 450-r.p.m., 2,300-volt, three-phase, 60-cycle, belted-type, alternating-current generators with direct-connected exciters.

At Riverdale the company has constructed a concrete dam with power house and have located therein two 250-kw, 200-r.p.m., 2,300-volt, three-phase, 60-cycle, directly coupled to water wheels.

In each of the above stations are located three 250-kw, oil-insulated, water-cooled transformers, which convert the generator voltage of 2,300 volts to 15,000 volts. The two stations, Riverdale and Somerset, which are located two and a half miles apart, are run in multiple with each other, and the combined output is transmitted to Stillwater, Minn., where it is reduced by means of three 400-kw, oil-insulated, water-cooled transformers for use in commercial and city lighting, and also for furnishing a large amount of current for power purposes.

The generators and transformers in each of the stations were manufactured and installed by the National Electric Company, of Milwaukee, and the water wheels in the Riverdale station were furnished by S. Morgan Smith, of York, Pa. The plant has now been in successful operation for some time, and is one of the best designed plants now in the Northwest. Mr. R. S. Feurtado, who is the engineer of the Western Gas & Investment Co., has given the design of this plant his entire attention and its successful operation is an evidence of his very successful supervision.

Thomson High Torque Induction Test Watt-Hour Meter.

To every central station or isolated plant the question of periodical meter calibration is of vital importance, and the customary method of making such tests is by the use of indicating instruments. Although there is no question regarding the accuracy of this method, the rapid growth in the electric lighting and power industry and the more than proportionate increase in the use of the rotating meter as the means of measurement, demand that some way be provided whereby tests may be made more quickly, and yet at the same time without in the least decreasing their reliability. Such a method is provided by the use of the Thomson high torque induction test watt-hour meter, now placed on the market by the General Electric Company, Schenectady, N. Y.

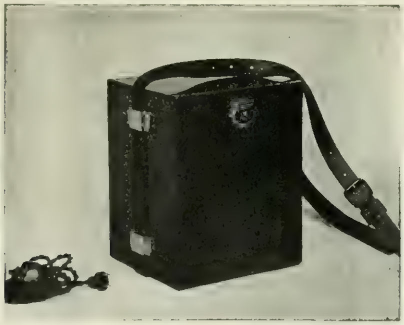


FIG. 1.—CASE FOR TEST METER.

In using this meter it is unnecessary that the load shall be constant, as the only observations necessary are the number of disc revolutions of the meter undergoing test and the pointer indications of the standard meter before and after test. Both meters integrate the instantaneous values and hence it is unnecessary to obtain the mean value or require an unvarying load. The time saving qualities of this device will be appreciated when it is remembered that no check tests have to be made and a reading, once commenced need not be discontinued on account of load fluctuations. Furthermore, the meter is so designed that one standard may be used for testing meters of different capacities covering a range from light load to full load. This also renders possible more rapid testing as no time is consumed in changing standards. Personal errors of observation are also practically eliminated as all readings may be made with precision. A stop watch is required only in checking the test meter with the primary standards.

The test meter is enclosed in a wooden carrying case provided with a substantial strap to aid in transportation. It is of a convenient size, being 10 in. by 8 in. by 7 in. in over all dimensions. The cover may be entirely removed from the case for sake of convenience when making tests. It is provided with lock and key for the prevention of tampering by unauthorized persons.

The register, which is very large and easily read, is placed on top, and is of the three-pointer type. The larger pointer reads directly in disc revolutions, and is subdivided into one hundred equal parts, so that it may be read to hundredths of a revolution. The two other and smaller pointers make one revolution for each ten or one hundred revolutions, respectively. As the full load speed of the meter is less than 35 revolutions per minute, a three-minute test at this load may be made before the indications repeat themselves.

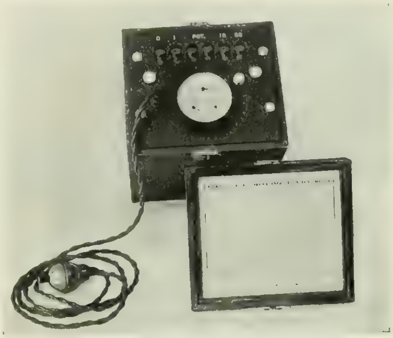


FIG. 2.—CASE WITH COVER REMOVED.

The connections are made by means of binding posts placed at the top. At the left of the dial is placed a plug receptacle in series with the potential coil. To the corresponding plug is attached, by means of a lamp cord, a pendant snap switch, the opening and closing of which stops or starts the meter. The cord is of sufficient length to permit of the test meter being placed at some distance from the operator, which may be necessary, for instance, when the meter under test is installed at such a height as to require the use of a ladder. A little to the right of the dial is placed a knurled thumb nut, by aid of which the moving element may be raised from its jewel bearing and securely locked during transportation.

The cup diamond has been adopted for the lower thrust bearing. The pivot is identical with that used for the ordinary sapphire bearing, consisting of a small piece of piano wire, glass hardened and highly polished, inserted in a removable brass shaft end.

The entire meter may be lifted from the case by two buttons on opposite sides, thus making it easily accessible for calibration. When removed from the case the meter will remain without support in an upright position resting upon the magnet core and central casting, to which all parts are fastened.

The potential winding is suitable for use on voltages ranging ten per cent on either side of the normal. Three current coils are employed, one end of each being connected to a common binding post, and the other ends terminating in each of the three remaining binding posts, which are properly marked for the various ampere capacities of the coils attached thereto. The capacities selected as being the most generally desirable are one, ten and twenty amperes, which are sufficient for testing meters from three to twenty-five amperes normal capacity. The ampere-turns of the three windings are equal, hence the torque is constant when the meter is operating under the same percentage of full load for the individual coils. In other words, when using the smallest winding with one ampere passing, the torque is equal to that produced by the largest coil with a current of twenty amperes. Thus, friction is entirely negligible and accuracy is obtained throughout its range. This feature will be found of the greatest importance when testing meters on light loads, for no corrections will have to be made for possible errors in the test meter.

High torque is a feature of the meter, and is obtained solely by efficient design. Internal losses are practically negligible, and the moving element is so light that all questions of jewel wear are eliminated. On account of the extremely high torque used it has been found difficult to obtain absolutely permanent magnets of standard design with sufficient strength to keep the full load speed within proper limits. Therefore, a new magnet system has been designed, in which two magnets are astatically arranged, one above and the other below the revolving disc. The pole pieces are designed to give the greatest possible damping effect with any given magnetic density in the iron portion of the circuit.

Instead of moving the magnet bodily, adjustment at full load is accomplished by shunting a greater or lesser number of the magnetic lines that would otherwise pass through the disc. Four movable angle pieces attached to the magnet poles provide the necessary means for adjustment. Accuracy at light load is obtained in the usual way; that is, by moving a lever, at the bottom of the meter, to the right or to the left, as may be required, thus shifting a small rectangular conductor situated between the disc and the potential winding. The distortion of the flux obtained by moving the position of this adjusting device alters only the light load accuracy of the meter without affecting the calibration at full load.

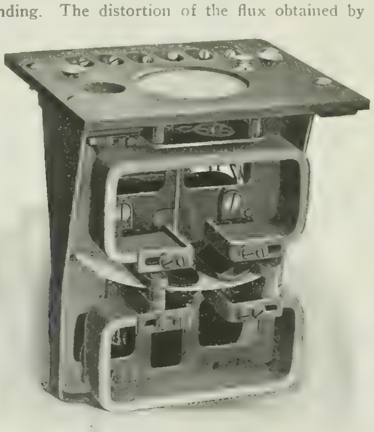


FIG. 3.—METER REMOVED FROM CASE.

As to accuracy, errors for ten per cent changes in voltage or frequency are entirely negligible, as is also the case when measuring inductive loads or operating on circuits of widely different wave forms. The three separate current windings render it possible to obtain the same accuracy on a ten-watt load as on a two-kilowatt load. In other words, the meter possesses the same accuracy throughout a range of 200 to 1

Extension of Acheson Graphite Works.

The International Acheson Graphite Company, of Niagara Falls, N. Y., with the recent completion of a large extension equipped with the most modern electrical and mechanical appliances and machinery, has doubled the capacity of its plant for creating graphite in the electric furnace, and has closed a contract with the Niagara Falls Power Company for another 1,000 hp of electrical energy in addition to the 1,000 hp previously used. The commercial importance of this artificial graphite may be estimated from the fact that the United States Geological Report for 1904 states that for that year the value of Acheson Graphite produced was \$217,790, all the graphite mined in this country amounting to \$341,372. New York state, which is considered rich in deposits, according to the official report of 1904 produced natural graphite worth \$119,509. Acheson Graphite is largely used in the manufacture of metal protective paints, dry batteries, stove polish, packing and as a lubricant. The electrochemical processes also consume an extensive supply of Acheson Graphite electrodes

Ball Side-Crank Automatic Engines.

The Ball Engine Company, Erie, Pa., has signalized the occupancy of its new shops by putting out a new line of engines, of which the Corliss type is shown in Fig. 1. As will be seen, the engine is of the side-crank type, and being constructed in sizes from 125 to 1,400 hp, it supplements the well known Ball center-crank engine, which ranges in sizes from 35 to 250 hp. The engine is built in both vertical and horizontal types, simple and compound, with balanced slide valves in the smaller and Corliss valves in the larger sizes. The new type combines the results of the long experience in engine design and building of the Ball Company, and for its manufacture the new shops of the company were specially equipped, thus assuring an engine entirely up-to-date, both in engineering design and in all the refinements of mechanical execution.

Among the reasons for adopting the side-crank type are that it avoids the use of an overhanging wheel, which is particularly objectionable in the case of direct connection to alternators, and it also eliminates a third bearing with the attendant difficulty of maintaining good alignment. In the new type a special and very simple means is provided whereby the alignment may be preserved. Two projections cast on the frame on either side of the main bearing just behind the crank are planed off on a line exactly parallel with the center line of the cylinder. A boss is formed on one side of the crank disc and a gauge is furnished to be attached to this boss; when the gauge is set to the line on one frame projection, by turning the crank half way over and keeping all the end play of the shaft in one direction, the gauge will be brought opposite the other projection. It is obvious that by this means any misalignment will be unerringly indicated. With this arrangement it is extremely easy to test the alignment at any time without recourse to the older method of dismantling the machine and running a line through the cylinder, which method at the best is one requiring great skill to arrive at correct results.

The main bearings (Fig. 2) are of a somewhat unusual construction, whereby the advantages of the two-part box with respect to simplicity of adjustment are combined with those of the four-part bearing with respect to rigidity, and in addition excellent lubrication insured. The bearing is in two parts and the lower box can be conveniently removed by raising the shaft a small amount. The boxes are very solidly locked in position, but yet may be readily adjusted while the engine is in motion. All adjustment is in only one direction and the boxes never have to be taken out to remove shims, since there is practically no wear on the top half of the box, thus permitting the cap to be rigidly bolted down.

The cross-head has babbitted shoes secured in a manner to prevent any possibility of their getting loose or being distorted when secured in place. The adjustment for wear does not shift the shoes endwise and consequently they are always central with the cross-head pin with no tendency to wear faster at one end than the other. The cross-head pin is so arranged than when it wears oval it can be turned through one-fourth of a revolution, thus presenting a new surface for wear, which process can be repeated indefinitely. The connecting rod is of the solid type, the ends being bored and slotted for the reception of the boxes. The boxes at the crank end are of iron, babbit-lined, and those at the cross head end of a special anti-friction bronze having practically the same coefficient as steel and iron, thus preventing the pins being seized through difference of expansion at a temperature more than normal. The adjusting wedges are threaded entirely through for the bolts, and when an adjustment is made the wedge is securely and solidly locked in position.

The crank and pin are machined from one casting of a special mixture of steel and iron having great strength and possessing wearing qualities much better than those of forged steel. This not only secures the best possible wearing surface for the crank-pin, but permits larger shafts and pins than could be otherwise used; in fact, the diameter for the fit on the crank shaft is larger than the diameter of the bearing, which enables the length of fit to be decreased, thus reducing the overhang.

All the principal bearings of the engine are oiled from a system of piping connected to a tank of oil which may be mounted on the top of the engine and arranged to act also as a filter. A pump attached to the crank pin returns the used oil automatically to the tank, this pump being of a special type having the ports for suction and discharge positively opened and shut at the proper time and containing no valves that can be clogged by waste or other foreign substances. Adjustable sight feeds are provided at each bearing, all of these being piped together and connected to the tank. Where several engines are installed, a large tank may be mounted and a supply pipe run to each engine, thus making a central oiling system for the station.

All of the engines, both of the Corliss and single-valve type, are controlled by a governor of recent invention (Fig. 3), which is claimed to be capable of the best governing that has yet been accomplished, and unlike many governors that can readily be made to fill temporarily the usual manufacturer's guarantee of regulation, it never gives trouble. By far the greater part of governor troubles is caused by pivots under excessive pressure, but in this governor the centrifugal force of the weight is resisted directly by the spring and not transmitted through any bearings. It has a powerful spring which implies a powerful governor not noticeably affected by the ordinary changes in friction of the valves and valve gear. The adjustments are so simple and so certain as not to require an expert; the speed can be changed to a wide range and a fine regulation secured by any one at all competent to make the ordinary adjustments around an engine. The speed is raised or lowered by changing the tension of the spring, the sensitiveness being controlled by moving the link connecting the weight and eccentric in or out along a row of holes provided for that purpose. These two simple adjustments, one controlling the speed and the other the regulation, are positive in their action, very easily made, and once made are permanent. The governor is exceptionally well adapted to engines driving alternators in parallel owing to the absence of excessive friction, and particularly the variable friction in the governor mechanism, which latter is the cause of the interchange of load between the alternators and results in the so-called hunting or unstable operation of the machines.

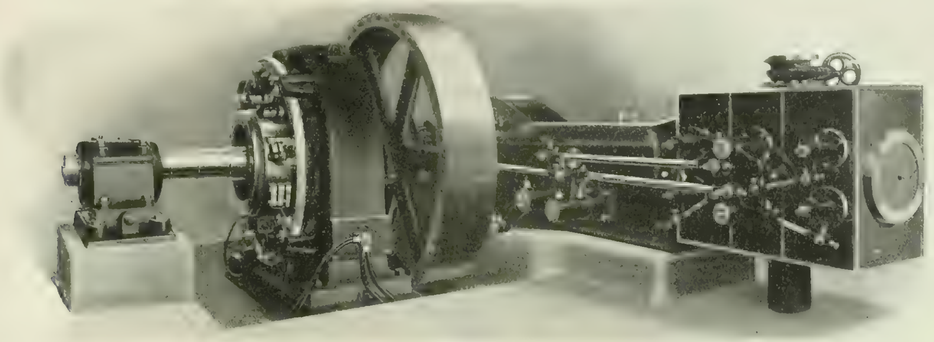


Fig. 1.—Horizontal Side-Crank Engine.

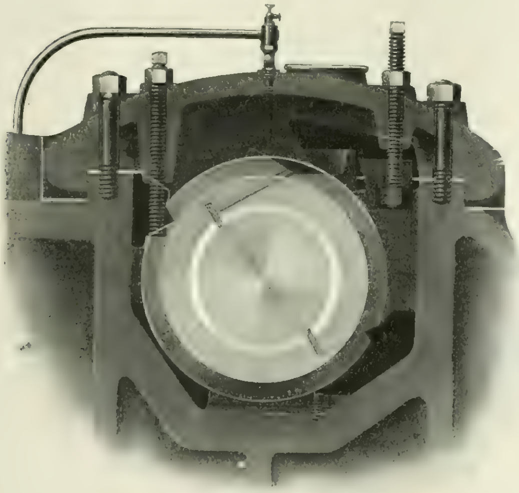


FIG. 2.—BEARING.

The parts above described are practically alike in both single-valve and Corliss engines. In the single valve engines the Sweet balanced valve is employed. While this is an expensive form of valve to make if properly finished, it keeps down the coal bills. Both sides of the valve are finished to true surfaces and to uniform thickness by successive operations of planing, grinding and hand-scraping, the final limit being one five-thousandths of an inch. The valve seat in the cylinder, the pressure plate and the distance strips which hold the pressure plate just far enough from the seat to permit the valve to work freely and yet be steam tight, are all finished with the same high degree of accuracy. The final finishing is done after the parts have been operated in the engine, so that any tendency to warp by heat and pressure may be detected and corrected. Practically the only wear on this valve is downward, which does not affect its tightness in any degree. Being comparatively thin, it can be run in very close adjustment without danger of sticking when starting up, and any wear that may occur is readily taken up. It will lift from its seat and relieve the cylinder from a moderate charge of water. In an extreme case the end of the valve will break out, thus opening the port widely and usually saving the engine, since in this case the only possible way to avoid a wreck is to instantly obtain an opening as large as the ports, and to do this something has to break; naturally there is no comparison between the time and expense of putting in a new valve and the danger, annoyance, delay and expense of repairing an engine which has been wrecked.

In the larger sizes of engines the Corliss type of valve is used, with a gear which retains the essential principle of the Corliss engine, but without its limitations in speed. By the use of the Armstrong non-detaching valve gear (Fig. 4), which is an ideal one for engines of this class, the valves are given a positive movement, prac-

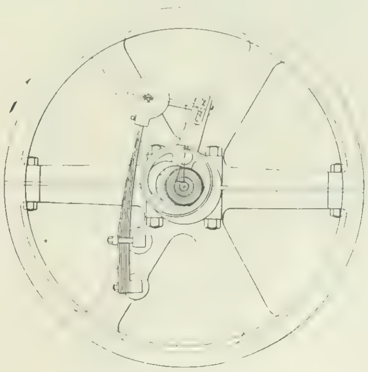


FIG. 3.—GOVERNOR.

tically identical with that accomplished by detaching gear and dashpot. The admission valves remain entirely motionless at least half of the time, start with a smooth and easy motion, and at usual loads have their highest speed at the instants of opening and closing. The motion is diagrammatically represented in Fig. 6, where the eccentric travel is horizontal and the valve travel vertical. The valve opening is in the middle of the valve gear travel when all parts of the gear from the wrist plate to the eccentric are at their highest speed, and consequently have the greatest leverage over the valve at the only time that it moves at all hard. The strain on the gear, from the wrist plate to the eccentric, is by this means greatly reduced, and also comes in the middle of the movement so that there is no reverse stress. The noiselessness of the valve motion does not depend upon closely adjusted bearings, which, in fact, can be very loose in every joint and the engine will still run quietly. This smoothness of action also tends to reduce the wear which takes place in the bearings of the valve gear mechanism.

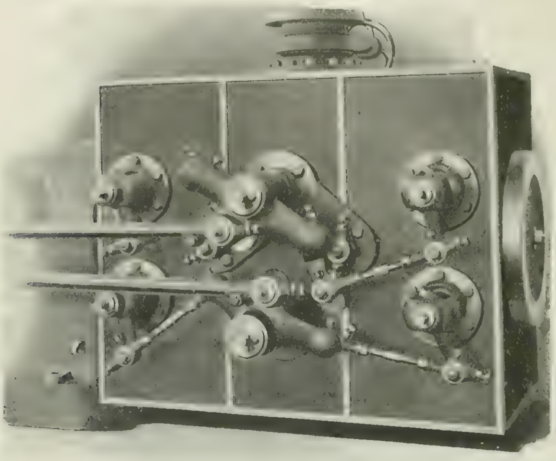


FIG. 4.—VALVES.

In cylinders of 20 in. and larger the valves are built in the heads, which permit very large port openings with a minimum clearance space (Fig. 5). Cylinders of less diameter have the valve seats cast integrally with them as in the usual type of Corliss cylinder. As these small cylinders are, however, in the Ball type longer in proportion to the diameter than in the larger ones, the clearance is kept sufficiently low to permit this construction.

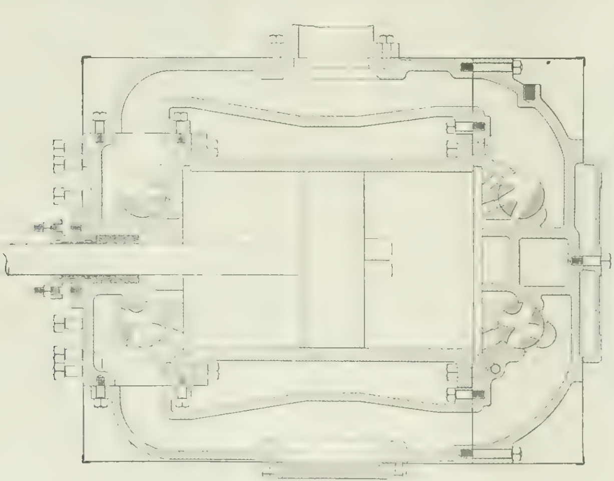


FIG. 5.—SECTIONAL VIEW OF VALVE GEAR.

The admission valves are triple-ported, permitting a very quick opening and closing without too rapid a movement of the valve, which construction also gives a more uniform pressure on the valve seat while opening and does not tend to wear off the edges of the port and valve as in the case of a single port. The exhaust valves are double-ported and differ slightly from the usual Corliss design in that they close off the ports on both sides of the valve and so reduce the clearance space, which arrangement also prevents the noise that occurs in Corliss engines, particularly the compound type, when the engine is running lightly loaded and the steam expands below the exhaust pressure, thereby causing the valve to lift. All of the Corliss type of engines are supplied with relief valves built into the cylinders in such a way as not to affect the clearance, and they are of unusually large size to afford all the protection that it is possible to obtain by this means.

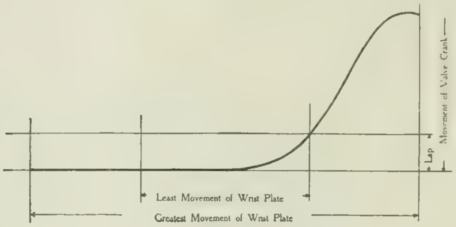


FIG. 6.—MOTION DIAGRAM.

The Advantages of Mechanical Draft.

The B. F. Sturtevant Company, of Boston, Mass., in its exhaustive treatise entitled "Mechanical Draft," points out that to a great extent the advantages of this method of draft production are interdependent, and that the possession of one advantage is evidence of the possession of others of similar character. "Thus the very adaptability of mechanical draft is indicative of the fact that it is more flexible than that produced by the chimney, is more readily controlled, and less influenced by climatic changes; while the apparatus for its production is more readily transported and has a higher potential value than a chimney. To a considerable extent these stand out as the conveniences of this method, regardless of their economies. When it is shown that increased efficiency can be secured by a method that is more convenient, the advantage of mechanical draft is established.

"The actual omission of the chimney is sometimes of far greater importance than would at first appear, while the readiness with which the rate of combustion may be increased is doubly appreciated when it is shown that under proper conditions the efficiency of combustion may be increased thereby. The purely economic features are presented most prominently in the ability to utilize low-grade fuels. The economy in the quality of fuel consumed has, in its relation to the use of mechanical draft on shipboard, an advantage which is closely allied to that resulting from the decreased space occupied.

"The economic results which may be secured through the introduction of mechanical stokers and devices for utilizing the waste heat of the gases are rendered most evident under the conditions of mechanical draft production, as are also the great advantage of preventing smoke and the blessings of good ventilation as they are exemplified on shipboard. The facts that the size of a boiler plant required for a given output can be reduced when a fan is substituted for a chimney, that the cost of the mechanical draft plant is usually far less than that of the chimney draft plant, and that its operating expense is likewise less under proper conditions, all point most conclusively to the purely economic advantages of the method which it is the purpose of this book to present."

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The lower temperature of the past week had a decidedly stimulating influence upon retail trade, but it was not cold enough to affect late crops which are maturing very satisfactorily. The utmost confidence prevails in all sections of the country, and excellent reports come in as to large trade in all lines. Manufacturing activity is fully maintained, the leading industries having contracts assuring little idle machinery during the balance of the year, and it is probable that more business will be carried over into 1906 than at the opening of any previous year. The growing disposition to place orders for distant delivery testifies to the well nigh universal faith that no setback will be experienced. Following the great activity in pig-iron buying last week has come a slight lull, but prices, none the less, have been again advanced to 50 cents. Record sales for this period of the year are reported in the past two weeks from Chicago, Philadelphia, Pittsburgh and Birmingham. In finished products the buying by railroads is still a feature; six to nine months' output of rails for next year is already reported booked. In addition, plates for shipbuilding, bars and a multitude of other forms are reported selling actively. Large orders for cars are reported this week. Coke is scarce and selling 35 cents a ton up from the lowest prices of the year. Coal also shows improvement as the season advances, and steam coals are also in better demand. Railway traffic reports suggest that more rolling stock and motive power could be used if obtainable, as is customary at this season, and gross earnings thus far reported for September surpass last year's by 1.1 per cent, which in turn were 6.5 per cent greater than those of 1903. Foreign commerce at New York for the last week showed gains of $3,165,372 in value of merchandise exported and $2,958,392 in imports, as compared with the same week last year. Money is a little firmer, but there is no stringency, and gold imports were checked by higher rates of foreign exchange. Mercantile collections improve as the season advances. Bank exchanges at New York were 31.7 per cent larger than last year, while at other leading cities the increase averaged 18.3 per cent. There is an unprecedented demand at top prices for all kinds of building material, marked freedom from industrial friction, and a market for labor and its products active as rarely before in the country's history. From the cotton belt come reports that no improvement is seen in the plant's condition. Deterioration from rain is reported as the result of heavy rains in the lower Mississippi valley. In the rest of the belt the plant is opening fast—prematurely, in fact, in some sections—and picking is generally active. The agreement is general that varying large shortages from last year's yields are certain, but definite calculation is, of course, still impossible. A large volume of business is being done in machinery, and electrical supplies continue in active demand. The metals are active, and the quotation on the New York Metal Exchange was advanced from 16⅛c. to 16⅜c. for Lake copper. The business failures for the week ending Sept. 28, according to *Bradstreet's*, numbered 185, against 173 the week previous, and 179 in the corresponding week last year

ELECTRICAL BUSINESS FROM JAPAN.—The General Electric Company has recently received orders from Japan for electrical machinery, as follows: Fusan Electric Company, two 45-kw, belt-driven direct current generators. Ashio Copper Mine, one 50-kw, 500-volt, 50-cycle induction motor; one three-phase 60-kw transformer and two switchboard panels. Nagoya Electric Light Company, 21 two-phase induction motors aggregating 210 horse-power; 40 60-cycle transformers aggregating 215 kw. Tokio Shigai Railway, two 25-hp induction motors. Arakawa Mines, two 65-hp induction motors geared to two Deane single-acting 8½ in. x 12 in. pumps, rated to deliver 650 U. S. gallons of water per minute against 1,010 feet head. Mitsui & Company, Tokio, three 50-kw, three-phase, 3,500-volt Curtis turbine generators; two 25-kw, 450-volt, direct-current tandem-compound marine generating sets; one 125-kw induction motor and 28 other induction motors aggregating 670 horse-power; six 30-kw transformers; nine three-phase transformers aggregating 225 kw, and a switchboard consisting of nine transformer panels.

A NEW INCANDESCENT LAMP COMPANY.—Announcement is made of the formation of the St. Marys Incandescent Lamp Company for the manufacture of incandescent lamps. A factory is now under construction at St. Mary's, Pa., to be completed within two months, which is intended to be the most up-to-date and best equipped incandescent lamp factory in the world. The initial capacity will be 6,000 lamps per day, but additional space will be provided for expansion. It is stated that a competent technical force has been selected, comprising men of long experience who have been prominently identified with the incandescent lamp manufacturing interest. The factory will have the advantage of a supply of natural fuel gas and other means of reducing cost. It is the intention of the company to operate entirely independent of the so-called incandescent lamp combination. The Eureka Electric Lamp Company, of Cleveland, O., organized by Mr. W. M. Rothschild, is merged in the new company, of which Mr. Rothschild is one of the directors. The company is financed by St. Marys, Erie and Cleveland capitalists.

EXPORT TRADE FIGURES.—Complete and classified returns of our foreign trade in August, published by the Government, show that the August export of manufactured goods was the largest by nearly $9,000,000 ever made in August, and the second largest ever made in any month of our history. Only in April of this year has last month's $51,300,000 figure been exceeded. It is a somewhat interesting fact, however, that August's imports of manufactures also established a record. The total was $18,382,000, against $14,309,000 in August last year, and $17,134,000 in April, 1897, when imports broke all previous monthly figures, because of the hurrying-in of articles on which the Dingley tariff's increased duties were to go into effect the following month. In June, 1893, when the movement of foreign manufactures to our shores was at its height, the total was $10,961,000. In the fiscal year 1893, $143,493,000 worth of manufactured goods were imported for consumption; in the fiscal year 1905, the total was $165,886,000.

CALCIUM CARBIDE IN CANADA.—Mr. T. L. Wilson, of Ottawa, Ont., has acquired extensive power privileges on the Saguenay River, Que. With 152 ft. head, over 30,000 hp may be developed at tidewater, with 30 ft. draught for navigation, insuring cheap shipping direct to New York and elsewhere. He estimates at least 250,000 hp available at this point from the 230 ft. head up to the discharge from Lake St. John. Mr. Wilson's property covers three miles of the river, including both banks of the river bed. He has built wharves, and owns a square mile of limestone within a short distance. Mr. Wilson contemplates the use of his electrical power in the production of calcium carbide. Within 20 miles of the shore of the St. Lawrence, and 100 miles below Tadousae, Mr. Wilson says there could be developed a power to the extent of 1,000,000 hp, but it is not now possible to utilize it commercially without a railway on account of requiring to store manufactured product during six months of the year.

GENERAL ELECTRIC IN COPPER.—Press advices from Boston say: "The General Electric Company is now in control of the Bully Hill property in Shasta County, Cal., it having paid $1,500,000 for the property to Captain De Lamar. The property, as acquired, consisted of 213 acres of land developed to a depth of 700 feet. The property was originally opened as a gold mine, but copper ores developed at depth. It is equipped with a smelter which cost $200,000, has two furnaces and a daily capacity of about 300 tons. The Bully Hill has been turning out from 8,000,000 to 10,000,000 pounds of copper per annum, but the General Electric Company will develop the property to permit a considerably larger output. The Bully Hill product, however, will only partially supply the General Electric Company's copper needs, for it consumes not far from 50,000,000 pounds per annum"

BIDS FOR HYDRO-ELECTRIC PLANT.—Bids will be received until Nov. 8 by L. W. Roys, city clerk, Tacoma, Wash., for constructing a hydro-electric generating plant of not less than 5,000 and not more than 10,000 hp delivered on the low tension side of the transformer at the distributing station.

BIDS FOR CABLES.—Bids will be received until Oct. 4 by the Board of Awards, Baltimore, Md., for furnishing for the use of the city of Baltimore underground cables, and for the use of the Electrical Commission special duct pipe. Chas. E. Phelps, Jr., is chief engineer.

TO MANUFACTURE AUTOMOBILES.—The American Locomotive Company, which has works in Schenectady, Providence, and several other cities, is to go extensively into the manufacture of automobiles, automobile trucks, and railway motor cars.

BIDS WANTED FOR LIGHTING FIXTURES.—Bids will be received until Oct. 24 by the Board of Trustees of the Public Library, Columbus, Ohio, for furnishing and installing electric and gas light fixtures. John J. Pugh is secretary.

HOLLAND-AMERICAN CONSTRUCTION COMPANY.—The Westinghouse interests are behind a new company which has been organized for the purpose of building electric railway power and lighting plants, canals and other public works in Europe. The Holland-American Construction Company is the name of the enterprise, and it is incorporated under the laws of the State of New York. The capital is $1,000,000. Holland has been especially chosen as the initial field for operations, largely because of the financial success attending the recently completed street railway which runs from Amsterdam to Haarlem, one of the residential suburbs of that Dutch city. The Amsterdam-Haarlem road was constructed by the London affiliations of the New York engineering and contracting firm of J. G. White & Co., and is owned by the Netherlands Tramways Corporation, which is incorporated under the laws of the State of Connecticut, and the stock of which is largely held by New Yorkers. The original organizers of the Holland-American Construction Company were J. F. Alden, at one time prominently connected with the American Bridge Company; Ralph George Kaelber, H. C. Brewster and C. H. Palmer, of Rochester. The company has now, however, passed into the control of the Westinghouse people. Four out of five of the directors are Westinghouse men. They are Newcomb Carlton, fourth vice-president of the Westinghouse Electric & Manufacturing Company, Limited; George C. Smith and Walter D. Uptegraff, of the Security Investment Company, of Pittsburg of which concern George Westinghouse is president, and Joseph H. Lukach, who is one of the directors and leading spirits in the British Westinghouse Electric & Manufacturing Company, Limited.

RECENT CURTIS TURBINE SALES.—Among recent orders received by the General Electric Company for Curtis turbines are the following: The Jackson Electric Railway, Light & Power Co., Jackson, Miss., has ordered a complete new installation of General Electric apparatus to replace its old plant, which will be abandoned in favor of the new. This apparatus consists of two 500-kw, 220-volt Curtis steam turbine-alternators, two motor-generator sets consisting of a 300-hp induction motor driving a 250-kw, 660-volt, direct-current generator, a 25-kw turbine exciter, a 25-kw induction motor exciter set, with other apparatus, switchboards and appliances. The Queen City E. L. & P. Co., Clarkville, Tenn., has ordered, with other apparatus, a 500-kw, 2,300-volt alternating-current Curtis turbine-generator with a 25-kw exciter. The Consolidated Light & Power Co., Deadwood, S. Dak., has purchased two 500-kw, two-stage, and two 1,500-kw, four-stage, three-phase, 2,300-volt Curtis turbine-alternators, which will be installed in the main steam generating station at Deadwood. The Denver Gas & Electric Co., has ordered a 2,250-kw, three-phase Curtis turbine alternator for its main generating station. The Fairmont & Clarksburg Traction Co., W. Va., has purchased two 500-kw, and one 1,000-kw, 2,300-volt Curtis turbine-alternators. The Public Service Corporation of New Jersey, at Newark, has ordered five 25-kw, 125-volt, non-condensing, direct-current turbine-generators complete with accessories. These will operate with 140 lb. steam pressure, and will be used for exciting purposes.

MORSE CHAIN FACTORY.—The rapidly increasing business of the Morse Chain Company has necessitated the building of a large new plant at Ithaca, N. Y., which will be operated in conjunction with the present factory of the company situated at Trumansburg, N. Y. It is the intention to make this new plant a model one in every way and ample facilities for expansion will be provided. The main building, which will contain the general offices, will be three stories in height and will measure 64x303 ft. over all. The first floor will be used for the machine shop and a floor space of 64x236 ft. has been set apart for this purpose. The other buildings to be provided will be one story in height and their general dimensions are as follows: Foundry, 68x135 ft.; forge shop, 36x86 ft.; pattern shop, 82x28 ft.; power house, 105x45 ft. Steel and concrete have been used throughout in the construction of this plant and everything has been done to provide for an equipment in keeping with the advanced machine shop practice of the times. This is illustrated by the fact that gear cutters, boring mills, lathes and general plant equipment to the amount of $50,000 will be installed, a greater portion of which has already been purchased. The machine shop will be equipped with 10-ton electric traveling cranes, as the light nature of the material under construction does not warrant the installation of very heavy cranes. The foundry will be equipped with electric cranes of 15 tons capacity, having a span of 50 ft.

ROWLAND TELEGRAPHIC APPARATUS.—The Rowland Telegraphic Company, of Baltimore, Md., is shipping a large quantity of apparatus to Germany for the Berlin-Frankfort line, one of the largest circuits in Germany, by the government telegraph authorities. The Rowland company's orders include several installations in America, the most important of which will be a line 1,000 miles long. This line will be equipped with a full octoplex apparatus and will maintain a continuous service about four times as great as has ever been secured in this country over an equal distance upon one telegraph wire. An interesting phase of the introduction of the Rowland system in America is its use upon private leased lines. The company has contracted to install a line of this kind between New York and Schenectady for the General Electric Company. The company will exhibit a quadruplex apparatus at the Milan Exposition of 1906, probably under the auspices of the Italian Government. The project of an entire change in the operation of the Italian telegraphs, based upon the introduction of the Rowland system, is now actively before the Italian Parliament. The Rowland engineers accompanying the installation going to Germany are Mr. Walter A. Houghtaling, formerly of the Postal Telegraph Cable Company, and Mr. L. Virgil Lewis. The chief engineer of the company, under whose direction the apparatus has been perfected, is Dr. Louis M. Potts, a graduate of Johns Hopkins University.

WILLIAM ROCHE DRY BATTERY COMPANY.—The business which has been conducted since the year 1897 by Mr. William Roche, at No. 52 and 54 Park Place, New York City, has been incorporated and is now owned by William Roche Dry Battery Company, a corporation organized under the laws of the State of New York, with a full-paid capital of $25,000. Mr. William Roche is the president of the new corporation, and has associated with him Messrs. C. Laton Ford (formerly first vice-president Celadon Roofing Tile Company, New York City), Ernest A. Lowe (president of the Lowe Electric Company), and William C. Hubbard, for a number of years with Westinghouse Electric & Manufacturing Company. The assets of the business have been taken over by the new corporation and all its liabilities have been assumed and will be paid by the new company. Mr. Lowe is vice-president, Mr. Ford, treasurer, and Mr. Hubbard, secretary. The Roche dry batteries and spark coils have won a most enviable reputation and are known the world over. They have been greatly favored by the United States Government, and are specified in many army and navy contracts for exacting work.

SWITCHBOARD EQUIPMENT COMPANY.—The Switchboard Equipment Co., of Pittsburgh, is moving its entire outfit to Bethlehem, Pa., and will maintain only a branch office in Pittsburgh, under the care of Mr. H. O. Smith, at 504 Lewis Building. The present plant has been found entirely inadequate, and Mr. D. R. Smith, the president, says that at Bethlehem they have not only a better location, but secure less expensive labor and proximity to the metropolitan market. The new shop is particularly adapted to their needs, being equipped as completely and efficiently as modern practice permits. It is several times the capacity of the old, and with the beginning of this month, they will be able to turn out circuit-breakers, etc., in larger quantities and make deliveries in the shortest possible time.

ARIZONA PLANT.—Plans and specifications are on file at the office of *The Engineering Record*, 114 Liberty St., New York, N. Y., for furnishing complete f. o. b. bidders works, one or more alternating-current, 900-kw, 25-cycle generators, one or more 100-kw, direct-current generators, for exciters, and one switchboard, for use in the Roosevelt power house, Roosevelt, Ariz., bids for which will be received until Nov. 1 at the office of O. H. Ensign, Los Angeles, Cal. Specifications are also on file for one or more 1,260-hp water wheels and one or more 140-hp water wheels with gate valves, pipe connections and governors for the Roosevelt power house, bids to be opened at the same place on Nov. 2.

THE ALBERGER CONDENSER COMPANY, 95 Liberty Street, New York, and 205 La Salle Street, Chicago, announces that it has recently acquired the entire Wainwright business, and will hereafter manufacture and sell the well known Wainwright feed water heaters and expansion joints. These specialties have lately been manufactured by the Taunton Locomotive Manufacturing Company, Taunton, Mass., which is now going out of business. Mr. William R. Billings, formerly treasurer and general manager of that company, has become connected with the Alberger Condenser Company and will be in charge of the Wainwright business under its new ownership.

GENERAL ELECTRIC RAILWAY MOTORS.—The latest 40-hp railway motor of the General Electric Company, known as the GE-80, is prominent and extensively known, as indicated by several recent orders from foreign countries, including 42 two-motor GE-54 equipments and six two-motor, GE-70 equipments for the Lima City tramways, Peru; 142 two-motor, GE-58 equipments with B-13 controllers and electric brakes for Milan Edison Company, Italy, which road uses General Electric equipments exclusively; 12 GE-70 motors for the Cape Electric tramway, South Africa, and five two-motor, GE-80 equipments for the Victoria Railway, Melbourne, Australia.

CONDUIT IN GENEVA.—The Board of Public Works, Geneva, N. Y., has authorized the superintendent to call for bids for the construction of 18,000 ft. of conduit.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was heavy in tone in view of the narrow money market conditions, although aggressive bearish activity was lacking. The advance in call-loan rates to 7 per cent acted as a check upon a further upward movement. Early in the week manipulative interests took hold of Brooklyn Rapid Transit and advanced it a little, with some effect on the other traction stocks. The standard railroad stocks were all somewhat heavy, irregular recoveries being succeeded by renewed declines. The industrials were not especially prominent, but the United States Steel stocks had support at the concessions, although they were affected by the general tendencies of the market. The electric and traction stocks were firm, notwithstanding the irregularity of other shares. Allis-Chalmers common and preferred both made net gains, the former ¾-point and the latter 2 points, the closing quotations being 18½ and 60, respectively. The sales of these shares were unusually large. General Electric made a gain of 2 points, closing at 181½, and Westinghouse advanced 2½, the last price being 170, ex-div. Metropolitan Street Railway was the exception and lost 2½ points, closing at 125⅞. Interborough Rapid Transit closed at 215¾, a net gain of 2¼, and Brooklyn Rapid Transit, of which 208,700 shares were sold, closed at 72⅜, an increase of 1⅞. Western Union remains steady at 93¼. Mackay common closed at 44¾, a net gain of 2 points. Trading on the curb was quiet, for the most part, during the week, with a sensational drop of 30 points in Chicago Subway and a rise of some 10 points in Standard Oil the only features. Both of these incidents excited a good deal of discussion. The collapse in Chicago Subway differed from those in other stocks which have occurred during the last few years, in that it did not imply any weakness in the company's financial position. From all indications the company is flourishing, though making less progress with its excavations than was promised some time ago. Chicago Subway closed at 56. The closing quotations of Oct. 3 are given in the following list:

NEW YORK

	Sept. 26	Oct.		Sept. 26	Oct. 4
Allis-Chalmers Co	18⅝	18	General Electric	182	182
Allis-Chalmers Co. pfd	59¾	60¼	Hudson River Tel	..	..
American Dist. Tel	30	32	Interborough Rap. Tran	212	213
American Tel. & Cable	92	92	Mackay Cos	43	46⅛
American Tel. & Tel	138	138	Mackay Cos. pfd	74¼	74
Brooklyn Rapid Transit	72	72¾	Marconi Tel	..	..
Electric Boat	30	30	Metropolitan St. Ry	125⅞	126¾
Electric Boat pfd	70	70	N. Y & N. J. Tel	..	.
Electric Lead Reduction	..	..	Western Union Tel	93¼	93½
Electric Vehicle	17	17	Westinghouse com.	169¼	168¼
Electric Vehicle pfd	22	22	Westinghouse pfd	..	..

BOSTON

	Sept. 26	Oct.		Sept. 26	Oct. 4
American Tel. & Tel	140⅛	139⅛	Mass. Elec. Ry. pfd	56	58⅞
Cumberland Telephone	119½	121	Mexican Telephone	1¼	1⅜
Edison Elec. Illum	247½	250	New England Telephone	136	137
General Electric	181	181	Western Tel. & Tel	16	14
Mass. Elec. Ry	14	13	Western Tel. & Tel. pfd	97	95

PHILADELPHIA

	Sept. 26	Oct. 4		Sept. 26	Oct. 4
American Railways	52⅛	52⅛	Phila. Electric	8⅞	9
Elec. Co. of America	11	11⅛	Phila. Rapid Trans	27½	28
Elec. Storage Battery	85	84	Phila. Traction	100¾	.
Elec. Storage Battery pfd	..	..			

CHICAGO

	Sept. 26	Oct. 4		Sept. 26	Oct.
Chicago City Ry	195	200	National Carbon	60	83
Chicago Edison	..	.	National Carbon pfd	114½	.
Chicago Subway	.		Union Traction	..	..
Chicago Tel. Co	..	.	Union Traction pfd	..	..
Metropolitan Elev. com.	25¼	25⅛			

* Asked.

CONSOLIDATION IN SAN FRANCISCO.—The plan for the consolidation of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation is being carried out according to programme. On Sept. 20 55,000 shares out of the 158,484 shares outstanding of the former company and 63,000 shares of the 150,000 shares outstanding of the latter company were placed in escrow with the Union Trust Company. The owners of the California Gas & Electric Corporation together with N. W. Halsey & Co., the New York bankers, are to purchase the stock of the other company. It is expected that the required amount of stock will be deposited before Nov. 15, when the deal is to be closed. Articles of incorporation of the new company, which is to be the holding corporation for the two companies that are being merged, are being prepared. Its preferred stock will go to Martin, De Sabla and their associates for their putting 80,000 shares of the California Gas & Electric Corporation shares in escrow in the Union Trust. Its common stock will go to N. W. Halsey & Co. for supplying about $4,000,000 in cash as part payment to the holders of San Francisco Gas & Electric stocks. The bonds of the new company to the extent of $10,000,000 also go to the San Francisco Gas & Electric stockholders in part payment. The stock being placed in escrow with the Union Trust Company, will be held as security for these 5 per cent bonds until they are all paid off. By means of a sinking fund they will be paid off at the rate of $250,000 a year. The Mutual Electric Light Company has not been absorbed by the projectors of the lighting merger.

INDIANA TROLLEYS.—Chandler Bros. & Company have compiled a pamphlet showing the properties, capitalization and earnings of the twenty-two principal electric railways in Indiana. It is a remarkable exhibition of development. The capitalization of the twenty-two principal companies in the State shows a total authorized of $128,350,000 and a total issued of $103,947,500. This is divided into stock outstanding $54,217,500 and bonds issued $49,730,000. The interest at 5 per cent on the bonds amounts to $2,486,500. The net earnings last year were $3,025,000. The twenty-two systems included in the booklet have a total mileage of 1,207 in operation. This will be increased to about 1,500 miles by the close of the current year. The gross earnings of all roads reporting earnings last year were $6,839,012 and operating expenses $3,813,171, leaving net earnings of $3,025,841.

WESTINGHOUSE BRAKE.—The total income of the Westinghouse Air Brake Company for the year ended July 31 was $7,958,568, an increase of $2,018,515 over the income of 1903-4. The net earnings increased $594,598. The income account, showing comparisons with last year, is:

	1905.	1904.
Total income	$7,958,568	$5,939,953
Expenses	†4,999,789	3,575,772
Net	$2,958,779	$2,364,181
Charged off and special depreciation fund	......	26,022
Surplus	$2,958,779	$2,338,159
Dividends	2,198,215	2,417,899
Surplus	$760,564	*$79,740

†Includes depreciation. *Deficit.

DIVIDENDS.—The Electric Storage Battery Co. has declared a dividend of 1¼ per cent on both the common and preferred stocks, payable October 2. E. W. Bliss Co. have declared the regular quarterly dividends of 2½ per cent on the common stock and 2 per cent on the preferred stock, both payable Oct. 2. The Manchester Traction, Light & Power Co. has declared a regular quarterly dividend of 1½ per cent, payable Oct. 16. The New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable Oct. 14. The directors of Cincinnati, Newport & Covington Light & Traction Company have declared the regular quarterly dividend of 1⅛ per cent on the preferred stock, payable Oct. 16. The directors of Standard Underground Cable Company have declared a quarterly dividend of 3 per cent, payable October 10.

U. S. TELEPHONE COMPANY.—Advices from St. Louis say that arrangements for the financing of the United States Telephone Co., recently incorporated at Albany with $50,000,000 capital, are going forward in New York, Pittsburg and St. Louis. The object of the new combination is to unite the long-distance trunk lines of the independents. St. Louisans who are interested say that within 18 months there will be an independent long-distance system from New York to St. Louis. Several New York banking firms are said to be concerned in the negotiations which are being conducted in the cities named.

CHICAGO ELECTRIC TRACTION.—By the sale of the Chicago Electric Traction Company to Indiana capitalists the Interurban Electric lines of the State will secure an entrance to Chicago, which they have been seeking for years, and by the construction of a line from Harvey to Kanakee their object will be accomplished. Jules S. Bache, of New York, chairman of the reorganization committee, announces that the syndicate gave the equivalent of $650,000 cash and $200,000 in stock of the interurban company for the property. The company's entire capital stock is not to exceed $2,000,000.

CONSOLIDATION IN KNOXVILLE.—The Knoxville Traction Company and the Knoxville Electric Light & Power Company have been merged into the Knoxville Railways & Light Company. A mortgage for $3,000,000 in favor of the Standard Trust Company, of New York City, has been recorded, looking to the complete refinancing of the properties. Ford, Bacon & Davis, New York engineers, will have charge of both light and railway construction.

ELECTRICAL EARNINGS.—The Manila Electric Railway & Light Company reports $76,900 gross for August, and $37,190 expenses. The Milwaukee Electric Railway & Light Company reports $277,015 gross for August and $152,852 total net. For eight months the total net income is $1,072,348, with $609,001 charges, leaving a surplus of $463,347, a gain of $32,179 over 1904.

INCREASED BULLOCK CAPITAL.—It is announced from Cincinnati that the capital of the Bullock Electric Company (Allis-Chalmers Company lessee) will be increased from $500,000 to $3,000,000. Of this increase, $1,500,000 will be 6 per cent cumulative preferred and $1,500,000 common. The purpose is to provide funds for extensive additions.

GAS AND ELECTRIC BONDS.—N. W. Halsey & Co. and Howard, Simmons & Co., have purchased an issue of $1,400,000 Western United Gas & Electric Company bonds.

General News of the Week

The Telephone.

BIRMINGHAM, ALA.—It is proposed by the City Council to have all the telephone and telegraph wires placed in underground conduits in this city, and an ordinance is now being drawn.

BIRMINGHAM, ALA.—The Independent Long-Distance Telephone Company's line between Decatur and Birmingham and between Bowling Green, Ky., and Decatur is almost completed. When finished connections will be made at Bowling Green with independent lines of the north and east, which will give Alabama independents connection with nine other states. Traffic arrangements are made with the independent exchanges in cities which the lines touch, including Birmingham, and there is a close business agreement between the long-distance company and the independent exchanges. The line will be extended to Memphis, Atlanta and Mobile.

LITTLE ROCK, ARK.—The Boonesboro and Stillwell Telephone Company has changed its name to the Cane Hill and Stilwell Telephone Company. The capital stock was increased to $10,000.

HANFORD, CAL.—P. H. Kerr Higgins, of Los Angeles, has petitioned for a telephone franchise here.

SAN FRANCISCO, CAL.—E. B. Jones, of Salt Lake City, who financed for $5,000,000 the Independent Telephone Company, which operates in Salt Lake City and surrounding towns, recently spent several days in San Francisco, looking over the telephone situation. Conferences were held with local business men regarding the support that might be expected if Mr. Jones and his associates entered the local field. The Home Telephone Company's application for a franchise has not yet been acted upon by the Board of Supervisors, and it is probable that there will be other bidders when the franchise is put up for sale.

COLORADO SPRINGS, COL.—The Home Telephone Company, with a capital of $50,000, has been incorporated by R. M. Handy and J. K. Vanatta.

BOISE, IDA.—The Bell Telephone Company has been granted permission to lay underground wires in this city.

WEISER, IDA.—The Independent Telephone Company has asked the City Council for a franchise to operate in this city.

POCATELLO, IDA.—The Rocky Mountain Bell Telephone Company is installing a new exchange in this city. Important improvements in its local system will also be made.

POCATELLO, IDA.—Articles of incorporation of the Yellowstone Park Railroad have been recently filed. A telephone system is to be operated in connection with the proposed road.

LEWISTON, IDA. — The Lewiston-Clarkson Home Telephone Company, Ltd., with a capital of $50,000 is pushing its business. Mr. J. E. McGillivray, manager, says, "We have organized an independent telephone company here with a considerably larger list of subscribers than that of the Pacific States Company. In a short time we shall begin the construction of a common battery multiple plant, with a capacity of 1,000 telephones, for which 700 contracts have been obtained to date, as against 500 in operation on the Bell plant. We are now in the market for all that goes to make up a modern plant. Part of the system will be underground construction.

FORT DODGE, IA.—The Badger Telephone Company has been formed. Capital, $10,000. Incorporated by H. E. Myhre, P. J. Folvag and others.

HAVELOCK, IA.—The Havelock Mutual Telephone Company has been formed with a capital of $28,000. George A. Speer is president; W. E. Pirie, secretary.

LINCOLN, ILL.—The Central Illinois Telephone & Telegraph Company has filed its acceptance of the new franchise ordinance.

PEORIA, ILL.—The Citizens' Telephone Company is installing another switchboard. This improvement will give a capacity for twelve hundred telephones.

NORTH VERNON, IND.—The Bell Telephone Company has established a new exchange in this city.

FENTON, MICH.—The Union Telephone Company has purchased control of the Fenton Mutual Telephone Company. A new system is to be installed and day and night service given.

SAULT STE. MARIE, MICH.—It is said that the Michigan State Telephone Company is about to buy the Pickford line, owned by F. S. Taylor, and that copper wire will be strung and the line extended to DeTour.

MUSKEGON, MICH.—The Michigan State Telephone Company is extending its lines from Muskegon to Pentwater. From Pentwater a submarine cable will be laid to connect with the line entering Ludington. A new switchboard has been installed at Muskegon.

FOLEY, MINN.—The Northwestern Telephone Exchange Company is contemplating the installation of an exchange in this place.

ALBERT LEA, MINN.—The Northwestern Telephone Exchange Company has purchased the local telephone exchange and will make improvements to cost [illegible]

ST. CHARLES, MINN.—The Northwestern Telephone Exchange Company, a franchise to which was recently refused by the City Council of St. Charles, is beginning an action in the Federal court to compel officials of St. Charles to show cause why it should not be granted a franchise.

RED LODGE, MONT.—It is stated here that the Bell Telephone Company will shortly purchase the system of the Montana-Wyoming Company.

BUTTE, MONT.—The Bell Telephone Company has decided to place all its wires in this city underground, and work in that direction will be commenced at once.

GREAT FALLS, MONT.—All the telephones of the Montana Central along the Neihart branch, and the Shelby line, have been removed and a telegraph system substituted.

ST. LOUIS, MO.—John L. Dunlop and J. M. Fetter, of Louisville, Ky., have been selected to do the underwriting in Kentucky for the United States Independent Telephone Company, and came to this city to make formal arrangements in the mattter. The United States Company is a merger of a number of large telephone companies. It is capitalized at $50,000,000. The apportioning of the underwriting is in the hands of Breckinridge Jones, of the Mississippi Valley Trust Company, of St. Louis.

TRENTON, N. J.—A committee of the directors of the Interstate Telephone Company of New Jersey, headed by William H. Hancock, of Trenton, N. J., has been appointed to look after the reorganization of the company.

PERTH AMBOY, N. J.—After accepting a franchise for twenty-one years and agreeing to pay to the city a percentage of its gross receipts, the Hudson & Middlesex Telephone Company has startled Perth Amboy by its offer to build and maintain a private telephone line from the City Hall to the Runyon water station, eight miles away, for $200 a year. Nearly a mile of the line will be a cable under the Raritan River. The New York & New Jersey Company asked $275 a year for the cable under the river, and wanted the city to build its own line from the cable end to Runyon. The Hudson & Middlesex offer was accepted and a contract will be made for 20 years.

ELLICOTTSVILLE, N. Y.—The Home Telephone Company has been formed, with a capital of $10,000, by Thaddeus S. Lane, of Jamestown, N. Y., and W. B. Page.

JAMAICA, L. I., N. Y.—The New York & New Jersey Telephone Company is erecting a new exchange building in this place. The cost of the structure is placed at $80,000.

CHARLOTTE, N. C.—The Bell Telephone Company will extend its lines out 12 miles from Charlotte to Beattie's Ford.

LEXINGTON, N. C.—The Piedmont Telephone Company has been incorporated at Lexington by Walter G. Finch and others, to build lines in Randolph and Davidson counties in North Carolina.

CHARLOTTE, N. C.—At the coming session of the South Carolina Legislature a bill will be introduced to require the Southern Bell Telephone Company to connect with all the small independent lines in the State. The railroad commission is now investigating the telephone situation to find the cost of connecting lines and the rates that would be equitable for long distance connections.

SPRINGFIELD, OHIO.—The Select Telephone Company has been organized. Capital, $60,000. Incorporated by F. W. Cangolfing and Edgar C. Hampton.

CINCINNATI, OHIO.—The Farmers & Merchants' Mutual Telephone Company has been organized, with a capital of $10,000, by G. W. McKeegan and others.

TOLEDO, OHIO.—It is stated that the party of Toledo capitalists who some months ago promoted the Cuyahoga telephone deal, are negotiating for the control of the Independent Co-Operative Telephone Company, of Detroit, and that the property will likely pass into their hands.

WAPAKONETA, OHIO.—The committee representing the bondholders who purchased the property of the Commercial Telephone Company, operating in Central and Southern Texas, sold under receivership proceedings, have reorganized the company, increased the capital stock to $500,000 and mapped out work for the projection and equipment of the system which now extends over 1,000 miles.

HURON, S. D.—D. B. Jefiries is seeking a franchise for a local telephone exchange.

HOUSTON, TEX.—The Southwestern Telegraph and Telephone Company is laying underground conduits along Preston Avenue from Hamilton to Caroline. Last year the company began laying the conduits and proposes to put down a certain percentage every year until the entire system is beneath the ground.

PRICE, UTAH.—The Eastern Utah Telephone Company has filed articles of incorporation. The capitalization is $50,000.

VANCOUVER, WASH.—Charles E. Sumner, of the Home Telephone Company, is asking for a franchise for the automatic telephone system.

SEATTLE, WASH.—The Independent Telephone Company, of Seattle, has made arrangements to branch out into Oregon and British Columbia. It is reported that bonds to the amount of $1,000,000 are being floated in New York for the improvement of the system. Later it is planned to invade eastern Washington, working from Spokane as a base and absorbing the smaller independent lines.

BALDWIN, WIS.—The Bush River Eau Galle Telephone Company has been formed with a capital of $3,500, by Lewis Crogen and Edward Christensen.

SHEBOYGAN, WIS.—The City Council has passed an ordinance requiring that electric light and telephone wires be placed underground. Bids for terra-cotta conduits will be advertised for at once.

Electric Light and Power.

LOS ANGELES, CAL.—The Pacific Light & Power Company, of Los Angeles, is preparing to develop electric power in Yavapai County, Ariz. The initial installation will consist of a 1,200-hp. hydro-electric plant, which it is expected will be increased to 6,000 horse-power eventually.

SAN FRANCISCO, CAL.—The Nevada Power Mining & Milling Company's electric power plant on Bishop Creek, Inyo County, Cal., has gone into commission after making a good record for construction. One of the two 750-kw. 3-phase National Electric generators of the initial installation is in successful operation, supplying lights in Tonopah and Goldfield, Nev. The second generator is being installed. A Pelton water wheel, operated under a head of 1,064 ft., is direct connected to each generator. The transmission line extends 85 miles to the junction at Alkali Springs, where it branches, the distance thence to Tonopah being 18 miles, and to Goldfield, 10 miles. An elevation of over 10,000 ft. is reached in crossing the White Mountains. An additional Bullock generator, of 1,500 kilowatts capacity, will be delivered by the Allis-Chalmers Company about December 1 and connected to a Pelton water wheel. The home office of the company is in Denver, Col.

YREKA, CAL.—Since the consolidation of the Siskiyou and Yreka electric light and power plants, many changes have been made, with more contemplated for greater capacity. At present the old Yreka plant at Shasta River, will be used for lighting purposes in supplying Yreka, Fort Jones, Greenview, Etna, etc., while the Siskiyou plant at Fall Creek, Klamath River, will supply all the power used and the lights at a number of places in Shasta Valley, and be taxed with 400 horse-power for the operation of the Montague box factory and the Yreka Creek dredger. A couple of large transformers have been sent over to Humbug, where about 40 horse-power will be used for the new Mono quartz mill. The Siskiyou Company is also putting in a large new dynamo at Fall Creek, which will increase the capacity of that plant from 700 to 2,000 horse-power, and there is 400 horse-power at the Shasta River plant, which makes a capacity of 2,400 horse-power. When the new dynamo is installed the two plants will be joined for supplying both systems, with expectation of extending wires to all other sections of the county, where needed.

DENVER, COL.—It is stated that improvements costing nearly $1,000,000 are to be made by the Denver Gas & Electric Company to its plant during the coming year. Next spring in the plant at Sixth and Lawrence streets a new Curtis 3,000-kw generating turbine is to be installed. Later on in the year a similar turbine is to be installed in this plant. New machinery costing about $150,000 to replace worn-out apparatus is to be purchased by the company. The building is to be enlarged at a cost of about $45,000. Four 500-hp boilers are to be installed.

COCHRAN, GA.—Bids for the purchase of $17,000 electric light and water bonds are wanted at once. Address Dr. T. D. Walker, chairman of the bond commissioners.

MONTICELLO, GA.—The town of Monticello has bought the electric light plant, the property of B. Jordan, and will operate it in connection with the waterworks system, using electric power for pumping the water. The two plants will be operated together.

LAWRENCEVILLE, GA.—J. W. Chapman, of Lawrenceville, has secured an option on a water-power near Brevard, N. C., and proposes to develop the same, and will build an electric light plant to supply the town of Brevard, and the Transylvania Railroad.

SAVANNAH, GA.—The Savannah Lighting Company has formally accepted the lighting franchise granted it by special ordinance. A representative of the American Conduit Company is expected here to make estimates on the underground work, although there is a report that the conduits of the Georgia Telephone Company may be used.

LEWISTON, IDAHO.—The Clearwater Irrigation, Land & Boom Company has been incorporated, with a capital of $150,000, by H. L. Pittock and F. W. Leadbetter, of Portland, Ore., and L. A. Porter, of Lewiston.

FREEBURG, ILL.—Plans and specifications have been completed by Owen Ford, of St. Louis, Mo., for the proposed municipal electric light and power plant, to cost about $9,000. Charles Keessler is village clerk.

BREESE, ILL.—The Breese Water & Light Company is preparing to install a central lighting plant, and will receive bids on the entire equipment until October 9. William H. Bryan, Lincoln Trust Building, St. Louis, Mo., is the consulting engineer in charge of the work.

CHICAGO, ILL.—Bids will be received until October 23 by the county commissioners for the old electric light plant at the county hospital, consisting of two Ideal engines, 125 horse power each; four National Electric direct current dynamos, of 35 kilowatts each. William McLaren is superintendent of public service.

CRAWFORDSVILLE, IND.—J. F. Davies, of Toledo, Ohio, has secured the contract for repairing the city electric light plant at $7,433.

VALPARAISO, IND.—The Valparaiso Lighting Company has been incorporated, with a capital of $150,000. The directors are C. H. Geist, C. B. Kelsey and Edw. Clifford.

SHELBYVILLE, IND.—The Shelbyville Water and Electric Light Company's plant has been purchased at receiver's sale by C. F. Street, of New York, the consideration being $30,000. Mr. Street will at once improve the property, retaining Mr. I. M. Nichols as superintendent.

WYNNEWOOD, IND. TER.—An election will probably be held the latter part of October to vote on issuing bonds for the construction of an electric light plant and water works, to cost $40,000.

MARSHALLTOWN, IA.—The General Electric Company has secured the contract for a new dynamo for the city lighting plant at $3,100.

COVINGTON, KY.—The National Construction Supply Company, of St. Louis, Mo., has submitted to the light committee of the General Council a proposition to install an electric light plant, with duplicate machinery of sufficient capacity to supply 400 arc lights of 2,000 candle power and 2,000 incandescent lights, for $75,000.

PORTLAND, ME.—The International Paper Company has brought a bill in equity in the United States Circuit Court here against the Bodwell Water Power Company of Old Town, asking the court to restrain the latter company from erecting and maintaining dams on the Penobscot River and the Stillwater branch.

ELK RAPIDS, MICH.—Arthur McMillan, of Toledo, has been granted a franchise for a commercial lighting plant in Elk Rapids. The village is to have not less than 25 arc lights at $75 per light, and above 25 lights the charge is to be $70 per light, on a moonlight and two o'clock schedule.

MIDLAND, MD.—The Consolidated Coal Company, it is stated, will erect a plant at Ocean Mine No. 1, with power enough to supply light to the town of Midland and surrounding places.

EDINA, MO.—The Edina Light Company has been incorporated, with a capital of $10,000, by Fred J. Wilson, Jane D. Wilson and Paul K. Gibbons.

WARSAW, MO.—At a special election held September 25 the proposition to issue bonds to the amount of $6,000 to build and maintain a municipal electric-light plant was carried. The present plant has proved inadequate.

MOREHEAD CITY, N. C.—Cincinnati capitalists have closed a contract with I. W. Riley, of Morehead City, to erect an electric light plant in this city, to cost about $15,000.

FAYETTEVILLE, N. C.—The Public Works Commission of Fayetteville, N. C., has issued specifications for a municipal lighting plant of 140-200-k.w. capacity. Proposals will be received to October 10.

SALISBURY, N. C.—It has been found that the water power at Whitney, near Salisbury, with a dam proposed to develop 25,000 horse-power, will, on account of the larger size of the basin, be capable of developing 50,000 horse-power. It is expected that the company, in which Mr. E. B. C. Hambley, of the Whitney Reduction Company is interested, will have 50,000 electrical horse-power on the market in two years. The contracts have been let for the dynamos, water-wheels, etc., for six units of 8,000 horse-power each. It is said that when the first 50,000 horse-power is developed, there will be 50,000 horse-power additional awaiting attention and that this will be developed, making a total capacity of 100,000 horse-power at the company's plant on the Yadkin River.

PORT CLINTON, OHIO.—The Port Clinton Electric Light & Power Company will add a district heating system to its plant.

LOVELAND, OHIO.—The Loveland Citizens' Electric Company has decided to issue $50,000 bonds, to be used for the extension of the plant.

LOUDONVILLE, OHIO.—Th electric light plant at this place was almost totally destroyed by fire Sept. 17. The city will be in darkness for weeks and the water supply will be cut off, as the plant furnished the power for pumping the water into the reservoir. The plant was owned and operated by the city and was valued at $10,000. The loss is partially covered by insurance.

HUNTINGDON, PA.—The Juniata Water & Power Company, recently incorporated, has purchased a site for a hydro-electric power plant in Warrior Ridge Gap. Construction will be started as soon as plans can be prepared. The proposed plant will cost about $1,000,000. S. L. Brumbaugh, of Philadelphia, is the manager.

WYOMING, R. I.—It is reported that an electric plant is to be built at Wyoming with a view to supplying electricity for the different business places in the two villages and possibly for street lighting.

ABERDEEN, S. D.—A vote will soon be taken in this place on the issuing of $35,000 bonds to establish a municipal lighting plant or to grant a franchise to put in such a plant.

CHATTANOOGA, TENN.—The Chattanooga & Tennessee River Power Company has been reorganized, with C. E. James, of Chattanooga, president; J. C. Guild, of Chattanooga, chief engineer, and John Bogart, of New York, N. Y., as consulting engineer.

HUMBLE, TEX.—The electric light and power plant was destroyed by fire recently.

WICHITA FALLS, TEX.—The Wichita Falls Water-Works Company has changed its name to the Wichita Falls Water & Light Company, and increased its capital from $50,000 to $75,000.

RICHMOND, VA.—As to the proposed municipal electric light and power plant, the city attorney has been requested to prepare an ordinance for the issue of $500,000 light plant bonds. The plant proposed will have a capacity of 2,000 horse power.

OLYMPIA, WASH.—The Pend O'Reille Electric Company, of Spokane, has filed articles of incorporation, with $50,000 capital stock, by J. L. Drumheller, W. G. Maloy, Joseph Scott and D. M. Drumheller.

OMRO, WIS.—The village will change the electric street lighting from arcs to incandescent.

LITTLE CHUTE, WIS.—The Village Board has granted a franchise to furnish electric lights to the Kaukauna Electric Company.

FORT FRANCES, ONT.—The Council is considering the installing of an electric light plant.

OSHAWA, ONT.—The Oshawa Light & Power Company has been incorporated, with a capital of $100,000.

TORONTO, ONT.—The city received authority at the last session of the Legislature to expend $40,000 for a new electric light plant on the Island, and the matter is now being undertaken.

The Electric Railway.

COLTON, CAL.—The Chamber of Commerce is considering the question of constructing an electric railway to Colton, Seth Hartley having asked for the franchise. The plan is to build a line from the west end of the county from Upland.

WASHINGTON, D. C.—The receiver for the City & Suburban Railway Company has been discharged and the long litigation over its property has ended.

EAST ST. LOUIS, ILL.—The Secretary of State has issued a license for the incorporation of the Herris & Johnson City Railway Company, with principal office in East St. Louis. The capital stock is nominally $10,000. The incorporators and first board of directors are : L. O. Whitnell, C. M. Forman, H. L. Browning, Wm. S. Forman and L. S. McWilliams, all of East St. Louis.

GREENFIELD, IND.—The Commissioners of Hancock County have granted a franchise to the Indianapolis, New Castle & Toledo Electric Railway Company for a branch line from Greenfield to Maxwell.

MARYSVILLE, CAL.—The Northern Electric Company, H. A. Butters, president, has closed a contract with the Westinghouse Electric & Manufacturing Company for three 400-k.w. motor-generator sets for the three substations on its new road now in course of construction between Chico and Oroville.

VINCENNES, IND.—The Vincennes, West Baden & Louisville Traction Company has closed contracts for the construction of its line. A large Philadelphia construction company, representing Eastern capital, has taken the contract at $2,000,000. The contract for the power house was let to another Pennsylvania concern for $300,000. The power house will be built either at Petersburg or Otwell. The line will run from Vincennes to French Lick, a distance of 66 miles.

INDIANAPOLIS, IND.—Articles of incorporation have been filed with the Secretary of State by the Indianapolis, Crawfordsville & Western Traction Company. The capital stock is $2,000,000. The new company has purchased all the assets of the Consolidated Traction Company, including franchises in Indianapolis, Crawfordsville, Covington and intervening towns, and county rights-of-way. The company proposes to complete the grade and road began by the Consolidated Company between Indianapolis and Crawfordsville and then build westward to Covington and Danville. The incorporators are: A. F. Ramsey, A. E. Reynolds, C. N. Van Cleve, E. P. Baker, G. P. Haywood, W. C. Mitchell, Edward Hawkins and A. A. Barnes.

PORT HURON, MICH.—The Rapid Railway Company will enlarge its power house and freight house in this city.

ST. LOUIS, MO.—The St. Louis Track Company has been incorporated with a capital stock of $5000, fully paid. The object of the corporation is to prepare and build the roadbed and lay tracks for railroads, etc. The incorporators are: J. H. McInery, Charles S. Belden and D. Walker Wear.

NEW YORK, N. Y.—The New York Railroad Commission, which has been investigating the recent accident on the New York Elevated Railway, has made its report. Paul Kelly, the missing motorman of the train, and Towerman Jackson are both held responsible for the accident. Kelly is blamed for running by the Sixth Avenue signal set against him, and Jackson because he set the Sixth Avenue switch against a Ninth Avenue train. The Commission makes various recommendations for changes in the matter of signals and operation of trains with a view to avoiding such accidents in the future.

ALLENTOWN, PA.—The Lehigh Valley Transit Company has closed contracts with the General Electric Company for a new plant which will have turbo-generators and many improvements costing several hundreds of thousands of dollars.

SHARON, PA.—The merger of the Pennsylvania & Mahoning Valley, Sharon & New Castle, and Youngstown & Sharon Traction companies is now assured. The deal involves the consolidation of almost $5,000,000 in railway properties and valuable franchises. The properties will be merged under the name of the Mahoning & Shenango Railway, Light & Heat Company. Extensive improvements will be made by the new concern, and $3,000,000 is to be set aside for betterments. Among the improvements will be the building of a line from New Castle to West Pittsburg, and another is contemplated between New Castle and New Wilmington, which may be extended to Mercer.

CHARLESTON, S. C.—On account of inability to get rights of way, it is reported that the new Charleston and Summerville Electric Railway may have to abandon its plans, at least temporarily. Part of the construction outfit is reported to have been sold by the owners and promoters.

UNION CITY, TENN.—The Union City & Reelfoot Railway Company, of Obion County, has been incorporated with a capital stock of $100,000. The incorporators are R. P. Whitesell, J. C. Burdock, T. B. Greer, A. E. Darrah, W. M. Turner, C. P. Wilson, John White, F. M. McGree, John Thaw, H. C. Sanfield and J. C. Reynolds.

WINNIPEG, MAN.—It is stated to be the intention of the Canadian Pacific Railroad to double track the road to Fort William, and to use electricity upon the mileage involved for a special service. The energy will be secured from the water powers near the line of the railway.

VERA CRUZ, MEX.—The State of Vera Cruz has granted to Alfredo Kennion a concession for the construction of a suburban railway system connecting the several towns in the neighborhood of Orizaba with the latter, the question of generating electrical power from the neighboring waterfall, which is of immense volume, being under consideration.

TORONTO, ONT.—It is announced that negotiations are being conducted for the sale of the franchise of the St. Catherines, Pelham & Welland Electric Railway to the Toronto & Niagara Power Transmission Company. This will give the Toronto and Niagara a route out of St. Catherines and into Welland, and a spur from Fonthill to Fenwick will be constructed also.

New Industrial Companies.

THE SCOTT ARC LAMP COMPANY, of Jersey City, has been incorporated with a capital of $1,000,000. Incorporators: Louis B. Dailey, Thomas F. Barrett and L. H. Gunther.

THE ROONEY ELECTRIC COMPANY, of New York, has been incorporated. Capital, $50,000. Directors: J. J. Rooney, Scarsdale; F. J. Rooney, John Rooney, Brooklyn.

THE ELEVATOR OPERATING CONTROLLER COMPANY, New York, has been incorporated with a capital of $10,000. Directors: Sam Loewy, C. F. Lewis and L. J. Doolittle, New York.

THE BIRMINGHAM ELECTRIC COMPANY, of Birmingham, Ala., has been formed, with a capital stock of $5,000. The incorporators are: C. J. Martin, Jr., D. A. Hunt, Alice Arvetta Hunt.

THE L. L. L. ELEVATOR CONTROLLER COMPANY, New York, has been incorporated with a capital of $25,000. The directors are: Sam Loewy, C. F. Lewis and L. J. Doolittle, New York.

THE AJAX ELECTRIC MANUFACTURING COMPANY, of Boston, has been incorporated with a capital of $5,000. The incorporators are: Charles C. Walker, Fred E. Smith and Leslie K. Storrs.

THE AMERICAN VOLTA COMPANY, New York, has been incorporated with a capital of $100,000. Directors, J. A. White, Meriden, Conn.; P. P. Lynn, New York, and William Hotchkiss, Montclair, N. J.

VAN FRANK ELECTRIC MANUFACTURING COMPANY has been incorporated at San Francisco, with a capital stock of $50,000, by J. E. Gordon, Thos. Mirk, H. L., F. T. and E. M. Van Frank.

THE MAINE DYNELECTRIC COMPANY has been organized at Lewiston, Me., for the purpose of conducting a general business in manufacturing and dealing in dynamo-electric and other power, heating and illuminating machinery. Officers: President, Dr. M. B. Smiley, of Auburn; treasurer, E. L. Philoon, of Auburn.

THE AUTOMATIC CLUTCH COMPANY, of Akron, Ohio, has been incorporated with a capital of $50,000. The incorporators are: Will Christy, L. C. Miles, E. E. Andrews, Frank Adams and G. G. Allen. The company will manufacture an automatic clutch invented by Mr. E. E. Andrews, of the Akron Electrical Manufacturing Company.

THE SELECTIVE TELEPHONE MANUFACTURING COMPANY, of Springfield, Ohio, has been incorporated with a capital stock of $60,000. The company will manufacture a selective telephone apparatus. Among those interested are Messrs. James M. Brailey, of Toledo; C. D. Juvenal and William M. Bruce, jr., of Springfield.

THE INTERSTATE TUNNEL RAILWAY COMPANY, New York City, has been incorporated to construct and operate a tunnel two miles long under the Hudson River between New York and New Jersey. The capital is $7,500,000. Directors: John B. McDonald and John D. Crimmins, New York; Mark T. Cox, East Orange, N. J., and Charles Stallings, Newark, N. J.

Personal.

B. V. SWENSON.

PROF. BERNARD V. SWENSON, of the University of Wisconsin, has been elected secretary of the American Street and Interurban Railway Association. He is a native of Chicago, where he was born May 3, 1872. After a preliminary education in the public schools of Chicago and at the Chicago Manual Training School he was graduated from the latter institution in 1889. Prof Swenson then entered the engineering school of the University of Illinois, from which he was graduated in 1893, completing both the courses in mechanical and electrical engineering and receiving the degree of bachelor of science in each course. He then engaged in instructional work in the university from 1893 to 1898, the last three years as assistant professor of electrical engineering. During this time he spent the summer of 1894 in travel in Europe and the summer of 189[illegible] in graduate study at Cornell. Prof. Swenson was appointed assistant professor of electrical engineering at the University of Wisconsin in 1898, and has been connected with this institution up to the present time, although he has been on leave of absence for the past year on account of his work as assistant superintendent with the Electric Railway Test Commission. He received the master's degree in mechanical engineering from the University of Illinois in 1901, and the master's degreee in electrical engineering from the University of Wisconsin in the same year. Besides his important work with the Electric Railway Test Commission, in which he has been associated with Prof. Norris, of Cornell University, and Prof. Goldsborough, of Purdue University, Prof. Swenson was a member of the International Jury of Awards at the Louisiana Purchase Exposition, and secretary of one of the electrical sections of this jury. He is joint author of "Testing Electro-Magnetic Machinery," Vol. I, by Bernard V. Swenson and Budd Frankenfield; the Macmillan Company, 1904; 420 pages octavo. The second volume of this book is now in preparation. He is also joint editor (with Prof. H. H. Norris, of Cornell University) of the "Report of the Electric

Railway Test Commission," now in press. He has also been a frequent contributor of papers and articles for the technical and semi-technical press. Prof. Swenson has also acted as consulting engineer in the design and on the superintendence of construction and testing of electric light and power plants and of electric railways, during the past ten years, when not occupied with other duties. Prof. Swenson is a full member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, and is an associate member of the National Electric Light Association. He has also served as chairman of the local branch of the American Institute of Electrical Engineers, at Madison, Wis., for two years, and is a member of Tau Beta Pi, an honorary engineering fraternity, and also of the Phi Delta Theta Fraternity.

MR. CHARLES GARLAND has recently resigned the position of secretary of The Westinghouse Machine Company to join the Pittsburg Fireproofing Company as vice-president and treasurer. Mr. Garland enjoys the distinction of having remained in the continuous service of one establishment for over 21 years. Arriving in Pittsburg from Ireland in 1883, at the age of 14, he entered the employ of The Westinghouse Machine Company, which at that time had been in existence but three years. From a minor position Mr. Garland gradually advanced, until in 1896 he was appointed assistant secretary and assistant treasurer. Two years ago he was advanced to the full secretaryship, which he held up to the time of his resignation. The Pittsburg Fireproofing Company, with which Mr. Garland has become identified, is engaged in the manufacture of fireproof materials of many kinds, with works located at West Pittsburg, Lawrence County, Pa., and main offices in the Bailey-Farrell Building, Pittsburg, where Mr. Garland has his headquarters. Mr. Garland will continue his residence at Edgewood Park, Pa., where he is a prominent member of the Edgewood Club, of which he has for some time past been secretary.

CHARLES GARLAND.

MR. HARRY H. ADAMS, M. E., who has just been elected president of the American Railway Mechanical and Electrical Association, was born in Jersey City, N. J., Jan. 7, 1871. His early education was obtained in the Jersey City public schools and later he attended Trinity Church School in New York. He entered Stevens Institute and graduated in the class of 1893. After graduating he entered the service of the Consolidated Traction Company of New Jersey, which was later merged into the North Jersey Street Railway Company, holding successively the positions of foreman of motor repair shops, assistant electrical engineer and finally master mechanic. This last position he held until Jan. 1, 1902, when he entered the services of the United Railways & Electric Company of Baltimore, Md., as superintendent of shops, in charge of the rolling stock and buildings, holding this position up to the present time. Prior to his election as president of the Association, he served as first vice-president.

HARRY H. ADAMS.

PROF. ELIHU THOMSON has just returned from his European trip, arriving on the "Teutonic," much benefitted by the change and rest.

MR. ROBERT BRUCE STEWARD, of the D. M. Steward Mfg. Co., of Chattanooga, Tenn., and president of the D. M. Steward Mfg. Co., of Canada, was in New York during the past week.

MR. JOHN I. SABIN, of the Pacific States Telephone Company, is to take a well-earned rest and, it is said, spend some six months on a Europe trip of travel and recreation.

MESSRS. C. K. SIEBERT, S. A. Duval and W. H. Roberts, of Elkhart, Ind., have formed a company for the manufacture of telephone supplies, with headquarters and factory in Chicago.

MR. J. E. KINGSBURY, representing the Western Electric Company in London for many years past, has been visiting this country and Canada with his family, and returned to England this week.

MR. R. G. HUNT, of the Fort Smith Gas and Electric interests, has become manager of the Consolidated Gas & Electric Company, of San Diego, Cal., which is conducted under Byllesby auspices.

MR. E. T. SCHATTLE, formerly connected with the Crouse-Hinds Company, of Syracuse, has accepted a position with the Crescent Electrical Manufacturing Company, of Rochester, where he will have full charge of the engineering department.

MR. BION J. ARNOLD, of Chicago, was a visitor in New York recently to meet his daughter on arrival from Europe and to place her as a "freshman" at Wellesley College. Outside his electric railway construction, etc., Mr. Arnold has of late had a good deal of steam railway work.

MR. O. A. STRANAHAN, who joined the Allis-Chalmers Company on December 1, 1904, to become manager of the power department, has been promoted to the position of sales manager. He assumed the duties of his new place on September 1. His headquarters are at Milwaukee.

MR. E. H. McHENRY, fourth vice-president of the New York, New Haven & Hartford Railroad, who has at present the supervision of the engineering department of the electrical division, will, after Oct. 1, have direct supervision of the engineering department of the entire New Haven system

MR. F. B. HUNTINGTON, the secretary of the Eastern Wisconsin Railway & Light Company, has been elected to the office of vice-president, to fill the vacancy caused by the resignation of Mr. T. F. Grover as vice-president and general manager. Mr. Huntington will retain the secretaryship for the present.

MR. ROBERT McF. DOBLE, consulting engineer of the Abner Doble Company, San Francisco, has returned from a trip of several months through the Sierre Madre Mountains on the west coast of Mexico and also in Colorado, where he was engaged in making examinations of several important electric long-distance power projects.

MR. JOHN GAVEY, C. B., engineer in chief and chief electrician of the British telegraphs, has been spending several weeks in this country, going as far as the Pacific Coast and visiting the Grand Canon of the Colorado. He sailed for home on the "Oceanic" this week, much benefitted by the trip. While here he made a special study of telephonic development.

MR. M. C. MILLER, who joined the Allis-Chalmers Company, a little more than a year ago, has been made assistant to the sales manager, with charge of all matters in that department which do not require the personal attention of the sales manager. Mr. Miller was formerly connected with the Westinghouse Electric & Manufacturing Company at Pittsburg.

MR. H. U. BADEAU has been appointed New York representative of the Switchboard Equipment Company, of Pittsburg, with headquarters at 39 Cortlandt Street. Mr. Badeau is a graduate of Rutgers College in the department of electrical engineering, and for the past several years has been with the engineering department of the Western Electric Company in New York.

MR. ERRETT L. CALLAHAN, the manager of the Promotheus Electric Company, of New York, has resigned to take charge of the electric heating work of the General Electric Company in the Chicago territory. Mr. Callahan has been very active in the electric heating field for the past four years, having also been connected with the Simplex Electric Heating Company as assistant manager.

MR. PHILIP TORCHIO, chief electrical engineer of the New York Edison Company, who has been spending several months in Italy with Mrs. Torchio, has returned home from his native land. A large part of the holiday was spent by Mr. and Mrs. Torchio on the beautiful shores of Lake Como. One incident of the trip was a luncheon given in Milan by a number of the Italian electrical guests in America last year.

MR. A. T. TOMLINSON has been transferred from the New York office of J. G. White & Co. to the Montreal offices of the Canadian White Company. He is a graduate of the Royal Military College of Canada. For six years he was engaged on railway work, a great part of his time being spent in Nebraska and Colorado. He also had charge of work on the Burlington & Missouri Railway, and the Denver & Rio Grande Railway. Mr. Tomlinson was with the Brooklyn Elevated Railway for about three years, and during that time had charge of the construction of about 1½ miles of road. In 1894 he went to Chicago to take charge of the extension of the Lake Street Elevated Railway. He afterwards became principal assistant and then assistant chief engineer of the Union Loop & Northwestern Elevated Railway, Chicago. In 1898 he was called to Boston to assist in the building of the Boston Elevated as consulting engineer. He had charge of a large part of the construction, and resigned before the completion of the work, entering the employ of the White Company in 1902.

MR. W. T. McCASKEY, who was, until recently, manager for Agar-Cross & Co., of London, and for years before identified with Edison, Westinghouse and other electrical interests, has joined the Allis-Chalmers Company and will act as a special representative where contracts are being considered for such work as the equipping of interurban railroads, hydro-electric projects and others requiring special knowledge. Mr. McCaskey is a native of Wisconsin, having been born in Richmond County, in 1863. His experience in electrical work began in 1882, when he took charge of the plant of the Eau Claire Electric Light & Power Company. Later he was connected with Sperry Associate Electric Company, of Kansas City, and he operated the first electric lighting plant in Fort Worth, Tex., in 1885. From 1889 to 1894 he was on the Pacific Coast for Edison and other interests. He spent the years from 1894 to 1899 in Chicago as a representative of the Standard Electric Co., etc., and then went to Buenos Ayres, South America, to represent the Westinghouse Electric & Manufacturing Company, and Agar, Cross & Co., remaining until 1901. He was director in Spain and Portugal for the Societe Anonyme Westinghouse until December, 1903, and manager for Agar-Cross & Co., until May 1 of this year. Mr McCaskey will make his headquarters in Milwaukee.

Legal.

EMINENT DOMAIN FOR TRANSMISSION LINES. In an opinion the Supreme Court of Washington State holds that the right of eminent domain does not extend to a company organized to generate and transmit electricity, unless public necessity requires it and the rights of the public to the use and enjoyment of the property have been regulated, guaranteed and safeguarded by legislation. The decision is said to dispose of the efforts of the White River Power Co. to acquire property of a rival corporation for a right of way for a canal. The White River Company proposes to dam the White River near Buckley, transport the water by canal to Lake Tapps, convert the lake into a reservoir and convey the water to Sumner, where 50,000 electric horse-power would be generated and all towns and cities on Puget Sound as far south as Olympia and north to the boundary line be supplied with light and power.

OCCUPANCY OF HIGHWAY.—In the appeal of the Ohio Postal Telegraph-Cable Company versus the Board of Commissioners of Sandusky County, the request of the company for an injunction to prevent the threatened removal or destruction of its lines by the local officers is granted and sustained by the Circuit Court for the Northern District of Ohio. It is held that a telegraph company which has built its line on a public highway, which is a post road with the consent of the local authorities having jurisdiction, and has filed its acceptance of the provisions of Rev. St. § 5263 (U. S. Comp. St. 1901, p. 3579) cannot be required to remove such line without compensation, nor can it be removed by the authorities, because since its erection it has become an inconvenience to the public, by reason of the construction of a street railway which occupies a portion of the highway, also, by consent of the authorities.

Obituary.

MR. F. B. HOSKINS.—We regret to note the sudden death by appendicitis of Mr. Frank B. Hoskins, ex-mayor of Fond du Lac, Wis., and president of the Eastern Wisconsin Railway & Light Company. He was born in Chenango County, N. Y., August 20, 1850, in which year his parents moved to Wisconsin. He began his business career in the First National Bank of Fond du Lac, and was later engaged prominently in wagon and hardware enterprises. He was elected register of deed on the Democratic ticket in 1878, served as a member of the common council and board of education, and was mayor in 1898 and 1899. For many years he was chairman also of the library board. Probably no other citizen had more business interests in the city than Mr. Hoskins. He was president of the Eastern Wisconsin Railway & Light Company, an office he had held for two years; he was president of the Harrison Postal Bag Rack Company and had been connected with that concern for about twenty years as secretary and president; he was secretary of the Fond du Lac Canning Co.; vice-president of the Fond du Lac Improvement Co., secretary and treasurer of the Citizens' Building Co., a director in the Commercial National Bank, a stockholder in the Fond du Lac Land Company and the Nehrbrass Casket Company. He was also a leading member of the Knights of Pythias. He leaves a widow and two sons.

MR. W. B. RANKINE.—We note with profound regret the death on September 30 of Mr. William B. Rankine, vice-president of the Niagara Falls Power Company, at Franconia, N. H., to which place he went for the benefit of his health August 12. The cause of death was congestion of the lungs, superinduced by heart trouble. Mr. Rankine was born at Owego, January 4, 1858. He was interested in the organization of the Niagara Falls Power Company, and at the time of his death was vice-president of that company, and of the Canadian Niagara Power Company and was in a large number of allied concerns. Besides his wife and mother, he is survived by three brothers, Harold, Delancey and Richard. Mr. Rankine's father was the Rev. Dr. James Rankine, an Episcopalian minister, at one time president of Hobart College. He entered Hobart in 1873 and left to go to Union College two years later. While at college he became one of the corporators of the Alpha Delta Phi fraternity. He was graduated in 1877. For the next four years he lived in Niagara Falls. He then came to New York City and entered the law firm of Vanderpoel, Green & Cummings. Three years later he struck out for himself. It was while living at Niagara Falls that he first conceived the idea of utilizing the great natural forces in the Niagara River and Falls for the production of power for commercial purposes. While in New York City he met prominent financiers and interested them in his plans. His leading associate and confidant was Mr. Edward D. Adams, to whom and himself, more than any other men, the modern utilization of Niagara on a grand scale is due. He succeeded in forming a company, called the Niagara Power Company, and became its secretary and treasurer. Later he was made a vice-president. Mr. Rankine always acted as the chief executive of the company, and spent his time between the works and the main office in New York City. Eventually he went again to live in Niagara Falls. For many years he was a member of the committee on admissions of the University Club. He also belonged to the Metropolitan Club and the Bar Association. Besides the Niagara Power Company, the Natural Food Company, one of the largest concerns in the city, paid him a salary as a member of its executive committee. In February, 1904, he married Miss Annette Norton, of Detroit, Mich. She was a few years younger than her husband. The funeral was held at the Episcopal Church, in Niagara Falls, at 11 o'clock last Tuesday morning. Mr. Rankine had a fine personality and made many strong and warm friendships. His hospitality at Niagara Falls will be remembered by many readers of this tribute to his worth and memory.

Trade Publications.

STEAM HAMMERS.—Bulletin 805 of the David Bell Engineering Works, Buffalo, N. Y., is devoted to single-frame steam hammers with reinforced guides and stiffened columns.

STEAM TRAPS.—The Youngstown Steam Trap Company, Youngstown, Ohio, has issued a neat illustrated catalogue devoted to steam traps. The construction of the device is well shown by means of cross-sectional views.

STOCKS AND DIES.—The Armstrong Manufacturing Company, Bridgeport, Conn., has issued a 48-page catalogue describing water, gas and steam fitters' tools and machines for cutting off and threading pipe.

LATHES.—Catalogue J4 of the Gisholt Machine Company, Madison, Wis., is an exceptionally neat publication presenting the constructional features and operating characteristics of Gisholt lathes, boring mills and tool grinders.

TRANSFORMERS. The Wesco Supply Company, St. Louis, Mo., has issued an interesting catalogue dealing with Moloney transformers. The elements which have been considered in the design of these transformers are treated quite fully.

LINE CUT-OUTS.—Bulletin No. 26 of the H. T. Paiste Company, Philadelphia, is an advance circular of catalogue No. 12, which is now on the press. The bulletin describes wooden and iron panel boxes, panel cut-outs, cartridge cut-outs and entrance switches.

LAMP SOCKETS. A trade postal of Pass & Seymour, Solvay, N. Y., is intended to draw attention to the P. & S. double-pole sockets. These sockets leave no chance for grounding; they have copper contact shells instead of the more usual brass or copper-plated ones.

TROLLEY LINE FIXTURES.—The Fletcher Manufacturing Company, Dayton, O., has just issued Price-List No. 531, dealing with sleet-proof pulleys, windlasses, mast arms, incandescent brackets, wire holders, insulated clamps, insulated racks, iron brackets, break arms and pins.

STEAM TURBINES.—The DeLaval Steam Turbine Company, Trenton, N. J., has issued a vest pocket catalogue dealing with steam turbine machinery. Illustrations are given of turbine-driven, direct-current and alternating-current generators, turbine-driven pumps and blowers.

TWO-STATION TELEPHONES.—The Electric Gas Lighting Company, 115 Purchase Street, Boston, has issued an illustrated folder, which serves to present the characteristics of the "Stayrite" two-station telephones. These telephones are designed for private lines and permit of the use of only two stations.

IRON AND STEEL WORKS EQUIPMENT.—The Wellman-Seaver-Morgan Company, Cleveland, O., has issued a well-illustrated catalogue dealing with charging and manipulating apparatus for open-hearth and re-heating furnaces. These machines are operated similarly to cranes, and are for the most part electrically driven.

LIGHTING SWITCHES.—A. P. Lundberg, 477 Liverpool Road, London, N., has issued some interesting literature dealing with switches of the quick-break type for lighting circuits. These switches are of the double-throw type, and are intended for use in connection with the control of a lighting circuit from any one of a number of different points.

INCANDESCENT LAMPS.—The Buckeye Electric Company, Cleveland, Ohio, has issued a folder with the title, "Lamp Limericks," which serves in a practical way to direct attention to the fact that in order for the user to obtain satisfaction from electric lamps he should act upon the well-known suggestion and "Better Buy Buckeye."

FORGE BLOWERS.—Leaflet No. 145 recently issued by the Northern Electrical Manufacturing Company, Madison, Wis., is devoted to forge-blower equipments. The blowers, which are direct connected to the driving motors, are built for outputs ranging from 75 to 425 cubic feet of air per minute under a pressure of 1.5 ounces.

TELPHERAGE.—Book No. 35 of the United Telpherage Department of the Dodge Coal Storage Company, Philadelphia, is a well-illustrated catalogue describing numerous telpherage plants now in successful operation. As a method of transporting materials, boxed, barreled or loose, solids or liquids, telpherage has proved entirely satisfactory.

NERNST LAMPS.—The Nernst Lamp Company, Pitttsburg, Pa., has issued a circular descriptive of the Nernst 220-440 volt, three-wire, alternating-current system, for small cities. A recent issue of the "Nernst Central Station Bulletin" reprints three letters which serve to show the beneficial effects which have followed the adoption of Nernst lamps by electric lighting companies.

METAL SHAVING MACHINE.—Bulletin No. 203 of the Jenney Electric Manufacturing Company, Indianapolis, Ind., deals with motor drive for curved-plate shaving machine. The motor, which is attached rigidly to the end of the driven machine, is furnished with enclosed heads to protect the windings and current-carrying parts and with doors to permit ready access to the brushes. The motor is of the compound-wound type.

ENCLOSED ARC LAMPS.—The American Arc Lamp Company, Kalamazoo, Mich., has recently issued its first catalogue of enclosed arc lamps. The lamps described have been in use for several years, having been originally placed upon the market by the Lea Electric Manufacturing Company, Elwood, Ind., but they have lately been improved in many important respects. These lamps are of both the direct-current and alternating-current types.

MILLING MACHINES.—The Cincinnati Milling Machine Company, Cincinnati O., has recently issued a 109-page catalogue illustrating a complete line of milling machines and attachments. The essential features of each machine are fully discussed. Among the new attachments are one for high-number indexing, one for rack indexing, an attachment for milling large cams and an attachment for milling worm wheels. The arrangement for direct-connected motor-driven millers is described at length.

RAILWAY APPARATUS.—The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has issued special publication No. 7040, devoted to Westinghouse railway apparatus. Illustrations and descriptions are given of direct-current railway motors, single-phase alternating-current motors, alternating-current generators, unit-switch system of train control and electric locomotives. One of the most interesting illustrations is one showing an external view of a 135-ton, 6600-volt, single-phase electric locomotive which is equipped with the sliding-bow type of pantagraph trolley.

RAILWAY SIGNALS.—The Blake Signal & Manufacturing Company, 246 Summer Street, Boston, has issued an illustrated catalogue dealing with the Blake signal system for electric and steam railroads. The Blake signals are practically visual telephone signals, and their use removes the one-sided feature of railway line telephone systems. It is not an automatic signal in the usual acceptation of the term, but it is intended for use in connection with a telephone system. The purpose of the signal is to allow the dispatcher selectively to signal to any telephone point on the line when he wishes to communicate with the passing crews.

TROLLEY LINE MATERIAL. The H. W. Johns-Manville Company, 100 William Street, New York, has issued a well-illustrated catalogue of 350 pages dealing with trolley line material. This catalogue is designated as No. 14 and is divided into 14 sections, as follows. Section I, trolley wire hangers, mine hangers, pull-overs; Section II, trolley cars, clips, splicing sleeves; Section III, strain insulators, turn buckles; Section IV, pole bracket arms, section insulators; Section V, pole line and third rail insulators; Section VI, miscellaneous material; Section VII, tools; Section VIII, "Noark" enclosed fuses and devices; Section IX, molded mica-sockets; Section X, electric heaters and electrotherms, Section XI, vulcabeston and molded materials, Section XII, general information and data; Section XIII, telegraph code; Section XIV, indexes.

SYNCHRONISM INDICATOR. The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4418, which serves to present the operating features of its synchronism indicator. The pointer of this instrument moves around the hands of a dial, and the angle of the pointer's displacement from the vertical position is a measure of the angle of phase difference between the two sources of electro-motive force to which the device is attached. If, therefore, the incoming machine is running too fast, the pointer rotates in one direction, and if too slow, in the opposite direction. Coincidence in phase is shown when the pointer remains stationary in a vertical position, and indicates that the machine should be thrown in. The constructive details of the indicator are outlined, and diagrams are given to show in what way it should be connected in the circuits of the generators.

◆

News of the Trade.

THE CHICAGO BATTERY COMPANY has been incorporated in Jersey City; capital, $125,000. Incorporators—Francis H. Howland, Charles L. Young, Benjamin J. Downed.

THE HAZELTON & DONALD MACHINE COMPANY, manufacturers of the well-known Acme metal saw table, has sold its business to the Hub Machine & Tool Company, 116 S. Sixth Street, Philadelphia, which will continue to carry on the manufacture of this machine as well as the other specialties put on the market by Hazelton & Donald.

THE SWITCHBOARD EQUIPMENT COMPANY, of Bethlehem, Pa., has opened a New York office at 39 Cortlandt St., which will be under the charge in Mr. H. U. Badeau. Mr. Badeau is a graduate of Rutgers College, Department of Electrical Engineering, and for the past few years has been with the engineering department of the Western Electric Company in New York.

THE R. M. CORNWELL COMPANY, of Syracuse, N. Y., is meeting with great success in marketing its new gasoline electric lighting outfit. This outfit includes its new "Wonder" gasoline engine and the "Wonder" generator. Many large orders have been taken recently, considerable of the business coming from abroad; one order for four outfits and twelve style "A" generators being received from Lima, Peru.

THE AMERICAN CAR & FOUNDRY COMPANY has recently added to its equipment at the Madison plant, Granite City, for the construction of steel and composite cars, among the equipment being 100 Boyer long stroke riveting hammers manufactured by the Chicago Pneumatic Tool Company. The Chicago Pneumatic Tool Company reports that business in general continues good and the prospects for the remainder of the year very bright.

THE CRESCENT ELECTRICAL MANUFACTURING COMPANY, of Rochester, N. Y., has recently reorganized. Mr. Windle W. Smith, who was formerly secretary, becomes president and general manager; the new treasurer is Mr. Benjamin S. Meyer. The reorganization provides for greatly increased manufacturing facilities. To this end, larger accommodations are being provided, and new machinery of the latest and most improved type is being installed. A new specialty that this company is putting on the market, and which is already meeting with great success, is a line of panelboards of all capacities and types. In order to handle special work in this line, a well-equipped engineering department is provided. The complete line of switches, fuses, plugs, cutouts, sockets, receptacles, attachment plugs, terminal lugs, etc., which the company has been putting on the market for some time, will, of course, be continued.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrochemical Society. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelphia. Next meeting Ithaca, N. Y., May, 1906.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, last Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Civil Engineers. Secretary, Chas. W. Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street Railway Association. Secretary, B. V. Swenson, New York.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, 56 Pine St., New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electrical Contractors Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 10, 1906.

Electrical Trades Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, L. A. Symmes, 820 Drexel Building, Philadelphia, Pa.

Electrical Trades Association of Canada. Secretary, J. A. Mann, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Illinois State Electric Association. Secretary, D. Davis, Litchfield, Ill. Ill. Next meeting, Peoria, Oct. 5 and 6, 1905.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Electrical Association. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, Kan., Oct. 14 and 15, 1905.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress St., Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association.. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Oct. 10, 1905.

Missouri Independent Telephone Association. Secretary, Frank S. Leach, Sedalia, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Cleveland, O., July 18, 1906

National-Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 1142 Wells Building, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in January, 1906.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio. Next meeting, Canton, O., Nov. 17 and 18, 1905.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

Southwestern Electrical and Gas Association. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

Street Railway Association of the State of New York. Secretary, C. B Fairchild, Jr., 114 Liberty St., New York.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago

Weekly Record of Electrical Patents,

UNITED STATES PATENTS ISSUED SEPTEMBER 26, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

800,154. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Feb. 7, 1905. A multiplex telegraph system in which a simple Morse circuit has superposed upon it rapid alterations or impulses of opposite polarity. In order to economize such alternating current, the idle shunt circuit hitherto indispensable in this sort of apparatus is always automatically cut out at the transmitting station, so that the full effect of the current is utilized.

800,155. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Mar. 11, 1905. Relates to modifications of the above.

800,156. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Mar 31, 1905 Cuts the main generator in and out of the main circuit in the act of transmitting signals, while maintaining the line intact by the use of a continuity-preserving transmitter.

800,157. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Apr. 3, 1905. Details of circuits relating to a multiplex telegraph.

800,158. TELEGRAPHY; Francis W. Jones, New York, N. Y. App. filed Apr. 27, 1905. Means for repeating from a Morse circuit into the alternating current side, and vice-versa.

800,160. MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES; Milo G. Kellogg, Chicago Ill. App. filed Nov. 30, 1891.

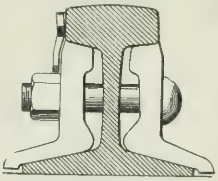
800,161. SWITCHBOARD FOR MULTIPLE EXCHANGES; Milo G. Kellogg, Chicago, Ill. App. filed Aug. 24, 1893.

800,170. MEANS FOR SECURING ELECTRIC CONDUCTORS; Carroll Potter, Philadelphia, Pa. App. filed Sept. 16, 1902. A form of staple for securing electric conductors to a panel board. The marble face of the board is drilled with holes inclined to one another so that when the staple is driven therein it cannot be readily withdrawn.

800,179. ELECTRIC SIGNALING SYSTEM; Howell W. Souder, Tamaqua, Pa. App. filed Jan. 27, 1905. An apparatus for controlling the signaling circuits of a trolley road block system including a pair of magnets, each of which is arranged to close the circuit of the other magnet, whereby they cannot be simultaneously operable. Lamps are displayed along the block whenever a car enters the same from either end.

800,181. METHOD OF PRODUCING ELECTRODES; Heinrich Specketer, Griesheim-on-the-Main, Germany. App. filed Feb. 18, 1903.

800,204. CIRCUIT BREAKER; Charles H. Brigham, New York, N. Y. App. filed Mar. 19, 1904. A thermostat in which the heat coil is wound in a casing having zinc and steel projecting rods. The relative movement of the rods under the influence of the heat releases a catch and effects the short circuit of the "sneak current."



800,229.—Rail Bond.

800,229. RAIL BOND; George A. Mead, Mansfield, O. App. filed Dec. 1, 1904. A form of rail bond designed to be soldered to the side edges of the respective rails. Minute projections are arranged upon the face of the bond to be soldered in order to hold the bond away from the rails and provide sufficient room for the solder to flow.

800,253. RAIL JOINT; George W. Whitman, Pleasanton, Kan. App. filed Feb. 24, 1904. The usual fish plate is provided with cut-away portions upon its upper edge for the rail bond.

800,294. TROLLEY POLE AND STAND; William W. Hallenbeck, Burrville, Conn. App. filed Jan. 12, 1905. A form of stand for trolley poles having two sets of ball bearings with horizontal and vertical raceways, respectively.

800,296. ANTI-CORROSION DEVICE FOR SURFACE CONDENSERS; Anthony Harris, Greenock, Scotland, and Frederic A. Anderson, Westminster, England. App. filed Apr. 25, 1905. The protective metal is supported by an insulated plate within a separate receptacle having communicating pipes to the condenser to allow water circulation. The condenser wall is in electrical connection with the protective metal.

800,315. CIRCUIT INTERRUPTER; George P. McDonnell, St. Louis, Mo. App. filed Aug. 5, 1903. A disk having spaced contact blades is rotated by an electric motor and serves to periodically charge line wires, across which may be connected any number of bells, which can be rung by separate push buttons.

800,370. MAGNETIC SEPARATOR; Charles M. Green, Lynn, Mass. App. filed Oct. 17, 1901. A drum-shaped magnet comprising two similar interlocking core bodies having pole pieces formed thereon is rotated in proximity to a hopper for feeding the ore. A revolving brush is effective to remove the magnetic material from the pole pieces.

800,375. LOAD METER; Elton J. King, Fort Wayne, Ind. App. filed Sept. 6, 1902. In order to adjust an alternating-current meter for vibration purposes without varying its phase relation, a small electromagnet is included in a shunt circuit from the mains, having a variable resistance therein, which serves to assist the usual damping devices.

800,376. TRAIN-LIGHTING SYSTEM; Sigvald Krohn, Berlin, Germany. App. filed Jan. 21, 1905. (See Current News and Notes.)

800,380. PROCESS OF PRODUCING ALKALI AND ALKALINE-EARTH-METAL HYDRIDS; Florentine J. Machalske, Brooklyn, N. Y. App. filed July 12, 1905.

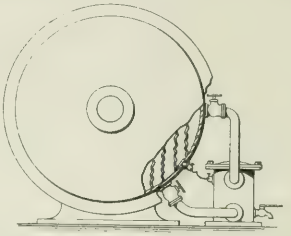
800,382. DYNAMO ELECTRIC MACHINE; John P. Mallett, Madison, Wis. App. filed May 10, 1901. The field magnet cores are made of wrought iron with flaring ends, upon which may be clamped split pole pieces of a less permeable material. The coils are slipped on the cores and afterward held in place by the pole pieces.

800,394. ELECTROMAGNETIC POWER GENERATOR; Joseph L. Potter and Reinhold A. Miller, Indianapolis, Ind. App. filed Dec. 31, 1904. A toy motor having an electromagnet and an armature connected to a pitman and crank. In order to extend the radius of movement the armature is made in layers, which are attracted successively.

800,404. SAFETY FUSE TERMINAL; Joseph Sachs, Hartford, Conn. App. filed Dec. 14, 1903. Employs a pair of split rings for clamping the line conductors, each of which rings has a flat upper face, upon which is bolted the fuse terminal.

800,472. ALARM SYSTEM; Felix McGloin, New York, N. Y. App. filed Dec. 31, 1902. The different fire alarm boxes are arranged in series upon a single wire, and in order to prevent interference of signals simultaneously given at different boxes, only the box nearest the central station continues its signal under these circumstances. The more remote boxes are delayed until such signal is transmitted.

800,482. SPRING ADJUSTING MECHANISM FOR ELECTRIC SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 18, 1904. The turn button of a rotary switch has a four-toothed ratchet wheel thereon, the inclined faces of which serve as cams to release a detent after a certain movement. The power spring then acts to throw the switch quickly.



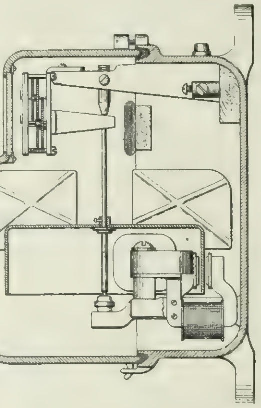
800,296.—Anti-Corrosion Device for Surface Condensers.

800,515. INCANDESCENT ELECTRICAL FURNACE; Frank J. Tone, Niagara Falls, N. Y. App. filed Dec. 7, 1904.

800,534. SECRET-SERVICE SYSTEM FOR INTERCONNECTING TELEPHONE LINES; Albert K. Andriano and Herman Herbstritt, San Francisco, Cal. App. filed Jan. 26, 1901.

800,538. APPARATUS FOR USE IN THE DISTRIBUTION OF ALTERNATING ELECTRIC CURRENTS; Arthur Francis Berry, Ealing, England. App. filed Dec. 3, 1904. A supplementary transformer is arranged to be put in series with a main transformer when the load on the distributing system falls below a a predetermined amount and to be short-circuited when the load rises above the predetermined amount.

800,584. TROLLEY WIRE COUPLING; Edward M. Leslie, Cincinnati, O. App. filed Nov. 20, 1903. A tube having tapered ends encloses the abutting sections, and a pair of toothed circular wedges are effective to retain them therein.



800,375.—Load Meter.

800,586. ELECTRICAL ROSETTE; James A. Mebane, South Boston, Va. App. filed Aug. 2, 1904. The rosette is made in two portions, having interlocking V-shaped projections and grooves. The grooves serve an additional purpose of forming a receptable for the fuse wire.

800,603. MAGNETIC CLUTCH MECHANISM; Harry A. Williams, Akron, O. App. filed Feb. 14, 1905. A pair of opposed rings having inclined faces are engaged by intermediate rollers. The clutch is thrown by energizing a magnet, which retards one of the rings so that it acts as a cam and rides upon the roller to become separated from the other ring and engage the friction faces of the clutch.

800,609. ELECTRIC CUT-OUT SWITCH; Nathan W. Crandall, Hartford, Conn. App. filed Nov. 19, 1904. A floor switch having a plate with an opening which is normally closed by an upwardly spring-pressed block. The plug depresses the block into contact with the terminals, and locking means are provided to maintain it so depressed.

800,611. DEVICE FOR CONTROLLING MOTORS; Frederick B. Duncan, Madison, Wis. App. filed Dec. 30, 1901. A system for controlling motor-driven machine tools, involving a single panel board having a rheostat for each motor thereon. The various rheostats are operated magnetically through pawl and ratchet devices. The latter can be set in motion by push buttons at the respective machines.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, OCTOBER 14, 1905. No. 16.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.........1139 Monadnock Block
PHILADELPHIA OFFICE.........929 Chestnut Street
CLEVELAND OFFICE.........402 Cuyahoga Building
EUROPEAN OFFICE.........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **566,500.**

NEW YORK, SATURDAY, OCTOBER 14, 1905.

CONTENTS.

Editorial 637
New York Fire Alarm Service........ 640
The United States Independent Telephone Company........ 640
An Investigation of Municipal Ownership........ 641
Completion of Another Atlantic Cable........ 642
Electric Railway Development in Holland........ 642
Convention of the Illinois State Electric Association........ 643
Electric Power in India........ 645
Convention of the Western Association of Electrical Inspectors........ 646
Indiana Independent Telephone Association........ 646
Water Falls in Egypt........ 646
Current News and Notes........ 646
Electrical Engineers of the Times.—XXXI. Charles H. Hines 648
Electric Power on the Blackstone River, Mass........ 649
Central Station Management........ 650
District Electrical Supply........ 651
The Design of Multiple-Coil Windings. By Charles R. Underhill........ 652
Rise of Niagara Power........ 654
Overhead vs. Underground Central Station Circuits........ 656
The Graphitized Filament Incandescent Lamp........ 657
New Telephone Patents........ 658
LETTER TO THE EDITORS:
Approximations of the B. & S. Gauge. By W. F. White 658
Digest of Current Electrical Literature........ 659
Book Reviews 663
Methods of Charging for Current Supply to Incandescent Lamps........ 665
Single-Phase Railway for Spokane........ 666
Electrically-Driven Pumps 667
Guy Anchor 668
Hartford Time Switches........ 668
The American Electrical Salesmen Association Organized........ 668
Industrial and Commercial News........ 669
General News of the Week........ 672

THE NEW YORK CITY FIRE ALARM SERVICE.

Elsewhere we print an abstract of a report by Mr. Kempster B. Miller on the fire alarm service of the Borough of Manhattan, New York City, which is startling in its arraignment of the existing system. Scarcely a single detail escapes scathing criticism, and in summing up, the system is pronounced fundamentally wrong in design, not constructed in accordance with any proper engineering plans and in physical condition so bad as to be practically in an advanced stage of decay, and liable at any time to failures rendering it wholly useless in time of greatest need. That such a situation should have been permitted to develop by the city authorities, who have never been niggardly in their appropriations for fire service, and allowed to exist under the very eyes of the technical insurance bureaus centralized in New York, is simply astonishing. Indeed, after reading the sweeping general charges and the flat condemnation of almost every detail of the present system, many will perhaps lay down the report with a feeling that the situation, while perhaps unsatisfactory, has been intemperately exaggerated. The standing, however, of the author of the report, its unqualified approval by the several underwriters' committees having cognizance of the investigation and by the committees' consulting engineer, Mr. John J. Carty, together with the array of data in the appendices justifying the strictures made, are confirmation that the report is but a revelation of an astonishing condition. But Mr. Miller does not deal wholly in denunciation. In the concluding portion of the report he offers as a substitute for the present defective system another which is worked out to insure absolute reliability of service, and in every electrical and engineering detail is thoroughly up to date. As the fire alarm service of many American cities has probably been modeled after that in New York, or has similarly been allowed to deteriorate, the report of Mr. Miller is of national interest, the action, therefore, upon the proposed new fire alarm system by the New York City authorities will be awaited all over the country with impatience by those interested.

◆

THE ILLINOIS STATE ELECTRICAL CONVENTION.

The convention held last week by the electric light men of Illinois was by far the most successful of the kind in the history of the Illinois State Electric Association. The members of this association have been brought together more closely than ever during the past year on account of the action of the State Legislature in placing it within the power of city councils to regulate electric light and gas rates. The unpleasant experiences of last spring, however, were but lightly touched upon at the recent convention, which was devoted entirely to a discussion of business and engineering questions. The Illinois conventions in the past have hardly been up to what might be reasonably expected of an organization of this kind in a state which has the largest number of central station lighting companies of any state in the Union. The convention last week, however, was so far in advance of all its predecessors as to mark a new era in the history of the association, and place it in a rank where it belongs among the State Associations. It is perhaps more difficult to conduct successfully an association of this kind in a state like Illinois with extremely large and extremely small companies, than it would be in a State where there are not such great extremes. At the Illinois convention there were representatives from companies operating in all sizes of communities, from those in Chicago with its two million population to those from towns of twelve to fifteen hundred inhabitants.

One of the most interesting developments taken up by this convention was that of supplying electric light and power from a central station in some large town to smaller villages from five to sixteen miles distant. It is quite true, as one speaker remarked, that there is seldom any good reason for maintaining two small central stations in towns that distance apart. There is still less reason for building a new central station in a small town when power can economically obtained from some neighboring large station. The transmission of power to suburban communities around large cities in this way has been developing for some time. Equal progress has not been made in the rural districts, although the reports from Illinois show that the new development has reached a number of places and undoubtedly there will be much extension in the next few years. Transmission lines of this kind will not bear very expensive construction because the total profits to be obtained from electric lighting of a village of seven to twelve hundred inhabitants will not pay interest on a very large investment; and it will surprise the engineer who has never figured upon it to see how soon the cost of a transmission line will equal that of establishing a small central station in the village to which it is proposed to transmit current. This is no argument against the practice, but is mentioned simply to indicate what careful figuring should be done before a move of this kind is made. Then, too, there is the question of farmers' service from such lines and how far it will pay to go into that class of work. Altogether there is much of vital interest to the small stations as well as the large ones in this subject. District electrical supply has been extensively practiced in various parts of Europe, and the experience there has pointed to the gradual extinction of the small generating plant, and the supply of large areas from a single generating station. Where the movement has started in this country, as in northern New Jersey, scores of small plants have been closed down, their former distributing system being fed from a central generating plant. This development, which may at any time spread with great rapidity, is one of serious concern to the smaller central stations, and should have their closest attention.

Harmonics in Three-Phase Systems.

A fascinating series of oscillographic records of current and voltage on the three-phase distribution system of Newcastle, England, are published in the June number of the *Transactions* of the Institution of Electrical Engineers by Dr. W. M. Thornton. Several moot points are elucidated by a study of these oscillographs. It is shown, for example, that the current and pressure are practically in phase when an alternator is operated entirely on a water-rheostat load. This fact had, indeed, been predicted and asserted from theoretical considerations at various times; but in this case the experimental demonstration is offered. Some have supposed that the electrolytic capacity of the water tanks might cause the current to lead the impressed e.m.f. by an appreciable angle. An analysis of the conditions ordinarily presented shows, however, that this capacity effect is very small. Consequently, we now have experimental evidence to show that the power-factor of a water load is practically one hundred per cent. Another valuable observation described is a simple stroboscopic method of observing the phase shifting of a synchronous motor. A signal or mark of white paint is made on some salient point of the rotor of the synchronous motor to be examined. The machine is then illumined by an arc lamp operated from the same alternating-current supply mains. A small auxiliary synchronous motor of the fan-motor type carries a disk with a suitable radial slot, and the paint mark on the working motor is observed through the slot when both motors are running. Under steady load, the paint mark appears stationary in space; but if the motor load is varied, the paint mark shifts its angular position in space. The shift is not made aperiodically or in a dead-beat manner, but in a series of diminishing swings, lasting for about half a minute. Similar observations may be made when the excitation of the working motor is varied. This stroboscopic method of observation should be both useful and instructive.

Lamp Efficiencies.

Our comments a few weeks ago upon this subject seem to have raised the usual comments and the appropriate rejoinders. Every time the question of rating comes up the same old chaff is threshed out. When all the arguments are summed up one comes by however circuitous a route back to the same old question as to what one really means by efficiency. And we are going here, Yankee fashion, to answer it by asking another. Do we mean by efficiency the quantity of light given by the expenditure of a given unit of energy, or do we mean the conception of each manufacturer as to the relative market value of his product? If the former, then there is but one possible criterion that can logically be applied; i. e., the amount of the total luminous flux for a given expenditure of energy. If the latter, for each value as quoted there are offered as many reducing coefficients as there are sellers of rival lamps. The amount of total luminous flux is correctly measured by the mean spherical candle-power of the illuminant and in no other way. This figure determines once for all the whole available light given out which can be employed in any way the user wishes—allowed to scatter as it will, concentrated in any given direction, or blocked off altogether.

The objections raised against rating by mean spherical candle-power are substantially two: First, that certain illuminants do not readily lend themselves to such measurement; and second, that light given in certain directions is wasted and ought not to be counted. Let us consider these contentions a bit. Now at the start we freely admit that a mean spherical measurement is always more difficult to make than a unidirectional measurement. The only sense in which certain illuminants do not lend themselves to mean spherical measurement is in having certain directions in which they are nearly non-luminous, and the only practical question is whether they should, therefore, be credited with a higher efficiency than they really possess. If they fail to give light in certain directions the deficit of illumination must be made up, if illumination is wanted, from another source. A light, for example, that gives all its radiation in a single hemisphere, will not make so good a showing in mean spherical candle-power as if it gave the same maximum in the shaded hemisphere as well; but, on the other hand, it gives less actual illumination and does not deserve to be credited with what it does not possess. Furthermore, it is not penalized in the least by mean spherical candle-power measurement, since, however, its rating works out, it is credited with all the light that it actually does give. The milk in the cocoanut is just this, that each purveyor of illuminants tacitly demands that his total luminous flux should be measured by its maximum value, in a certain direction by him prescribed. This is a not unnatural attitude and should be taken quite good-naturedly as part of the game—but not too seriously.

The other contention that light in certain directions is wasted and should not be counted is broadly and generally sheer nonsense. In the first place, in illumination as ordinarily carried out, each point receives light from several sources, thus utilizing the flux in various directions, and also by diffuse reflection in which still other flux takes part. The diffused illumination is often more important than the direct, and in entirely diffused lighting—really the most beautiful form of illumination—the direction of the initial light is of very little consequence. Second, if, as sometimes happens, strong direct illumination in a particular direction is wished, it can be easily and economically secured by the use of a proper shade or reflector. To test the sincerity of this objection based upon directed illumination it is only necessary to put the objector squarely upon record as to whether in rating his particular light on its maximum flux he is perfectly willing to let the other fellow fit his lamp with a first-class reflector and figure the efficiency along the beam. And again, the usefulness of a lopsided luminous flux depends on how it is directed, and one can just as well direct a symmetrical flux with a reflector as juggle the axis of the illuminant. In point of fact, we think that the importance of the natural distribution of luminous flux about the radiant is very much exaggerated. The significant practical differences between illuminants are those depending on color and on intrinsic brilliancy. Let us come to the total magnitude of the light furnished, by measuring the whole of it, and then take up these really important differences on their merits. They give room enough for all the "taking points" needed in the prosecution of business without confusing the prior issue of luminous efficiency. Under present conditions, as witness discussions at meetings of the smaller electrical associations, the whole matter of lamp efficiencies is under contempt, and lamp manufacturers should welcome the clearing up of a situation under which all claims as to merit are apt to suffer in minds rendered suspicious by entirely conflicting claims and counterclaims made as to efficiency.

GROUNDING INTERIOR CONDUIT SHEATHINGS.

The June number of the Transactions of the British Institution of Electrical Engineers publishes a paper read by Mr. W. W. Lackie before the Glasgow local section on the subject of "earthing." This paper sets forth somewhat novel and startling suggestions for house wiring and interior-conduit construction that have considerable interest, not only for the engineer, but also for the general public in Glasgow. The Glasgow electric lighting system is in the hands of the city corporation. The system corresponds to what is sometimes known in the United States as the Edison three-wire system, with 500 volts between outers and 250 volts on each side of the neutral. The neutral is normally grounded at one of the generating stations. Interior conduits are employed in the buildings with metallic sheathings which are both continuously connected and locally grounded. The ground connection is almost universally made through the house water mains. It is stated that during the three years, 1902-1904, inclusive, there were 33 fires in the city of Glasgow due to defective electric-light installations. The total number of installations, connected at the end of that period being 11,000. This represents an average of one fire per annum per thousand installation attributed to defective electric light installations. Expressing the result in terms of the 700,000 8-cp lamps connected, of 33 watts each, there was an average of one fire per annum per 60,000 lamps connected. Of the 33 electrically guilty fires, 15, or almost half, occurred through the melting of lead gas pipes in the buildings, by heavy current leaks through these pipes to ground. Of these, 8 occurred in installations where the iron piping or metal sheathing of the conduits was not properly grounded, and 7 in installations where it was grounded. From this it may be inferred that the grounding of interior conduit sheathings under the practical conditions existing in Glasgow is not a complete safeguard against fires caused by the melting of soft gas-pipes and the kindling of the gas.

It is, we believe, the experience in this country that the grounding of continuous metallic sheathing of interior conduits is a complete protection from fires due to such causes. The reasons for this difference between the experience in America and in Glasgow are, perhaps, firstly, that our gas pipes are almost invariably of iron, a much more difficult fusible substance than soft metal alloy; and secondly, that our three-wire voltages are only one half as great as those existing in Great Britain. The paper contains useful data in various directions. Thus it states that measurements have shown the resistance of the ground between the generating station at Port Dundas and a point in Waterloo Street, distant 1,580 yards therefrom, to be approximately 0.05 ohm. This seems to be an unusually low resistance, although information is meagre concerning such ground-resistances. It corresponds to the resistance of a copper cable of one million circular mils directly connecting the localities, or to a continuous iron return of about 7,000,000 circular mils. It is perhaps not a ground resistance in the strict sense of the term, but is probably the resistance of the buried metallic pipe system, between the two places. At all events, it is evident that with such a ground-return system the current strength which might momentarily flow to ground through a fault in the interior conduit sheathing, under 250 volts pressure, might readily be several hundred amperes, and in particular cases might exceed one thousand amperes.

In view of these conditions, the paper proposes that the sheathing of interior conduits should be carefully kept out of contact with metallic systems in the house construction, and that appropriate sections of the sheathing should then be connected to ground at one point through a resistance of, say, from 3 to 25 ohms, according to local conditions. The object of grounding at one place through a resistance, instead of grounding at many places as thoroughly as possible, is to limit the strength of the momentary current rush to ground if a fault should occur in the conduit. Hitherto we have had two opposing schools in wiring. One has advocated insulating everything. and keeping off the ground. Its doctrines suggested the term groundphobia. The other school has advocated grounding everything in sight and its doctrines have suggested groundmania. In this paper we have a hybrid suggestion of always grounding a little, or gently, through resistance. As the matter appears to us, groundphobia is all very well for systems only employing very low pressures, and nowhere coming into the neighborhood or territory of high-pressure systems. It becomes untenable in the dealing with high-pressure systems entering dwelling houses; or systems that may possibly come into connection with high pressures. In these latter cases, groundmania certainly protects life and person, but it may lead the way to heavy current rushes through faults that may be capable of initiating fires under certain conditions; as, for example, when readily fusible gas-pipes stand in the way. It would seem that from the standpoint of American practice, grounding each installation through a rheostat or rheostats is quite unnecessary and would be a needlessly complicated process; while it is to be hoped that even under such conditions as are reported in Glasgow this complicated addition to house wiring will not be considered necessary. Possibly a little extra resistance in the ground connection at the generating station might serve as a partial substitute; but it is not very easy to make suggestions that are valid for conditions three thousand miles away.

New York Fire Alarm Service.

Last December a committee appointed by the New York Board of Fire Underwriters to investigate the fire alarm service of the Borough of Manhattan and New York City secured the services of Mr. Kempster B. Miller to conduct a technical investigation of that service, with Mr. J. J. Carty acting as consulting engineer. Mr. Miller's report, dated September 12, 1905, has now been printed, occupying 54 large quarto pages and a number of appendices, bringing the total up to 131 pages. Maps to the number of thirteen are bound separately. The report is accompanied by a letter from Mr. J. J. Carty approving the plan submitted by Mr. Miller for establishing a new fire alarm system for Manhattan, and by letters of approval also from the committee of twenty of the National Board of Fire Underwriters and from Mr. J. C. Forsythe, chief inspector of the Electrical Department of the New York Board of Fire Underwriters.

A thorough inspection of the existing system was made by Mr. Miller, including the design, construction and operation of the central office, the system of circuits, the location of fire alarm boxes and signal receiving stations, and numerous electrical tests were made upon the cables and their mechanical condition examined in an exhaustive manner.

The conclusions of Mr. Miller from his investigation are startling. The fire alarm telegraph system of the Borough of Manhattan is reported fundamentally wrong in design. It is not constructed in accordance with any proper engineering plans and its physical condition is so bad that it must be characterized as being in an advanced stage of decay and liable at any time to such failures as to render it wholly useless to the fire fighting department in the time of its greatest need. Faulty in original design and construction, the plant has deteriorated, has been patched and repaired in its various parts as they, from time to time became unworkable; and it is declared that the system long ago reached the stage where it could not be transformed into permanent proper working order by any further patching or even by radical repairs.

As a consequence of this deplorable situation, Mr. Miller considers that the only remedy is to establish a new fire alarm system, separate and distinct from the present one, and when the new system has been established and is in working order that the old one be abandoned and dismantled.

This very severe arraignment of the present condition of the fire alarm system is supported in the appendices by notes showing the present condition of fire alarm cables, manholes and service boxes and other details of the installation, and by the data of tests of cables and a record for a given month of troubles developed in the fire alarm telegraph system. The report proceeds to give in detail a description of the present plant, the various defects existing being pointed out. So antiquated, however, was the system found and so poorly installed that the conclusions following the consideration of each of the numerous details investigated are with scarcely an exception condemnatory, this remark applying also to the auxiliary telephone service.

The second part of the report, consisting of 14 pages, proposes a system to replace the present one. Briefly, Mr. Miller recommends a single fire-proof central office located immediately south of Central Park, the building not to contain any gas pipes or boilers and the floors containing the electrical apparatus and exposed wires to be built at such a height above the ground that there would be no possibility of a flood due to a cloudburst, the breaking of a water main or other cause. It should contain no skylights and precautions should be taken to prevent its injury by falling objects from other structures, as in conflagrations or windstorms. The building should be solely used for the fire alarm central office, and not open to the public, and occupied only by those charged with the duty of operating and maintaining the fire alarm system. The electrical apparatus within the building should be of a fire-proof nature and mounted upon non-combustible supports, no ornamental cabinet work being used. The number of cable approaches should be made as numerous as practicable in order to avoid danger of total interruption. The report then goes into detail concerning feeder cable routes, box circuit arrangement, gong circuit arrangement, box and gong circuit conduit, types of cables and manholes, terminal posts, fire alarm boxes, box location, signaling instruments at the apparatus houses, central office apparatus, and the telephone system.

For fire alarm cables rubber covered, lead encased wire is recommended, and for telephone circuits the usual paper-covered, lead-encased twisted cable; it is further recommended, however, that the city shall not operate the telephone service between the central office and the various department houses, but lease the necessary facilities from the telephone company doing business in New York. The system of wire circuits recommended is radically different from the present system and new types of terminal posts and improved form of fire alarm box are recommended. An entirely new kind of central office apparatus is also recommended.

In conclusion, Mr. Miller points out that whereas the fire alarm system of New York City has undergone little change during the past twenty years, during that peroid one improvement after another in American industries has followed so rapidly that it is a common thing to replace serviceable machinery and apparatus on account of the superior efficiency thereby obtained. In New York City the fire alarm telegraph system is in every respect obsolete and is totally inadequate for the service demanded of it, and the recommendations made, notwithstanding that in some respects they are radical, are stated in fact to be as a whole conservative in view of the existing situation. The new construction which is recommended has been so long deferred that there is a real danger that before the remedy can be applied the present defective fire alarm system may be the cause of a great disaster.

Mr. J. J. Carty, in a letter accompanying the report, states that after carefully studying the question he concluded that any plan looking to utilization of any substantial part of the present fire alarm system is impracticable and wholly out of the question. The only alternative, therefore, is the establishment of an entirely new system, and when this is ready for service the present one should be abandoned. Having reached this conclusion, he studied in every detail the plan proposed by Mr. Miller for establishing a new system in Manhattan and found that this plan will in every reasonable manner provide the maximum degree of reliability of operation, the minimum expense for maintenance and that it will in first cost, all things considered, be the most economical one for the City of New York to adopt in place of the defective system now in use. The conclusion of the committee of twenty of the National Board of Fire Underwriters is that the proposed system of Mr. Miller shows sound engineering in all its essential features, including those which are departures from earlier methods, and without hesitation the entire report and its recommendations are endorsed. Mr. J. C. Forsythe, chief inspector of the electrical department of the New York Board of Fire Underwriters, in a letter states that Mr. Miller's recommendations are in line with the best engineering practice, and when carried out will result in giving the borough the protection which its importance certainly deserves, emphasis being placed on that part of Mr. Miller's report urging the necessity of prompt action in the substitution of a new for the old system.

The United States Independent Telephone Company.

Announcement is made of the completion of the permanent organization at Rochester, N. Y., on October 7, of the United States Independent Telephone Company, the incorporation and general plans of which have already been noted in these columns. Mr. Thomas M. Finucane has been elected president of the company and among the directors are such well-known men as Adolphus Busch, Walter B. Duffy, George Eastman, the president of the Eastman Kodak Company; August Gehner, president of the German-American Bank of St. Louis; Robert C. Hall, of the Independent telephone system of Pittsburg; William H. Page, of this city; Hendrick S. Holden, president of the Commercial National Bank of Rochester, and Hiram W. Sibley.

Mr. Finucane states that the company possesses franchise rights in New York City similar to those owned by the Bell Company. The plans of the United States Company are set forth by Mr. Finucane in the following statement printed in the daily press of October 7:

"The formation of the United States Independent Telephone Company is the first step in the movement to furnish telephone companies with standard apparatus and with a guarantee that their supply cannot be cut off through the absorption of manufacturing companies by the Bell interests; to knit together in connecting systems the independent telephone lines of the country, which, unappreciated as the fact may be in the East, to-day considerably outnumber the lines owned or controlled by the Bell Telephone Company, and to aid independent telephone companies in the installation of their plants and improvement of their service.

"There are to-day over 5,000 telephone companies in this country independent of the Bell systems. In response to the demand of these companies for product and appliances and for a centralized unity of action, the United States Independent Telephone Company has been incorporated.

"The independent telephone lines represented directly or indirectly by or through one or another of our directors comprise systems which extend substantially from Kansas City, Mo., to New York.

"Our plans have been the subject of consideration for some months. In formulating them we have had conferences with leading lawyers in the cities of New York, St. Louis and Rochester, among them were William H. Page, Jr., Samuel B. Clarke, William C. Trull and Frederick P. Delafield, of New York City; Richard V. Lindabury, of New Jersey, Walter S. Hubbell, of Rochester, and Judge Henry S. Priest, of St. Louis, Mo.

"In result we acquired and now own franchise rights in New York City which, in the opinion of our attorneys, are similar in scope and character to those of the Bell Telephone Company. These we propose to make the subject of the installation of a plant with a present capacity of 225,000 telephones and an ultimate capacity of 750,000 telephones for New York City and the tributary districts which environ it.

"Our company to-day authorized its collateral trust mortgage of $25,000,000, and the underlying securities will comprise a control of the Stromberg-Carlson Telephone Manufacturing Company, which manufactures a thousand telephones a day, and the New York Independent Company, which latter owns the franchise rights above referred to."

Mr. Finucane on Monday of this week made public details concerning the franchise under which the company expects to do business in New York City. The franchise is that granted to the Mercantile Electric Company on June 29, 1894. Papers filed with the Secretary of State and County Clerk on October 7 show that the Mercantile Electric Company was merged into the New York Independent Telephone Company, the stock of which is owned by the United States Independent Telephone Company. Of the franchise Mr. Finucane says:

"The Mercantile company began the construction and operation of its system throughout the subways of the Empire City Subway Company and subsidiary conduits constructed for its own account, which it owns. These cables and wires extend through portions of Broadway, Wall, Cortlandt, Cedar, Pine, Nassau and Broad Streets. The system now centers in 120 Broadway, where its switchboards are located. The appliances of the company have been used in connection with burglar alarm business and are adapted to and have been used for telephone purposes.

"We are required to use the ducts of the subway company unless this restriction is removed by the city. On the other hand, the charter of the subway company requires it to construct subways for us on our putting up a bond to cover the expense of building the conduits applied for and to rent them to us at rates fixed in the subway company's charter.

"Our franchise is an operating property and has been for more than ten years. Its rights to lay wires underground come from the same source and are in the same form as those of the Bell Telephone Company. * * * *

"We are advised by counsel that these two franchises, ours and that of the Bell Company, are the only two existing franchises which give the grantees in terms the express right to use electrical conductors for telegraphic and telephonic business."

Mr. Finucane thinks that his company, in less than two years, will have 225,000 telephones in operation in New York City. He says the citizens of New York and other cities will get the best telephone service they ever had.

The Great Eastern Telephone Company, of New York City, formed to operate in and between the cities of New York, Albany, Syracuse, Rochester, Buffalo and other cities and villages of the State, was incorporated at Albany, October 9. The line will connect with other telephone companies in other parts of the United States and Canada. The company has a capital of $1,000,000. The directors are William H. Schack, Eugene H. Brock, Elias J. Beach, Egbert A. Reynolds, D. A. Reynolds and W. Myron Reynolds, of New York City, and Stephen M. Conger, of Queens Borough, New York.

An Investigation of Municipal Ownership.

Considerable progress has been made by the special committee appointed recently by the executive committee of the National Civic Federation to investigate public ownership and operation of such utilities as gas, water, electric lighting and street railways. A general meeting, which was largely attended by representative men, was held at Earl Hall, Columbia University, New York City, October 5, when in the absence of President August Belmont, the meeting was called to order and addressed by Mr. Samuel Gompers, first vice-president of the Federation. In a letter regretting his absence on account of sickness and an operation, Mr. Belmont said:

"The subject of municipal ownership and operation of public utilities is forcing itself upon the attention of all thoughtful persons. Unfortunately, the very lack of comprehensive and authoritative data and information leaves the discussion to theorists, who often advance arguments which can neither be accepted nor rejected, for the very reason that no authoritative data exist. The National Civic Federation will now try to obtain true and reliable facts to guide the student and legislator in seeking the best means to establish peace and maintain co-operation between capital and labor. To the accomplishment of this purpose I have encouraged this movement and advocated the missions of the sub-committees.

"The relations of capital and labor are vital to the prosperity of the individual and to the State. It is proper, therefore, that arguments should be based on correct facts and known conditions. The Civic Federation has no greater work among its varied duties than to secure these data. The committee, which it purposes to send abroad, represents every shade of thought and opinion on the subject. This committee, when it returns, will report to a larger commission of men at home likewise drawn from every part of the country and representing every phase of life. The Civic Federation has no interests to serve and no arguments to make on the subject, but to present the facts and conditions as they may exist abroad and at home, for the use and benefit of the entire country, without respect to special interests."

The general question was discussed throughout almost the entire day, and it was decided not to take up any of the large questions connected with governmental ownership and operation of steam railways, telegraphs, etc., but to limit the inquiry, at least at this stage, to municipal utilities. There was considerable discussion as to how far even this limited inquiry should go, but a consensus of opinion was manifested as to the subjects mentioned above as being those particularly desirable for study. Special emphasis was laid upon street railways as perhaps the matter that was most deeply interesting to the population of some of the largest American cities at the present time.

Before the close of the day the following officers and committees were elected and appointed:

Officers.—Melville E. Ingalls, president, Big Four Railroad, Cincinnati; John Mitchell, vice-president, president United Mine Workers, Indianapolis, Ind.; John G. Agar, second vice-president, president Reform Club, New York City; Edward A. Moffett, secretary, editor *Bricklayer and Mason*, New York City.

Executive Committee.—The officers ex-officio and Alexander H. Revell, merchant, Chicago, Ill.; E. E. Clark, grand chief Brotherhood of Railway Conductors, Cedar Rapids, Iowa; Isaac N. Seligman, banker, New York; E. Rosewater, editor *The Bee*, Omaha, Neb.; William Wirt Howe, lawyer, New Orleans; Samuel Insull, president Chicago Edison Company, Chicago; John Bancroft Devins, editor New York *Observer*, New York; Frederick N. Judson. attorney, St. Louis, Mo.; Carrol D. Wright, president Clark University, Worcester, Mass.; Hamilton Holt, editor *The Independent*, New York; Walter MacArthur, editor *Coast Seamen's Journal*, San Francisco, Cal.; D. L. Cease, editor *Railroad Trainmen's Journal*, Cleveland, Ohio; Franklin MacVeagh, merchant, Chicago, Ill.; Henry M. Farnam, Yale University, New Haven, Conn.; George H. Harries, Washington Railway & Electric Company, Washington, D. C.; Louis D. Brandies, lawyer, Boston, Mass.; Marcus M. Marks, manufacturer, New York City; James O'Connell, president International Association of Machinists, Washington, D. C.; Lawrence F. Abbott, editor *The Outlook*, New York City; R. R. Bowker, editor *Publishers' Weekly*, New York; Alexander C. Humphrey, president Stevens Institute, Hoboken, N. J.; J. W. Jenks, Cornell University, Ithaca, N. Y.; John Tobin, president Boot and Shoe Workers' Union, Boston; Frank A. Vanderlip, National City Bank, New York City.

Committee on Investigation (to investigate the subject in America and foreign countries).—M. E. Ingalls, Big Four Railroad Company, Cincinnati, Ohio; Talcott Williams, editorial writer, *The Press,* Philadelphia, Pa.; W. D. Mahon, president Amalgamated Association of Street Railway Employes, Detroit, Mich.; Frank J. Goodnow, Columbia University, New York City; Walton Clark, United Gas Improvement Company, Philadelphia, Pa.; Dr. Albert Shaw, editor *Review of Reviews,* New York City; Edward W. Bemis, superintendent water works, Cleveland; John H. Gray, Northwestern University, Chicago, Ill.; Walter L. Fisher, Municipal Voters' League, Chicago, Ill.; Timothy Healy, international president Stationary Firemen, New York City; William J. Clark, General Electric Company, New York City; H. B. F. MacFarland, president Board of Commissioners, District of Columbia, Washington, D. C.; Daniel J. Keefe, president International Longshoremen's Association, Detroit, Mich.; Frank Parsons, president National Ownership League, Boston; John R. Commons, University of Wisconsin, Madison, Wis.; J. W. Sullivan, editor *Garment Workers' Bulletin,* New York; Leo S. Rowe, University of Pennsylvania, Philadelphia; F. J. McNulty, president International Brotherhood of Electrical Workers, Washington, D. C.; Albert E. Winchester, manager South Norwalk Electric Plant, South Norwalk, Conn.; Charles L. Edgar, president the Edison Electric Illuminating Company, Boston, Mass.; Milo H. Maltbie, franchise expert and former editor *Municipal Affairs,* New York City.

At the adjournment of the meeting of the commission, 15 members of the Committee on Investigation met informally to confer upon means for carrying out effectively the purpose of the movement, and a sub-committee of this investigation committee, consisting of Messrs. Goodnow, Walton Clark, Bemis, Sullivan and Maltbie was appointed to prepare a set of questions designed to cover all the vital points on which information is desired in this country and abroad. These questions will be taken up at an early date in November by the larger committee on investigation for such action as may then be deemed advisable. During all the discussions there was a strict avoidance of the polemical aspects of the question and a strenuous insistence upon the desirability of securing by the work of the committee the absolute facts and data irrespective of the interpretation that might subsequently be put upon them. Inquiries will be carried on by the committee, not only in this country but in Europe, it being necessary, for example, to cross the Atlantic to secure figures with regard to municipal street railway operation, there being virtually no roads of that character in the United States. It will be some months before the work of the commission can be completed and brought to public attention.

Completion of Another Atlantic Cable.

Reference was made editorially in these pages last week to the completion of another Atlantic cable. The Commercial Cable Company's fifth cable from Canso, Nova Scotia, to Waterville, Ireland, was put in operation on October 6. This makes seven trans-Atlantic cables worked in direct connection with the lines of the Postal Telegraph Cable Company. All of them are duplexed so that their combined capacity is fourteen messages at one time. The new cable is said to be the best and most expensive submarine cable ever laid. It was manufactured by the Telegraph Construction and Maintenance Company, of London, having been begun in March, 1905, and finished and shipped on board their steamer *Colonia,* on August 3.

Atlantic cables are always laid from west to east because the prevailing winds in the summer months on the Atlantic are from the west, and ships make much better speed going eastward; consequently the *Colonia* sailed direct from England to America, arriving off the coast of Nova Scotia on August 16. She landed the heavy shore end of the cable on the morning of August 18. Moving out from the shore she struck a rock and remained fast on it for four days. The injuries she sustained compelled her to go into drydock at Halifax with 2,300 miles of submarine cable aboard. She was the largest and heaviest ship ever taken on that drydock, exceeding by thousands of tons the United States battleship *Indiana* of ten thousand tons, which went into drydock there a couple of years ago. Repairs were made and the *Colonia* took the seas again. On September 23 she laid her course from Canso, N. S., paying out cable. On September 28 she passed through a hurricane in mid-Atlantic, although on that day the weather on both sides of the Atlantic was reported fine, with gentle winds. On October 3 she arrived without a mishap at a point 187 miles from the coast of Ireland, where the final splice was to be made between the cable that she had paid out from the American side and the 187 miles of cable previously laid westward from the Irish coast by the steamship *Cambria* in the month of June. The weather was heavy and the *Colonia* was compelled to heave to for several days awaiting smoother seas to enable her to make the final splices on October 6.

At some points the cable was laid at a depth of nearly three miles below the surface of the sea. The quantities of material used in the manufacture of the cable were 1,411,200 pounds of copper; 799,688 pounds of gutta percha; 16,845,000 pounds of brass tape, jute, yarn, iron wire and preservative compound. The signaling speed of this cable is fifteen per cent greater than that of any other cable of equal length in the Atlantic. The cost of the cable varied from one thousand dollars to six thousand dollars per mile, according to the character of the ocean bed and depth of water, the great variation in cost being naturally due to the different diameters and weights of the sections of the cable. In the neighborhood of the fishing grounds off the coast of Newfoundland, a type of cable midway between deep water and shore end cable is used. This intermediate size is made strong to resist injuries from the anchors of fishing craft, the most prolific source of danger to submarine cables. This intermediate type is made just heavy enough to afford reasonable prospect of retrieving it in the event of its being damaged by the anchor of a fishing vessel.

Electric Railway Development in Holland.

Attention was called recently in these columns to the Holland-American Construction Company, incorporated under the laws of the State of New York and backed by Westinghouse interests, its object being the construction of the most extensive electric railway system ever projected by Americans in Continental Europe. The scheme provides first for the building of a railroad from the German frontier to the North Sea. Later on it is proposed to build several branches. The western terminus of the proposed line is Wykan Zee, on the shore of the North Sea, about three miles north of the west end of the Amsterdam Canal. The main line is to cross Holland in a southeast direction to Arnheim, about a dozen miles from the German frontier. From Wykan Zee it will run to Zaandam, and thence into Amsterdam, the principal city in Holland. Continuing in approximately the same southerly direction, the main line will cross the canal that connects the Rhine with the Zuyder Zee to Utrecht. From Utrecht the road will cross the lower Rhine Valley to Rhenen, a small town some five miles north of the Rhine, where it will turn slightly north of due east to its terminus in Arnheim. It is said that the system may be extended by the construction of branches so that ultimately the entire lines to be built by the Holland-American Company may aggregate some 250 miles.

Wykan Zee, the proposed western terminus of the line to be first constructed, is not now in direct land communication with Amsterdam, but from Zaandam to Arnheim the road will practically parallel steam lines already in operation. Both freight and passengers will be carried by the proposed road on its main line and branches. The ballasting of the lines will be in accordance with the best American practice, and the rails will be heavy to permit of high speed. The average speed to be maintained between towns is expected to exceed fifty miles an hour. The road will be constructed on a private right of way, as is necessary under the Dutch laws.

The board of directors of the Holland-American Company includes the names of four Westinghouse men—George C. Smith, vice-president of the Security Investment Company of Pittsburg, of which George Westinghouse is president; Walter D. Updegraff of the same concern, Newcomb Carlton, fourth vice-president of the Westinghouse Electric & Manufacturing Company, who has charge of the financial end of the Westinghouse electric interests in New York and Joseph H. Lukach, a director and financial head of the British Westinghouse Electric & Manufacturing Company, Limited. John F. Alden, at one time prominently connected with the American Bridge Company; J. George Kaelber, Charles H. Palmer, and John H. Beckley, who are also largely concerned in the new company, have sailed for Europe. On reaching the other side, they will be joined by Mr. Lukach, and the whole party will proceed to Holland to look over the carrying out of the enterprise, which will represent an expenditure not far short of $5,000,000.

Convention of the Illinois State Electrical Association.

The Illinois State Electric Association convention held its sixth annual convention at the National Hotel, Peoria, Ill., October 5 and 6, 1905. The attendance was large, the programme exceptionally suited to the character of the membership, and the social features were well selected and excellently carried out. Much of the success of the meeting was due to Mr. David Davis, who as secretary, had charge of the preparations, and his election at the meeting to the presidency was particularly appropriate.

The new president, Mr. David Davis, was born in Litchfield, Illinois, in 1868, where he has lived his entire life. He was educated in the public schools of Litchfield and began his business career in a bank in that city. Gradually working his way up in the banking business he incidentally became secretary of the Litchfield Gas & Electric Company, of which he was later made manager as well. His connection with this company dates back ten years. He was one of the organizers of the Illinois State Electric Association, as the minutes of the first meeting in 1900 show, and served as its treasurer up to a year ago, when he was elected to the important office of secretary. His work as secretary is best shown by the report of the convention of last week, which was by all means the most successful and profitable ever held by the association. In just recognition of his work he was at that convention elected president. During the Spanish-American war he served with the Fourth Illinois Regiment, and is prominent among the Illinois Spanish war veterans, being last year department commander for Illinois.

PRESIDENT DAVID DAVIS.

President E. B. Hillman, of Quincy, called the first session of the convention to order about 11 a. m. October 5. He made a brief address, saying that the little "roughness" that the members of the association had been treated to the last year had brought them closer together than ever and made them realize the necessity of organization and of pulling together. His reference, of course, was to the rate-making legislation which was passed by the last Illinois legislature.

After some routine business Secretary D. Davis, of Litchfield, read the financial report which showed a balance on hand, including the balance from the previous year, of $188.45. Applications for membership were then received from fifteen companies. A committee was appointed to draw up amendments to the constitution and by-laws to suit some new conditions which are arising. This committee consisted of Mr. H. E. Chubbuck, of Ottawa; Mr. S. S. Davis, of Rock Island, and Mr. F. W. Little, of Peoria.

Mr. J. J. Frey, of Hillsboro, made a suggestion that the association give its secretary a salary and have him collect and distribute information of value to the members. Secretary Davis suggested that this was a work which was already being carried on by the National Electric Light Association better than a state organization could possibly do it, and he suggested that it would be better for companies desiring this kind of service to join the N. E. L. A. rather than to attempt to do this in the state organization. He thought it would be better for the association to continue its work along about the same lines as in the past. Mr. Chubbuck agreed with Mr. Davis as to the association's field. Mr. F. W. Little, of Peoria, said it was impossible for the N. E. L. A. to get information from any of the smaller stations. After some further informal discussion of this question, it seemed to be the consensus of opinion that no change be made in the plan of work of the association. The meeting then adjourned until Thursday afternoon.

Thursday afternoon the session was opened by the reading of a paper on "Underground vs. Overhead Lines," by Mr. H. B. Gear, of the Commonwealth Electric Company, Chicago, which is printed elsewhere in this issue. This paper was intended for the benefit of a number of companies in the larger Illinois towns where underground work is being considered for the business districts.

In the discussion of this paper Mr. R. S. Wallace, of Peoria, inquired as to the depreciation of underground conduits and also how feasible it would be to reach part of the customers through the property of other customers where laterals are put in only at the corners and middle of each block, as indicated in Mr. Gear's paper. Mr. Gear replied that depreciation of a conduit was an unknown quantity. The cement and tile was probably as durable as the earth in which it was placed. This was not true, of course, of the old-fashioned pump-log conduit. The cable should be good for ten years or longer. Some depreciation must be allowed to meet changes in the art. As to customer's service lines, in some cases it would be possible to run iron-pipe conduit along the outside of buildings, to give service from one customer to another. It was contrary to city regulations in Chicago to have the service for one customer to run through another customer's premises, the idea of the city authorities being to keep down the number of wires running in front of or under the sidewalks and in basements of buildings.

Mr. A. V. Schroeder, of Springfield, wished to know if there was any higher rate charged in Chicago in the underground distribution district than where the distribution was overhead. Mr. Gear replied that the only underground conduit work recently done in the Commonwealth Electric Company's district in Chicago, in residence streets, consisted in placing the main feeders underground and making the distribution for the consumers in each block overhead. In any case it is difficult to discriminate in rates between overhead and underground lines.

Mr. Wallace, of Peoria, asked what was done to detect theft of current on secondary lines placed under the sidewalk, and what was the practice in regard to the manhole transformer. Mr. Gear replied that the refusal of the owner of the premises to allow the company to inspect the wires was always taken as a suspicious circumstance calling for further investigation. It is the aim to keep clear of transformers in manholes as far as possible, as, after heavy rains, manholes are likely to be flooded. Where it was necessary to use them, the secondary net-work fed by the underground transformer was separated by fuses from the balance of the network, to prevent a general short-circuit of the secondaries if the transformer was flooded. Mr. G. H. Lukes, of Evanston, asked whether the figure of $1.25 given by Mr. Gear as a cost per lineal foot of four-duct conduit line included manholes for service laterals. Mr. Gear replied that it did not, and said in answer to a further question from Mr. Lukes, that wherever lines could be placed in the alley, the most practical scheme was to run overhead service lines to the buildings in a block from a distributing pole in the alley, having the main feeders underground in the alley. That was undoubtedly the most desirable plan, but it was not always possible to do this in Illinois towns and he had, therefore, in his paper assumed the most difficult case.

Mr. Hillman asked whether, assuming as a hypothetical case, a town of 25,000 population in which an overhead line had depreciated to such a point that it was of no value and it would have to be entirely rebuilt, Mr. Gear would advise the rebuilding with overhead construction or would suggest underground work in the business district. Mr. Gear replied that he would prefer to do all the detail distributing to customers overhead, but that there was much safety in putting the main lines in underground conduit because heavy pole lines are subject to considerable interruption of service from the falling upon them of telegraph and telephone wires and from chance crosses between the line wires themselves.

The convention then heard the report of the committee on revision of constitution of by-laws, submitted by Mr. F. W. Little, of Peoria. One amendment offered provided that any member company whose property might be sold or leased to a municipality should cease to be a member. Another amendment provided for a closer scrutiny of applications for membership than formerly, and a third amendment provided for four vice-presidents. These amendments were all adopted.

At the request of J. J. Frey, of Hillsboro, chairman of the committee on insurance, the convention gave a few minutes of its time to hearing E. R. Townsend, electrical inspector for the insurance companies of Illinois. Mr. Townsend told how central station construction had improved so that instead of being a very poor class of risk as it was formerly when the old schedule was made it was now one of the best. It was now proposed by the insurance companies to put an expert at work making a survey of all the central station properties of the state, giving suggestions as to the ways in which these risks could be improved so as to secure better rates. The electrical machinery of the present day was not as susceptible to water damage as older machinery. Poor wiring and lack of proper lightning protection was responsible for much of the electrical risk in the older stations. He gave several examples showing how reductions of rates as much as 50 per cent had been obtained by central stations making small improvements. The most important reductions by small changes were usually available on the better class of buildings. He then read the schedules to be adopted by the Western Union of Underwriters.

Mr. Homer E. Niesz, of Chicago, said that he had been working for such a revision of the central-station schedule for a long time, as it had been evident that the old schedule on central-station risks was entirely antiquated and suited to conditions of twenty years ago, rather than to those of to-day. After some further remarks on this matter, the discussion was closed to be taken up on the following day in connection with the report of the insurance committee.

Prof. S. W. Parr, professor of applied chemistry, University of Illinois, read a paper on "Composition and Heating Values of Illinois Coal." The paper at first briefly outlined what the buyer of coal usually wishes to know, first as to the amount of ash it contains, and second, the amount of clinker likely to result from its combustion. He found it true from a long series of investigations that screenings run uniformly higher in ash than lump coal, this being confirmed also by popular observation. There was good reason for this fact when the methods of mining were considered. In Illinois most of the coal is mined with the aid of coal-cutting machines, which cut a space several inches high under the lower part of the vein. These machines, in cutting, produce a large amount of the screenings, and the coal in the lower part of the vein is high in ash. The presence of sulphur was usually taken as an index to the amount of clinker that would form, but such an assumption was not always safe. A better index of the clinkering qualities of the coal would be the amount of sulphur mixed and compounded with iron. Moisture runs higher in slack than in lump coal. It is not, therefore, wonderful that slack or screenings, being high both in ash and in moisture, gives in practice such poor results. Much of the paper was given up to emphasizing by various statistics the point that not all of the volatile matter in coal is combustible as is frequently assumed. This non-combustible volatile matter, while very small in high-grade eastern coal, such as Pocahontas, was high in Illinois coal. Taking all these things into consideration, if we calculate the number of pounds of coal to make 100 pounds of combustible with Pocahontas coal, we find that it will take from 104 to 109 pounds of coal, while with Illinois coal it will take from 119 to 141 pounds of coal, and with lignite coal, from 120 to 162 pounds of coal. The effect of such difference in coal upon a boiler steaming capacity is very apparent. He then classified the different veins of coal being mined in Illinois, giving the characteristics of each. In the discussion which followed, in answer to a question as to the form in which the non-combustible, volatile matter appears in the flue gases, he said that they appeared as steam. There was no doubt that some coals lose, by standing, their volatile gases more readily than others.

A paper on "Interurban Transmission" was read by Mr. W. R. Pinckard, of Chicago, which is printed on page 651 of this issue. In the discussion following this paper it became apparent that such lines had been built in several places in Illinois with marked success. Mr. Lukes, of Evanston, asked whether Mr. Pinckard would advocate the placing of both lightning arresters and transformers on a pole on a 16,000-volt transmission such as he outlined. Mr. Pinckard replied that with such a voltage he would place them in a house. Mr. Lukes raised another question as to whether a company building such a transmission line could afford to jeopardize the whole service by attempting to distribute power to various small users along the way, the income from which would be small. This question had come up with his company, and it was a serious one. Mr. J. J. Frey, of Hillsboro, whose company has operated such an interurban transmission some time and is about to start another one, said that this question of how far to cater to small users along the way was also a very serious one with them. They had a number of such on the line. Mr. E. L. Brown, of Elmwood, who has such a line, reported that he had many farmers on the line and had found the business very satisfactory. He made it a practice to set the transformers on short stub poles.

Mr. Gear, of Chicago, spoke of two 9-mile transmission lines to suburban towns which his company operated. These lines have a voltage of 8,800, and at the various suburban towns where current is required, step-down transformers giving 2,200-volt secondary current are placed on short poles, and the distribution over each town made at 2,200 volts, as in standard practice. There was no reason why two small plants should be operated within eight or ten miles of each other. President Hillman expressed the opinion that such interurban lines must come inevitably in order that the lighting of small villages might be accomplished economically. He thought there would be much development along this line.

Mr. Frey, of Hillsboro, in answer to further questions, said he had a transmission line 16 miles in length, operating at 16,500 volts. The cost of the line was about $6,000 per mile. He had secured a franchise for the pole line. Mr. Frank J. Baker, of the North Shore Electric Company, operating in the suburban districts near Chicago, said that his experience had convinced him that it was best by all means to secure a private right-of-way, as it was easier and less expensive than to secure a franchise. In Illinois such franchises require, first, the permission of all the property owners, and such permission in proper legal form is difficult and sometimes almost impossible to secure. A private right-of-way could often be purchased for less total expense. His company had several such lines and is building more.

A well-attended session was held Thursday evening, at which time Mr. F. W. Willcox, of the General Electric Company, read a paper on the new graphitized carbon filament incandescent lamps. The question of increasing the efficiency of incandescent lamps can, he said, mainly be accomplished in two ways: First, by a more intelligent use of reflectors and the proper placing of the lamps; and, second, by improvement in the filament, both of which characterize the new General Electric high efficiency lamp. Moreover, there is reason to expect an even greater increase in efficiency with low-voltage heavy filament lamps by the introduction of this new filament than in the lamps of higher voltages with smaller filaments.

Mr. Niesz, of Chicago, expressed the opinion that while the increase in efficiency may be equivalent to a reduction in rates for current, a reduction in rates does not mean a reduction in income. The cheapening of light means that more will be used and the business will be greater in the long run. In general, looking at the matter in a broad way, it is to the interests of the central station companies to introduce improvements as fast as they come out. He spoke positively and at length on these points.

Then followed a very long and animated discussion of the question of free lamp renewals. Although the majority of the members, especially of the larger companies, practice and favor free lamp renewals for customers, there were a number of officers of smaller companies present who did not believe it a proper policy for small companies. Mr. Willcox called attention to the fact that all the larger central stations of the country considered it one of the essential things in the business to renew lamps without cost for customers, in order to keep up the efficiency of the service, and that if the company did not furnish free lamp renewals, the customers would purchase the cheapest and most inefficient lamps they could get. Such lamps would remain on the circuit until they were unfit to be used, but the customers would never renew them until they were burned out. The results would be that the customers would be paying a high price for the light secured and the poor lamps would stand in the way of the giving of good service by the central-station company. The central-station company was making every effort to improve the efficiency of its apparatus all along the line and it was a serious mistake to allow the customer to stand between the company and good results with poor lamps. Some of the representatives of smaller companies persisted that they could not see why it was necessary to assume the expense of free renewals. Mr. Frank J. Baker then stated that he did not formerly believe in free lamp renewals until he had experience with a company where customers purchased their own lamps. The 16-cp lamps on the circuit were found to be consuming from 70 to 80 watts, and were being purchased at a Chicago department store. The only thing that stood in the way of large customer's bills was the fact that at the same time many of the meters were running slow. In order to weed out these low-efficiency lamps, when the meters were overhauled the practice was adopted of retailing the best high efficiency lamps at customers at 10 cents each, which effectually prevented the further use of poor lamps. One of the greatest objections to not furnishing free renewals was that frequently in a house one-third of the sockets would be out of use because of burned out lamps through the neglect of customers to purchase new lamps.

Mr. Gear described the practice of the Chicago companies in following up complaints of customers as to poor light. The first point investigated was as to whether a consumer was receiving proper voltage. Being assured on this point, the inspector would examine the customer's lamps as to dirt, inefficient globes and reflectors and other matters likely to cause poor results. Finally, if lamps were getting dim, they were replaced and the old lamps returned to the company. Lamps not burned out were tested as to candlepower and if found reasonably near initial efficiency, would be cleaned, packed up and sent out again. Many of these older lamps were used for supplying customers' demands for colored lamps by the dipping process. It was found, however, that only 10 per cent of the unburned lamps coming in under such a policy were good enough to send out again.

Mr. C. A. Vallette, of Edwardsville, still maintained that free lamp renewals were beyond the small company. Mr. H. E. Chubbuck, of LaSalle, asked why the compromise of selling the customer a good lamp at less than the cost of a poor one was not a good one for the small company. Mr. R. A. McLaughlin, of Galesburg, told how in Galesburg eighteen months ago customers' sockets were filled with inefficient lamps purchased mainly from hardware stores. The company adopted the policy of advertising lamps at 15 cents each, or less than the hardware stores could afford to sell them. The company now has the business of furnishing lamps to its own customers.

Mr. Willcox pointed out that this compromise of furnishing lamps at cost or less was better than no attempt to regulate the matter, but that if the companies sold high-efficiency lamps which would burn out in 400 hours or less, the customer would be dissatisfied at the short life of the lamp and might complain that the company was trying to get the better of him by selling poor lamps. Since lamp renewals were so small in proportion of the total expense in any event, why stop half way? Why not go the whole distance and keep customers satisfied by giving them first class service and renewing lamps free of charge? A number of smaller companies reported furnishing free renewals and much in favor of this practice. The discussion, although on a subject which is accepted as a matter of course by a majority of the larger companies of the country, was nevertheless both interesting and amusing; so much so, in fact, that those in attendance did not realize the lateness of the hour until the president announced that it was time to adjourn, at 10:40 p. m. The Illinois Association is not without its humorists and these had full swing in this lamp renewal discussion.

The president appointed as a nominating committee, Mr. X. Caverno, of Kewanee, Mr. R. S. Wallace, of Peoria, and Mr. R. H. Abbott, of Petersburg.

Friday morning the committee on insurance, consisting of Mr. J. J. Frey, of Hillsboro, and W. A. Thomas, of Abington, made its report. This committee found at the beginning of its work that there had been no new schedules for central-station risks for the past ten years. He found further that the members who had responded to the committee's inquiry had paid in premiums in the past five years, $124,105, and received in payment for fire losses $3,911. Out of the 99 companies, members of the association, 45 of those that replied carried insurance and 30 did not. The committee armed with these figures went to the insurance authorities, with the result that Mr. Townsend, who spoke the day before, had been appointed electrical inspector to investigate the matter and changes were now in progress by which insurance on central stations could, where the buildings were of fairly modern construction, be reduced from 20 to 60 per cent. The committee estimated that the changes will save the members from $60,000 to $80,000 in premiums during the coming five years. The losses on the average risk in Illinois were stated to be 55 per cent of the amount paid in premiums, while on the central-station risks the proportion of losses on premiums was ridiculously small. In the discussion which followed, it appeared from the statement by Mr. Niesz, of the Chicago Edison Company, that by some mistake the report of that company was not received by the insurance committee. That company had sustained losses amounting to only 2 per cent of the amount paid in premiums, and part of that loss was through the spontaneous combustion of stored coal in the coal pile. He moved a vote of thanks to the insurance committee for the important results it had secured, which motion was unanimously carried. The committee was continued to investigate the question of public liability and employer's insurance during the coming year.

The convention passed a vote of thanks to the officers for their efficient work during the past year and to the central station men of Peoria for the excellent way in which the convention was being entertained. The convention then went into executive session and elected the following named gentlemen as officers of the association for the ensuing year:

President, Mr. D. Davis, Litchfield; first vice-president, Mr. J. N. C. Shumway, Taylorville; second vice-president, Mr. E. L. Brown, Elmwood; third vice-president, Mr. E. McDonald, Lincoln; fourth vice-president, Mr. E. H. Gray, El Paso; treasurer, W. J. Day, Bement; secretary, Mr. H. E. Chubbuck, Ottawa. Executive committee: Messrs. W. B. McKinley, Champaign; E. G. Schmidt, Springfield; F. J. Baker, Chicago; S. S. Davis, Rock Island; E. B. Hillman, Quincy.

The convention adjourned Thurday noon in order that it might have the afternoon and evening to enjoy the entertainment programme prepared by the local central station men in Peoria. At 2 p. m. a special steamer was in waiting to take the party up to the head of Lake Peoria and return. After this a carriage drive around the city occupied the time until 6 p. m. The party brought up in time for dinner at the Country Club, situated on a beautiful spot on a bluff of the Illinois River, about four miles from the center of the city. The beautiful drive along the river bluff at sundown was enjoyed very much, but not less than the dinner which was in waiting for the entire party at the club. After dinner all were entertained by a theatre party at the Grand Opera House to see Haverly's Minstrels. All arrangements were perfectly made by F. W. Little, manager, and R. S. Wallace, superintendent and chief engineer, of the Peoria Gas & Electric Company, who were the entertainers.

Electric Power in India.

Plans are now being perfected for the generation of electric power on a large scale in the Punjab for transmission to Lahore and Amritsar, the Punjab Power Association of London having been formed for this purpose. The power is to be generated on the Bari Canal and transmitted over a distance of 70 miles to the first mentioned city and 100 miles to that named second. Coal at the points of delivery of the power now costs from $5 to $6 per ton, and it is expected that the low price at which electric power will be supplied will give a great interest to industrial undertakings at Lahore and Amritsar.

The United Provinces Power Association of London has also been formed to develop hydraulic power on the Jumna River and to transmit electric power to Delhi, 140 miles distant, and possibly to Simla, 95 miles distant in the opposite direction. Prof. Carus-Wilson is consulting engineer for the Punjab project, and Messrs. Molesworth and Roechling for the United Provinces Power Association.

Convention of the Western Association of Electrical Inspectors.

The Western Association of Electrical Inspectors, which was organized at Chicago last June, held its convention October 5 and 6 at the underwriters' rooms in the National Life Building, Chicago. Twenty-nine members were present. This organization now has 114 members, 66 of whom are municipal inspectors, 46 underwriters' inspectors and 2 inspectors in the employ of public service corporations. Since the organization meeting last June the secretary has issued eight bulletins and seven committee reports, making in all 51 pages of printed matter. Two of these bulletins called the attention of inspectors to defective material which is being offered upon the market. The other bulletins were on matters pertaining to the association.

A number of suggestions for additions to the National Electrical Code were offered by members, and after discussing these, six were recommended by the association for addition to the code. A number of reports of special committees were heard, most of which were referred back to their special committees for further action. More new standing committees were created as follows: Electric Crane Wiring, Induction Motors, Co-operation with National Electrical Contractors' Associations and Other National Bodies, and Underground Wires. The next meeting will be held at Indianapolis in October, 1906.

The officers elected last June will continue until the next annual meeting at Indianapolis. The secretary is W. S. Boyd, 382 Ohio Street, Chicago.

Indiana Independent Telephone Association.

A meeting of the First District of the Indiana Independent Telephone Association was held in South Bend on October 4 and 5, a large number of delegates being in attendance. Mr. Theodore Thorwood, vice-president of the First District, presided. Many interesting topics relating to the progress of the independent movement in the First District were discussed. Plans were perfected calculated to lead up to a further extension of lines in all localities and into Chicago. Automatic telephone service was explained and discussed, and it was decided to install this system wherever it is possible to do so. Reports were made showing a rapid growth of the independent properties in the district, there being 16,109 telephones now in use.

Among those present at the meeting were George W. Beers, of Fort Wayne, president of the Indiana Association; C. S. Norton, of Indianapolis, secretary-treasurer; and Jesse W. Weik, of Green Castle, member of the executive committee of the State Association. John O. Harney, of Cleveland, assistant secretary of the National Association was present, and gave a talk. A banquet was held at the close of the meeting.

Waterfalls in Egypt.

According to the London *Times*, the electric lighting of the Fayoum is at present under consideration by the Fayoum Local Commision. The scheme provides for the supply of electric power to the factories, established at the capital, Medinet el Fayoum. Overtures have been opened with several companies, and it is being proposed to utilize the waterfalls, situated five or six miles from the town. It may surprise even well-informed persons, including some who have visited Egypt, to learn that there is a difference in levels between the low-Nile at Howara, about 50 miles to the south of Cairo, and the Birket el Qzroun of over 220 feet. This fact was first made public by the researches of Mr. Cope Whitehouse, who has persistently sought to induce American electric companies to take advantage of this magnificent source of electric power, even without any compensation himself. The London Times also states that "irrigation works of an important nature will shortly be commenced in the Fayoum region, a large credit for which has been recently voted." If these irrigation works include the conversion of the Lulu and Raiyan depresions into storage reservoirs, the water power will represent 2,000,000,000 foot tons per day, from a fall of from 15 to 70 feet.

Central Union Telephone Meeting.

Branch managers of 26 exchanges of the Central Union Telephone Company in the northeastern part of Ohio, including the Akron district, held a meeting in Akron September 27. The object of the meeting was to afford opportunity for the managers to discuss methods for improving service, for the maintenance of plants and other topics tending toward improvement. District Superintendent F. G. McConnell presided. All the managers reported that their exchanges are enjoying an increase of business.

The next meeting of the district managers will be held in Akron about the first of the year.

CURRENT NEWS AND NOTES.

PENNSYLVANIA TO ELECTRIFY ATLANTIC CITY BRANCH.—The announcement is made that the Pennsylvania Railroad proposes to electrify one of its Atlantic City lines.

POOL ROOM OPERATION.—Both the Western Union Telegraph Company and the New York & New Jersey Telephone Company have refused the request of Police Commissioner McAdoo to aid the police in detecting pool room operations.

ELECTRIC TRACTION FOR THE ERIE.—President Underwood, of the Erie Railroad, is quoted as saying that a committee is considering the question of electrical equipment for the road's suburban service, also for the section of the line between Susquehanna and Deposit, a distance of 15 miles, where the grades are heavy.

DEATH OF MR. SABIN.—As we go to press we have received telegraphic advices of the death of Mr. John I. Sabin, one of the leaders of electrical development on the Pacific slope, and for a great many years foremost as a successful telephone manager. He was not in good health, and was contemplating a six months' European tour, free from all business.

BAD WIRE CONDITIONS.—City Electrician Corson, of Haverhill, Mass., has been investigating the condition of the police signal and fire alarm wires that were placed underground in the conduits four years ago, and he has found that the wires are in a bad condition. He reported the conditions at the last meeting of the committee on fire department and was authorized to secure estimates of the cost of reconstructing the systems. Mr. Corson has been unable to find any plans of the municipal wires that were placed under ground and he is unable to tell the exact amount of wire that will be needed to reconstruct the two systems. It is estimated that it will cost about $3,000 to reconstruct the entire system with the use of lead-covered cables.

ELECTRICITY FOR CHINA.—The following item is from the Seattle (Wash.) *Times*: "Albert C. Lee, of Providence, R. I., an electrical engineer, and Y. C. Lee, of New York, a civil engineer, cousins and both natives of China, have been summoned to Canton by the viceroy ruling that province to make the preliminary estimates for the installation of a big municipal power and lighting plant, with the probability that a system of electric railways under municipal control will follow. They sailed on the *Dakota*. The expenditure of millions of dollars to give the city of Canton a modern lighting and power plant will follow the reports of these two Chinese authorities, both of whom have been educated in this country. In fact, Albert C. Lee has been in America for thirty years, is married to an American woman, and declared to-day that he had almost forgotten his native tongue. Y. C. Lee, in America for seven years, speaks English with a fluency creditable to a native. If the city of Canton builds the big electrical plant now planned it is probable that American manufacturers will supply all materials. Albert C. Lee has worked in his profession with American goods and places the utmost confidence in them. Both men believe American electrical machinery better adapted than any other to the Chinese requirements."

THE OHIO INTERURBAN RAILWAY ASSOCIATION.—This association will hold a meeting at the Chittenden Hotel, Columbus, October 26. No definite programme has been arranged. It is the intention to discuss general plans for the future.

POWER IN PERU.—The waters of Lake Titicaca, the largest body of water in Peru, and the highest navigable lake in the world, are to be utilized for electric power development in connection with various enterprises in its vicinity, and for long distance transmission.

PITTSBURG TELEPHONE CONVENTION.—The Pennsylvania State Independent Association will hold its annual convention on November 9 and 10, at Pittsburg. A large attendance is expected. Mr. H. E. Bradley, 135 South Second Street, Philadelphia, is secretary.

NEW YORK ELECTRICAL SOCIETY.—The opening meeting of the season of the New York Electrical Society will be held at the Edison station, Twenty-seventh Street, near Sixth Avenue, Monday evening, October 23. Mr. Peter Cooper Hewitt will lecture on "Electrical Reactions of Gases."

ALBANY WIRES.—It is proposed to install an extensive conduit system at Albany, N. Y., and a sub-committee has reported on a plan for thus disposing of all the telephone and telegraph wires, taking one district at a time. Some work has already been done by the Western Union and Postal Telegraph Companies, the Hudson River Telephone Company and the Home Telephone Company.

ELECTRIFIED ITALIAN ACTIVITIES.—U. S. Consul Dunning, of Milan, reports activity in Italian industries. He says that new textile, chemical, cement, chocolate, silk, and other factories are going up all over the northern part of the peninsula, or are being enlarged. The present prosperity is doubtless due in large measure to the utilization of the waters of the Alps and Apennines for generating electricity for light and power.

BLACK SANDS.—Dr. David T. Day, chief of the division of mining and mineral resources in the U. S. Geological Survey, is now conducting an investigation of the black sands of placer mines of which there are now 8,000 in the United States. Dr. Day has received some 828 samples up to date of report from all over the country, and a laboratory is at work at the Portland Exposition. Magnetic separators are a prominent part of the apparatus.

IMPORTANT WIRELESS TRANSACTION.—The European and colonial rights of the American De Forest Wireless Telegraph Company have recently been sold to an English syndicate by Frank Z. Maguire, of New York and London. Mr. Maguire is well known in electrical circles and has been developing American enterprises abroad for a number of years past. Lord Armstrong, of the great shipbuilding concern of Armstrong-Whitworth, is the chairman of the new company, and it is understood that a number of other prominent financial men are connected with the enterprise. The patents of Nevil Maskelyne are included in the purchase. The capitalization is £120,000.

OHIO INDEPENDENT TELEPHONE ASSOCIATION.—A meeting of representatives from companies in the seventh district of the Ohio Independent Telephone Association met in semi-annual session in Lima, Ohio, October 5. Mr. D. J. Cable, of Lima, in the absence of vice-president George H. Metheaney, called the meeting to order. Independent telephone affairs were discussed, and plans broached for big improvements in individual exchanges. The district has 73 exchanges, as against eight of the Bell; and 86 toll stations, as against 76 of the Bell, while individual subscribers now exceed 22,500 offices and residences. Every company reported an increase in business for the past six months. Among those present from outside the district were F. L. Beam, of Mt. Vernon, president of the Ohio State Association, and A. D. Kramer, C. Y. McVey and M. B. Overly, capitalists of Cleveland.

FARES TOO LOW.—United States Consul Daniels, with regard to the municipal electric railway at Sheffield, writes to the Department of Commerce and Labor: "The city of Sheffield, in the management of its electric tramway system, finds itself confronted with a condition that some of the more far-seeing members of the city council (notably Sir Joseph Jonas, the lord mayor) have insisted, has existed for some time, and that condition is, despite the fact that the system has been operated at an apparent profit, while furnishing cheaper transportation than any system in the United Kingdom, due to a failure to properly charge off a reasonable amount yearly for depreciation of plant. This failure brings them face to face with the necessity of adjusting and raising the fares or operating the system at a loss, possibly, or, at any rate, no profit." This absence of a proper allowance for depreciation is unfortunately a common failing in such enterprises.

PRINTING TELEGRAPH.—The printing telegraph system of Mr. John C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, has been described in these columns. Patents on details, etc., are being issued almost every week. On October 3 a further patent was granted to Mr. Barclay on a method of avoiding sparking at the contact points of the selecting relays of his receiving apparatus. Mr. Barclay found that when the circuits controlled by the selecting relays were broken by the return of the armatures to their normal position objectionable sparking resulted at the contact points. In the patent just issued it is shown that he overcomes this objection by breaking the circuit through the contact points before the points themselves are separated. In many telegraph instruments it is customary to minimize the effects of breaking a circuit at contact points, but in this instance Mr. Barclay removes the cause of the sparking before the effects can be produced.

THE BERLIN ELECTRICAL STRIKE.—The latest information cabled to this country regarding the strike of electrical workers in Berlin is to the effect that the companies expected a complete victory. The men's main hope to compel concessions by depriving the city of electric light has been shattered by an influx of non-union electricians from the provinces, attracted by the liberal terms offered by the companies. These men, with many engineer students from the technical schools, are working under police protection. They are sumptuously fed and housed and their work has prevented any trouble to the users of electric light. A committee of the strikers appealed to Burgomaster Kirschner to mediate, but notwithstanding this 25 meetings on the night of October 3 resolved to continue the strike. These probably took heart from sympathetic strikes as Breslau and Hanover. The strikers there have been successful in interrupting the tramway service. The larger part of public sympathy is said to be with the employers, who have the reputation of treating their men well.

CABLING PEACE.—In these electric times the old slow methods of ratifying a peace are obsolete. It is announced from Washington that the treaty of peace between Russia and Japan will become effective upon its approval, without waiting the formal exchange of ratifications at Washington. This course has been decided upon that the speediest possible termination of the war may be had. The treaty, it is understood, has passed through the necessary preliminary stages of approval in each country and is now before the respective Emperors of Japan and Russia for the royal signatures. As soon as it has been signed this fact will be communicated by cable to the State Department at Washington, and the Washington Government will apprise each Emperor of the act of the other. With this accomplished the war will be at an end. The formal exchange of ratifications will be carried out in Washington as soon thereafter as the signed treaties reach here. This formal exchange will be accomplished by the drawing up and signing of a protocol or memorandum of exchange by special plenipotentiaries commissioned for that purpose. Besides signing the protocol the copy of the treaty which the Emperor of Russia has signed will be delivered to the Japanese plenipotentiary for transmission to Japan, and the copy signed by the Emperor of Japan likewise will be delivered for transfer to St. Petersburg. This act, according to present intentions, will be devoid of all formality. As yet the special plenipotentiaries have not been commissioned and no arrangements have been made for the exchange. Precedent is found for the telegraphic exchange of ratifications in the manner in which the last treaty between the United States and China was made operative.

WIRELESS BETWEEN NEW YORK AND CLEVELAND.—It is stated that wireless telegrams were successfully exchanged between New York and Cleveland, on October 6. The distance between the two cities, in a direct line, is about 550 miles.

POLICE TELEPHONES.—With the aid of the new police telephone signal boxes, operated as a part of the New York telephone system, the local police were able to catch a negro murderer in about forty-five minutes after the deed had been committed.

NEW YORK CITY LIGHTING PLANT. The Bridge Department has made arrangements with the electric lighting companies to purchase their wires, etc., on the Williamsburg Bridge, so that they will not have to be removed when the city starts to operate its own lighting plant under the bridge. This plant, which will have a capacity of 400 hp, will be ready for use soon. It will cost the city $100,000 and will utilize street refuse for fuel in the generation of steam.

GOVERNMENT WIRELESS SERVICE.—A dispatch from Newport, R. I., states that on October 6 the naval torpedo station at that point was in wireless communication with Cape Henry, Washington, Philadelphia, Salem, Boston, New York and Long Island. The tests are to continue for several days. By using a German system eighteen words a minute were received clearly and accurately from Cape Henry, a distance of 350 miles; Washington, 325 miles; Philadelphia, 250 miles, and Portsmouth, 150 miles.

ALTERNATING-CURRENT TESTING COURSE.—The evening course in alternating-current testing to be given at the Polytechnic Institute of Brooklyn will begin Thursday, October 12, at 7.30 p.m. and will extend over a period of twenty successive Thursday evenings. This course will consist of twenty elaborate tests upon rotary converters, transformers, induction motors and other alternating apparatus. Reports in engineering form will be expected of the students. The course will be under the direction of Sydney W. Ashe, who had charge of the direct-current course last year.

NEW YORK Y. M. C. A. COURSE IN ELECTRICITY.—The Young Men's Christian Association of New York City in its night school, held in the West Twenty-third Street building, gives a two-year course in electricity, the instructor being Mr. James Mason Knox. The first year course is intended for students who have had little or no previous knowledge of the subject, or whose knowledge is fragmentary or deficient in elementary principles. The second year course is designed for students who have had some experience in electrical lines. This latter course consists of a review of the elementary principles of electricity and a consideration of direct-current and alternating-current apparatus and their operation.

BIG INTERURBAN CONSOLIDATION.—A Washington dispatch states that nearly all the interurban electric railroads of Ohio and Indiana are being merged by Philadelphia capitalists. Two holding companies are to be formed, one in Ohio and one in Indiana. Hugh J. McGowan, president of the Indianapolis Terminal Traction Company, will be at the head of the Indiana holding company, and J. C. Schoepff, president of the Cincinnati Traction Company, at the head of the holding company for Ohio. About $50,000,000 is involved. The syndicate is known as the Elkins-Widener-Morgan-McGowan combination. Several central west men are associated with the Eastern financiers, among them Senator Foraker. There are about 1,200 miles of line in each State.

TELEPHONY IN MANILA.—The Philippine Islands Telephone Company, composed of leading capitalists representing large telephone and banking interests of San Francisco, is preparing to begin business in the city of Manila. A 50-year franchise has been secured. Louis Glass, general manager of the Pacific States Telephone & Telegraph Company, of San Francisco, is president, and E. C. Gee, is manager of the new company. The underground conduits are now being installed by Mr. Gee. A fire-proof building will be erected at once to accommodate the telephone exchange and offices. About 3,000 subscribers are expected at the start. The Western Electric Company has contracted to supply the common-battery multiple-switchboard plant, installed ready for use by April 16, 1906. This equipment will be made in New York and shipped via the Suez Canal. About $180,000 has been paid up on the capital stock of the company by John I. Sabin, Louis Glass, Homer S. King, W. H. Crocker, Charles R. Bishop, S. G. Murphy and their associates. Manila will be given a telephone service equal to the best in this country.

Electrical Engineers of the Times.—XXXI.

MR. CHARLES H. HINES.

Charles H. Hines was born in Buffalo, N. Y., March 6, 1865. His primary and high-school education was received at Plainfield, N. J. While following the medical course in the New York Medical College, he became interested in electricity and in 1884 he entered as a student the works of the Daft Electric Company at Greenville, N. J., where, under the personal supervision of Mr. Leo Daft, he assisted in the first commercial railway work in this country, and in equipping the cars Volta, Ampere and Ben Franklin, the latter being used in the Daft pioneer experiments on the New York elevated. From 1886 to 1891 he was in the employ of Mr. Augustus Noll and the Edison Electric Illuminating Company of New York, passing from a workman to general foreman. In 1891 he went to Salvador, Central America, where he designed and erected steam and hydraulic alternating-current plants in two cities, these being among the first electric plants installed in those countries. In 1893 he installed the city plant at Tampico, Mexico, and also in the same year that at Newton, N. J. In 1896 he became superintendent of construction for the Andrews-Ryan Company of Boston, and installed two central exchanges, at Hampton, Va., and Haverhill, Mass.

MR. C. H. HINES.

In 1898 and 1899 Mr. Hines was engaged in cable work at Santiago and Manila, and in 1901 while a constructing engineer for the General Electric Company in the foreign department, erected large plants at Charleston, S. C., and Banes, Cuba. In August, 1901, he was appointed superintendent of the electrical department of the Lorain Steel Company, remaining with that company until February, 1893, when he was appointed electrical engineer of the Canadian Pacific Railroad. While occupying this latter position he designed large plants at Montreal and Fort William, aggregating 10,000 hp, and had charge of the electrical work of 8,000 miles of railroad and two steamship lines. This position he resigned to accept employment by the Erie Railroad Company as consulting engineer and to prepare a report on equipping the Erie shops electrically. Upon the expiration of this duty Mr. Hines went to the United States of Colombia where he reconstructed the Medellin electrical generating plant. While here he became interested in gold mining and upon his return to this country was sent back as superintendent of two large gold mining properties.

Mr. Hines is an inventor in several departments of electrical engineering and has been granted patents among others on a brush holder, magazine arc lamp, reduction furnace, controller, brake, system of car ventilation and method of winding coils. He has contributed a number of articles to the technical press, dealing principally with electric power distribution in shops.

Electric Power on the Blackstone River, Massachusetts.

Blackstone River is a succession of water powers. Rising in Worcester County, Massachusetts, this stream flows about 50 miles to tidewater at Providence, R. I., with a total fall of some 600 ft. Its drainage area is not far from 500 square miles and its normal discharge seems to vary between two and three thousand cubic feet per second at a point about ten miles above its mouth. At intervals of several miles along the greater part of the length of the Blackstone, dams have been erected to develop its power for a large number of mills, most of which are devoted to some branch of the textile industries. Such a development has been made in the river close to the point where it crosses the line between the States of Massachusetts and Rhode Island, by the Blackstone Manufacturing Company, in the town of that name. This water power development differs from others along the river, however, in that electric energy is the means used for its distribution in a large plant devoted to the manufacture of cotton cloth. In this case the power house and the great cotton mill are only 600 ft. apart, and the electric distribution was adopted because of its superiority over mechanical methods.

For the purpose of this water power development a masonry dam was laid across the Blackstone River a fraction of a mile above the site of the power house (see Fig. 1) and a large storage pond was thus created. A canal brings water from this pond to the point on the river bank where the power is to be developed, and maintains there a head of 32 ft. above the river level. Between the end of this canal and the river is the power house with concrete foundation that contains arched openings for the tail water, as shown in Fig. 2. On leaving the canal water passes down through four vertical turbine wheels that set near the bottom of the pit. Each of these four wheels is 45 in. in diameter, is rated at 375 hp under the head of 32 ft., and its vertical shaft connects through bevel gears with a common horizontal shaft on the main floor of the station above. These vertical turbines and the improved Lombard governors by which their speed is regulated were made by the Holyoke Machine Company, Worcester, Mass. For the horizontal shaft to which the four turbines are geared the speed of revolution is 200 per minute, and this shaft carries the revolving magnets of an 840-kw, three-phase, 60-cycle, 440-volt generator, at one end. The entire discharge of the river is said to yield from 700 to 1,000 hp for the operation of this generator.

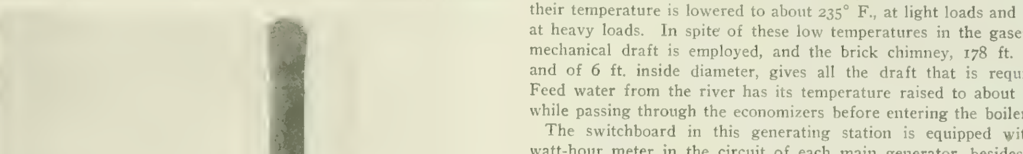


Fig. 2.—View of Combined Steam and Water Power Station.

Besides the water-driven alternator just named the same power station contains a 750-kw steam-driven generator which is used to supplement the output from water power. A cross compound horizontal engine, with cylinders of 24 and 48 in. diameter and 48-in. stroke carries the revolving magnets of this 750-kw generator between the two main bearings, and operates at 90 r.p.m. This engine was made by Filer & Stowell, Milwaukee, Wis.

FIG. 1.—DAM OF BLACKSTONE MANUFACTURING COMPANY.

Exciting current for the two alternators is supplied by two belt-driven, four-pole dynamos each rated at 22½ kw, 125 volts and 600 r.p.m. Steam for the engine just named is generated at 125 pounds gauge pressure by three Sterling boilers rated respectively at 200, 250 and 400 hp, and the engine usually operates with a vacuum of 25 in. The gases of combustion pass from these boilers to a Green economizer before they reach the chimney, and in the economizer their temperature is lowered to about 235° F., at light loads and 285° at heavy loads. In spite of these low temperatures in the gases no mechanical draft is employed, and the brick chimney, 178 ft. high and of 6 ft. inside diameter, gives all the draft that is required. Feed water from the river has its temperature raised to about 240° while passing through the economizers before entering the boilers.

The switchboard in this generating station is equipped with a watt-hour meter in the circuit of each main generator, besides the usual indicating instruments, and the electric outputs from steam and water power are recorded separately. All of the generating equipments above named are contained in a one-story brick building with a basement underneath the engine room. Between the engine and boiler room there is a heavy brick wall. The floor of the engine room is of wood, and the roof is supported on steel trusses. Pocahontas lump and slack coal is fed to the boiler furnaces by hand and a large quantity of this coal is stored below the high bank just outside of the station. This coal is now carted from the railway, but later a spur track will bring it to the storage space. From the power station to the large cotton mill where electric energy is used in motors, a distance of about 600 ft., there are two three-phase, 400-volt circuits made up of bare copper cables supported on wooden poles. Each of these cables has an area in cross section of 600,000 circular mils.

The mill in question is a brick building with three stories and a basement and is devoted to the manufacture of cotton cloth and sheetings. On the several floors the processes by which raw cotton is converted into finished goods are operated entirely with electric power. For the transformation of the electric to mechanical power, 440-volt, three-phase induction motors are employed. These motors are suspended from the ceilings and are connected by belts with the long lines of shafting that drive the looms and other machinery.

On the first floor of the mill, which is devoted to weaving, the looms are driven from motors and shafting on the basement ceiling, so that the space above the looms is clear of belts. Power for the entire mill is supplied by sixteen induction motors that range from 15 to 150 hp in individual capacity, and have a combined rating of 1,365 hp. The list of motors includes four of 150, eight of 75, three of 50 and one of 15 hp.

Spinning and weaving operations offer a more constant load than that in many other lines of manufacture, and as the entire output of the power plant is metered in this case it is possible to determine the ratio between the average rate of energy consumption and the total motor capacity. This ratio may be found either for the motor rating, which represents the capacity to deliver mechanical power, or for the capacity of the motors to absorb electric power, which involves their efficiency. Of these two ratios the one involving the efficiency of the motors in the way just stated is the more useful for some cases, but the ratio between motor rating and the average power consumed is sufficient for present purposes.

As all the motors in the cotton mill have a combined rating of 1,365 hp, it is evident that if operated at full and constant load they would do 1,365 hp-hours of work per hour. To do this work the motors would necessarily absorb more than the equivalent amount of electric energy, because of their internal losses, but the energy actually received by the motors would cover all losses as well as the mechanical work delivered.

With these principles in mind it is instructive to compare the electric output of the power station with the motor rating during certain periods of operation. For this purpose the output of the power station is taken during each of four recent consecutive weeks. During the earliest of these weeks the mill operated 58 hours and the total output of the power station was 55,330 kw-hours, so that the average load was 953.9 kw, or 1,278.6 hp. As the motors are rated at 1,365 hp, it follows that the average rate of consumption of energy by the motors during this week was equal to 93 per cent of their total rating. This includes the small loss in the distribution circuits.

During the second week the mill again operated 58 hours and the output at the power station was 55,600 kw-hours, amounting to an average of 958.6 kw, or 1,284.9 hp of load. The motors during the working hours of this week, therefore, absorbed energy at an average rate equal to 94 per cent of their rating. In the third week the mill operated 47.5 hours and the entire output at the power house was 42,320 kw-hours, corresponding to an average load of 890.9 kw, or 1,194.2 hp. This average load was 87 per cent of the motor capacity. Operating time for the mill in the fourth week was again 58 hours, and the electric generators delivered 49,350 kw-hours through the meters, representing an agerave load of 850.8 kw, or 1,140.4 hp. In this case the average load was down to 83 per cent of the motor rating.

It may be suspected that the lower percentages of average loads to motor capacity in the two weeks last named was due to the non use of a part of the mill machinery, but this cannot be definitely stated. Where electric energy is to be purchased by meter for the operation of a large equipment of motors, data of the sort just considered aids materially to determine the amount that will probably be consumed, in any given class of work.

By means of the watt-hour meters in the circuit of each generator at the power station, independent records are kept of the energy outputs from steam and water power. As the company controls the entire discharge of the river, the rule is to utilize all the available water, and to use only as much steam as is necessary to meet the additional demand for power. During the earliest of the four weeks above named, the generator driven by water power delivered 69 per cent of the entire electric output of the station. For the following week water power did 65 per cent of the entire work. Water was falling in the river at this time and in the third week it carried only 53 per cent of the average load. In the fourth week the percentage of the electric output developed by water power was 51. These weeks are taken in one of the dryest times of the year, and it seems probable that in some months much larger parts of the entire load might be carried by water power.

During the week above named, when water developed 69 per cent of the total electric output, the work done by the water power was 38,540 kw-hours, which corresponds to an average load of 664 kw, or 890 hp. This power is developed by about 246 cu. ft. of water per second falling 32 ft., and if the combined efficiency of the penstocks, turbines, gearing and shafting, and generators may be taken as 65 per cent, then 379 cu. ft. of water per second would be necessary to develop electric energy at the rate of 890 hp.

All of the electric equipment above named was manufactured by the Westinghouse Company. The description of this interesting distribution of electric water power has been obtained through the courtesy of Mr. George E. Spofford, superintendent of the Blackstone Manufacturing Company, of Blackstone, Mass., and Providence, R. I.

Central Station Management.

Under the head of "Management" the "Question Box" of the National Electric Light Association gives in 21 printed pages answers to 19 queries relating rather to the technical than the business side of central station management.

Seven replies are given to the question whether a day service is justifiable in a small town, what kind of power business can be worked up in such a place, and what system of charging should be applied. One answer is "No"; another that a power service would not pay in a town under 5,000 population, and a third that it would not pay in a residential town. One answer gives the caution that any company seeking power business should be very careful not to take on power that will lap over into the lighting period too much in the winter. Another states that the class of power business in such plates is apt to be intermittent service for very small users, and even at a relatively high rate the total income would not be sufficient to warrant the expense of carrying the business. Where motors are very small or the use is intermittent a 10-cent rate should be low enough, and a 5-cent rate should be the very lowest limit. Two of the answers state that the rate will depend entirely upon the hours the power is used and upon the operating expenses of the plant, and one suggestion is for a sliding schedule of rates the same as for lighting, but less by the cost of lamp renewals.

The matter of thawing out frozen water pipes was the subject of five replies, and in each instance it was stated that this work was found profitable. In one case a water barrel resistance was used with a 15-kw, 2,000-100-volt transformer, the secondary main being a No. 4 wire. By this arrangement pipes varying from ¾ to 5 in. in diameter were thawed out. The standard charge was $7.50 for each pipe, but if two houses were on the same service a reduction was made. The average return after deducting the entire labor charge was something like 50 cents per kw-hour. While the above-mentioned arrangement worked well, another is recommended, consisting of a 10-kw transformer with a secondary wound for 50-100-200 volts, together with a reactance coil for 250 amp. In another case a transformer was used, giving 55 volts in the secondary, with reactance coils for control; with this pressure any ordinary ¾-in. iron service pipe about 125 ft. long will be thawed out with 135 amp. in from four to eight minutes. A direct-current station used an automobile charging rheostat for short lengths of pipe and a water rheostat for larger lengths, the voltage being 110 and 220. One of the contributors recommends that there should always be an ammeter in circuit and that judgment must be applied in determining how much current may be safely used at any particular place. The New York Edison Company reported that the electric current is the quickest and cheapest one for thawing out pipes and the results are very satisfactory. When the current was taken from the New York distributing system a water rheostat was used, and when storage cells were used they were variously connected so that different voltages could be applied to the frozen pipe.

The following query received six replies: "Will a small central station with no day circuit, and operating at 1,100-52 volts at 125 cycles, be warranted in changing over to 2,200-230-115 volts, 60 cycles, the transformers being old, but the wattmeters comparatively new and of the commutator type?" Two of the replies are in the affirmative, two in the negative and two are qualified. One of the former is in the affirmative, provided the plant is a growing one, and another that the change would be advisable, the old wattmeters being suitable for the higher frequency. Another reply advises scrapping the old transformers or placing the primaries of two transformers in multiple and the secondaries in series, thus getting 104 volts and using two-wire secondaries instead of three-wire, as proposed. Another reply is that the change could be made by simply purchasing new transformers. Two of the replies state that there is no advantage to be gained by changing over from 125 to 60 cycles. One of these adds that transformers are more efficient at 125 cycles than at 60 cycles, and another implies that the reverse is true. It is also stated that a 50-volt commutator meter can be changed to 100 volts at a cost of $6 each. An inquiry as to what charge should be made for inspecting the wiring in a house which was wired when built, but to which current is not supplied until several years later, brought out four replies, none of which favor any charge. As to inspection, in one case this is done by the central station for the underwriters. Another advises the maintenance of an inspection system unless this is provided for by the municipality or underwriters or both; and a third that the company should examine all wiring independent of the underwriters.

A question as to whether a central station in a town of 10,000 people should do the house wiring and deal in fixtures brought forth nine replies, of which only two were in the negative, two were non-committal and the other five strongly in the affirmative. Of seven replies to an inquiry as to the advisability of charging a 5 per cent penalty for non-payment of bills in ten days from their date, five are unqualifiedly in the negative; one company reports that it charges at least a 10 per cent penalty for non-payment of bills after ten days from date, and another that a cash discount of 10 per cent on all bills paid before the 15th of the month is the most satisfactory method of bringing about prompt collections. Most of those replying in the negative state that it is illegal in their States to charge penalties for non-payment of bills.

An example of the little attention paid by central stations to systematic methods for obtaining new business is given in the fact that not a single reply was received to a query asking what percentage of income is spent for soliciting and advertising. The charge for cutting of wires and interruption of service by the moving of houses was the subject of seven replies. One central station always moves its wires free of charge when in the way of moving buildings or when trees are taken down; another always renders bills for this work, but in no instance has it been found possible to collect them, notwithstanding that an ordinance had been passed in favor of the central station. In another case all time over two hours at each crossing is charged for. In the case of the other station's reporting, a charge is made to cover the expense and no difficulty has been found in collecting the bill.

An interesting subject was brought up in an inquiry asking if an electric light company with a 20-year franchise granting the use of one side of alleys for the erection of pole lines can prevent any other company, either lighting, telephone or telegraph, from using the same side of the alley by placing its poles between its wires. One reply is that if the second company receives a franchise to erect poles and string wires, it would seem that the first company did not have an exclusive franchise, and it is, therefore, apparently unable to prevent the second company from erecting poles between its wires and stringing wires above or below. The first company, however, should be able to claim damages for any injury done to its poles, wires or service by the second company. Another answer is that if the company can prove that the new company has entered its property, limited its capacity or in any way injured its service or its employes, the courts would doubtless give redress. The advisability of charging for the fittings of the "Meridian" lamp was the subject of five replies. In one case the fittings are given free of charge; in two cases the first fittings supplied are free and renewals charged for, and the advice of two others who submit replies is to charge for the fittings.

The query "Who pays for the street connection, the electric light company or the consumer?" received 14 replies, are unanimous in the opinion that the lighting company should stand the expense. Free commercial arcs and rates for the same was the subject of 11 replies, every one stating that the practice of the writer's company was to furnish arc lamps for commercial lighting free, the lamps remaining the property of the company. In two cases the wiring is charged for, but in all cases there is no charge for keeping the lamps in repair. In only one case is a flat rate charged, in all others the rate being on a meter basis. An inquirer who wishes to know under what conditions a small central station at present equipped with 133-cycle apparatus would be justified in changing over to 60-cycle apparatus is informed in three answers that the change would only be justified in case a power load can be worked up. One answer qualifies this with the statement that an inductive load of arc lamps for small motors might give rise to a serious reactive drop with 133 cycles, while on the other hand Nernst lamps appear to have a longer life on 133 cycles than on 60 cycles. A single answer to a query on the subject of recruiting central station employes states that the best method is the apprenticeship system. By this system the young men secured can be made to serve in the various departments, say six months in each, the salary being increased as they become more efficient. The apprentices should at least have entered a high school prior to employment.

A question of policy is discussed in reply to a query asking if it is advisable to make a rebate to hold a consumer in case of a disputed bill, it being known that the meter and meter readings are correct. The majority of the 9 replies strongly advise to stand by the record. Several answering are, however, of the opinion that rather than lose a profitable customer it is advisable to propitiate him by according a rebate. As to whether it is good practice to insist on deposits from all consumers, irrespective of their responsibility, 9 opinions are expressed, only one of which is unqualifiedly in favor of demanding deposits from all consumers; a second favors the practice with a few exceptions owing to the profit from the interest on the deposits, but all others condemn the practice of exacting deposits from responsible customers. Another question of policy came up in connection with an inquiry as to the practice of central stations with respect to turning current on an installation which has not been properly made, but which has been passed by the city inspectors. Two of the three answers favor making a protest in writing; the third says that the test should be as to whether the installation would endanger the company's lines or apparatus.

District Electrical Supply.

In a paper read last week before the Illinois State Electric Association, Mr. W. R. Pinckard discussed the subject of the transmission, from existing central stations, of electricity for power and lighting to be used in small towns and rural communities, from the standpoint of the smaller central stations in cities of from three to ten thousand inhabitants, assuming that their systems are generally single-phase, with a frequency of 7,200 or 16,000 alternations, and not treating the question of transmitting large amounts of current by the two or three-phase system at very high voltages for power purposes.

Almost the entire territory of the State of Illinois presents attractive opportunities for the expansion in this direction of the type of plants referred to. It is probably true that where water power is available, current for power and lighting can be distributed over a wide territory at a cost which could not be met by steam power under ordinary conditions. However, there are central stations favorably located for fuel at a low price, with ample water for steam and condensing purposes, which might find it profitable to transmit current within a radius of about twenty miles, for the purpose of supplying outlying communities of from 200 to 2,000 inhabitants, and, possibly, also furnish large farms along the transmission line with current at profitable rates for lighting and power. This idea is now being tried in several localities in this state, two of which are quite ambitious, but they are neither of them yet in operation, though they probably soon will be. In one case the objective point is a town of about 1,500 inhabitants, sixteen miles from the central station. This place has a steam plant in which everything inside the station will be abandoned, with the exception of the switchboard. Thereafter the series alternating current street arcs and the incandescent lighting for tories and residences and such motor service as may be secured, will be supplied by the central station sixteen miles away. It is commonly accepted as the rule that the voltage on such a line should be at the rate of about 1,000 volts per mile of line or circuit; therefore, in this case, the power is to be transmitted at 16,500 volts.

With such a business as a nucleus it gives the central station access to some other business adjacent to its transmission line. There are in many localities, progressive farmers who desire the convenience and safety of electric light in their homes and barns and such service could be supplied to them without entailing too great a cost for apparatus, since a transformer is all that would be required. Mr. Pinckard cited one instance in the state where there is a large dairy farm provided with an electric light plant of its own, driven by a gasoline engine and furnishing current for about 200 incandescent lamps. The engine is used during the daytime for grinding feed, pumping water and other power required about such an establishment. The owner would be glad to take current from an interurban line, should there be one near by, as the use of the gasoline engine is dangerous and requires the services of an expert to keep it in order. In addition to the lighting it might be found profitable to furnish such farmers with the power required in threshing, shelling corn, sawing wood, etc.

Several manufacturers of transformers now furnish, as a standard line, oil insulated transformers in sizes from 1 to 50 kw for 3,300, 6,600, 11,000 and 16,500 volts primary, arranged for either 1,100 or 2,200 and 110 or 220 and 220 or 440 volts on the secondary side; therefore, being standard, they can be secured within a reasonable time and at a reasonable price. However, owing to the necessity of providing insulation required for the high voltage, the cost of such transformers is considerably higher than those wound for only 1,100 or 2,200 volts primary. Some of these transformers are provided with multiple ratio taps; so that the secondary e.m.f. can be raised 5 or 10 per cent, thus compensating for that amount of drop in the line. The step-up and step-down transformers at the ends of the line should be located in substantial, fireproof buildings, wherein should also be installed the necessary lightning arresters and such switchboard apparatus as may be required. Intermediate transformers along the line may be suspended from poles in the usual way, but on lines above 6,600 volts the fuse boxes are not made for outdoor service and would have to be mounted under cover.

The line should be of bare copper, and great care should be exercised in the selection of poles, cross arms and insulators. The poles should, of course, be so placed and of such a height that they would clear all trees and, where necessary, the limbs of the trees should be cut away so that they would not come in contact with the lines.

Another important point to consider is the protection of such a line from injury by lightning. For this purpose several manufacturers furnish lightning arresters for the protection of high-voltage transformers and these should be installed in all cases. One arrester would be required for each line of the circuit and at each end of the circuit on the high tension side. If there are transformers located along the line they, of course, should also be protected. It should be borne in mind that the most expensive lightning arrester affords no protection without a good ground connection.

There are other factors to be considered under certain circumstances. For instance, "when more than one transmission line is strung on the same poles the alternating-current in each line induces e.m.f's in the other lines and affects the line drop. This interference of one line upon another is, however, obviated by crossing or transposing the lines at frequent intervals." Some engineers, however, do not recommend this practice. Another consideration is the power factor of the load. In the case of incandescent lighting only, this amounts to practically unity and need not be considered, but in the operation of alternating-current arc lamps and motors, creating a low power factor on the line, it would have to be taken into consideration. Core loss, efficiency and regulation of transformers should also receive consideration.

To enter this line of work will probably necessitate an increase in present central station equipment and a considerable investment in the necessary transformers and pole line, and to what extent it is profitable to do this depends upon the revenue to be secured. It is a subject well worthy of study by any who may have reached the limit of business in their own community and who find it necessary to go outside after more business or else be content with what they have.

◆

The Design of Multiple-Coil Windings.

By Charles R. Underhill.

Among the several methods of winding electromagnets so that the sparking due to self-induction shall be minimized, the best two are what are known as the differential winding and the multiple-coil winding. This does not refer to external methods of compensation.

While the differential winding (of which there are two classes) is very effectual in suppressing the "sparking," the winding is not very economical for continuous duty, as only one-half of the winding is available for magnetizing the core. However, the differential winding is less expensive in first cost than the multiple-coil winding, for a given voltage, as much coarser wire and less turns are used in the former than in the latter.

The extreme commercial condition for the multiple-coil winding is illustrated in Fig. 1, where the respective ends of each layer are all connected together. Since in this type of winding the full voltage is across each of the multiple wires or separate coils, this arrangement is not practicable for comparatively high voltages on coils of moderate size, as the wire in each layer would have to resist the full line voltage without overheating. This applies most fully to the first or inner coil, which having the least resistance must pass the most current.

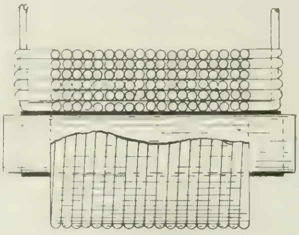


FIG. 1.—WINDINGS WITH LAYERS CONNECTED IN MULTIPLE.

The principle of the multiple-coil winding is that the inner turns (or separate coils) have less resistance, but a greater coefficient of self-induction than the outer turns, owing to the different diameters of the inner and outer turns, and hence the time constants of the separate windings are different.

For electromagnets three or four inches in length by two or three inches in diameter, to operate on 110-volt, direct-current circuit, the writer has had excellent results from six separate windings per spool, wound over each other, and connected in multiple as in Fig. 2. While Fig. 2 shows the terminals at opposite ends of the bobbin, by making the layers even in number, the terminals may all be brought out at the same end of the windings, as in Fig. 3. This arrangement produces the same general effect as six layers of coarser wire, with a corresponding decrease in voltage, and therefore is just as efficient, with the exception that there will be less copper in the fine wire winding owing to the greater ratio of insulating material on the fine wire. This ratio is illustrated in Fig. 4.

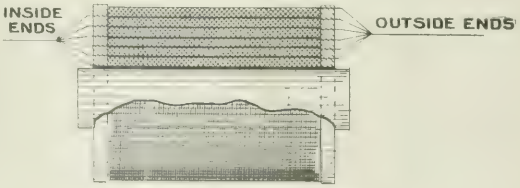


FIG. 2.—MULTIPLE-COIL WINDING.

In order to ascertain the safe current carrying capacity of the winding, a plain or regular winding may be assumed. As an example consider the bobbin in Fig. 5. The winding is to be connected directly across 110 volts direct current, and will be in use at such intervals that a radiating surface of 2 sq. in. per watt (not considering end areas) will be sufficient to prevent an unsafe rise in temperature. The superficial area will then be $\pi D L$, in which D is the outer diameter of the winding in inches and L is the length of the winding, also in inches. Therefore, in this case $\pi D L = 3.1416 \times 2.5 \times 3.5 = 27.5$ sq. in., and hence $\frac{27.5}{2} = 13.75$ watts will be permissible for the winding. The resistance of the winding will then be $R = \frac{E^2}{W} = \frac{12{,}100}{13.75} = 880$ ohms.

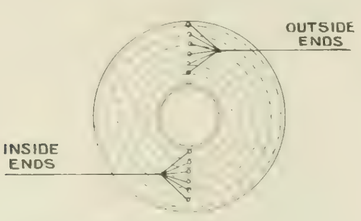


FIG. 3.—TERMINALS ON SAME END OF COIL.

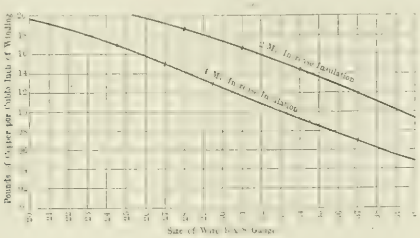


FIG. 4.—RELATIVE WEIGHTS OF COPPER IN DIFFERENT SIZES OF INSULATED WIRE.

Referring to Fig. 6, M is the mean or average diameter of the entire winding space, and Ma, Mb, etc., are the average diameters of the coils constituting the multiple-coil winding. Therefore, M also represents the average of the mean diameters of the coils a, b, c, etc. If all the coils were of the same diameter, and hence of the same resistance, the joint resistance would be proportional to $\frac{M}{n}$, where n is the number of coils, 6 in this case. Although the mean diameters Ma, Mb, etc., are variable, they vary in a direct ratio to one another, and therefore by comparing $\frac{1}{n}$ of their "average mean diameter" with their "joint mean diameter," we may obtain a basis from which to compute the proper wire to use which shall give the desired resistance when the coils are connected in multiple. $\frac{1}{n}$ of the average mean diameter $= \frac{M}{n} = \frac{1.75}{6} = .292 = Ma$ (see Fig. 6). The joint mean diameter will be

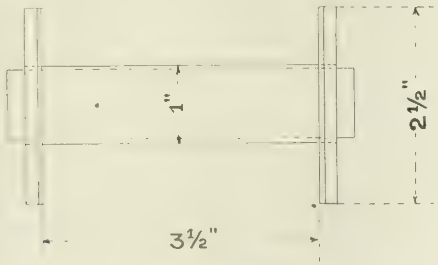


FIG. 5 BOBBIN.

$$Mj = \frac{1}{\frac{1}{Ma} + \frac{1}{Mb} + \frac{1}{Mc} + \frac{1}{Md} + \frac{1}{Me} + \frac{1}{Mf}} \qquad (1)$$

$$= \frac{1}{.889 + .727 + .615 + .533 + .471 + .421} = \frac{1}{3.656} = .274$$

Therefore, the ratio will be $.274 : .292 = .94 : 1$, which means that the joint resistance will be .94 times $\frac{1}{n}$ of the average resistance of the coils, and since this latter is

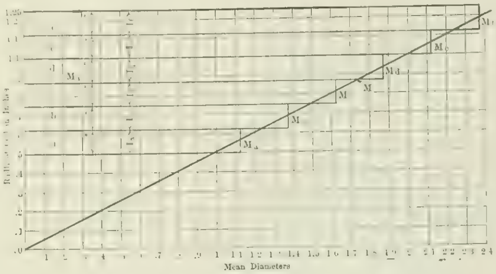


FIG. 6.—MEAN DIAMETER OF MULTIPLE-COIL WINDINGS.

$$Ra = \frac{Ra + Rb + Rc + Rd + Re + Rf}{n^2} \qquad (2)$$

the joint resistance

$$Rj = \frac{Mj\,(Ra + Rb + Rc + Rd + Re + Rf)}{Ma\, n^2} = \qquad (3)$$

$$\frac{.94\,(Ra + Rb + Rc + Rd + Re + Rf)}{n^2}$$

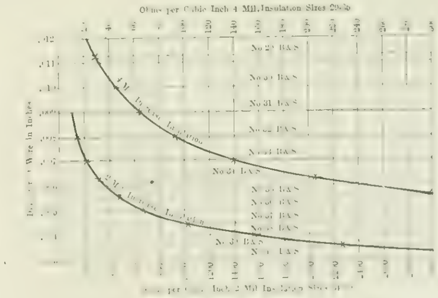


FIG. 7.—OHMS PER CUBIC INCH OF WINDING.

and since $Rj = 880$ and $n = 6$,

$$(Ra + Rb + Rc + Rd + Re + Rf) = \frac{880 \times 36}{.94} = 33{,}700;$$

therefore, the ohms per cubic inch $= \frac{33{,}700}{14.4} = 2{,}335$, which corresponds very nearly to No. 39 B. & S. wire with 2-mil insulation. (See Fig. 7.)

If paper is inserted between the coils and varnish used, a No. 39 B. & S. wire with 1.5-mil silk insulation would meet the requirement. Therefore, assuming the ohms per cubic inch to be 2,335.

and calculating the volumes of the coils separately, which are found to be 1.55, 1.89, 2.23, 2.58, 2.92 and 3.26 cu. in., respectively, the resistances will be 3,620, 4,410, 5,210, 6,020, 6,820 and 7,610 ohms, respectively. Their joint resistance will then be:

$$\frac{1}{\frac{1}{3620}+\frac{1}{4410}+\frac{1}{5210}+\frac{1}{6020}+\frac{1}{6820}+\frac{1}{7610}}$$

$$\frac{1}{.000276+.000226+.000192+.000166+.000147+.000131}$$

$$\frac{1}{.001138} = 880.$$

Now also the ratio

$$\frac{Mj}{Ma} = \frac{Mj}{\left(\frac{M}{n}\right)} = \frac{Mj\,n}{M} = \frac{n}{M\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)}; \qquad (4)$$

and since $(Ra + Rb + Rc + Rd + Re + Rf) = Rs$, (5)

$$Rj = \frac{n}{M\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)} \times \frac{Rs}{n^2} = \frac{Rs}{Mn\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)}; \qquad (6)$$

and hence

$$Rs = Rj\,Mn\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right). \qquad (7)$$

Therefore, to calculate the ohms per cubic inch, Rv direct, use the formula

$$Rv = \frac{Rj\,Mn\left(\frac{1}{Ma}+\frac{1}{Mb}+\frac{1}{Mc}+\frac{1}{Md}+\frac{1}{Me}+\frac{1}{Mf}\right)}{V} \qquad (8)$$

where V is the value of the total winding space in cubic inches.

In practice, paper or other insulating material is placed between the separate coils, since the total voltage is between adjacent coils, and hence the space occupied by the paper or other insulating material must be deducted from the total winding volume. It will be observed that the resistance of the inner coil, *a*, is only 3,620 ohms, while that of the outer coil, *f*, is 7,610 ohms, which is more than twice the resistance of coil *a*; therefore, there will be generated in the inner coil, *a*, twice as much heat as generated in the outer coil, and hence if the proper resistance is not provided, coil *a* will get very hot unless there is a sufficient mass of core material to conduct away the heat to be radiated from the frame.

Instead of calculating the "ohms per cubic inch" for the wire used in the multiple coil winding, a regular winding of one coil may be assumed, and the diameter of the wire Δ found by comparing the "ohms per cubic inch" with the diameter of the wire in Fig. 7.

The diameter of the wire for the multiple winding will then be

$$\Delta s = \frac{\Delta}{\sqrt{n}} \qquad (9)$$

As this is only an approximate method it is best to assume 4-mil insulation for the regular winding, and 2-mil or 1.5-mil insulation for the multiple-coil winding. To determine the proper size of wire (4-mil increase insulation in this case) the "ohms per cubic inch" must now be found, which of course are equal to the resistance divided by the volume of the winding in cubic inches.

The volume of the winding (see Fig. 5) will be $\pi M L T$, where M is the mean or average diameter of the winding and T is the winding thickness or depth.

In the case considered $\pi M L T = 3.1416 \times \left(\frac{2.5+1}{2}\right) \times 3.5 \cdot \left(\frac{2.5-1}{2}\right) = 3.1416 \times 1.75 \times 3.5 \times .75 = 14.43$ cu. in., and the "ohms per cubic inch" will be $\frac{880}{14.43} = 61$. A glance at Fig. 7 shows that the nearest B. & S. copper wire with 4-mil insulation is No. 31.

Formula (9) is derived from the fact that in any case the resistance per unit volume for any wire is inversely proportional to the fourth power of the diameter of the wire. (The presence of the insulation varies this somewhat as Fig. 4 will show, so formula (9) is only approximate.) And since $Rs = n^2R$ (approximately), $\Delta s^4 = \frac{\Delta^4}{n^2}$, where $\Delta s = \frac{\Delta}{\sqrt{n}}$.

Here Δ is the diameter of the wire in the regular winding, and Δ*s* represents the diameter of the wire in the multiple-coil winding.

This may be verified by referring to the examples worked out, and to Fig. 7.

* * *

Rise of Niagara Power.

HYDRAULIC developments for power purposes about Niagara Falls represent neither an invention nor a revolution, but a growth. Substantially every type of hydraulic construction in the great plants now nearing completion has had a forerunner on an humble scale. Wheel pits and tunnels, canals and pipes, horizontal wheels and vertical shafts, stations above the falls and stations in the gorge below, have been repeatedly constructed on different scales as the engineering arts and the methods of power distribution have advanced.

Perhaps the first industrial application of Niagara power was that in the sawmill built by the French in 1725, on the New York bank of the river near the upper rapids, for the purpose of making lumber to be used in Fort Niagara. From the date just named down to about 1800 sawmills appear to have been constantly in use along these rapids. Augustus Porter built a sawmill on the New York bank of the upper river in 1805, and two years later Porter and Bacon erected a gristmill near the same location. It seems probable that small heads of water were obtained at these mills by means of short canals approximately parallel with the river bank. From about 1822 to 1885, in which latter year the mainland opposite Goat Island was taken as a part of the New York State Park, a canal ran from near the head of the upper rapids down toward the American Falls, and mills were built between this canal and the river. In these rapids there is a fall of about 50 feet, and a part of this head was utilized by taking water from the canal to the wheels, and then discharging it into the river above the falls. Bath Island lies between the New York bank and Goat Island, and was the site of a paper mill as early as 1825. This mill, destroyed by fire in 1858, was replaced by another which met a like fate in 1882, and the third mill seems to have been in operation on this island when it was taken for the state park in 1885. Five tons of paper was the daily production of the second mill. The third mill had turbines of 400 hp capacity. The head of water for these wheels could have been no more than the fall of the rapids along the sides of this small island. As late as the year last named there was standing between a canal and the river, a little above the Cataract House, a gristmill of Witmer Brothers, built in 1822, which operated with three turbine wheels. Not far from the Cataract House a wing dam ran out into the rapids and diverted water into a short canal, as late as 1882, and between this canal and the river were several mills with turbine wheels that had an aggregate capacity of at least 525 hp. The largest of these mills was that of Hill & Murray, where 10 tons of wet pulp were manufactured daily with the aid of turbines of 400-hp capacity. From this same canal, in 1879, water began to be taken to operate a Brush arc dynamo with a capacity for twenty 4,000-cp lamps. The dynamo was driven by a 33-in. turbine wheel of 36-hp capacity under the water head of 12 ft. Prospect Park and the Falls were lighted by arc lamps equipped with reflectors and connected to this dynamo. Thus it seems that before 1885, when the state park displaced most of these mills, the rapids above the American Falls were operating turbines with a total capacity of about 1,000 hp, at heads much less than the 50 ft. which these rapids might have been made to furnish. Water used for this power development was returned to the river above the crest of the Falls. Meantime the diversion of water above the Great Cataract, and its discharge into the gorge below for power purposes, had already begun. As early as 1842 Augustus Porter proposed a canal to lead water from the upper Niagara River to the gorge, and in 1853, the Porter family granted the Niagara Falls Hydraulic Co. a plot of land having a frontage of 425 ft. on the upper river, extending for nearly a mile along the Gorge below the Falls, and with a width of 100 ft. in a strip 4,400 ft. long between these river frontages. The object of this grant was to secure the construction of a canal from a point above to one below the Falls, so that mills might locate at the lower end of the canal and have a high head of water. Excavation of this canal began with a celebration in 1853.

Completion of the work was delayed for lack of funds, but Horace H. Day secured the property in 1860, and, on July 1, 1861, finished the canal with a length of 4,400, a width of 36, and a depth of 8 ft. This canal terminates in a basin near the top of the Gorge with a water surface of 210 ft. above that of the river below. Further development was arrested at this time by the Civil War, and it was 1870 before any of the great power thus made available was utilized. About that time the Gaskill gristmill was built at the lower end of the canal. This mill appears to have been equipped with turbines of 100-hp capacity under not less than 25 ft. head. In 1877 the canal just mentioned and the river frontages at its upper and lower ends were purchased by the Niagara Falls Hydraulic Power & Manufacturing Co., and Schoellkopf & Matthews began the erection of a flour mill to utilize a part of the power in the same year. This mill was located at the top of the cliff near the lower end of the canal, was 64x126 ft. on the ground in its main part, six stories in height, and was equipped with two American turbine wheels with a combined capacity of 900-hp under a head of 50 ft. Water was carried down to these wheels through a boiler-iron pipe 9 ft. in diameter, and this development had the highest head and the greatest power capacity of any that had been made at Niagara Falls up to that time. The original Gaskill mill, that of Schoellkopf & Matthews nearby, and all those erected at the end of the canal in question for about twenty years utilized the water power by sinking wheel pits in the cliff and then excavating a nearly horizontal tunnel from the bottom of each pit to the face of the cliff in the Gorge. Turbine wheels were located at the bottoms of these pits, the water from the canal after passing through the wheels was discharged from the tunnels, and a vertical shaft from each wheel delivered its power at the top of the cliff. All of these wheel pits were excavated before turbine wheels for heads of 100 ft. and over could be readily procured, and the depths of the pits ranged approximately between 25 and 90 ft. Water being thus discharged into the Gorge high up on the face of the cliff, the greater part of the power that might have been obtained from it was wasted. In 1881, one of the wheel pits in question was sunk to a depth of 86 ft. below high water level in the canal, and was given an area of 20x40 ft. From the bottom of this pit a tunnel 160 ft. long and 10x6 ft. in cross-section was cut to the face of the cliff. In the pit three 45-in. turbine wheels were placed, and each of these wheels, rated at 1,000 hp, was supplied with water through an iron penstock seven ft. in diameter. About one year earlier than this, in 1880, the Cataract Manufacturing Co. installed a 48-in. American turbine in a pit of sufficient depth to give a water head of 83 ft. to furnish 1,300 hp for the manufacture of wood pulp. The two wheels first installed quickly broke under the head just named, but the third was of much greater strength and able to withstand the pressure. For this 48-in. wheel a circular pit 8 ft. in diameter was excavated through the rock, and from the bottom a tunnel 6 ft. in diameter was cut to the face of the cliff. The wheel was placed on the ledge at the bottom of the pit, which filled with water during operation, and the vertical shaft was braced at intervals by stays across the pit. A distinct advance in the use of high water heads at Niagara Falls was made in the two pits last named, and what was there done has been repeated on a larger scale in some of the recent power work. A number of pits besides those named were sunk from time to time along the top of the cliff at the lower end of the canal, and the discharge from their tunnels creates a miniature Niagara even to this day.

During the winter, water falling from the tunnel outlets freezes before it reaches the river, and forms a small mountain of ice in the Gorge. In 1899 the aggregate capacity of the water wheels supplied by the canal and mechanically connected to the machinery of manufacturing plants along the cliff was 7,523 hp.

Among these plants was that of the Cliff Paper Company, especially notable as the first to utilize substantially the entire head of Niagara Falls, and the first to be located in the Gorge. This company operates a paper mill at the top of the cliff, and a pulp mill at its foot, at the edge of the river. After passing down a wheel pit in the cliff and driving turbines under a head of 75 ft., the water for the pulp mill goes into an iron penstock and drops another 125 ft. to horizontal Leffel wheels that develop about 2,500 hp. From the tail race of these wheels the water flows directly into the river. This pulp mill in the Gorge was erected and operating before either of the great electric stations at Niagara Falls were built, and prior to 1895, only two of these stations, one on the American and another on the Canadian side of the river, have since followed it to the foot of the cliffs. One of these stations, that of the Niagara Falls Hydraulic Power & Manufacturing Co., close to the pulp mill of the Cliff Paper Co., began to generate electric power in 1896, with horizontal turbines operating under a water head of 210 ft. from the canal above. This was the first electric station to locate in the gorge.

During the previous year another plan for the development of power with the combined head of the Falls and upper rapids had been carried to completion in the plant of the Niagara Falls Power Company. Between 1883 and 1885, Thomas Evershed, an engineer engaged in the survey of the Niagara Falls Park Reservation, proposed a tunnel running beneath the city of Niagara Falls, and a system of canals and wheel pits, for the purpose of power production. The tunnel was to have a length of about 2.5 miles, was to connect with smaller tunnels, and was to vent at water level in the Gorge, just north of the reservation. Main and branch canals were to divert water from Niagara River above the upper rapids, and to deliver it in wheel pits along the lines of tunnels, for turbine wheels located on the pit floors. A company was formed to carry out this idea in a revised form, under which the wheel pits were brought close together and electric distribution of power was to take the place of branch canals and tunnels. For the development of electric energy the generators were to be mounted at the tops of vertical shafts that rose from turbine wheels near the bottom of each pit. The plan finally adopted included a surface canal 250 ft. wide at its head on the river front, 1.25 miles above the American Falls, 1,700 ft. long in a direction approximately at right angles with the river, and 12 ft. deep. On either side of this canal a wheel pit was to be excavated to a depth of 178 ft., and a tunnel 7,436 ft. long was to connect the bottoms of the pits with the river in the gorge below the Falls. The tunnel width was 18.82 ft., its height 21 ft., and its area in cross-section 386 sq. ft. Ground was broken for this development on October 4, 1890, and the first sale of electric energy was to the Pittsburg Reduction Co. for the production of aluminum on August 26, 1895. The canal and tunnel were designed for a capacity of 120,000 hp., at the head of 136 ft. utilized in the first wheel pit. In the great wheel pit and tunnel of 1895 may be seen an extension of the plan followed in the hydraulic development for the Gaskill mill more than twenty years earlier. Each plant included a canal to bring the water from the upper river, a wheel pit with turbines at the bottom, a vertical shaft rising from each wheel to the ground level, and a tunnel to discharge the tail water into the gorge. In the later development, however, the tunnel is more than a mile instead of only a few feet in length, the head is 136 to 150 ft. instead of 25, and the capacity is 120,000 instead of 100 hp.

The plant of the Niagara Falls Power Company set the pattern for electric stations with wheel pits and tunnels, and the Niagara Falls Hydraulic Power & Manufacturing Co., by locating its generating equipment at the foot of the cliff, in 1895, fixed a type for those who run pipes down into the Gorge and connect them with horizontal turbine wheels for the operation of electric generators. Both of these examples on the American side of Niagara River have been followed on the Canadian bank. In Queen Victoria Park the generating plants of the Canadian Niagara Power

Co. and the Toronto Niagara Power Co. are reproductions of the electric stations with tunnels, wheel pits and vertical shafts on the New York bank, with such minor improvements as experience has dictated.

In the Gorge, close to the foot of the Horseshoe Falls and diagonally across the river from its American prototype of ten years ago, is the new plant of the Ontario Power Co. This plant, like that of the Hydraulic Power and Manufacturing Co. across the Gorge, takes water above the upper rapids, leads it from the top to the foot of the cliffs in steel pipes, passes it through horizontal turbines that are direct connected to their electric generators, and discharges it into the lower river. While the much larger and later plant of the Ontario Power Co. presents many modifications of detail, perhaps its most striking departure from its prototype is in the use of a steel pipe line instead of a canal to bring the water to the top of the cliff.

◆

Overhead vs. Underground Central Station Circuits.

In a paper entitled "Overhead Versus Underground Lines," read at the meeting last week of the Illinois State Electrical Association, Mr. H. B. Gear discussed the relative advantages and disadvantages of overhead and underground wires with especial reference to the conditions existing in medium-sized cities.

Overhead lines have been employed almost exclusively by central station companies in all except the larger cities, principally because with this system a given amount of business can be transacted between generating station and consumer with a minimum investment. Indeed, were it not for the availability of this system there would be no central station service in the majority of the smaller cities. In this connection it may be remarked that the possibility of maintaining overhead lines at small cost has no doubt led some central station managers to make their construction so cheap that it has become a source of unreliable service and a menace to life and property. This state of affairs has no doubt been one of the factors in creating a public sentiment in favor of underground distribution.

The maintenance of overhead lines is comparatively easy owing to the ready accessibility of such lines for inspection at all times. The exposure of overhead lines, however, subjects them to a high rate of depreciation on account of the action of the elements. Continuity of service cannot even be approximated with overhead lines in a distributing system of any considerable extent, no matter what precautions are taken or how good the construction. This becomes a serious matter in cases where considerable amounts of power are being distributed for manufacturing purposes over such lines, as interruption of service means loss not only to the central station company but to the consumer, whose employes are standing idle while the service is off. The discharge of lightning arresters, the occurrence of grounds in the limbs of trees and elsewhere, the swinging of wires in high winds during a storm, all are sure to interrupt service on every part of the system at one time or another. It is usual for the telephone lines to be carried on the same streets with the electric lighting lines. There are, therefore, many places where one set of wires pass under or above the other. In time dangerous situations are apt to result from this condition, in case the upper set of wires breaks and falls across the lower.

The principal advantage of underground construction, aside from æsthetic considerations, is that, where employed for reasonably large areas, it relieves the central station manager of the troubles that beset his overhead lines in stormy weather, and continuity of service may, therefore, be more nearly approximated. The maintenance of underground lines which have been installed in accordance with approved methods is comparatively simple, the necessity for repairs being less frequent than on overhead lines. However, when trouble does occur it is usually of such a character that a longer time and more expense is required to make repairs.

The installation of underground services is also troublesome where the walls of basements are waterproofed. Laterals cannot be put in every building on account of the prohibitive expense and it is therefore, necessary for consumers in whose buildings there are no laterals to extend their wires outside their own premises as much as 50 to 75 ft. in some cases.

The failure of the insulation of cables near points where connections are made between overhead and underground lines is apt to be troublesome, especially where the length of the underground system is short (less than 400 ft.) on account of the action of lightning. It is, therefore, necessary to provide lightning arresters near all cable poles. On such combination systems, where the underground work extends over a considerable area, this trouble, however, is not so likely to be experienced. The failure of joints between overhead and underground lines on cable poles due to the action of the elements is also a detail which has proven quite generally troublesome. It is difficult to protect the grounded sheaths of the lead cable so that it is safe for linemen to work on the pole without introducing other elements of construction which are equally dangerous to continuity of service.

In order that some idea may be had of the elements entering into the cost of underground construction, a typical underground system, such as might be required for a city of 15,000 to 25,000 will be taken. The use of underground lines for general distribution in scattered residence territory is prohibitively expensive and will, therefore, not be considered.

In the case assumed large manholes are provided at street intersections for the purpose of allowing ample room for the installation of transformers, jointing of cables, etc. Smaller manholes are provided at points where laterals are installed for services. Four ducts have been provided, although only two of them are occupied by the primary and secondary cables which have been included in the estimate. The average central station has some series arc or 500-volt power service which would occupy the two remaining ducts, and though these were not occupied by such circuits, it would be advisable to install them for future use. The additional expense of two ducts at the time the conduit line is being laid is small as compared with what it would be if it was desired to lay additional ducts later on, and conduit work is subject to a very low rate of depreciation.

The primary cables are of No. 6, as this is the smallest size which it is practical to use for mechanical reasons. The secondaries have been figured on the three-wire system, the copper being No. 2 B. & S. throughout. This perhaps would not be the practice as there are usually large blocks of load concentrated in the immediate vicinity of transformers which make larger cable necessary at these points and permit the use of smaller cable at other points. However, the net result would be about the same from the standpoint of investment as if No. 2 wire were used throughout. Transformers of 15 to 25 kw capacity are assumed to be required to carry the load, a total capacity of 125 being assumed. The value of transformers is not included in the figures given as they would be the same for either overhead or underground construction.

The cost of installing the system above described, assuming that it were done as a job of undergrounding overhead lines, would be about $9,000,000, the items being as follows:

3,425 linear feet of four-duct conduit line at $1.25	$4,300.00
Six 5x5 manholes, at $100.00	600.00
Thirteen 3x3 manholes, at $45.00	585.00
1,500 linear feet of iron pipe laterals, at 40 cents	600.00
10,000 feet of No. 2 cable, at 14 cents	1,400.00
5,000 feet of No. 6 cable, at 11 cents	555.00
3,500 feet of service cable, average No. 4, at 11½ cents	400.00
Junction boxes and incidentals	300.00
Labor of installing cable and services	300.00
Total	$9,040.00

The cost of overhead lines of equivalent capacity to distribute the load provided for in the above described underground system would not be over $2,000, using the best construction. The investment required for underground construction in a business district may therefore be taken as being from four to five times as great for overhead construction.

Having before him estimates of the cost of placing his overhead lines underground, the central station manager is confronted with the problem of determining whether or not the income from the consumers supplied in the territory under consideration will warrant an increase in the fixed charges resulting from the investment necessary to place his lines underground. There being no great saving in the maintenance charges, the question resolves itself into one of determining whether the greater degree of continuity of service will offset the increased expense in fixed charges. Or, in case the line has been ordered placed underground by municipal authorities, it is a question of determining whether it would be better to lose the business than to incur the additional expense due to the underground investment.

For example, in the case illustrated above, assume that the maximum load of 125 kw is used three hours per day during 300 working days per year. The current consumption of the district would then be 112,500 kw-hours. The interest and depreciation on the investment of $9,000, figured at 15 per cent amounts to $1.350. The cost of supplying customers in this district would therefore be 1.2 cents per kw-hour more than it is with overhead lines. If the average daily use of current were two hours instead of three, the consumption would be correspondingly less, and the increased cost of current in this district would be 1.8 cents per kw-hour.

If this were residence territory with a maximum load of 20 kw, the investment in underground work would be only slightly less, says $7,500. If the maximum load of 20 kw were used on an average of three hours per day, the annual current consumption would be 18,000 kw-hours with fixed charges of $1,125. The cost of current delivered to this territory, due to placing the wires underground, would then be about 6 cents per kw-hour more than with overhead lines. This cost would, of course, vary with longer or shorter hours use of the current, but this figure would perhaps represent average conditions in first-class residence territory. Having determined the increased cost per kw-hour due to the undergrounding of these lines and knowing his other costs, the central station manager can readily determine whether or not the proposed investment in underground work will be warranted.

In cities which are laid out with alleys, the expense of going underground may often be avoided by moving the pole line into the alleys where their presence is not objectionable and where the overhead services to buildings can still be maintained. Much can be done in the way of mollifying the public demand for underground work by keeping main pole lines out of the business district as far as possible and keeping all pole lines on business streets in first class condition.

The Graphitized Filament Incandescent Lamp.

Our London contemporary, the *Electrician*, prints the following abstract of an English patent just issued having for its subject the new type of incandescent lamp filament which formed the subject of a paper read by Mr. John W. Howell at the recent Asheville meeting of the American Institute of Electrical Engineers:

An ordinary base filament is heated in a carbon tube furnace to a very high temperature. This firing is preliminary to the final firing after the filament has been "treated" or "flashed" and is done for reasons which will be explained later. The firing is done by placing the filaments in bundles in small capsules, tubes or boats and passing these boats through the carbon tube furnace. If desired the filaments may be packed in carbon dust. The time of passage of the filaments through the furnace may be widely varied. Good results have been obtained by firings varying anywhere from 20 or 30 minutes to a number of hours. The carbon tube furnace may be of any suitable construction, but it has been found best to use an ordinary tube of carbon of about 3 in. outside diameter and 1¼ in. inside diameter. One tube used was packed in carbide of titanium and had asbestos or other plugs at either end and water-cooled clamps for introducing and taking out the currents. The current used with a tube of the above dimensions may be in the neighborhood of 1,900 amp., and involves the expenditure of energy at the rate of about 23 kw. This power can conveniently be obtained from the secondary of an alternating-current transformer.

After the base filament has received the preliminary firing in the electric furnace it is subjected to the ordinary "flashing" or "treating" process, whereby it receives a coating of what is believed to be graphitic carbon, and is again put into the carbon boats or receptacles and passed through the carbon tube furnace; in this second firing the furnace may be run at the same temperature as that corresponding to the first firing. It was attempted to measure the temperature by observing an incandescent filament placed in the line of vision with the furnace interior and then equalizing the luminosity of the filament with that of the furnace interior. After making this adjustment it was found that with the furnace at the usual temperature this filament was running at about double its normal voltage. Thus, if a 50-volt incandesceent lamp be employed, then, for the purposes of this measurement the lamp is found to run in the neighborhood of 100 volts. The temperature was calculated from the law of Lummer, that at high temperatures the ratio of luminosity of a filament equals the twelfth power of the ratio of the absolute temperatures. Assuming that the filament of the incandescent lamp had the same temperature as the interior of the furnace this makes the range of temperatures used in the furnace between 2,300° C. and 3,000° C. These temperatures as measured in the above manner check with the readings of temperatures of the furnace obtained by the use of an instrument known as the Wanner spectrophotometric pyrometer. The minimum limit of furnace temperature at which the beneficial effects of the invention are obtained, it is difficult to state with certainty, though it is believed the results cannot be obtained below 2,000° C. It is certain that for the best results the temperature must be at or above a temperature much higher than this and at which quartz, platinum and the rare oxides vaporize and disappear. The carbon tube of the furnace, at these most extreme temperatures, does not last more than a few hours and must then be renewed.

It has been found that the change which is produced in the "flashed" or "treated" filament by firing in the furnace is one which takes place in the shell or coating, produced by the "treating" or "flashing" process, while practically no change or, at least, comparatively little change is produced in the base filament upon which the coating or "flashing" is applied. A section of the shell or coating of the filament 1 in. or more in length may, without difficulty, be removed from the ordinary 16-cp filament, and when removed is found to consist of a little tube with very thin walls. The material of this tube is believed to be a new form of graphite. It answers certain chemical tests for graphite, as, for example, by producing graphitic acid when treated with highly oxidizing reagents in a manner well understood by chemists, and gives the characteristic graphite lustre when rubbed on paper. It is furthermore extremely tough and flexible, to illustrate which the little microscopic tube may be readily pressed perfectly flat with the blade of a knife, and will thereafter resume its original form.

With respect to its specific resistance, this of course may vary, depending upon the temperature at which it was fired, but in any case is extremely low. Its resistance for a given unit of 1 meter long by a square millimeter section varies from 0.6 to 1.6 at a temperature of 20° C. while Zellner ("Die Künstlichen Kohlen," p. 251, published by Julius Springer, Berlin, 1903), in the same units, gives the resistance of ordinary carbon as 20 to 50, Ceylon graphite 2 to 8, and Acheson artificial graphite 12. The material is nonmagnetic, and has a metallic lustre. Its specific gravity is considerably higher than that of either graphite or carbon, and in one sample tested was found to be in the neighborhood of 1.96. The tube above referred to is believed to consist entirely of the new form of carbon above mentioned, and constitutes a hollow filament which can be and has been mounted as the filament of a lamp. It is usually found more convenient to use the composite filaments consisting of a core of ordinary carbon and a shell of the new form of carbon as fully described above.

In describing the best mode known of carrying out the invention, there has been prescribed a firing of the base filament prior to "flashing" or "treating" thereof and a subsequent firing after the "flashing" or coating obtained by treatment in the hydrocarbon has been applied. This double firing obviates or prevents the appearance of minute bubbles or blisters on the surface of the filament as may occur when there is no preliminary firing of the base filament. These bubbles have the appearance of being caused by gas pressure developed within the filament while the coating or "flashing" is in a pasty condition. It is probable that the bubbles are caused by the effort of impurities, metallic or otherwise, to escape from the base filament through the coating or "flashing." The preliminary firing of the base filament by removing to a greater or less extent these impurities has been found to have the effect of preventing the appearance of these bubbles in the filament. The double firing of the filament, however, results in a somewhat different appearance in the completed article. With a single firing of the "flashed" filament the surface is black and shiny, although apt to be marred by the presence of bubbles or blisters. With the doubly-fired filament, once before "flashing" or "treating" and once after, the surface of the filament is free from bubbles and may under certain conditions have a greyish velvety appearance. It is considered best to raise the temperature of the filament rather slowly in the first firing, to avoid a weakening of its structures due to a too sudden escape of gas.

Other filaments than squirted cellulose filaments have been treated in accordance with this invention with similar results. It has been found that by taking an ordinary base filament and coating it with hydrocarbon, as by dipping in asphaltum, and then firing in the furnace at the high temperatures hereinbefore mentioned, results similar to those characteristic of the "flashed" filament can be obtained. That is, there can be obtained a filament the specific resistance of which is much less than that before firing and the temperature resistance coefficient of which either approaches or becomes a positive value.

It is thought at present that the impurities in the base filament, probably the potassium, on being driven out by the heat of the electric furnace unite with the graphite coating or "flashing" and enable it to soften and form some combination which is at present unknown, perhaps a simple potassium carbon solution. Whatever this impurity may be, it is subsequently driven off, leaving the particles of the resultant graphite or carbon associated with each other in a relation very much closer than the relation in which they are associated in all forms of carbon hitherto known, and much more analagous to the manner of association of the particles in ordinary metal. This theory, if correct, would account for the lustre and density, the high specific gravity, the strength, the elasticity, etc., of the new form of carbon which differentiate it from all other forms of carbon now known.

New Telephone Patents.

SELECTIVE SYSTEMS.

While it would seem that almost every conceivable form of selective principle had been employed by inventors, still every few weeks brings out some new means of attack. This week we have a synchronized pendular arrangement patented by D. F. Laughlin, of Clyde, Kan.

In this system a series of adjusted pendulums are provided for the operator, each of the series having a period corresponding to one and only one of the stations on each line. Thus, for four-party working, four characteristic pendulums are required. The key or operator's pendulums, are arranged to control electric circuits, impressing on the line currents, say, during their forward strokes and cutting this off on the backward stroke. Normally at each station an electromagnet is connected to the line at each station, in the field of which the selecting pendulum is suspended. If the operator starts a pendulum a series of pulls will be exerted upon all station pendulums, but these will be synchronized with one only, which will respond with constantly increasing amplitude of vibration. In the path of the station pendulum is a trip bar, which becomes unlatched by being struck by the vibrating pendulum when the amplitude becomes sufficient. This trip bar closes the talking circuits and cuts off the vibrator circuit. The restoring of the hook switch resets the trip bar.

Another selective system has been patented by S. M. Gant, of Indianapolis. In this system selection is made at a distant central point of line center, between any one of a group of branch lines. Three lines are required for the main line and these are connected to a set of relays at the line center. By manipulating three switches or their equivalent, in proper sequence, the relays being interconnected, almost any combination of operated and non-operated relays may be obtained, each combination serving to control the connection of one branch line with the main line.

TELEPHONE CARRYING CASE.

For testing purposes it is often necessary to carry about a telephone set, and Mr. A. G. Davis, of Baltimore, has patented a carrying case and support. The bottom of the case carries transmitter and receiver supports, and to this bottom is secured leather or cloth flaps, with the usual eyelets and fasteners, so that the whole may be closed up like a wallet. Metal hooks on one flap serve as a means of hanging up the set when opened for use.

MULTIPLE SWITCHBOARD CIRCUIT.

In 1899 and 1891, respectively, Mr. M. G. Kellogg, of Chicago, applied for two patents for switchboard devices, which have just been issued. One of these describes the arrangement of clearing out and line drops with which cut-off jacks may be dispensed. Mr. Kellogg permanently bridges the line drop to ground and makes it of so high impedance as not to affect the talking circuit. He bridges the clearing-out drop to ground also, and while this prevents disturbance of the talking, yet for ringing currents its effective resistance is so low that the high-wound line signals are too much shunted to operate.

The second patent describes the use of pulsating ringing current for the selection at will of either to polarized drops. Both these patents are assigned to the Kellogg Switchboard & Supply Co. The ideas on both were probably developed in the production of the Kellogg divided multiple system.

INTERCOMMUNICATING SYSTEM.

Messrs. A. K. Andriano and H. Herbstritt, of San Francisco, have jointly patented a lockout intercommunicating system, which is quite ingenious. When one party desires a second, he sets his indicator and rings. If the desired station be not busy this combined act will connect the desired party to the line and signal him. If, however, he be busy, through the agency of electromagnets, the calling party will be apprised of the fact by a humming produced in his telephone. Similarly, if any station try to listen to a conversation, the connecting of himself will be to a busy line and hence he receives the buzzing noise. The patents for this system have been assigned to the Direct Line General Telephone Co., of San Francisco.

LETTER TO THE EDITORS.

Approximation of the B. & S. Gauge.

To the Editors of Electrical World and Engineer:

SIRS:—In connection with the article by Mr. C. P. Nachod on "Some Approximations of the B. & S. Gauge" in your issue for September 23, allow me to offer an application of one of the formulæ presented, which may be of service to some of those who find the slide rule often closer at hand than a table of wire sizes.

From Mr. Nachod's formula,

$$cm. = \frac{2^{20-\frac{n}{3}}}{10}, \qquad (1)$$

the familiar formula for the sizes of wires on direct-current systems becomes

$$\frac{10.8 \times 2D \times I}{V} = \frac{2^{20-\frac{n}{3}}}{10}, \qquad (2)$$

where D = distance in feet to load,
I = current in amperes,
V = drop in volts.

Formula (2) can be reduced to

$$\frac{216 \times D \times I}{V} = \frac{2^{20}}{2^{\frac{n}{3}}}, \qquad (3)$$

$$2^{\frac{n}{3}} = \frac{2^{20}}{216} \times \frac{V}{D\ I}, \qquad (4)$$

or approximately,

$$2^{\frac{n}{3}} = 5{,}000\,\frac{V}{D\ I}; \qquad (5)$$

and

$$n = 3\,\frac{\log\ 5{,}000\,\frac{V}{D\ I}}{\log\ 2}, \qquad (6)$$

or approximately,

$$n = 10\left(\log\ 5{,}000 + \log\frac{V}{D\ I}\right) \qquad (7)$$

$$n = 36.90 + 10 \log\frac{V}{D\ I}. \qquad (8)$$

This formula, which will give the size of wire directly, is accurate to the nearest B. & S. size, and is much easier to handle than may seem to be true at first glance. The calculation often reduces to simple numbers, and at most requires the reading of only one logarithm on the slide rule.

As an example, let the distance be 100 ft., the current 100 amp., and the drop 10 volts. Then $\frac{V}{D \times I} = \frac{1}{1{,}000}$, and $n = 36.99 - 30 = 6.99$; i. e., between No. 6 and No. 7. The ordinary solution indicates 21,600 circular while No. 6 and No. 7 have 26,250 and 20,816 circular mils, respectively.

A second example may be given to show the accuracy of the formula when dealing with larger wires. Let $D = 200$, $I = 500$, and $V = 10$. Then $\frac{V}{D \times I} = \frac{1}{10{,}000}$. $n = 36.99 - 40.00 = -3.01$; i. e., about No. 0000. The ordinary solution calls for 216,000 circular mils, while No. 0000 has an area of 211,600 circular mils.

Detroit, Mich. W. F. White.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Brush Holder.—An illustrated description of a new brush holder made by a British company. The spiral spring which serves to exert a uniform pressure of the brush on the commutator is totally enclosed in the cartridge-shaped arm of the brush-holder, and is thus out of the way of dust and accidental injury. The milled nut, *A* (Fig. 1), when screwed further into or out of the hollow brush-holder arm, serves to adjust the pressure of the spring. The latter presses against a small plunger which abuts, at one end, against the face of the cam, *B*, securely clamped to the brush spindle, *C*, while its other end passes through the hollow nut, *A*. When the brush wears down to become useless, the small projection, *D*, comes in contact with the head of the plunger and prevents the brush from descending further. Hence the metal parts of the brush-holder cannot possibly damage the commutator. The cam, *B*, is of such a shape that the brush, when lifted off the commutator, remains in this position, thus allowing any adjustments necessary and facilitating the renewal of the brush.—Lond. *Elec.*, Sept. 22.

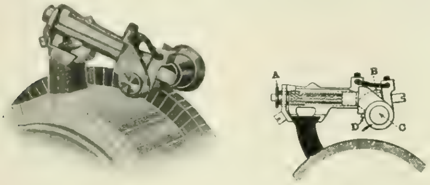


FIG. 1.—BRUSH HOLDER.

Variable-Speed Alternating-Current Motor.—Reyval.—An illustrated description of two machines exhibited by the Société Alsacienne. One machine is a commutator motor designed for three-phase currents at 110 volts and 50 periods. Its normal speed at no-load is 1,000 revolutions, and its normal power 20 to 25 hp. It is operated in combination with a small booster which gives changes of voltage between 25 and 195 volts. The stators of both machines are connected in parallel with the network. The rotor of the motor and the movable portion of the booster can be connected so that their e.m.f.'s are either (1) in opposition or (2) in series. In both cases the speed is regulated by varying the potential difference between the three brushes of the motor. In the first case (1) the maximum speed of the motor is that of synchronism (1,000 revolutions for six poles and a frequency of 50 periods per second) the speed diminishes when the counter e.m.f. produced by the booster increases. In the second case the maximum speed is far above the speed of synchronism and is the greater, the greater the e.m.f. of the booster added in series to that of the motor. The motor which may also be operated as a repulsion motor by single-phase current has all the good qualities of the direct-current series motor. There is no sparking at the commutator.—*L'Eclairage Elec.*, Sept. 9.

Liege Exposition.—Illustrated descriptions of direct-current and alternating-current generators, motors and transformers exhibited by the Westinghouse Company, especially railway motors, motors for steel works, and other apparatus.—*L'Eclairage Elec.*, Sept. 16.—A description of a direct-current, 475-kw, 550-volt Lahmeyer dynamo, running at 150 revolutions per minute and driven by a Diesel engine. Both the dynamo and the engine are described in detail and illustrated.—*L'Eclairage Elec.*, Sept. 23.

Commutators.—Lees.—An illustrated article on the maintenance of commutators and brushes, giving practical rules and describing various commutator appliances.—Lond. *Elec. Eng.*, Aug. 25 and Sept. 1.

Lights and Lighting.

Church Lighting.—An illustrated description of the lighting installation of the new cathedral in Berlin, Germany. Indirect illumination is made use of. Arc lamps are arranged in hidden places above the cornices in the main cathedral, on the galleries of the cupola, which by reflectors distribute the light uniformly throughout the vast hall. These effects are added to by illuminants of the same kind, throwing their light upwards from magnificent candelabra placed in the aisles, and preventing the formation of any disturbing shadows. With the light of these arc lamps, softly diffused from the roof, is mixed that of hundreds of glow lamps mounted on the same candelabra, as well as on brackets and chandeliers. The electric lighting plant includes at present about 1,900 incandescent lamps of 15 to 25 normal cp, upwards of 100 Nernst lamps and about 70 arc lamps of 6 to 15 amperes. The motive power plant includes 6 electric drives, one of which (10 hp) actuates the organ blowers, while two 9-hp motors are set apart for the bell work and the remainder for fans and a lift. The organ motor works at 1,175 r.p.m. on a high-pressure blower yielding 96 cu. meters per minute at a pressure of 200 mm. water column in the organ reservoir, and is actuated by a starter placed close to the keyboards.—Lond. *Elec. Review*, Sept. 22.

Power.

Direct-Current for Power Distribution.—Ayrton.—A lecture delivered before the British Assoc. Adv. of Science on the distribution of power. The author "preaches heresy," speaking in favor of the use of high-tension, direct-current for power transmission and distribution. Its advantages over alternating-current are less liability of breakdown of insulation, since from the point of view of economical transmission 60,000 effective volts alternating means exactly the sasme as 60,000 volts direct, while from the point of breakdown of the insulation 60,000 effective volts alternating is as bad as 85,000 volts direct, indeed may be worse than 100,000 volts direct. Further, with direct-current there is "no question about self-induction reducing the current—no objection, therefore, to putting the conductors as far apart as the risk of brush discharge may necessitate—no question about capacity current, no resonance troubles, etc." The author also states as another advantage of direct-current transmission as carried out by Thury that it is the current that is kept constant and the electric pressure that is automatically raised when the demand for power is increased. It is far more easy to maintain the constancy of the current flowing around a long circuit than to prevent the bobbing up and down of the electric pressure at the distant end of a long transmitting line and "that irritating dancing of the lights." "Constant current has also its well-known disadvantages, but these would not come into play if the constant current were not taken into houses, mines, etc., but used to drive motor-generators in sub-stations." The author then speaks of the development at Niagara Falls and argues whether similar developments of the electro-metallurgical nature are possible at the Victoria Falls in South Africa. "But jealously guard the beauty of your falls: Niagara was glorious nature, to-day it is power. Victoria is poetry."—Lond. *Elec.*, Sept. 22.

Size and Number of Units in Power Stations.—Bushnell.—An article on the important influence which the choice of size and number of generating units may have upon the coal consumption of an electric power station. The main factor in the question is, of course, the fact that prime movers operate less efficiently (usually much less) at light loads than at full loads. That is to say, it is cheaper to run one engine fully loaded and have the other lie idle than to run both engines at half load. Another factor is that in electric railway power stations it is not regarded as practicable to change the speed of the air or circulating pumps, or to alter the quantity of cooling water to suit the varying loads upon the station, and these auxiliaries are usually operated at point sufficient to take care of the maximum load. Therefore the percentage of loss in the auxiliaries increases very rapidly as the load upon the main engine decreases. The two factors mentioned result in a distinct economy from such a number and proportion of generating units that, at all times of the day, the units in operation may be run at nearly full rated load. An illustration is given of two stations in which one would expect the fuel used per kw-hour to be practically the same, but on account of the different choice of units one station consumes 5 pounds of coal per kw-hour and the other only 3.8 pounds. —*Engineering News*, Sept. 28.

Electric Power Distribution in Italy.—An article on the power distribution by the Societe Lombarda in northern Italy. The main station is the hydraulic plant at Vizzola; it is five years old and has a capacity of 12,000 kw and supplies a net work of 120 miles. Most of the current is supplied to spinning and weaving mills. One year after opening of this plant the increasing demand for electrical energy necessitated the erection of another plant in Turbigo of a capacity of 3,500 kw. This plant was also provided with steam reserve having capacity of 5,400 hp. Another hydraulic plant utilizes 20,000 hp from the falls of the Poschiavino River; the capacity may be increased to 40,000 hp and the distributing network will cover about 90 miles. Some data are given on the cost of the installation and on the rates of charging. It is stated that the company paid last year 9 per cent dividends on the capital invested.—*Elek. Bahnen*, Sept. 4.

Controllers.—DUBOIS.—An article illustrated by diagrams on the construction of controllers for the operation of electric motors for various power purposes, and on the operation of the controllers by relays.—*L'Industrie Elec.*, Sept. 10.

Electricity in South African Mines.—WALSH.—A short article enumerating the various applications made of electricity in South African mines. These include the operation of deep-mine pumps and other mining machinery and lighting.—*Amer. Elec.*, October.

TRACTION.

Measuring the Resistance of Rail Joints.—SOULIER.—A description of an instrument of the Siemens & Halske Co., by which resistance of a rail joint can be directly compared with that of an equal length of rail. The apparatus is shown in Fig. 2. An insulating platform is placed on the rails with two contacts, x and y, at both sides of the joint. The differential voltmeter, t, is placed with the two terminals, h g, on the contact, ss, so that h g, are thereby electrically connected to the points, x and y, respectively. The conducting rod, B, is connected to a third terminal, i, of the voltmeter. The cane, B, is moved along the rail until there is no deflection of the needle of the differential voltmeter. That means that the same potential difference exists between points x and y as between y and B; in other words, the rail joint itself has a resistance equal to a length of rail a minus b.—*L'Industrie Elec.*, Sept. 10.

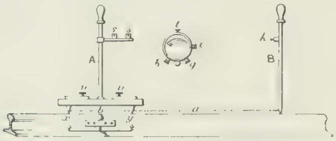


FIG. 2.—DIAGRAM OF APPARATUS.

All-Steel Cars for Electric Railways.—A note stating that a demand has arisen in England for steel cars on electric railways. In some new cars for the Great Northern and City Railway Company, the only wood used will be that for the arm rests separating the seats. The use of steel for the body of the car makes it possible to combine great strength with light weight, as the whole lower portion of the sides is trussed so as to form a regular girder. As compared with wood, the saving in weight amounts to about 3 or 4 tons on a car weighing (in wood) 18 to 20 tons. This means, of course, a considerable reduction in operating expenses, and this is obtained without any reduction in the accommodation afforded, while the appearance is at least as good as if the car were of wood. The cost of the all steel cars is about the same as one of fire-proofed timber.—Lond. *Eng'ing*, September 22.

Railroad Terminal Power Plant.—An illustrated description of the generating station of the New York Central & Hudson River Railroad at Weehawken, N. J. The plant has a total capacity of 2,000 rated boiler horse-power. Alternating current is used almost exclusively, 600-volt current being used for power and 2,300 volts for lighting. The power is chiefly used in a grain elevator which is equipped throughout for motor drive, the total capacity installed aggregating 3,300 horse-power. Three-phase, 25-cycle induction motors are used.—*Amer. Elec.*, October.

Alternating-Current Traction.—HERZOG.—Notes on trials on the Seebach-Wettingen road operated by alternating current at 15,000 volts. Three different methods of suspension are being experimented with. They are described in detail and illustrated.—*Elek. Bahnen*, Sept. 4.

Philippines.—FAUSER.—A long and profusely illustrated article on the building of an electric railway in the Philippines.—*Elec. Age*, Sept.

WIRES, WIRING AND CONDUITS.

Acetate Wire.—An illustrated article on the new acetate wire of the Allgemeine Elek. Ges., Berlin, which is greatly superior to silk-covered wires with respect to the space it occupies. The copper conductor is covered with a seamless layer of the excellent insulating material "cellulose-tetra-acetate." By means of special machinery numerous very fine layers are coated one above the other around the copper. The wire is said to be flexible, of high elasticity and great strength and to resist very strong mechanical stresses, although the insulating layer is only about 0.02 mm. thick. It is absolutely non-hygroscopic, is not affected by temperatures below 150 degrees, and layers of 0.02 mm. thickness are perforated in general not below 1,500 volts. The company makes acetate wires in all sizes from 0.07 to 0.17 mm. diameter of copper. The saving of space in comparison with silk-covered wires is given in the following table:

	Space factor in per cent.		
Thickness of wire.	Acetate wire.	Single silk-covered wire.	Double silk-covered wire.
0.07 mm	48	32	17
0.08	50	35	20
0.10	54	40	25
0.12	57	44	29
0.15	61	49	34
0.18	64	53	38
0.20	65	55	41

In this table "space factor" is the percentage of copper in a square surrounding the cross-section of the insulated wire.—*Zeit. f. Beleucht.*, Sept 10

ELECTROPHYSICS AND MAGNETISM.

Alpha Particles of Radium.—BRAGG AND KLEEMAN.—An account of an experimental investigation of the alpha particles of radium and their loss of range in passing through various atoms and molecules. The alpha particle moves always in a rectilinear course, spending its energy as it traverses atoms of matter, until its velocity becomes so small that it cannot ionize and there is in consequence no further evidence of its motion. Each alpha particle possesses, therefore, a definite range in a given medium, the length of which depends on the initial velocity of the particle and the nature of the medium. Moreover, the alpha particles of radium which is in radioactive equilibrium can be divided into four groups, each group being produced by one of the first four radioactive changes in which alpha particles are emitted. All the particles of any one group have the same range and the same initial velocity. The following are the values of ranges in air at a pressure of 76 cm. and a temperature of 20° C.:

Radium	3.50 cm.
Emanation of Radium A	4.25
Radium A or Emanation	4.83
Radium C	7.06

The results also show that the four groups are alike in all respects save that of initial speed: and further, that the alpha particle spends its energy at a rate which is approximately inversely proportional to the square root of its speed. The loss of range of alpha particles in consequence of their passage through various substances is fo all the materials examined in traversing any atom nearly proportional to the square root of the weight of the atom. The loss in the case of a complex molecule is proportional to the sum of the square roots of the weights of the constituent atoms.—*Phil. Mag.*, Sept.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Durlach.—FREYSS.—Notes on the Durlach electric station which supplies current for power and lighting purposes to some railway stations and repair workshops in and near Karlsruhe. The station is owned by the state railways of Baden, and is presumably the largest of the numerous electric works which are attached to other railway stations of the system. It is stated that these railway stations altogether generated some 8,000,000 kw-hours during 1904, over 16,000 metric tons of coal being consumed for this purpose; that is, about 4½ lb. per kw-hour. The plant contains low-speed horizontal steam engines directly coupled to large dynamos. At present there are two three-phase generating sets each of 850 kw. The total capital expenditure was $325,000, of which nearly one-half was spent for the buildings, which are very elaborate and ornamental. The total capital expenditure for the plant installed is $191 per kw. Towards the end of last year the entire plant was officially tested. The chief results are: Steam consumption per kw-hour at full load (excluding excitation) 20.6 lb. weight of coal consumed per kw-hour generated (excluding excitation) 2.52 lb., mechanical efficiency of engine 92 per cent and efficiency of the alternator (excluding excitation) 96.7 per cent. The load factor was 28.2 per cent in 1904.—Lond. *Elec.*, Sept. 22.

Sub-Stations.—COLLISCHONN.—Long illustrated descriptions of some new sub-stations erected by the Felten and Guilleaume-Lahmeyer Works. The first sub-station described is in Breslau and transform three-phase current into direct current of 2 × 220 volts. The power given out in direct current is 1,000 kw. The set consists of a three-phase synchronous motor with a normal capacity of about 1,450 hp at 5,000 volts and 50 periods, coupled on each side with a direct-current dynamo giving 500 kw at 220 volts to 293 volts. The number of revolutions per minute is 187. The second sub-station described supplies the Hoechst chemical works in Gersthofen with direct-current for their electrochemical work. There are in use two motor-generators. Each consists of a three-phase synchronous motor of 1,650 hp at 5,000 volts, 50 periods and running at 107 revolutions per minute, and a direct-current dynamo giving 7,500 amperes at 112 to 150 volts.—*Elek. Zeit.*, Sept. 21.

Small Gas Engine Plant.—HOWARD.—A short article in which the author describes the isolated plant in a drug store in Worcester, Mass. A small gas engine drives a 17.5-kw generator supplying current at 110 volts. The outfit is situated in an obscure corner of the basement, together with a storage battery capable of discharging at the rate of 25 amperes on an eight-hour basis. Current is used for lighting both arc and incandescent lamps and for operating a small motor driving an ice crusher and an ice-cream freezer. Very little attention is required by the equipment beyond reasonably frequent inspection to see that everything is working properly. It is estimated that the cost of power per kilowatt-hour is 3 cents. —*Amer. Elec.*, October.

Isolated Plant Engineering. —HOBART.— An article containing much practical information concerning general engineering practice in a small plant The article deals with steam plants, and treats of the economical production and utilization of steam.—*Amer. Elec.*, October.

ELECTROCHEMISTRY AND BATTERIES.

Aluminum Industry.—Statistics of the production of aluminum and bauxite in 1904. The production of aluminum in the United States has increased nearly tenfold in as many years. The production in the United States was 83 pounds in 1883, 61,281 pounds in 1890, 7,150,000 in 1900, and the consumption in 1904 was 8,600,000 pounds. The world's production in 1903 was 8,252 metric tons valued at $4,950,400 of which the United States produced 3,402 tons valued at $2,325,000. Aside from the electrical industry in which aluminum is gaining favor as a substitute for copper conductors for transmission lines, there has been expansion in other directions. The steel industry has become an important consumer of aluminum. The consumption of thermit shows marked expansion.—Publication of *U. S. Geological Survey.*

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrostatic Voltmeter.—A description of an electrostatic voltmeter of Jona for measuring very high voltages. An instrument for 100,000 volts is shown in Fig. 3. The movable disc, *P*, is attracted by the stationary disc, *Q*, the two discs being connected respectively with the two poles of the apparatus, the voltage of which is to be measured. *P* is attracted and the degree of attraction is read on the dial directly in kilovolts. The stationary disc is mounted on a small column of ebonite passing through the bottom of the glass vessel, *V*, which is filled with paraffin oil. Concentrically with the walls of this vessel and electrically connected with the movable disc, *P*, is the metallic cylinder, *C*, which equalizes the potential in the interior of the apparatus. An instrument for 200,000 volts is also described.—*L'Industrie Elec.*, Sept. 10.

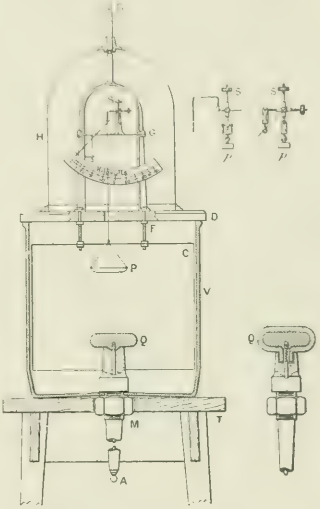


FIG. 3.—ELECTROSTATIC VOLTMETER.

Leakage Indicator.—An illustrated description of some new instruments made in England, especially a leakage indicator for two-wire direct-current installation in mines, as shown diagrammatically in Figs. 4, 5, 6, which are self-explanatory. The pointer rests in the middle of the scale if the insulation of the two mains be sensibly equal (Fig. 5). If a ground develops on either, the pointer at once deflects and shows by the direction of its deflection

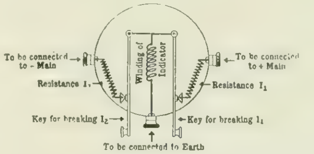


FIG. 4.—LEAKAGE INDICATOR.

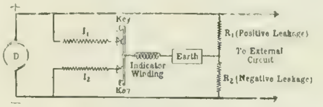


FIG. 5. -LEAKAGE INDICATOR.

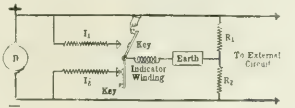


FIG. 6.—LEAKAGE INDICATOR.

on which main the failure has occurred. This indication may be supplemented by a bell if required. To find the absolute value of the insulation of each main, the method indicated in Fig. 6 is used; it is, to depress first the + and then the —key and note the positive and negative deflections in degrees. From these two readings, the value of the insulation is found by the use of a table supplied with the instrument.—Lond. *Elec.*, Sept. 22.

Water Rheostat.—Haden.—A short article on the construction of an efficient and easily made rheostat in which galvanized iron wire immersed in pure water is used. The rheostat is designed to absorb a load of 100 kilowatts for nine hours continuously with less than one per cent fluctuation.—*Amer. Elec.*, October.

Telegraphy, Telephony and Signals.

Electric Clock.—An illustrated article on the "synchronome" electric clock. Each clock face has a one-wheel step-by-step dial movement behind it, operated by a switch combined with a pendulum in such a way that its switching function is automatically performed every half-minute. The actual switch consists of a weighted lever which falls in the act of driving the pendulum until it reaches the armature of an electro-magnet and makes the contact which causes the magnet to replace the weight and at the same time advances all the dials one tooth. The driving of the pendulum by the weighted lever has usually been accomplished by an ordinary clock escapement which imparts small impulses at every beat. Recently this arrangement has been improved upon as follows: In Fig. 7 *A* is the upper part of an ordinary seconds pendulum. *B* is a weighted lever or gravity arm centered at C. This lever is normally at rest, being supported by the vertical lever *D* centered at *E.* A pawl or driving click, *F*, pivoted on the pendulum is idly rotating the wheel, *G*, one tooth at each complete vibration of the pendulum. The wheel, *G*, has one of its teeth, *H*, cut shallow, and its object is to direct the pawl, *F*, once in every revolution, that is to say, once in every half minute, against the back, *J*, on the vertical lever, *D*, so that the support of the gravity arm, *B*, may then be withdrawn. This gravity arm then falls and bears with its whole weight upon the pendulum through the medium of the spring, *S*, traveling with it until the lower limb of the bell-crank lever comes into contact with the platinized screw, *K*, in the tail of the armature, *L*. The magnet, *M*, then resets the weighted lever, and the dial magnets in circuit with it are actuated as in the usual "synchronome" switch. The advantages of the new arrangement are pointed out.—Lond. *Elec. Times*, Sept. 21.

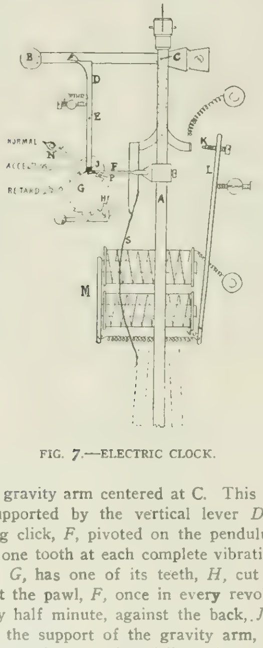


FIG. 7.—ELECTRIC CLOCK.

Microphone.—Experiments have recently been made with long-distance telephony from Rome, Italy, to London with alleged good results. A new microphone, devised by Majorana, has been used in these tests. "According to the statements of the inventor, it is based on the contraction of a capillary column of liquid under the influence of sound waves. The contractions produce changes of resistance in an electric circuit in such a way that waves of 500 periods per second produce, under favorable conditions, telephone currents of 100 milliamperes. The best microphones in use at present in Italy give telephone currents of 20 to 25 milliamperes. The sounds received should, therefore, be very strong with the Majorana microphone. Moreover, it is stated that they fulfill all wants with respect to clearness of speech."—*Elek. Zeit.*, September 7; from *L'Ettricista,* July 1.

Printing Telegraphic Apparatus.—Guarini.—An illustrated description of the Siemens & Halske printing telegraphic apparatus. A perforated band is first prepared by means of a special apparatus termed a perforator and operated like a typewriter. This band is introduced into the automatic transmitter, where the holes in the paper cause alternately positive and negative discharges into the line. In the receiver a strip of photographic paper is unwound in a dark chamber in front of a type wheel, upon the periphery of which the letters of the alphabet are perforated. This wheel moves synchronously with the transmitter; at the moment when the letter transmitted passes in front of the sensitive strip, an electric discharge takes place between the spheres of an oscillator, and the letter is photographed. As the type-wheel revolves at the rate of 2,000 r.p.m., and as a letter can be printed at each revolution, the maximum speed of transmission can be calculated at 120,000 letters per hour, or about 20,000 words. Fig. 8 shows the type wheel revolving between the spark-gap and the photographic tape. The different parts of the apparatus are described in detail.—Lond. *Elec. Rev.*, Sept. 22.

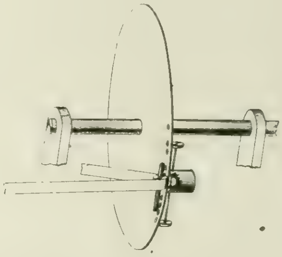


FIG. 8.—PRINTING TELEGRAPH APPARATUS.

Miscellaneous.

Construction of a Jump Spark Coil.—An illustrated article on the construction of a jump spark coil for gas engine ignition purposes. Sufficient data are given to enable any fairly competent amateur to build the coil.—*Amer. Elec.*, October.

Aluminothermics.—A report by a Franklin Institute Committee on Goldschmidt's method of aluminothermics with applications to welding and repairing.—*Jour. Franklin Inst.*, September.

Manufacturing Plant.—Fully illustrated descriptions of the new plant of the B. F. Sturtevant Company at Hyde Park, Mass.—*Iron Age.*, Sept. 28, *Amer .Mach.*, Sept. 28.

Electric Welding.—A report by a Franklin Institute Committee on the Cleveland Cap Screw Co.'s cap screw and bolts with a description of the method of electric welding used.—*Jour. Franklin Inst.*, September.

Shop System for Electrical Contractors.—Auerbacher.—A description of a shop and accounting system suitable for concerns doing a general electrical contracting and jobbing business. Various forms are given, which have been designed to avoid the cumbersome details in many record forms. The method of keeping these and their significance are dealt with at length.—*Amer. Elec.*, October.

Diamonds.—Crookes.—A paper presented before the British Association of Advanced Science, at Kimberley, South Africa. Carbon volatilizes at the ordinary pressure at a temperature of about 3,600° C. and passes from the solid to the gaseous state without liquefying. To liquefy it high pressure must be added to high temperature. On cooling it will then crystallize and artificial diamonds are obtained. Two methods of making small artificial diamonds are described. The first one depends on the solution of iron in carbon, the second employs closed-cylinder explosions.—Lond. *Elec.*, September 8.

BOOK REVIEWS.

Transactions of the International Electrical Congress of St. Louis, 1904. Three volumes. 2,844 pages, 698 illustrations in the text, 124 inserted half-tone sheets and three photogravure frontispieces. Price, in paper covers, $10.

These three portly tomes should do much toward giving a new lease of life to the idea of International Electrical Congresses held in conjunction with world's fairs. The earlier congresses derived their importance largely from being scientific legislative bodies, and with the decay of this function it seemed that the *raison d'etre* of such international meetings would pass away. While at St. Louis a Chamber of Delegates, appointed by governments, formed part of the congress, it was well understood at the outstart that the proceedings of this section would not have a high importance, and in fact its only action was to formulate recommendations, the adoption of which will make it the last of its line. These recommendations, which will undoubtedly be given effect, provide for the transfer to two international commissions—one appointed by governments and another by national professional bodies—of the work heretofore taken cognizance of by the officially appointed section of an international electrical congress; and there is little probability that the meetings of the former, or, even of the latter, will be held amid the distractions of a world's fair.

The great success of the St. Louis Congress was thus due to its purely professional programme—the reading and discussion of scientific and engineering papers. As printed in these volumes, the proceedings form perhaps the most important single contribution ever made to technical literature, whether judged with respect to average intrinsic merit, or collectively as an epitome of the state of electrical scientific and engineering knowledge in the year 1904. It is particularly in this latter character that international electrical congresses deserve continuation, for no one can question the value of taking systematic account at intervals of the current state of knowledge in the rapidly developing departments of electrical science and engineering, and the experience of the St. Louis Congress has demonstrated that authoritative writers the world over will gladly respond to an appeal for collaboration based on these grounds. As a first attempt in this direction the St. Louis proceedings naturally fall short of the ideal of such a *comptes rendus*, several of the papers being quite perfunctory in character, and a few others scarcely more than "write-ups" of ephemeral or even no value. Future congresses can, however, easily remedy these defects, one obvious means being to confine the selection of subjects and authors and the final acceptance or rejection of papers submitted in response to invitations, to a small and carefully selected commission, instead, as appears to have been done in the case of the St. Louis Congress, of so loosely distributing this function that there was no positive check on the inclusion of unfit papers.

The total number of papers contained in the *Transactions* is 159, the following nationalities being represented: United States, Canada, Mexico, Great Britain, Italy, Sweden, Germany, Japan, Australia, France, Belgium, Denmark, Switzerland, Hungary and Austria. In the discussions there are represented, in addition, India, Argentine Republic, Spain and Holland. The *Transactions* also contain an account in detail of the organization of the congress, the proceedings of the opening and closing general meetings and the proceedings of the Chamber of Delegates.

Of the eight sections of the congress undoubtedly the proceedings of Section A—General Theory, Mathematical and Experimental—are of the highest permanent value. Twenty-seven papers were presented in this section, with scarcely an exception of an exceedingly high order of merit. The subject of radioactivity was treated in papers by Elster and Geitel, Rutherford, J. J. Thomson and McLennan. Electrical units and electrical standards are the subjects of papers by Carhart and Patterson, Ascoli, Giorgi, Wolff and Jaeger. Other subjects are the theory of ionization by collision, by Townsend; alternating current theory of transmission speed over submarine cables, by Kennelly; the mechanical equivalent of heat as measured by electrical means, by Barnes; electric arc, by Child; the absolute measurement of inductance, by Rosa and Grover; the coherer (which would seem to belong to the telephone section) by Guthe; recent advances in the analysis of the earth's permanent magnetic field, by Bauer; Lorentz's theory of electricity, by Webster; electric conduction in metals from the standpoint of the electronic theory, by Drude; magnetostriction, by Nagaoka; secondary standards of light, Violle; condensation nuclei, by Wilson; electrical conductivity of gases, by Lewis; electrostriction, by More; wave lengths between the longest thermal and shortest electric waves, by E. F. Nichols. Dr. Pender contributed a most interesting paper giving an account of his work in confirming the accuracy of Rowland's great experiment on the magnetic effect of moving charges, and Dr. Arrhenius, in a remarkable paper, treated of the electric charge of the sun. The discussions in this section are of a value and interest commensurate with the importance of the subjects considered, many of those taking part being men of international scientific authority. In particular the discussions on units and standards is of timely interest and importance.

In Section B—General Applications—twenty papers were presented, the authors being Steinmetz, Behrend, S. P. Thompson, Ryan, Blondel, Eichberg, Mordey and Hansard, Jouaust, Sharp, Nodon, Rosa, Lloyd and Reid, Day, Boucherot, C. A. Adams, Rushmore, Arnold and la Cour, Heyland and Hobart. Among the subjects treated are eddys and hysteresis in iron, magnetic viscosity, electrolytic rectifiers, testing of alternating-current generators, plunger electromagnets, high-pressure insulation, single-phase railway motors (which seems misplaced in this section), armature reactions, alternators in parallel, induction motors, regulation of alternators, compound alternators with alternating-current excitation and the commutation of direct and alternating currents. The principal discussions were on eddys and hysteresis in iron, testing of alternating-current generators, influence of wave form on the rate of integrating induction meters, the design of high-pressure insulation, armature reaction, the leakage reactions of induction motors and the regulation of alternators. The paper by Prof. E. Arnold and J. L. la Cour, forms an exhaustive treatise on the subject of the commutation of direct and alternating currents, the text and illustration taking up almost 70 pages of the *Transactions*.

In Section C—Electrochemistry—fifteen papers were presented, the authors being Ostwald, Lorenz, J. W. Richards, Kennelly and Whiting, Heroult, Hulett and Carhart, Guthe, Goldschmidt, Betts and Kern, Kahlenberg, Haber and Bruner, W. D. Bancroft, Edstrom and T. W. Richards. Among the more practical subjects treated are the electrical extraction of nitrogen from the air; the chemistry of electroplating; chlorine in metallurgy; alumino-thermics; electrometallurgy of iron and steel and the Edison storage battery. Other subjects are the carbon cell, the silver voltameter, the lead voltameter, standard e.m.f. cells, electrolysis of fused salts, electrolysis and catalysis, electrolytic conduction, the electrochemical series of the metals, and the hypothesis of compressible atoms. Almost every paper presented in this section was the subject of discussion, the most lively being that on electrolytic conduction.

Section D—Electrical Transmission of Power—comprises sixteen papers. Those of Perrine, Gerry, Kelly and Bunker, Nunn, Hancock, Hayward and Baum treat more particularly of the design and operations of the far western transmission plants. A paper by Scott deals with electrical power transmission in a general way, and Mershon in a mathematical paper sets forth formulas for determining the maximum distance to which electric power can be economically transmitted. Papers on details of electric power transmission were presented as follows: High-tension transformer, by Peck; aluminum as an electrical conductor, by Buck; conductors for long spans, by Blackwell; high-tension insulators, by Converse. The remaining papers are on experiments with transformers of very high voltages, by Prof. H. P. Smith, sparking distances, by Fisher, and a curious contribution entitled "Electrical Transmission Plants in Switzerland," which in fact treats of Swiss central stations, scarcely touching upon power transmission in the usual acceptance of that term. Moreover, the paper merely gives a crude synopsis of a table of data compiled and printed by the Association of Swiss Central Stations. The discussions in this section, which are both more voluminous and more discursive than those of any other section of the Congress, are principally confined to various aspects of high-tension transmission in California and the Rocky Mountain region.

The lengthiest section of the *Transactions* is that occupied by Section E—Electric Light and Power. Twenty-five papers were presented before this section, the authors being Arthur Wright, E. De Fodor, G. N. Eastman, W. C. L. Eglin, Carl Roderbourg, E. Jona, Philip Torchio, Alex Dow, Gotthold Stern, L. A. Ferguson, Prof. Clarence Feldmann and Joseph Herzog, Dr. C. P. Steinmetz, Prof. Andre Blondel, Col. R. E. B. Crompton, Prof. Lombardi and G. Mellazo, Prof. E. L. Nichols, Gerhard Goettling, Henry Noel Potter, W. L. R. Emmet, Prof. A. Rateau, F. Hodgkinson, C. D. Haskins, G. Ross Green, V. Poulsen and H. F. Parshall. Subjects represented by two or more papers are the steam turbine, three papers; direct vs. alternating-currents for central station distribution, four papers; meters and meter rates, four papers; distributing systems, three papers; luminous electric arcs, two papers. The subjects of other papers are the Prussian system of train lighting; insulating materials for high tension cables; standardization of electrical apparatus; stroboscopic observations of the arc; standards of light; storage batteries; the Nernst lamp; a system for producing continuous electrical oscillations, and a description of the Yorkshire & Lancashire Electric Power Companies.

The principal discussions were on rates for electrical supply; direct current vs. alternating-current distribution from central stations; luminous electric arcs; standardization of electrical apparatus and the steam turbine. Three of the four papers on central station systems championed the direct-current side, and in the discussion the advocates of direct-current were present in great majority. Consequently, if one were to judge by the space occupied by its partisans and by their aggressiveness, the direct-current presentation carried the day. This might indeed be considered the last grand rally for the direct current, for one is not rash in predicting that when electric supply distribution comes up before another congress for discussion, there will be only one side to the question—and that will not be the direct-current side. The contributions by Profs. Steinmetz and Blondel on luminous electric arcs are of the highest value, every phase of the subject being ably treated by these distinguished writers.

The paper by Col. Crompton on the standardization of electrical apparatus gave the results of the deliberations of the English Electrical Standardization Committee. The discussion developed a wide difference between British and American opinion on the subject of standardization, and it would appear to be wise for the British Standardization Committee to delay final action on their work until the whole subject has been considered by the international standardization commission recommended by the Chamber of Delegates. Owing to the lamentably backward condition of electrical engineering in Great Britain, that country can scarcely hope to impose her decisions as to standardization on countries like the United States, Germany, Italy, Austria-Hungary, Switzerland and France—all far in advance of her in electrical engineering design and practice; consequently any rules formulated in conflict with the practice of these countries will, while complicating the international standardization situation, at the same time tend still further to minimize Great Britain as a factor in the electrical industry outside her territorial bounds.

Among the papers of more permanent value presented in this section are those of Eastman on protection and control of large high-tension alternating-current systems; Jona on insulating materials of high-tension cables; Feldmann and Herzog on the distribution of voltage and current in closed conducting networks; the papers of Blondel and Steinmetz on the luminous arc; Nichols on standards of light; Lombardi and Melazzo on stroboscopic observations on the arc; Green on wattmeters, this forming an excellent contribution to the central station side of the subject; and the admirable paper of Parshall on the district supply of electrical energy, which treats a question that is rapidly assuming high importance in this country. The omission of a half dozen perfunctory and "write-up" papers from this section would have strengthened it.

Section F—Electric Transportation—includes 16 papers, exactly one-half of which relate directly to single-phase traction systems and apparatus, the authors being B. J. Arnold, Steinmetz, Deri, Latour, Bragstadt, Danielson, Lincoln and Niethammer. To this list should also belong the paper by Eichberg, printed in another section. All of these papers were discussed together, the discussion occupying 10 pages of the *Transactions*. This budget of papers and their discussion form the most complete presentation in print of the several forms of single phase street railway systems and motors. The only other discussion of importance in this section was that on the presidential address delivered by Mr. B. J. Arnold at a joint meeting of the Congress, and the American Institute of Electrical Engineers, the subject being the electrification of steam railroads. This discussion occupies 20 pages, and together with that above mentioned forms a most interesting and complete contribution to the modern electric railway problem. Another paper of great permanent value is that of Mr. Frank J. Sprague on the history and development of the electric railway. This paper traces all of the important steps in the development of the electric railway, beginning with the experiment of Davenport in 1834, dates and all important details being given. A concluding paragraph also discusses the trunk line electrification problem. Still another discussion of heavy electric traction is given in a paper by Mr. Philip Dawson, the subject being the electrification of the British railways. The conclusion of Mr. Dawson is that there is no country in the world in which electrification would be a greater benefit to the railways than the United Kingdom, and that when once a movement in this direction begins the rate of transformation will be rapid. Other papers contributed to this section are as follows: The storage battery in electric railway service, by J. B. Entz; the Monorail railway, by E. B. Behr; the booster in railway service, by Prof. Dr. Rasch; breaking high speed trains, by R. A. Parke.

Section G—Electric Communication—included 20 papers. By far the most interesting of these are four papers on wireless telegraphy, the authors being the Marquis Solari, John Stone Stone, Dr. Lee De Forest and Dr. J. A. Fleming. The discussion on these papers, unfortunately, was not very extended, the only point treated being the theory of the so-called electrolytic receiver. A paper on high-frequency telephone circuit tests by Dr. Kennelly, and another on loaded telegraph lines in practice, by Dr. H. B. Hayes form valuable contributions to the more technical side of telephony. Mr. J. Hesketh in a paper gave an account of the ravages in Australia of an insect which attacks the lead covering of telephone cable; it appears from the discussion that trouble from the same source has been experienced in China, and even in the Southern states of this country. Rapid telegraphy was treated in five papers, their respective authors being Mr. J. C. Barclay, Mr. P. B. Delany, Mr. F. W. Jones, Dr. L. M. Potts and Prof. Ferdinando Lori. Other papers are on telegraphy and telephony in Japan by Mr. Saitaro Oi; simultaneous telegraphy and telephony, by Herr Joseph Hollos; military use of the telegraph, telephone and cable, by Colonel Samuel Reber, U. S. A.; automatic vs. manual telephone exchanges, by K. B. Miller, which paper was followed by a discussion of some length; the theory of telephone exchange development, by M. de la Touanne; economical features in modern telephone engineering, by Mr. L. W. Stanton; features of the Dunbar two-strand common battery systems, by Prof. J. C. Kelsey. Prof. G. F. Sever contributed a valuable collection of data relating to the electrolysis of underground cables. These are comprised in five tables, in which are digested opinions regarding electrolysis of underground conductors and its remedy, collected from railway and municipal reports and numerous other sources of information on the subject. The discussion of this paper brought out some further points of interest.

The final pages of the *Transactions* contain the proceedings of Section H—Electrotherapeutics, the roll of members and list of subscribers to the *Transactions*. Twenty papers were presented in Section H, the only one of interest to electrical people being a report by Dr. Samuel Sheldon, Mr. W. J. Jenks and Mr. C. L. Clarke on current classification and nomenclature, and on tests of electrostatic machines. All the other papers are on medical subjects. In most cases they reveal scarcely a speaking acquaintance with electrical science, properly speaking, though dealing largely in electrical terms. In the opinion of the reviewer, a blunder was committed when the branch of electrotherapeutics was given representation as a section of an electrical congress, the empirical methods of this branch of medicine—if, indeed, it may be considered a recognized branch of medical science—having nothing in common with the methods of physical science.

The Automobile Pocketbook. By E. W. Roberts, M.E. Cincinnati: Gas Engine Publishing Company. 320 pages, 51 illustrations.

This convenient book for the pocket should be found useful by automobilists who wish to learn the principles of gas engine vehicles and obtain hints as to their care and operation. The preface states that in the preparation of the matter the author applied to manufacturers of automobile engines for information and consulted the instruction books issued by the various automobile manufacturers. Matters of design are wisely not entered into, and in the thirty-six chapters of the book is scattered practical information relating to the care and manipulation of every detail entering into a gas engine automobile.

Methods of Charging for Current-Supply to Incandescent Lamps.

In judging the various methods used or proposed for charging for current it is necessary to form first a clear idea of the conditions which should be fulfilled by a perfect method. These conditions are as follows:

1. The charges for current to different consumers should be approximately proportional to the cost of supplying them, unless it can be conclusively shown that another ratio of charges secures greater profits. In most mercantile transactions the cost of production ultimately governs prices; there is, therefore, a strong presumption in fixing the price of any commodity in favor of being governed by its cost of production.

2. The method of ascertaining the amount of the charge should be reasonably accurate, simple and consequently cheap; it should consume little or no power and should not interfere with good voltage regulation.

3. In charging for current to small and poor consumers it is desirable to know beforehand the cost of supplying the current and the consequent charge, so that it can be collected in advance without giving credit.

In ascertaining the degree of perfection of any method it is, therefore, necessary to consider first what determines the cost of production of the current supply. Here it is of some importance to distinguish between a water power plant and a steam plant.

In a water power plant using no storage, either of water or by means of storage batteries, the cost of current supply is governed by the peak load and is practically independent of the number of kilowatt-hours furnished. A charge based on the peak load caused by each consumer is, therefore, in proportion to cost of production. Such a charge will alone perfectly comply with the first condition mentioned.

Where storage batteries are used it would, on superficial consideration, appear that this is not the case, since the current not used during times of small load can be used for charging the batteries, and these can furnish part of the peak load. This current would otherwise go to waste, or would not be produced, without material reduction of cost. It may, therefore, be assumed to cost practically nothing. The part of the peak load supplied by the batteries may then be cheaper than that supplied directly. If the method of charging according to peak load would cause an almost continuous peak so as to make the charging of batteries impossible, then charging according to peak load would not be in proportion to cost of production. This is, however, never the case; it is, therefore, strictly true, whether storage batteries are used or not, that the cost of production of the current supply for different consumers is, in a water power plant, in proportion to the peak loads caused by them. Where this method of charging does not greatly increase the number of kilowatt-hours used with a given peak load, the kilowatt-hours will generally have no material influence on the cost of current supply even in a plant where water storage is extensively used. And the above holds, therefore, also in this case.

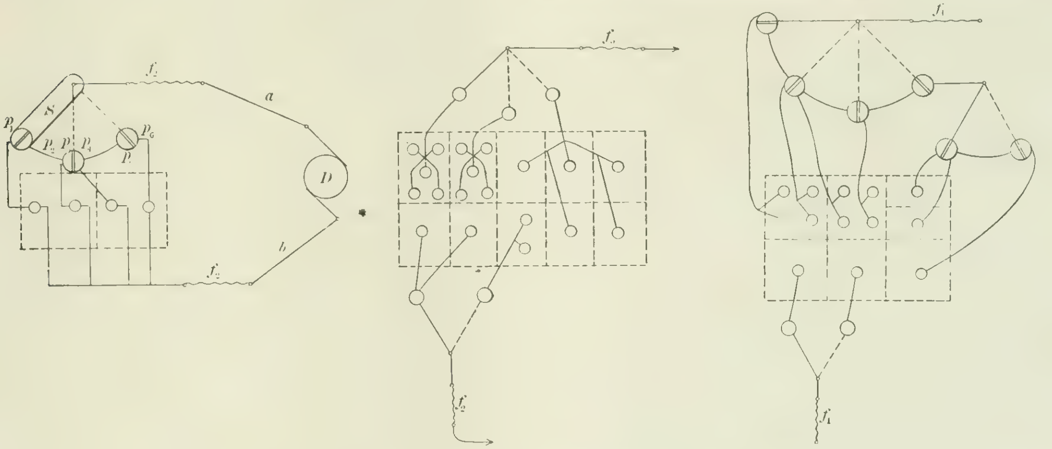
In steam plants it is evident that the coal consumption is nearly proportional to the number of kilowatt-hours used. With 4 pounds of coal used per kilowatt hour at the lamps and coal at $3.50 a net ton in the bunkers, the cost of coal per kilowatt-hour is 0.7 cent. If all costs, inclusive of interest and profit on capital, amount to 7 cents per kw-hour at the lamps, the coal causes 10 per cent of the total cost.

Small changes in the number of kilowatt-hours corresponding to a given peak load will hardly affect the cost of the boiler room force. All other costs in a steam plant are practically proportional to the peak load. With a given peak load an increase of 50 per cent in the number of kilowatt-hours used will cause an increase of only about 5 per cent in the cost of the current supply.

Generally more than 0.9 of the cost of current supply is proportional to the peak load and less than 0.1 is proportional to the number of kilowatt-hours used. A perfect method of charging would be governed by this proportion. We are now prepared to judge the degree of perfection of the existing and some proposed methods of charging for current supply to electric lights.

There are two fundamentally different methods of charging and various compromises between them in use. The first of these is based on the number of lamps installed and the second on the number of kilowatt-hours of current used. In the first the peak load which may possibly be caused by the consumer, but not that which he will actually cause, governs the charge. A concrete case is best adapted to show the great difference between the two. Take a tenant of a five-room flat who has three lamps in the drawing-room, three in the dining-room, two in one of the bedrooms and one each in another bedroom, the bathroom and a kitchen, in all 11 lamps. He may possibly light these 11 lamps at the same time and thereby cause a corresponding peak load. If he is of an economical disposition he could easily get along without using more than four lamps at one time. He may use three in either the drawing or dining room and one in the kitchen, or he may use two in one bedroom and one each in another bedroom and bathroom.

A flat rate based on the number of lamps installed is, therefore, far from identical with a rate based on the actual peak load caused by the consumer. Consequently, it does not comply with the first of the three conditions of a perfect system of charging. Where it is in force the consumer has little inducement not to light occasionally all his lamps at the same time and thereby to produce a peak load equal to the current needed for all the lamps installed. It is, however, a simple and cheap method of charging; it consumes no power and does not interfere with the voltage regulation; it permits the fixing and collecting of the charge in advance, but does not allow



Figs. 1, 2 and 3.—Diagrams of Distribution of Lights.

an accurate estimate of the cost of current supply. It causes large peak loads and is mainly for this reason very uneconomical. The method has, therefore, been largely supplanted by some one of those based on the use of meters.

Meters generally measure the number of kilowatt-hours used; they do not measure the peak load caused by the consumer. This latter is, however, the most important of the factors governing the cost of current supply. In making out the bills an attempt is made to correct this deficiency of meters by either estimating or measuring by a special meter the amount of the peak load and then basing the bill partly on the peak load and partly on the number of kilowatt-hours used. The estimate of the peak load has the defect that it assumes it to be a given fraction of the number of lights installed, and thereby removes the inducement for economy in regard to peak load, which does exist where the peak load is measured. The consumer with an estimated peak load has no special reason not to use during the hours of plant peak load all his lights at the same time, and cannot be supplied as cheaply as a consumer with a measured peak load. Watt-hour meters do, therefore, not comply with the first condition, which requires charges in proportion to cost of production. They are, moreover, most defective as regards the second and third conditions, which must be fulfilled by a perfect method of charging.

They are complicated and consequently expensive contrivances; they are costly to maintain in good order; they soon begin to run slow and must be repaired; they must be read monthly and it is practically necessary to make out monthly bills. They consume power and cause loss to the company by going slow. They cause a variable loss of voltage and thereby interfere with good regulation. The cost of supplying the consumer cannot be foreseen nor can his charges be fixed beforehand. These objections become especially serious where small consumers using only a few lamps at the same time are to be supplied. For these small consumers there is, however, a new method available which almost completely complies with all the conditions of a perfect method of charging. It consists in the use of a combination of switches and fuses for limiting and measuring the amount of current supplied to the consumer. It can be most easily explained by means of concrete examples.

In Fig. 1, s represents a switch arm of a three-point switch. Each point, $p_1 p_2$, $p_3 p_4$, $p_5 p_6$, consists of two insulated parts, which are covered and connected to the current supply at one position of the switch. The part p_2 of the first point is electrically connected with p_3 of the second point, and p_4 is connected with p_5. The points are connected as shown with lamps indicated by circles in the rooms, the walls of which are marked by dotted lines; f_2 represents fuses adjusted to the current required by two lamps; a and b are the mains leading to the source of current. The switch shown permits the lighting of two lamps at one time, either both in one of the two rooms or one lamp in each room.

Fig. 2 shows a total of 10 lamps in 10 rooms, 7 of which can be lighted at the same time. One three-point and one two-point switch are required and permit the simultaneous lighting of various groups of 7 lamps. The fuses are intended to be closely adjusted to the number of lights supplied through them. They will thereby give an additional guarantee to the company that no largely excessive amount of current is used. This latter could, however, be done by connecting around the switches or otherwise interfering with them.

Fig. 3 shows 13 lamps in 7 rooms, 5 of which lamps may be lighted at the same time. One of the switches has four split points, another supplied from this two split points, and a third independent switch two solid points. These switches permit 10 different combinations of 5 lamps to be lighted at one time. The last two examples shown are about the most complicated for which various combinations of the contrivances shown are adapted. The consumer may desire on special occasions to light all his lights at one time. To make this possible a special locked switch connecting all the lamps to the supply must be installed. The key to this switch would have to be kept by the company, which will, upon notice received, make the connection at any time except when the load reaches the capacity of the plant. This causes little expense to the company and can be done for a small charge. The charge for current would be based on the number of lamps used at one time or on the peak load which the consumer causes. If he pays in addition for the lamps he uses he has sufficient inducement to turn them out when not wanted. By this method the peak load alone is considered in charging, but it is the actual peak load and not an arbitrarily estimated one. It is, therefore, to the interest of the consumer to make the peak load as small as possible and thereby to decrease the cost of his current supply. This result is not secured by either a flat rate or the use of watt-hour meters. The consumer will hardly neglect to turn out his lights when he goes to bed since not to do this would materially increase the cost of his lamps.

The bulk of the small consumers have practically the same habits and will use nearly the same number of kilowatt-hours for a given number of lamps used at one time. Charges based on this number of lamps are, therefore, very nearly in proportion to the cost of supply. The method here proposed agrees more perfectly than any of the existing methods—with the possible exception of one based on the use of two meters—with the principle of charging according to cost of production. No meter is required on the consumer's premises, the switches use no current and cause no reduction of voltage; they are cheap to buy and maintain.

The yearly cost of a meter allowing 10 per cent of cost of meter installed, for interest, taxes and profit on investment, the cost of maintaining it in good condition, of reading it and making out and collecting monthly bills, the cost of the power it consumes and the losses it causes to the company by its inaccuracy—these amount in all for a small dwelling using four lamps at one time to about $5.

The yearly cost of the switches which replace the meter and simpler switches that would otherwise be used, is, together with the royalty and the cost of making out and collecting yearly or half-yearly bills, probably not in excess of 60 cents per dwelling.

The saving in small dwellings is, therefore, considerable, and will, in many places, make it possible to furnish electric light cheaper than gas. This will enormously increase the demand per square mile and will thereby greatly reduce the cost of current distribution, causing another saving varying much in amount with circumstances and often of more importance than that above mentioned.

For large dwellings using many lights the costs inseparably connected with the use of meters are not such a heavy burden and the contrivances described are not suitable for them since they would limit the freedom of the presumably wealthy occupant to an extent which he would not submit to. In small dwellings a nearly absolute freedom in the choice of lights to be used at the same time becomes possible without much complication in the switches.

The advantage due to the greater demand per square mile and the consequently reduced cost of distribution will extend to all consumers, whether they use meters or not. The contrivances described will, therefore, not replace meters; they will rather be a means of extending the use of electric lights to districts, which could previously not be profitably supplied an account of the excessive cost of meters for small dwellings. Most of the new districts supplied will contain a number of large dwellings; the use of meters may, therefore, even be increased by supplying a cheap substitute for them in places for which they are not well suited.

The above-described method has been devised by Joseph Mayer, C.E., 1 Broadway, New York, who has applied for patents on its details.

◆

Single-Phase Railway for Spokane.

A contract has just been closed with the Spokane & Inland Railway Co. by the Westinghouse Electric & Manufacturing Co., of Pittsburg, Pa., for the equipment of an electric road, the present terminals of which will be Spokane, Wash., and Moscow, Idaho, 146 miles apart. The roadway is completed from Spokane to Waverly, a distance of 34 miles, and operation will be begun on this as soon as possible. The road is a home enterprise, the stock being held entirely by men living in the district through which the line passes—business men, professional men and farmers. The directors of the company are J. P. Graves, president; F. A. Blackwell, vice-president; F. Lewis Clark, John Twohy and Alfred Coolidge, all men of wealth who have been so long identified with enterprises of magnitude that their names insure the success of any undertaking with which they associate them.

In selecting the equipment for this road, both the direct-current and the single-phase systems were considered, but, after careful comparison the single-phase alternating current system was adopted. Not only did the estimates show a large saving in initial investments and in annual operating expenses in favor of the single-phase system, but a form of heavy traction is made possible which would be practically unfeasible with the direct-current equipment. Besides the passenger traffic the company is preparing to do a heavy freight business and also to carry mail and express.

Power for the operation of the road will be purchased from the Washington Water Power Co., which will supply three-phase currents at 4,000 volts, 60 cycles, to a frequency changing station approximately 1½ miles from the generating station. Seven 750-kw, oil-insulated, water-cooled transformers will step down the voltage from 4,000 to 2,000 volts, the potential for which the induction motors of the frequency changing sets are wound. There will be four of these motor-generators or frequency changers of 1,000-kw, capacity each at normal rating. Each consists of a 1,000-hp, three-phase, 2,000-volt, 60-cycle induction motor, a 1,000-kw, single-phase, 2,200-volt, 25-cycle revolving-field alternator, and a 750-hp, 550-volt, direct-current generator which is to float on the storage battery acting alternately as a motor and generator. The three machines will be mounted on a single bed plate with seven bearings. Exciting current for the alternators will be supplied by three sets, each consisting of a 750-hp, three-phase, 2,000-volt induction motor and a 50-kw, direct-current generator.

Nine 675-kw, oil-insulated, water-cooled transformers will step-up the voltage from 2,200 to 45,000 volts, at which pressure it will be transmitted to the fifteen transformer sub-stations, each containing two 375-kw, 45,000-6,600-volt, oil-insulated, self-cooling transformers. A twenty-three panel switchboard, electrically operated automatic oil circuit-breakers, and protective apparatus, complete the equipment of the frequency changing station. Low-equivalent lightning arresters and choke coils are provided for both primary and secondary circuits in all sub-stations.

The transmission lines will consist of two No. 2 copper wires, and the trolley will be of the standard catenary construction, using a No. 3-0 wire and carrying current at 6,600 volts.

Each passenger car will be equipped with four 100-hp motors, capable of maintaining a schedule speed of 35 to 40 miles an hour. In the freight service four 150-hp motors will be used on each car. For the heavy freight service double locomotives weighing approximately 70 to 80 tons will be used, each consisting of two parts and each part a complete 35 to 40-ton locomotive. Two or more of these locomotives may be coupled together and operated from the front cab as a single unit. The motor cars and locomotives will all be operated by the Westinghouse multiple-unit control system. The motors will operate under three different conditions, 6,600 volts alternating-current in the interurban districts, 700 volts alternating-current in the smaller towns, and 575 volts direct-current in the city of Spokane.

Electrically-Driven Pumps.

The accompanying illustrations show the latest designs of the Allgemeine Elektricitäts-Gesellschaft for electrically-driven pumps. The outfits have been designed with especial reference to the best running conditions of high-speed electric motors. A most noticeable feature is the very compact arrangement of the pump and the motor.

The single-acting principle has been adopted throughout and for smaller outputs only one plunger is used (Fig. 1). In larger sizes, however, where the necessity for dealing with greater quantities of water requires it, the double plungers are employed, as shown in Fig. 2. All parts are designed specially for the requirements of high-speed pumps, and a short stroke is chosen to keep the plunger within the required limits, namely, 3 to 4 ft. per second.

The water, entering through the suction pipe (Fig. 3) is first retained in the suction chamber situated before the suction valves, *A*. which are arranged as group valves round the plunger. The delivery valves, *B*, are likewise grouped, concentrically and directly opposite to the suction valves. To render the flow of water uniform from the delivery outlet, which is arranged on the side of the pump, an ample delivery air vessel, *F*, is provided. The valves open and shut automatically, and in order to make certain of proper working at the high speeds of the pump, they are specially designed for the purpose, with as little weight as possible, small lift and large valve area, so that all pounding or failure in action is precluded.

The valve seatings and rings are of metal, to prevent leakage; the seatings are provided with leather rings, but for pumping warm water metal seatings are alone employed. The springs are of hard-drawn brass, and keep the valves firmly up against the seatings. The delivery valves are at once accessible on removing the cover, *E*, and the suction valves likewise, on removal of the cover, *D*, which is held in place by the cover, *E*.

An air compressor is supplied to furnish the necessary compressed air to the delivery air vessel, and is driven from the cross head pin directly or in the larger types, by a pin from the end of the pump shaft. The compressor cylinder is designed with a large clearance space; to compress the air to the pressure required to discharge into the air vessel at the point *H* (Fig. 3), the clearance space must be filled with water. For this purpose water enters the compressor at the end of the suction stroke, when the plunger uncovers several openings in communication with the air vessel at the point *G*. The action of the compressor ceases when the water level in the air vessel is below the point *G*, and begins again when compressed air is required, namely, when the water has risen above the opening, *G*, and has entered the compressor.

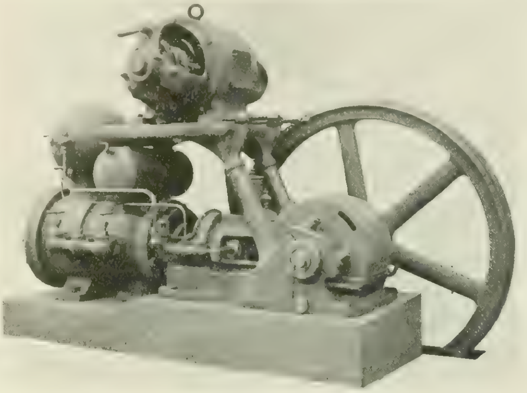


FIG. 1.—SINGLE-PLUNGER PUMP.

For driving the pumps by means of high-speed electric motors, belts have been found most satisfactory. It is claimed that the double reduction heretofore generally required for electrically-driven pumps, with spur or worm gear, cannot compare in efficiency with the belt drive. The steadiness of the drive is assured by the heavy fly-wheel. The speed variation in the different types varies between 1.5 and 3.5 per cent. In cases where the necessity arises, the speed variation can be still further reduced by the use of a heavier fly-wheel.

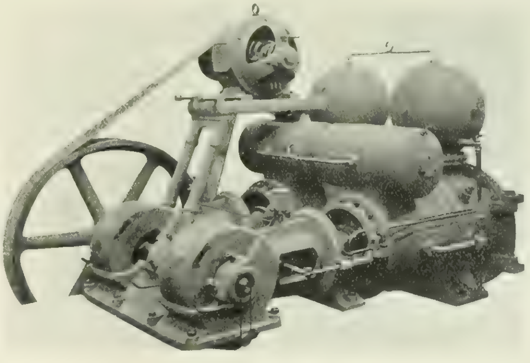


FIG. 2.—DOUBLE-PLUNGER PUMP.

The unique design of the suction chamber, where the water is retained directly in front of the suction valves, the arrangement of the specially-designed suction and delivery valves opposite each other, giving short and direct passages for the water through the pump, together with the correct choice of the velocities for the water, result in a noiseless pump, there being no hammering, even at the highest speeds. The above constructional features, together with those already described, insure not only a high efficiency, but also greatly increase the facility for dealing with maximum suction lifts.

A pump of this design, running with a great number of strokes per minute, in comparison with a slow running pump with long stroke, divides up the quantity of water to be delivered in a unit of time, into a correspondingly increased number of smaller deliveries. These, following each other in rapid succession, constitute more nearly a continuous delivery than that obtained from a slow-running pump, even if multiple-acting. The equalization of any remaining unsteadiness of the flow of the water in the pipes is provided for by the air vessels already described.

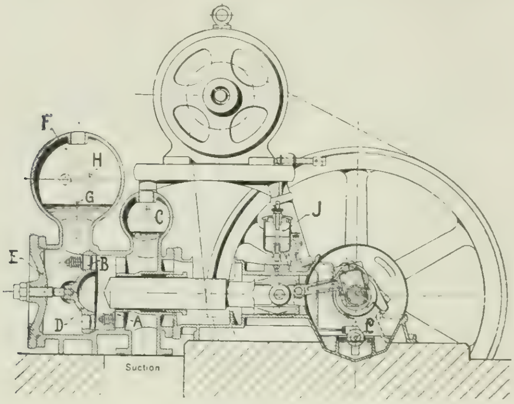


FIG. 3.—SECTIONAL VIEW OF PUMP.

The starting resistances, supplied for either continuous-current or three-phase motors, operate automatically to start and stop the pumps, as required in installations in which the working of the pump is intermittent; the possibility, thereby, of dispensing with the constant services of an attendant, enables considerable reductions to be made in the running costs. The arrangement is of practical application for filling and emptying tanks and reservoirs, and for hydraulic plants generally; it can also be used for starting and stopping the pump from one or more distant points.

◆

Hartford Time Switches.

The Hartford Time Switch Company, 97 Warren Street, New York, is placing on the market two new types of time switches. The original Hartford switch, known as type "B," is the simplest form of such switches and merely provides for turning current on and off daily at the hours desired. One of the new types, known as type "C," is used for electric sign work principally, one of its functions being to omit automatically the switch throws on Sunday. The second new type, known as type "D," operates for two periods each evening—in the early evening, and when theatregoers are returning home, the light being cut out in the interim. These three types cover a range of 33 different switches, and in addition the company has designed many switches for special work, from a kind that automatically throws on a signal light for 10 seconds once a day, to others that operate only once a week. Of these special switches one which will prove of interest to central station managers is arranged to keep automatically a sign lighted for one or two hours later on Saturday night than other nights, omitting entirely the Sunday lighting if desired. The other is a small compact switch made of a capacity up to 20 amp. and designed for installation in the interior of tubular poles, such as are now being so largely adopted for street lighting purposes.

◆

The American Electrical Salesmen Association Organized.

At the time of the Illinois State Electric Association Convention at Peoria, Ill., last week, a number of salesmen got together and organized the American Electrical Salesmen Association. The first meeting at which the organization was made was held at the Lud Hotel October 4, 1905, the organization being perfected on the following day.

This body is intended to be more than local in its character. It is believed by its organizers that an association of this kind can do good work in promoting a more fraternal spirit and better acquaintance among salesmen traveling for the electrical companies. It will be the aim of the organization to do this and to raise the standard of ethics and technical knowledge among such salesmen. The first annual convention will be held January 6, 1906, at Chicago, during the time of the Electrical Exhibition. There are no dues to be paid in the association and the management will be largely in the hands of the executive committee. The officers elected were: Vincent Gray, president, St. Louis; George H. Erich, secretary, 218 North Court Street, Rockford, Ill. Executive Committee—E. E. Rines, of Chicago; Edward Kerns, of Chicago; E. R. Wood, of Moline, Ill.

An engineering corps was elected, consisting of E. E. Rines, 2420 Indiana Avenue, Chicago; J. S. Corby, of Chicago; Thomas G. Grier, of Chicago. It will be the duty of the engineering corps to carry on whatever educational features it seems desirable to introduce, and to look after the presentation of lectures or papers.

◆

Guy Anchor.

The accompanying illustrations show the D. & T. (drive and twist) form of guy anchor, which has been designed for use in soft earths, solid clay or sand. The anchor is driven into the ground the desired depth with a sledge or maul (Fig. 1). The blades are then set by twisting to the right three revolutions (Fig. 2). The design of the blades, like those of a screw propeller, causes them to spread when the anchor is twisted. The pitch is such that they spread to an angle of 90° in three revolutions.

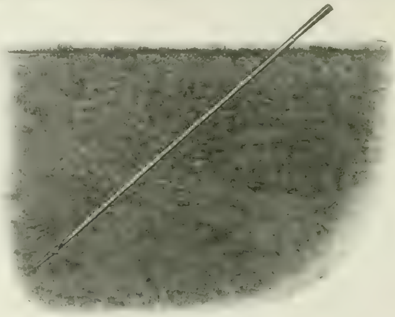


FIG. I.—ANCHOR DRIVEN IN CLAY OR SAND.

The spreading of the blades sinks the anchor about one inch, so that there is no lost motion in the ground. The pull is on earth that has not been disturbed.

It is stated that the anchor can be set by one man in 60 seconds.

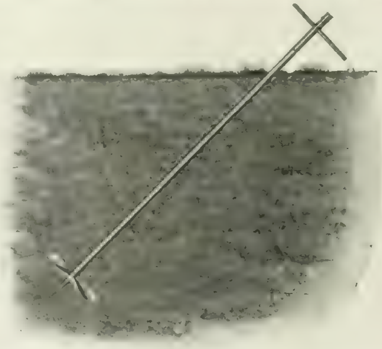


FIG. 2.—ANCHOR AFTER BEING TWISTED THREE REVOLUTIONS TO THE RIGHT.

This device is being placed upon the market by the D. & T. Anchor Company, La Crosse, Wis.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports continue favorable and there is no indication of any anxiety as to the future. Higher temperature checked retail distribution of seasonable merchandise, but preparations for heavy fall and winter trade continue with no diminution. Industrial activity increases, a large tonnage of new business assuring full time at the steel mills still further into next year, and the textile factories are busy. Better crop news weakened cotton and grain prices slightly, but there will be enormous profits to the growers even if quotations go still lower. No serious weakness is feared, no matter how large the production, owing to the interest of exporters. Complaints as to car shortage increase, the grain, coal, coke, iron and lumber trades all reporting congestion from this cause. Undiminished activity is witnessed in the iron trade, demand for crude and finished products surpassing previous years at this period. Higher levels of future cost, particularly as to coke and ore, confront these trades. Collections for the country in general are good. Taken as a whole, Southern trade advices are better, and some markets free from yellow fever quarantine restrictions, which, by the way, are being relaxed, report distinct improvements in trade and collections. A downward turn in prices of agricultural products was in evidence, a result of the pressure of new large crops of fine quality. There were free buying and large shipments of dry goods, clothing, groceries, shoes, hardware and lumber in all leading Western and Northern markets. Free buying of pig iron was again a feature of the week at leading markets, advances of 25 to 50c. per ton being noted at some points, and prices still tending upward. Steel billets are 50c. to $1 higher, and light rails have advanced $1. Records were broken in the August exports of various iron and steel material made through New York. Hitherto such shipments have been sent abroad principally through Philadelphia and Baltimore, but in August New York handled about two-thirds of the entire consignments made to various parts of the globe via Eastern seaboard points, or 42,117 tons out of a total of 58,764 tons of steel rails, billets, beams, blowers, wire, wire nails, and pipe which left these shores. The shipment embraced the largest single consignment that has ever left any American port. The different countries to which exports were made were Great Britain, Ireland, Australia, Mexico, Argentine Republic, Chile, Belgium, Holland, Denmark, Norway, Sweden, Germany, Italy, Central America, South Africa, Canada, China, Japan, Philippine Islands, Dutch East Indies, Ceylon and Greece. In all, 27,443 tons of steel rails went forward, the Argentine Republic taking 13,306 tons. Cuba was a purchaser to the extent of 8,838 tons. Mexico, notwithstanding the recently inflicted additional tariff, took three lots, amounting to 3,450 tons, while Chile got 1,749 tons. The steel billets went principally to England. The September exports of wire, wire nails, and pipe exceeded 14,000 tons. The wire shipments also amounted to 7,835 tons. Australia was the principal buyer, taking 4,728 tons. The September nail shipment amounted to 1,865 tons, which went mostly to England. More than 4,300 tons of pipe went abroad last month, 2,030 tons of which went to Europe. Lead and copper are higher. There was a good demand for copper and consumers paid 16⅝c. for Lake and electrolytic for immediate shipment. Special brands command ⅛ to ¼c. more. *Bradstreet's* reports 189 business failures during the week ending October 5, against 185 the week preceding, and 195 in the corresponding week last year.

THE BALL & WOOD COMPANY, 17 Battery Place, New York, has recently added to its works at Elizabethport a plant for turning out welded flanged pipe and pipe bending. The company is now in position to meet the demand of contractors and engineers for a pipe joint to withstand the higher steam pressures coming into use, due to the increasing preference for superheated steam. It will do no pipe fitting and will undertake no piping contracts, but is prepared to quote prices and fill orders for the material used in this line of work. In its new plant the Ball & Wood Company has endeavored to avail itself of the latest improvements in every line of equipment, not only in making the joints and bends but in handling the material. A new building has been erected, in which all the tools are driven electrically. Heavy, high-speed lathes, facing tools, multiple drills have been installed, and through the use of the new tool steels the largest flanges are faced and drilled quickly and accurately. Electric cranes, oil furnaces and modern hammers complete the equipment for turning out work promptly. After this work is completed every joint is tested under hydraulic pressure to the required specification before it is shipped and the result of this test is stencilled on the pipe.

TROLLEY IN IOWA AND TEXAS.—Engineers Cason & Barrett, of Kansas City, Mo., state that the survey of the proposed route for an electric railway between Fairfield, Birmingham and Keosaqua, Ia., proved the route impracticable from both an engineering and financial standpoint and was therefore abandoned. A new survey was started, however, for a route between Fairfield and Keosaqua via Stockport. By connecting Fairfield and Keosaqua through Stockport instead of Birmingham, the road will be about thirty miles instead of twenty. Mr. Henry S. Hackbusch, civil engineer for Cason & Barrett, is still retained in charge of the field party. The firm has also just signed a contract for preliminary survey and investigation of the proposed electric interurban road connecting Corsicana, Fairfield and Palestine, a distance of 75 miles. Mr. J. V. Watkins, of Corsicana, is promoting the enterprise, and states that he has capital enough back of him to swing the undertaking easily. The route has already been looked over and Messrs. Cason & Barrett state that they will probably have their corps of engineers at work on the survey by Oct. 15, 1905.

BIDS WANTED.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until October 20, to furnish at the navy yards at New York, N. Y., 31 motor-generators, 2 to 15-kw, 80 to 220-volt, seven alternating armatures, 2 to 5-kw. Bids will also be received until October 24 at the same Bureau to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., navy supplies as follows: Electrical cable, incandescent lamps, electrical supplies, thermostats, sockets, wire, conduit and fittings, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

NAVY SUPPLIES WANTED.—Bids will be received until October 17 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C. and Norfolk Va., incandescent lamps, electrical supplies, double conductor switch stands; outlet boxes, Holophane hemispheres, wireless clusters, electric deck hoists, steel conduit, drilling and milling machine, power trimming press, sheet press, bar steel, etc. Address, H. T. B. Harris, Paymaster-General, U. S. N.

EXPORT TRADE LARGE.—Up to August 31, 1905, imports amounted to $770,412,026, as against $667,269,364 in the preceding year; and exports were valued at $966,612,607, as compared with $851,203,457 in the first eight months of 1904. The value of manufactures exported during the first eight months of 1905 practically equaled the total exports of manufactures during the entire calendar year 1899, being $370,198,670, as against a total of $380,787,891 for the entire year of 1899. Should the commercial activity indicated by the August figures continue during the succeeding four months, the calendar year 1905 will show the largest volume of commerce, both as to imports and exports, ever recorded.

BIDS FOR TURBINES.—The following are reported to be the bids opened on October 4 by the Board of Bond Trustees, Jacksonville, Fla., for furnishing two 500-kw steam turbine generators, with necessary equipment, for the extension of the city lighting plant: General Electric Company, $38,963; Providence Engineering Works, of Providence, R. I., $40,945; Allis-Chalmers Company, $36,135; Westinghouse Machine Company, Pittsburg, Pa., $36,767 for bid "A" and $35,367 for bid "B." Warren Electric Manufacturing Company, Sandusky, Ohio, $31,925; two bids, single flow and double flow, same for each.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Mt. Pleasant, Ill.; Hunter, N. D.; Union, Miss.; Harris, Pa.; Des Moines, Ia.; Roann, Ind.; Tower Hill, Ill.; Milacca, Princeton, Foley, North Branch, Rush City, Mora, Forest Lake, Grandy, Lindstrom, Braham, Minn.; Olathe, Kan.; Rochester, N. Y.; Truro, Ia.; Kalama, Wash.

THE ROBINS CONVEYING BELT COMPANY has recently secured through Messrs. J. G. White & Co., of New York, the contract for the belt conveyors for the U. S. naval coaling station at Olongapo, Philippine Islands. The Robins Co. is also constructing a belt conveyor for handling coal for the Lackawanna Steel Company's plant at Buffalo, and expects to ship shortly a large order of belt conveyors for the Santander Iron Mines, Santander, Spain.

PRICES WANTED.—Lawson, Sykes & Company, Courtland, Ala., want prices on machinery and equipment for an electric light plant.

G. E. RAILWAY MOTORS.—The General Electric Company reports a large demand for its railway motors, as indicated in the following list of recent contracts: The Central Illinois Construction Company, Decatur, Ill., has added two four-motor, 65-hp, and two four-motor, GE-73, 75-hp Sprague-General Electric type M control equipments complete. The South Bend & Southern Michigan Railway Company, South Bend, Ind., has ordered five four-motor, GE-74, Sprague-General Electric Type M control equipments. The Columbus, Delaware & Marion Railway Company, Delaware, O., has ordered three GE-73 type M equipments and one four-motor, GE-1000 equipment, with K-6 controllers, while the Interurban Railway Company, Des Moines, Ia., has ordered eight 4-motor, GE-73 Sprague-General Electric type M control equipments, and the San Francisco, Oakland & San Jose Railway, Oakland, Cal., has ordered three two-motor GE-66 (125 hp) equipments of type M control, which are in addition to 14 equipments already in operation on this road. The San Antonio Traction Company, Texas, has ordered 12 two-motor, GE-67 equipments with K-10 controllers. The Galveston City Railway Company, Galveston, Texas, 17 GE-54 motors with K-10 controllers. The Northern Texas Traction Company, Cleveland, O., 10 two-motor, GE-54 equipments with K-10 controllers. The New York City Interurban Railway Company has added 10 four-motor, GE-80-A, 38-hp equipments with K-33 controllers to its present equipment. The Philadelphia Rapid Transit Company has also ordered five two-motor, GE-80 equipments. The Scranton Railway Company, Scranton, Pa., also ordered 30 GE-80 motors. The Syracuse Rapid Transit Company has ordered nine four-motor, GE-67 equipments with controllers. The Memphis Street Railway Company, Memphis, Tenn., has added 35 four-motor, GE-57 equipments. The Rochester Railway Company has added six four-motor, GE-54 equipments, making a total of 86 of these 25-hp motor equipments on its lines. The Kanawha Traction Company, Charleston, W. Va., has ordered six two-motor, GE-57 equipments, and the Gulfport & Mississippi Coast Traction Company, Gulfport, Miss., 12 four-motor, GE-57 equipments with K-14 controllers. The United Railway of San Francisco has added 50 four-motor, GE-1000 equipments with K-4 controllers.

POWER PROJECTS AT DULUTH.—It is stated by the *Iron Age*, that the General Electric and Westinghouse Electric companies are formulating plans for the electrification of Proctor Hill, on the Duluth, Missabe & Northern Railroad. This is a 2 per cent grade for about six miles, running from the shipping docks of the company on the harbor of Duluth to the terminal and transfer yard of the company at Proctor, Minn. Loaded ore trains from the mines are run to Proctor and there taken by switch engines down to the docks. The same engines bring back empty cars, which are made up for the return trip to mines at Proctor yard. About 2,500 will be required for handling trains on this grade, and if arrangements are made with either company for an installation the power will be furnished by the Great Northern Power Company, which is now building its hydro-electric works at Duluth. It is not yet determined whether alternating or direct current will be used in this work. The same companies are also working out plans for the possible electrification of the Duluth-St. Paul line of the Northern Pacific Railroad. This line connects Duluth and Superior with Minneapolis and St. Paul, and is about 165 miles in length, with a very heavy freight and passenger traffic. With the exception of a 1 per cent grade out of Duluth, and slightly steeper entrance into St. Paul, the line is reasonably free from gradients. It is one of three steam lines connecting these cities and carries an immense amount of coal and package freight as well as some grain, and runs several passenger trains each way daily. The second project is not so sure as the first and may not come for a considerable time. The successful electrification of the Duluth, Missabe & Northern's terminal line will mean that electrical railroading will be extended to the entire length of that line as well as to both the other roads reaching from the iron ore ranges to Duluth.

Financial Intelligence.

THE WEEK IN WALL STREET.—The rise in rates for money and the consequent restriction upon the market checked speculative activity in stocks and prices were inclined to ease off in spite of manipulative support by large interests. There was an evident disposition to bring industrials into more prominence, but this was limited by the money market conditions. Notwithstanding these, however, the market showed a decided disposition to recover ground. United States Steel stocks throughout the week appeared to be well supported, the buying of common being especially good. Common and preferred both reached the highest prices of the year, viz., 39 for the former and 105⅞ for the latter. Traction securities received some attention under the lead of Brooklyn Rapid Transit, but the gains were subsequently lost. Brooklyn Rapid Transit touched 73⅜ but closed at 71⅝, which is a net loss of 1⅛ points. Metropolitan Street Railway made a slightly better showing, closing at 126[illegible], a net gain of [illegible] point. Interborough Rapid Transit was the greatest sufferer of all the tractions, the closing price, 210½, representing a net loss of 3[illegible] points. The electric securities were generally weak and little was done in them. Allis Chalmers common closed at 18, a net decline of ½, and preferred at 60½, a gain of [illegible] point. General Electric lost 1 point net on the week's business, closing at 180[illegible], and both the Westinghouse stocks closed with a net decline of [illegible] point each, common closing at 169½ and preferred at 164[illegible]. Western Union was inactive, closing at the lowest quotation of the week, 98[illegible]. American Telephone & Telegraph is unchanged at 138[illegible], and American Telegraph & Cable is off ½ point, the closing price being 92[illegible]. Four hundred shares of Electric Storage Battery sold at prices ranging between 85¼ and 84½, the closing quotation being 85, which is a net gain of ¾ over the closing quotations of the previous week. The curb market during the week held fairly well considering the heaviness of the Stock Exchange list during a large part of the time. There was less liquidation on the curb, and it was not affected to any extent by the money market, because call loans are rarely made on unlisted stocks. Standard Oil scored a rather sensational rise, following up the movement of the previous week. The rise during the present week amounted to more than 30 points, making about 40 points in two weeks. The closing quotations of October 10 are given in the subjoined table:

NEW YORK

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
Allis-Chalmers Co	18	17¾	General Electric	182	180½
Allis-Chalmers Co. pfd	60¼	60½	Hudson River Tel	..	..
American Dist. Tel.	32	32	Interborough Rap. Tran	213	213
American Tel. & Cable	92	92	Mackay Cos	40⅛	40⅜
American Tel. & Tel.	138	138	Mackay Cos. pfd	74	74½
Brooklyn Rapid Transit	72¾	71⅝	Marconi Tel		.
Electric Boat	30	30	Metropolitan St. Ry	126⅝	127
Electric Boat pfd.	70	70	N. Y. & N. J. Tel.		
Electric Lead Reduction			Western Union Tel	93½	93⅝
Electric Vehicle	17	16	Westinghouse com.	168¼	167½
Electric Vehicle pfd.	22	23	Westinghouse pfd.	..	.

BOSTON

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
American Tel. & Tel	139½	137½	Mass. Elec. Ry. pfd	58⅞	57
Cumberland Telephone	121	121	Mexican Telephone	1⅝	1¾
Edison Elec. Illum.	250	249	New England Telephone	137	136
General Electric	181	179	Western Tel. & Tel.	14	14
Mass. Elec. Ry.	13	14	Western Tel. & Tel. pfd.	95	95

PHILADELPHIA

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
American Railways	52½	52½	Phila. Electric	9	8⅞
Elec. Co. of America	11⅛	11¼	Phila. Rapid Trans	28	27¾
Elec. Storage Battery	84	82	Phila. Traction	.	.
Elec. Storage Battery pfd.					

CHICAGO

	Oct. 4	Oct. 11		Oct. 4	Oct. 11
Chicago City Ry	200	.	National Carbon	63	61
Chicago Edison		150	National Carbon pfd		
Chicago Subway		.	Union Traction	..	
Chicago Tel. Co			Union Traction pfd	.	.
Metropolitan Elev. com	25⅛				

* Asked

WELSBACH ANNUAL REPORT.—The annual report of the Welsbach Co. shows that it earned $17,307 more net profit for the fiscal year just ended than in 1904, when the company's business felt the effect of the commercial depression. The company's policy has been to push the sales and be content with a smaller margin of profit on the goods, thus putting the business on a more stable basis. This resulted in 1905 in an increased volume of business and of net earnings as well. The net earnings are the largest of the present company in any year except 1901, when they were $625,837. The $7,000,000 bonds are getting the benefit of the operations of the sinking fund which has now acquired nearly $1,000,000 of the bonds, and after meeting the sinking fund requirements, charging off something to depreciation and paying the usual September dividend of 2 per cent., the company was able to carry forward a small surplus. The United Gas Improvement Company owns control of the $3,500,000 stock. The present price for the bonds is about 65 and for the stock 24.

AURORA, ELGIN & CHICAGO.—Plans are being matured for the retirement of the $1,500,000 of the preferred stock and the substitution of $2,000,000 of 5 per cent bonds. The original bond issue was $3,000,000, which was to cover the cost of the property. The purchase of an expensive private right of way, which is 100 feet wide, the laying of the track on stone ballast with very heavy rails and the elaborate equipment of the power house brought the cost $1,700,000 above the expectations and up to $4,700,000. To make the bond issue equal to the value of the property it is to be increased to $5,000,000 and the cumulative preferred stock is to be retired. This gives to the common stock [illegible] of the value of the surplus above fixed charges. Present earnings of that property show a satisfactory gain in both gross and net earnings.

THE MEXICAN TELEGRAPH COMPANY shows gross earnings for the quarter of $[illegible] and net of $[illegible]. The Central & South American Telegraph Company shows gross earnings for the quarter of $[illegible] and net of $210,500.

BOSTON EDISON REPORT.—The Edison Electric Illuminating Co., of Boston, has issued its report for the year ended June 30, 1905. The meeting of stockholders was held this week. The income account compares as follows:

	1905.	1904.	1903.	1902.
Gross	$3,346,027	$3,125,516	$2,667,808	$2,460,158
Expenses	2,143,106	2,009,691	1,683,085	1,510,427
Net	1,202,921	1,115,825	984,723	949,731
Miscellaneous profits	33,286	37,396	32,502	25,981
Total increase	1,236,207	1,153,221	1,017,225	975,712
Interest and dividends	1,164,791	1,075,813	955,970	859,614
Surplus	71,416	77,408	61,255	116,098

Lamps and motors connected as of June 30, 1905, compare as follows:

	1905.	1904.	1903.	1902.
Incandescent lamps	708,384	627,441	493,492	442,934
Arc lamps	10,102	9,358	8,106	8,348
Motors, horse-power	26,416	24,150	20,801	19,130

Of the increase shown for the fiscal year just closed 57,509 incandescent lamps, 493 arc lamps and 2,017 horse-power of motors were added in the purchase of the Woburn Light, Heat & Power Co. The remainder is the increase in new business for the year. President Charles L. Edgar says: "The growth of the company in lamps and motors during the year has been satisfactory. During the year the property of the Woburn Light, Heat & Power Co. has been purchased and a contract entered into with the Newton & Watertown Gas Light Co. for supplying that company with all its electricity until such time as the final purchase of its electric property is consummated. The new turbine power station has been in successful operation since last fall, the installation of two 5,000-kw units having been completed at that time. Another unit of the same size has recently been ordered and will be installed during the summer of 1906. The old generating station at Framingham has been discontinued and the property is for sale. The steam stations at Natick and Somerville have been turned into sub-stations, the steam apparatus being retained as a reserve. The steam stations located at Head place and Hawkins street have been turned into sub-stations and the apparatus disposed of, all of which is reflected in the decrease in the reserve for maintenance account shown in this year's balance sheet."

PENNSYLVANIA ELECTRICS.—The merger, recently announced in these columns, of the Pennsylvania and Mahoning Valley Railway Company, operating the New Castle and interurban lines of Youngstown, Niles and Warren, and the Sharon and New Castle Street Railway Company, controlling the local lines of Sharon and interurban lines to Youngstown and New Castle, has been ratified by the stockholders. It was decided to accept the offer made by J. W. Blackburn, of Youngstown, Mr. Barton, of Cleveland, and others, for the transfer of the properties of the two concerns. The new company is the Mahoning & Shenango Railway, Light & Heat Company. The deal involves about $5,000,000 worth of railway property and valuable franchises. The company will expend about $3,000,000 in improvements and extensions, as soon as stock to the amount of $10,000,000 is issued. One of the extensions will be a line from New Castle to Mercer through New Wilmington. It is also announced that the deal has practically been closed for the sale of the Titusville Traction Company to Murray A. Verner, of Pittsburg, and the McClure syndicate of Philadelphia. This means a consolidation of all electric light and street railway companies in Crawford County and eventually all the lines in western Pennsylvania and eastern Ohio will be merged and under control of one company, headed by Philadelphia, New York and Pittsburg capitalists. It is said that when all the lines are united it will represent properties which will be capitalized at $15,000,000.

LARGE WESTERN TROLLEY DEAL.—In Philadelphia, papers have been signed transferring four important Western traction companies to a Philadelphia syndicate headed by Randal Morgan, of the United Gas Improvement Company. The properties and the securities outstanding upon them are as follows:

	Bonds.	Pfd. stock.	Com. stock
Ind. N. W. T. Co	$2,500,000	$450,000	$2,500,000
Ind. & Western	1,500,000	750,000	1,250,000
C. B. Lake & Newark	1,250,000	500,000	1,000,000
C. New. & Zanesv	1,250,000	400,000	850,000

All of these roads were built, financed and managed by Tucker, Anthony & Company. Negotiations have been pending since the early part of August. It is understood that the sale involves the transfer of about $14,000,000 in cash and securities. While these properties are not sold to the United Gas Improvement Company, as a company, the fact that the Improvement Company has large traction interests in Indiana and Ohio which connect with the above four roads, makes it quite possible that they will in time turn up in the ownership of these properties.

ELECTRIC STORAGE BATTERY.—The English subsidiary of the Electric Storage Battery Company has issued its annual report, and the figures show that the year just closed was the best in the history of the plant. Dividends of 6 per cent. on the preferred and 8 per cent. on the common stock, were paid, but earnings were sufficient to pay about 70 per cent. on the common, which very high rate was, of course, due to the small amount of this issue. All of the common stock of the English company is owned by the American company. The reason the larger part of this 70 per cent earned on the common stock of the English company was not paid, was that it is intended to pay off the bonded debt, which matures next December, and which will be provided for entirely out of cash in bank, leaving the company entirely free of any debt whatever. In this respect the American and English companies will thereafter be similarly circumstanced, as the parent company has no debts of any kind.

DIVIDENDS.—Stone & Webster report that a semi-annual dividend of 75 cents on the preferred stock of the Houghton County Electric Light Company and a dividend of 50 cents on the common stock are payable November 1. The directors of Standard Underground Cable Company have declared a quarterly dividend of 3 per cent, payable Oct. 10. The Hudson River Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable Oct. 14. Stone & Webster state that a semi-annual dividend of $2.50 per share has been declared by the Edison Electric Illuminating Co. of Brockton and a semi-annual dividend of $4 per share by the Lowell Electric Light Corporation. Both dividends are payable November 1 to stock of record October 12.

SALE OF PADUCAH PROPERTIES.—Stone & Webster have purchased the street railways, electric light and gas companies of Paducah, Ky., and have combined them under one management under the name of the Paducah Traction & Light Co., incorporated under New Jersey laws. The combined earnings for 1905 and 1906 (estimated) follow:

	1905.		1906.
Gross earnings	$225,000		$270,000
Operating expenses (56%)	126,250	(60%)	162,000
Net earnings	98,750		108,000
Fixed charges	.....		63,000
Net profit	.....		45,000

KANSAS INTERURBAN TROLLEYS.—Mr. James T. Manning, of the Kansas City Oil Supply Company, has succeeded in financing the interurban trolley line of which he is president, and work is to begin within sixty days. Mr. Manning says that the work of constructing the new road would be started within sixty days. The length of the line will be sixty-four miles and the maximum grade 4 per cent. A contract for the grading has been let to the Tonganoxie Construction Company. The name of the interurban company is to be the Kansas City, Lawrence & Topeka Short Line. The officers of the organizing company are James T. Manning, E. M. Lambkin, Martin Gallagher, Easton, Kan.; W. Laning, Tonganoxie.

CHICAGO NORTHWESTERN "L."—The Northwestern Elevated Railroad of Chicago has issued its report for the year ended June 30, 1905. The income account follows:

	1905.	1904.	1903.	1902.
Gross	$1,786,414	$1,724,929	$1,642,456	$1,499,014
Expenses	616,628	566,076	517,441	425,061
Net	$1,169,786	$1,158,853	$1,125,015	$1,073,953
Changes, taxes, etc.	952,627	955,599	941,605	922,322
Surplus	$217,159	$203,254	$183,410	$151,631
Earnings on $5,000,000 preferred stock	4.34%	4.06%	3.67%	3.03%

CUYAHOGA TELEPHONE.—The earnings of the Cuyahoga Telephone Company for the six months ending June 30, 1905, have been as follows:

Gross		$273,375
Expenses	$143,707	
Taxes	9,973	
		153,680
Net earnings		$119,695
Deductions		72,009
Surplus for six months		$47,686

CONSOLIDATION IN HELENA.—J. G. White & Company and associates, who recently purchased the stock and bonds of the Helena Light & Traction Company, have incorporated the Helena Light & Railway Company under the laws of Connecticut with $1,500,000 of authorized capital stock, of which $900,000 is common and $600,000 is 5 per cent cumulative preferred; present issues, $561,000 common, and $374,000 preferred stock. A mortgage has been made to the Knickerbocker Trust Company, of New York, to secure an authorized issue of $1,500,000 twenty year 5 per cent gold bonds of $1,000 each, maturing September 1, 1925.

General News of the Week

The Telephone.

NEW CASTLE, ARK.—The New Castle Telephone Company has been formed, with a capital of $1,700, by J. L. McDougal, president; W. J. Dillon, secretary.

SAN FRANCISCO, CAL.—The Pacific States Telephone Company's exchange in Berkeley, Cal., is threatened with a strike, because a Japanese girl has been employed, there being a scarcity of operators.

SANTA BARBARA, CAL.—The city service of the Sunset Telephone and Telegraph Company will be completely overhauled and a new line built to San Francisco. A line is also to be built from San Francisco to Los Angeles.

SAN FRANCISCO, CAL.—The City Trustees of Berkeley, Cal., have closed a contract with the Signal Phone Company, of Milwaukee, Wis.; the Kilbourne-Clark Company, Pacific Coast agents, for a complete police patrol telephone system. Twenty boxes and a switchboard will be installed.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company is rapidly completing three fire-proof brick buildings in San Francisco. The company has purchased real estate at these centers for future exchanges. The growth of the system for fifteen years to come has thus been planned. All of the underground conduit work now being installed is done with provision for the needs of this period in the future. With the opening of the new 8-story telephone exchange on Bush street near Grant avenue, next March or April, the new common-battery, multiple-switchboard system will be used throughout the city and the old apparatus abandoned. The new switchboards and buildings will cost $1,775,000, and the entire expense of the betterments will reach $2,100,000. There are over 47,000 telephones in use in the city. The East office and the West office are now being operated with the new equipment, giving about 14,000 subscribers an improved service. The South office on West Mission Street, near 11th, will begin operations in January, with probably 10,000 subscribers connected. The switchboard can take care of 18,400 telephones. A considerable increase in the number of subscribers is expected as soon as the changes have been made, and the new offices will accommodate a total of 60,000 main loops. The executive offices will be moved to the new general office building on New Montgomery Street, between Mission and Howard, which will be completed in December.

FLORENCE, COL.—The Colorado Telephone Company will build a new line from this city to Querida via Wetmore and Greenwood.

LEWISTON, IDAHO.—The Pacific States Telephone Company will make improvements in its system in this city to the amount of $21,000. Protests against the company's present service are believed to have led to the decision.

ATHENS, ILL.—The farmers on the Sugar Point telephone line sold out their telephone interests to the independent company.

SPRINGFIELD, ILL.—The Central Union Telephone Company will lay its wires underground at Springfield at a cost of $100,000. It is said that the Central Union and the Home Telephone Companies will spend about $100,000 in improvements in their service in the twin cities.

ADVANCE, IND.—The Max Co-operative Telephone Company has been granted a franchise by the Advance town council to build lines in that place.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has just installed a new private branch exchange switchboard in the new post-office and court house building. There are 50 local stations. The Central Union Telephone Company has also installed a similar plant in the same building.

KOKOMO, IND.—Despite the refusal of the City Council to amend the franchise of the Citizens Telephone Company so as to permit it to enter into a long-distance service contract with the Central Union Telephone Company, the service has been instituted and it remains to be seen what effort, if any, will be made to forfeit the property to the city.

EVANSVILLE, IND.—The case of the Cumberland Telephone Company against the city of Evansville has been set for argument in the United States Circuit Court of Appeals in Chicago on Nov. 7. The suit arose out of an attempt to oust the company from the streets of the city on the alleged ground that the company's franchise had expired. The city won in the trial courts and the company appealed. The matter has been in litigation for over two years.

CONVERSE, IND.—The Converse Telephone Company, which for the past five years has been a sub-licensee of the Central Union Telephone Company, has severed its connection with that company, the contract having expired. The company has entered into a long-time contract with the New Long-Distance Telephone Company, of Indianapolis, and the Delaware County Telephone Company, of Muncie, for service over their respective lines and connecting exchanges.

LAFAYETTE, IND.—A deal has been consummated whereby the Tippecanoe Telephone Company's system passes to the ownership of the Central Union Company for a consideration of $22,000. The deal gives the Bell Company 180 miles of wire from this city to Crawfordsville, running through the villages of Romney and Linden and a good agricultural district. The system was built by Dr. Pyke, of Romney, who began with seven telephones ultimately building north to Lafayette and south to Crawfordsville. Mr. Pyke said he would have preferred to sell to the local independents, but they were too slow in considering the matter. The local independents say they do not need the line, since they have another competing line covering the same territory and now controlling the bulk of the business, besides the line just sold is old and out of date, fit only for junk.

DES MOINES, IA.—The Mutual Telephone Company has increased its rate for direct business telephones from $36 to $42 per year. The two-party line service remains unchanged at $30 per year.

CHANUTE, KAN.—The Home Telephone Company of Kansas City, which is the parent of the Kansas City Long Distance Telephone Company, has made a proposition to take over the Chanute exchange and the exchanges in Erie, St. Paul, Galesburg, Thayer, Humboldt and two or three other rural lines. It is the object of the Kansas City people to secure all the local exchanges in this part of the State.

PADUCAH, KY.—The plant of the People's Independent Telephone Company has been sold by Special United States Commissioner E. W. Bagby.

PADUCAH, KY.—The City of Paducah, Oct. 6, filed suit to oust the East Tennessee Telephone Company from the city on the ground that it has no franchise. The East Tennessee is operated by the Cumberland, and the suit marks the beginning of a war between the Cumberland and the independent lines here.

BOSTON, MASS.—The Massachusetts Telephone Company has just completed the laying of its main in the leather district of Boston, and is now making an active canvass of the leather trade for subscribers. The company has for several years supplied a large number of the wool houses with a service. At the present time the company has slightly less than 800 subscribers, whereas its central switchboard has a capacity of 1,800 lines. All of the service supplied is unlimited, with private lines to each subscriber at a cost of $48 a year. Although the company's charter permits it to operate anywhere in the state of Massachusetts, and it has already obtained franchises from 63 towns, it has so far opened but two exchanges aside from the local one, these being in Stoughton, where 100 subscribers have been obtained, and Taunton, where 300 connections have been made. The Massachusetts Telephone Company is controlled by the Telephone, Telegraph & Cable Company of America.

ST. JOHNS, MICH.—The Laingsburg Telephone Company has added 197 new telephones to its system since April 1. The average increase for September has been 3 per day.

EMMET, MICH.—The Michigan Telephone Company is constructing a line out of Emmet and through Wales to Thornton, which, when completed, will cover St. Clair County.

MORA, MINN.—The Tri-State Telephone Company has bought the local exchange and will remodel and improve it.

ST. JAMES, MINN.—The St. James Telephone Company has been formed. Capital, $25,000. Incorporated by H. M. Serkland and P. N. Sterrie.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will this fall enlarge its present building at Fifth Street and Third Avenue south.

GARFIELD, MINN.—The Farmers and Merchants Co-operative Local Telephone Company has been formed with a capital of $10,000, by Peter Engstrom and Gustaf Loo.

ST. PAUL, MINN.—By a deal the Twin City or Tri-State Telephone Company takes over 300 miles of line in northern Minnesota and Wisconsin, covering 16 exchanges and rural lines and giving the purchasers a practical monopoly of the telephone situation in ten counties. The property was formerly managed by the Minnesota Mutual Telegraph and Telephone Company. Heretofore all business over these lines and connecting points has come into the twin cities over the lines of the Northwestern Telephone Company. The territory covered by this new deal includes Pine, Mille Lacs, Benton, Isanti, Chisago and Washington counties in Minnesota and Burnett and Polk counties in Wisconsin.

JACKSON, MISS.—The Mississippi Telegraph Company has applied for a charter of incorporation; capital, $25,000; to run a line from Jackson, Miss., to West Point, Miss., about 200 miles. W. T. Naff and J. S. Anderson, Jackson, Miss., are the incorporators.

HELENA, MONT.—Extensive improvements are to be made in the local system of the Rocky Mountain Bell Telephone Company, including the installation of a new [illegible]-line switchboard.

ST. LOUIS, MO.—The Telephone Construction Company has filed articles of incorporation. The capital stock is $15,000, full paid. The incorporators are R. F. Spencer, Charles Sutter, J. H. Murphy, J. L. Hermann and J. J. Schatzman.

ST. JOSEPH, MO.—An organization of District No. 1 of the Missouri Independent Telephone Association, which includes St. Joseph and the counties of Buchanan, Atchison, Worth, Nodaway, Gentry, Harrison, Andrew, De Kalb, Clinton and Holt has been effected.

ST. LOUIS, MO.—The approximate number of subscribers to the Bell Telephone service in the city of St. Louis is now put at 25,000, the largest in the history of the company. Despite sharp opposition there has been a considerable gain right along in the amount of business done by the local Bell corporation. The long-distance service has also been extended materially during the past six months, lines being strung throughout many parts of the Southwest hitherto barren of telephone communication.

KANSAS CITY, MO.—One hundred and forty men, employees of the Bell Telephone Company, representing all departments, met at the Coates House, Kansas City, and organized the Bell Telephone Society. The following officers were elected: L. A. Mack, president; S. A. Butler, Jr., vice-president; Charles Bozard, secretary; N. Harris, treasurer; E. J. Richards, chariman of the entertainment committee; J. T. Marshall, chairman of the membership committee, and R. L. Shaw, chairman of the executive committee. The club expects to have a membership of 300 in the near future.

ST. LOUIS, MO.—Plans for financing the new United States Independent Telephone Company, the $50,000,000 corporation organized to consolidate the independent telephone systems in a number of cities, including St. Louis, are progressing rapidly. The Western end of the merger is being handled by the Mississippi Valley Trust Company, which is apportioning the underwriting of the securities for all the territory outside of New York State. Breckenridge Jones is in New York representing the Kinloch directors at a meeting of the interests, which is expected to perfect the merger. It is statd that it has not been determined so far whether the Kinloch company will be absorbed by the United States, but in any event the local company will be in a long-distance service agreement which will make it a part of the working system. An issue of $17,000,000 in collateral trust bonds is to be the basis of the financial scheme. About $1,500,000 of the bonds will be placed in St. Louis and the rest apportioned among other cities. A bonus in stock of the company is given to the purchasers. The underwriting figure is withheld at present. The companies already absorbed are located at Indianapolis, Cincinnati, Louisville, Cleveland, Pittsburg, Rochester and Philadelphia. Valuations at which the stock of these companies is to be taken over have been fixed and the payment will be made in cash or securities, at the option of the holder.

LINCOLN, NEB.—The Steinauer Telephone Company, which was incorporated in 1900, has amended its articles of incorporation by increasing the capital stock from $3,000 to $25,000.

CANTERBURY, N. H.—The town of Canterbury, acting through the board of selectmen, has refused to allow the New England Telephone & Telegraph Company a right to build a line through the town, and the company, through its attorneys, has filed an appeal with the superior court. So far as is known the town is the first in New England to refuse a franchise to the Bell Company. The action of the town is based on the claim that the exclusive right to establish a telephone line in the town has been granted to an independent company.

CAMDEN, N. J.—The Southern Telephone Development Company has been incorporated here with a capital of $100,000.

JERSEY CITY, N. J.—The Coast Line Telephone Company, which is a Jersey City independent concern, has sent out notices offering free service for six months to all subscribers who will be willing to pay $1 a month for unlimited service for one year thereafter. It is said that this company has secured 7,000 subscribers through this offer. The Coast Line concern was formed last spring, and will cover a territory in the State thirty miles west from the Hudson River. D. A. Reynolds is the president, and the main offices are at 15 Exchange Place, Jersey City. Mr. Reynolds is also manager of the Atlantic Telephone Company, which proposes to do an independent business in Greater New York, except Staten Island, with another concern, to be known as the State Line to operate in Westchester County.

LOWVILLE, N. Y.—The Central New York Telephone & Telegraph Company will operate a telephone exchange in Lowville.

BUFFALO, N. Y.—The Frontier Telephone Company has asked permission of the city to install public telephone on several street corners in this city.

BUFFALO, N. Y.—These directors, to serve for a year, have just been chosen at the annual meeting of the stockholders of the Frontier Telephone Company: William H. Andrews, Charles E. Austin, Martin Carey, Robert W. Chapin, William A. Douglas, Charles W. Goodyear, R. R. Hefford, Burt G. Hubbell, Clark L. Ingham, Andrew Langdon, F. C. M. Lautz, H. H. Littell, L. C. Lufkin, H. H. Persons, George A. Plimpton.

FARGO, N. D.—The Northwestern Telephone Company is stringing extra wires between Fargo and Jamestown. The new line will be used entirely on local business, leaving the old for through business.

JEFFERSONVILLE, OHIO.—The Bell and Citizens Telephone exchanges were recently destroyed by fire.

GUTHRIE, OKLA.—A mortgage has been filed by the Pioneer Telephone Company in favor of the Pioneer Trust Company for $750,000. It covers all lines and exchanges in both Oklahoma and Indian Territory, all of which are now owned by the Pioneer Company.

PIERRE, S. D.—J. L. W. Zietlow has purchased the lines and exchanges of the Capital City Telephone Company for the Dakota Central Company.

CHAMBERLAIN, S. D.—The Great Western Telephone Company, capital $25,000, has been incorporated by Warren Young, David Henry and Frank B. Rowe. A line will be extended to Presho.

HUNTINGDON, TENN.—The citizens of Newbill, in this county, have organized an independent telephone company. They will extend a line from Newbill to Huntingdon, connecting with the Cumberland Company. R. E. May is president of the new company, and J. A. Seates is secretary and treasurer.

DEL RIO, TEX.—T. H. Sharp and others, of San Angelo, have purchased the local telephone exchange of C. W. O'Dell. The consideration was $6,300.

LAREDO, TEX.—It is understood that the Rio Grande and Eagle Pass Railroad contemplates installing a telephone line from its depot in this city to its mines.

DALLAS, TEX.—The Texas Independent Telephone Clearing House Association has been organized in Dallas and application has been made to the Secretary of State for a charter. The purpose of the organization is to organize the independent long-distance telephone business under one head for the mutual benefit of all lines concerned.. The incorporators are E. W. Dunaway, Paris; A. J. Brown, Dallas; Cecil L. Simpson, Dallas; J. N. Earle, Waco; J. E. Boynton, Waco; G. R. Butler, Gainesville, and C. A. Shock, Sherman. There are 75 companies in the State which own about 10,000 miles of toll lines.

MADISON, WIS.—The City Council has ordered the Wisconsin Telephone Company to place its wires underground.

Electric Light and Power.

UKIAH, CAL.—The Supervisors have granted the Eel River Power & Irrigation Company a franchise for a transmission line from Potter Valley to Ukiah.

SAN FRANCISCO, CAL.—The Northern Water & Power Company has been formed by H. L. Atkinson, C. P. Pritchard, T. A. Allan and others; the capital is $5,000,000.

SANTA MARIA, CAL.—The Isaac Springer Investment Company, of Los Angeles, has purchased the Santa Maria Light & Power Company, and contemplates extending its lines to Guadalupe.

SAN FRANCISCO, CAL.—The General Electric Power Company, of San Francisco, has been incorporated with a capital stock of $1,000,000, by J. P. Lucey, W. E. Cashman, W. T. Love and K. J. C. Seymour and Guy C. Calden.

LOS ANGELES, CAL.—The Pacific Light & Power Company, of Los Angeles, is preparing to develop electric power in Yavapai County, Ariz. The initial installation will consist of a 1,200-h.p. hydro-electric plant, which it is expected to increase to 6,000 horse-power eventually.

SAN FRANCISCO, CAL.—The General Electric Company is equipping a sub-station plant in the United Railroad's power house at the intersection of Eleventh and Bryant streets, San Francisco. Five 1,100-kw step-down transformers will take current at 13,200 volts from the lines of the California Gas & Electric Corporation, reducing the voltage to 440 volts. Five 1,000-kw rotary converters will then supply direct current for the operation of cars. The present sub-stations will be retained in service after the new power contract goes into effect, January 1, 1906.

SAN FRANCISCO, CAL.—John Martin & Co. have sold two orders of 7-strand aluminum cables, aggregating 150,000 lbs., to the California Gas & Electric Corporation for use on its extensions. An additional 45-mile, 3-phase transmission line will be built between San Francisco and San Jose. Six-naught cable, of 350,000 circ. mills will be used. The other order, consisting of No. 1 aluminum, will be used on a new branch transmission line, tieing in near San Jose and extending 40 miles to the cement works of the Santa Cruz Portland Cement Company's new plant at Davenport, Santa Cruz County. Power will be supplied for the manufacture of about 5,000 barrels of cement per day.

GREELEY, COL.—The Home Electric Light & Power Company has increased its capital from $4,500 to $50,000, and will enlarge its plant and supply the entire town. Professor Hayes, vice-president of the State Normal School, is an officer of the company.

NORWICH, CONN.—An electric plant is to be installed at the Kingsbury box and printing company's factory for lighting purposes.

NEW BRITAIN, CONN.—The H. B. Olmstead Company has put a fine electric plant in its factory. A new 50-hp. upright Westinghouse engine is being installed. This engine will operate a 400-light dynamo and supply power in certain departments when the main steam engine is not running.

COLUMBUS, GA.—A committee has been appointed to investigate the cost of a municipal electric lighting plant for this place.

OCILLA, GA.—The Mayor and Board of Aldermen have awarded to Engineer J. B. McCrary of Senoia, the contract for an electric light plant and water works system, to cost about $28,000.

CICERO, IND.—The Sanborn-Marsh Electric Company, of Indianapolis, has secured the contract for constructing an electric light plant here.

VINITA, IND. TER.—The plant of the Vinita Electric Light, Ice & Power Company was destroyed by fire Sept. 26.

MUSKOGEE, IND. TER.—G. W. Sargent, of Joplin, Mo., has asked for permission to construct a power plant to replace the one recently destroyed by fire.

CHICAGO, ILL.—John H. Radford is preparing plans for an addition to the electric light plant, at 58th St. and Cottage Grove Ave., Washington Park, for the South Park Commissioners.

QUINCY, ILL.—The Royal Trust Company, of Chicago, filed a foreclosure suit Sept. 28 against the Independent Light & Power Company, of Quincy. Edwin B. Hillman was appointed trustee. In 1904 the company issued 175 mortgage bonds of $1,000 each, drawing 5 per cent. interest. It is said that the interest has not been paid on these bonds, and the aggregate claims of the trust company are $183,993. It is expected that the Quincy Gas, Heating & Lighting Company will buy the stock.

WILLIAMSBURG, KY.—Gleaves & Co., of Lynchburg, Va., propose to construct and own water works and an electric light plant at Williamsburg, to cost about $45,000. J. A. Gillman is the engineer.

EASTPORT, ME.—The Copen Light & Power Company has been organized at Eastport, for the purpose of generating and supplying gas and electricity for lighting, heating and mechanical purposes in Perry, Pembroke and Dennysville, in Washington county, Maine, with $10,000 capital stock. The officers are: President, Chas. E. Copen, of Eastport; treasurer, Chas. H. Emery of Eastport.

BUCKSPORT, ME.—There are rumored plans for the development of an electric power plant at Orland upper falls. Recently an expert has been making estimates of the extent of the power, the storage of water, the size of the watershed, the annual rainfall, etc., and the result of these will no doubt warrant the expenditure of many thousands of dollars, in the construction of dams, acquirement of flowage rights, purchase of real estate, besides the construction of buildings, installation of machinery, etc.

MEDWAY, MASS.—The Kendall Construction Company, of Boston, has been awarded the contract by the Medway Electric Light & Power Company, to entirely reconstruct its street and commercial lighting systems in this city.

MONROE, MICH.—The Board of Public Works has authorized City Engineer J. W. White to investigate the water power in River Raisin, with a view to damming the stream at Dubois farm or Sisters Island, for use in the operation of the electric light plant.

VIRGINIA, MINN.—The Council has voted to extend the arc lighting system.

ST. LOUIS, MO.—The written acceptance by the General Service & Development Company of the terms imposed in its franchise recently granted by the county, has been filed. This company owns an electric plant at Brentwood and recently purchased the electric plant and contracts of the West St. Louis Water & Light Company, which is supplying a part of St. Louis County.

RAVENNA, NEB.—The Village Trustees are considering the question of constructing an electric light plant.

HASTINGS, NEB.—The municipal electric light and power plant is being enlarged by the addition of a [illegible]-h.p. engine and generator, costing between $15,000 and $20,000.

AUBURN, N. Y.—The Auburn Gas Company has decided to purchase the plant and franchise of the Citizens' Light & Power Company, of Auburn.

PHOENIX, N. Y.—The Phoenix Fuel, Light & Water Company has been granted permission by the State Commission of Gas and Electricity to issue $100,000 bonds.

ROCHESTER, N. Y.—The Board of Supervisors has authorized the Building Commission to procure an estimate of cost of an electric lighting plant for the court house.

HERMON, N. Y.—The State Commission of Gas and Electricity has granted the application of the Hermon Electric Light Company, to transact business and issue $15,000 of stock.

AMSTERDAM, N. Y.—It is stated that the minority stockholders of The Magneto Electric Company have voted to accept the proposition of The Globe Electric Controller Company to merge the two companies by pooling the minority stock. The plan of The Globe Company is to capitalize a company at $250,000.

UTICA, N. Y.—The Hudson River Electric Power Company contemplates the construction of a 60,000-volt transmission line from Ballston to Utica. This line is now being surveyed and construction will begin in about 30 days. Steel towers will be used, spaced about 550 ft. apart. The company expects to purchase the towers, but will itself erect them and put up the conductors.

CHARLOTTE, N. C.—The Southern Power Company has recently had representatives in Spartanburg and Columbia, S. C., in each of which towns it is desired to bring 10,000 horse-power of electrical energy when the new developments are finished. About the same amount is now being used about Charlotte.

FOSTORIA, OHIO.—A committee has been appointed by the Board of Trade to look into the matter of establishing a municipal electric light plant. The present electric lighting contract with the city expires in August next.

GALION, OHIO.—According to the statement just issued by the service department, the cost of maintaining and operating the street arc lamps of this city by the municipal plant is but $27 a light per year. Much of the actual cost is paid from the earnings of the commercial department of the plant, leaving but a small balance to be paid by the taxpayers.

CLEVELAND, OHIO.—The Bradley Electric Light, Heating & Power Company has applied for a franchise for the use of the streets and other public parts of the city for the purpose of laying its wires. Under the State law the council must submit the matter to a vote of the people before any action can be taken. The company proposes to generate all the power in one central station and distribute it throughout the city through substations.

BAKER CITY, ORE.—The Fremont Power Company, of which John Waterman, John T. Thomson, Sumpter, Oregon, and Walter Fernald are the incorporators (capital, $200,000) will build the Olive Lake power plant near the Red Boy mine immediately.

PHILADELPHIA, PA.—The Philadelphia Electric Company has secured the electric lighting contract in this city during 1906 for a total of $1,073,271.

WILKES-BARRE, PA.—The Wilkes-Barre Gas & Electric Company is to equip its battery of six 225-h.p. boilers with a forced draft apparatus installed by the B. F. Sturtevant Company, of Boston, Mass.

PHILADELPHIA, PA.—It has been decided to award the contract for thte city's lighting for 1906 to the Philadelphia Electric Company. This corporation, which has the contract for this year, was the only bidder. Its offer was $1,070,000 or $1[illegible] less than what the city pays for 1905.

HAZELTON, PA.—This city was in darkness on the night of Oct. 6 as a result of a strike of the electric workers. The streets being in total darkness, few people ventured out at night. The policemen carried dark lanterns, which they attached to their belts, and thus equipped they escorted timid people to their homes.

HUNTINGDON, PA.—The Juniata Hydro-Electric Company, of Philadelphia, has commenced work on the development of an extensive water power on the Juniata River, near Huntingdon. A concrete-steel dam about 600 ft. long is now under construction, to be followed by a canal and power house. The contractors on the work are the Ambursen Hydraulic Construction Company, of Boston, Mass.

NEWPORT, R. I.—The council committee on street lighting has been authorized to ask for bids for the erection and installation of a municipal electric lighting plant.

GAFFNEY, S. C.—A party of surveyors recently visited Broad River, near [illegible], [illegible] capitalists who may bring about extensive electrical development.

SALT LAKE CITY, UTAH.—The Inter-Mountain Power Company is preparing to build a system of hydro-electric plants near Salt Lake City, with steam auxiliary. The capacity will be [illegible] horse power. Plans and specifications are in course of preparation by Frank C. Kelsey, Salt Lake City.

AMERICAN FORK, UTAH.—It is understood here that J. H. Bigger and J. E. Hill, of Salt Lake City, expect to develop 950 horse-power for electric lighting and propelling machinery in the American Fork mining district. An application has been filled with State Engineer Caleb Tanner, asking for 22 ft. of water to be taken from the American Fork Creek. The proposed diverting works will consist of a dam, spillway, headgate and pipe line, about 4,000 feet long.

OGDEN, UTAH.—I. W. Wade has been looking into a proposition relative to the construction of a power plant on the river 17 miles out of Blackfoot, Idaho. Christian Just, of Blackfoot, and others are interested in the project. Mr. Wade states that by the construction of a canal about 1,500 feet long a power plant could be established without building a dam and 1,000 horse-power developed. The power could be increased by erecting a dam. The plan is to furnish light and power to Idaho Falls and Blackfoot. The cost of the project is estimated at $100,000.

ASHLAND, VA.—The Virginia Light & Power Company, recently incorporated, proposes to furnish a light and power service. No engineer has been appointed yet and no bids have been asked for.

MONTPELIER, VT.—The Consolidated Lighting Company of Montpelier, has increased its capital stock from $350,000 to $1,000,000. The increase was voted last May, when the plant changed owners.

TACOMA, WASH.—The Nisqually Power Company has been incorporated by R. L. McCormick, Edw. Cookingham and others, to construct a power plant near the Tacoma Eastern R. R. below Eatonville.

SPOKANE, WASH.—The Big Bend Water Power Company has been organized by J. H. Tilsey, John E. Peterson, Reuben Cross and others, to develop 15,000 horse-power about 28 miles down the river. E. Tappan Tannant is the engineer.

SEATTLE, WASH.—The demand for light and power for commercial purposes has been so heavy that City Engineer Thomson and Superintendent L. B. Youngs, of the water and light department, will soon make arrangements for increasing the municipal lighting plant by installing another hydro-electric unit at a cost of $15,000. There are now two units with a capacity of about 3,500 horse-power and with the third one, the capacity will be increased to 5,000 horse-power.

MARTINSVILLE, W. VA.—The citizens voted on Sept. 28 to issue $12,000 bonds to complete the electric light and power plant. J. R. Gregory is the city engineer.

PORT WASHINGTON, WIS.—No engineer has as yet been engaged for the proposed water works and electric light plant. The probable cost of construction is $75,000. W. A. Tholen is city clerk.

GUANAJUATO, MEX.—The Peregrina Mining Company, operating in Guanajuato, intends to erect a cyanide plant with a capacity of 250 tons, to be operated by electric power.

CITY OF MEXICO, MEX.—George G. Bergman, of the City of Mexico, has applied for a concession to develop water power and build an electric plant on the River Blanco, near Vera Cruz.

CITY OF MEXICO, MEX.—Vicente Martinez, of the City of Mexico, will build an electric plant for the transmission of electric power at Xicotlacotia between the states of Morelos and Guerrero.

CITY OF MEXICO, MEX.—Pedro Alvarado, the wealthy Mexican mine owner, has awarded to Weisel & Kock, of Parral, Chihuahua, the contract for installing a new electric power plant at his Palmullio mines. Boilers are to be of the high-pressure type; engine, of the standard Corliss make, compound-tandem, with direct-connected 700-k.w. alternating-current, 2200-volt generators and exciter. Weisel & Kock are in the market for electrical supplies.

OTTAWA, ONT.—The Dominion government has passed an order granting permission for the construction of a dam across the Rainy River at Fort Francis. This proposal has been before the government for a long time, and electrical interests have been urging for the power to make the improvement.

OTTAWA, ONT.—The Ottawa Electric Company, in order to prevent all possibility of impaired service owing to the carrying out of works of improvement, shortage of water, anchor ice, etc., has decided to install a steam reserve plant of considerable capacity, in addition to the steam plant already owned and operated by this company as an emergency plant. The new installation will consist of a Westinghouse-Parsons steam turbine direct connected to a 2-phase 1,500-kw alternating-current generator. The exciter will be mounted on a bracket and on the turbine frame, and direct connected to the turbine shaft, and there will be other sources of current for exciting the field, which will be available at any time in case of failure of the exciter. The boiler capacity will be sufficient to operate the turbine and generator to the highest limit allowable for overload when desired.

MONTREAL, QUE.—The equipment of the power plant of the Kaministiquia Power Company, now being erected at Kakabeka Falls, near Fort William, Ont., will be the best that can be secured. A part of it has been contracted for in Germany, while the motors, transformers and other equipment will be supplied by the Canadian General Electric Company. The actual water head is [illegible] feet high, which is considerably higher than at Niagara Falls. It is the intention of the company to generate 30,000 horse power, the first installation on which work is now being rushed, being 10,000 horse power. The company expects to deliver power into Fort William about June 1 next, and the indications are that the entire amount of power that will be available will be readily disposed of. In addition to contracts with the Ogilvie Flour Mills Company, which will take 1,000 horse power, and the town of Fort William, power will be sold to the Canadian Pacific and Grand Trunk railways, and a large American industrial company will also take power from the company.

The Electric Railway.

SAN FRANCISCO, CAL.—The Vallejo, Benicia & Napa Valley Electric Railway has been sold to Boston capitalists.

STOCKTON, CAL.—A third electric railway may be built in Stockton, and if it is constructed it will be part of another interurban system, which will extend to the Yosemite Valley. A. C. James is interested.

STOCKTON, CAL.—An electric railway is to be built to the Yosemite Valley from Stockton, and will be financially backed by Keene and Van Cortland of New York. All the franchises have been secured and the road will be run to Gentry.

SAN FRANCISCO, CAL.—Cory, Meredith & Allen, of San Francisco, have been retained as consulting engineers for the Pueblo Suburban Traction & Light Company, of Pueblo, Col. Mr. Wynn Meredith has left for Pueblo and will be there about two weeks getting data and details preparatory to making additions and modifications of the company's present rather extensive hydro-electric transmission system. The company's plant is located on Beaver Creek and power is transmitted to Victor and Pueblo.

SAN FRANCISCO, CAL.—The Sacramento & Lake Tahoe Railway Company has been incorporated to operate a road from Sacramento to a point on the southern shore of Lake Tahoe. The line will be about 125 miles long, and a branch line of about 4 miles in length will connect the main line with Newcastle and Auburn. Three other branches are also projected. The company is capitalized at $7,500,000 and the incorporators are B. G. Raybould, W. S. Graham, Auburn; Leo Alexander, Thomas H. Nicholls, James H. Swift, T. Otway Sadlier, Edward J. Haas, John A. Black and Charles Wesley Reed.

WILLIMANTIC, CONN.—The Willimantic Traction Company's property has been transferred to the Consolidated Street Railway Company, the holding company of the New Haven's Connecticut trolley lines.

ATHENS, GA.—The Athens Electric Railway Company is erecting a turbine station, the initial capacity of which will be one 500-k.w. unit. The plant is designed for a capacity of 4 machines.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company, and its allied corporations, have elected officers as follows: President, John Blair McAfee; vice-president, H. H. Cumming; secretary and treasurer, A. J. McKnight; general counsel, W. H. Barrett; general manager, R. E. Hunt.

BOISE, IDAHO.—Articles of incorporation of the Boise Valley Railway Company, Limited, have been filed with the Secretary of State, the capitalization being $1,000,000. The intention of the company is to build an electric railway from this city to Caldwell, a distance of 30 miles, and a branch road to the plant of the Barber Lumber Company, six miles from this city. The directors of the incorporation are: B. F. .Olden, John McMillan, Robert Noble, A. Ross, H. E. Neal, D. R. Hubbard, W. N. Donaldson, O. V. Allen and H. P. Ustick..

BOISE, IDAHO.—The Roberts & Abbott Company, of Cleveland, is doing the preliminary engineering work on the Boise Interurban Railway Company's project. It contemplates building a line from Boise City to Caldwell, a distance of 30 miles, another line from Boise City to Nampa, a distance of 38 miles. Surveys are also being made for a 14-mile spur line to Pearl, an important mining town. The project also contemplates the development of a water power of about 6,000 horse-power, located about 50 miles from Boise.

CHICAGO, ILL.—A definite proposition for a new franchise grant to the Chicago City Railway Company and the Chicago Union Traction Company has been made by the companies to the Chicago City Council. The offer is equivalent to $30,000,000 or $35,000,000 cash to the city, and provides for the termination of all rights under the ninety-nine year act and ordinances at the expiration of twenty years.

CHICAGO, ILL.—The Chicago City Railway has submitted terms on which it asks a twenty-year franchise. The company agrees: To interchange transfers and route through cars over Union Traction lines, to rehabilitate lines with new cars and grooved rails, and to furnish service as required by City Council; to accept twenty-year franchise in lieu of all present rights and let the city purchase after a stated time; to change all cable lines to trolley power, using underground trolley in State Street and downtown if desired; to sweep and sprinkle streets occupied by its lines, to fill, grade, pave, and repair sixteen feet of street occupied by its lines, to make public reports of its earnings; to pay compensation on percentage basis, increasing with length of grant, charging 5 cents fare.

NOBLESVILLE, IND.—The Indianapolis, Hartford City & Eastern Traction Company has asked for a franchise in this city.

FORT WAYNE, IND.—Through service from Fort Wayne to Lima, Ohio, was inaugurated on Sept. 9 over the Fort Wayne, Van Wert & Lima line.

INDIANAPOLIS, IND.—The Indianapolis, Columbus & Southern Traction Company next year will build an extension to Seymour, Ind., 18 miles distant.

NEW ALBANY, IND.—R. W. White, John F. Stratton, C. D. Kelso and others have organized and incorporated an interurban express company. The capital stock is $10,000. It is the purpose of the company to deliver expressage, packages, parcels, etc. It will operate exclusively over the interurban roads.

BLUFFTON, IND.—A company has been formed in this city to finance and construct the Marion, Bluffton & Eastern Interurban Railway from Marion to Bluffton. The company is capitalized at $500,000, and is said to have a friendly understanding with the Fort Wayne & Wabash Valley Company. L. C. Davenport, of Bluffton, is president, and W. A. Kunkel, secretary and treasurer.

INDIANAPOLIS, IND.—The Louisville & Indianapolis Traction Company has filed articles of incorporation. The capital stock is $10,000. J. R. Schindel is president and Samuel Adams, secretary. It is the purpose of the company to build an electric railway between Louisville and Indianapolis, paralleling the Pennsylvania road to Columbus, Ind., where the cars will be operated over the tracks of the Indianapolis, Columbus & Southern Indiana Traction Company.

INDIANAPOLIS, IND.—The Wabash & Northern Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $[illegible], which is to be increased to $8[illegible]. The road will be a part of the Indiana Northern Traction Company, but will be distinct for the purpose of issuing bonds. The company will in addition to building and operating a line from Wabash to Warsaw furnish light, heat and power to a score of towns and cities along the line. James A. Barry, Lincoln Gynn and others are directors. The company's headquarters will be in Wabash.

HOPKINSVILLE, KY.—A 20-year franchise for an electric street railway has been sold to John H. Bell, Jr., of Hopkinsville.

FREDERICK, MD.—The sale of the Frederick & Middletown Electric Railroad has been formally consummated. The company organized by electing officers as follows: President, James E. Ingram, Jr., Baltimore; vice-president, J. Roger McSherry, Frederick; secretary, Emory L. Coblentz, Middletown; treasurer, Thomas H. Haller, Frederick. The new management says it will make extensive betterments to the road.

WARE, MASS.—The Hampshire & Worcester Street Railway has been sold at auction to C. G. Schulte, representing the American Trust Company of Boston, for $[illegible] over and above all incumbrances. The road was sold for non-payment of taxes.

MARSHALL, MO.—Ernest D. Martin and associates are promoting an electric railway to extend from Marshall to Sedalia, and from Marshall to Miami, a distance of 50 miles.

ST. LOUIS, MO.—A charter has been issued to the St. Louis, Lakewood & Grant Park Railway, of St. Louis, which has a capital of $300,000. F. M. Estes, L. H. Conn, H. H. Waters and others are the directors.

TRENTON, N. J.—The Rio de Janeiro Tramway, Light & Power Company, recently incorporated under the laws of New Jersey, has filed a certificate changing its name to the Villa Isabel Tramway Company.

ROME, N. Y.—The Rome and Oneida Electric Railway has been incorporated, capital, $350,000. Directors, Dr. T. L. Hall, C. C. Goodwin, New York; L. J. Laky and G. A. Lally, Detroit.

CHARLOTTE, N. C.—The Southern Power Company, Charlotte, will build a 60-mile railway from the Great Fall development on Catawba River to Harmony, S. C., for the use and convenience of the company.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company will extend its Brighton Street line to manufacturing plants east of the city.

MARION, OHIO.—The Marion-Bucyrus Railway & Light Company has organized with the following officers: President, E. A. Bartholomew, Toledo; vice-president, J. W. [illegible], San Francisco; secretary, R. S. Giles, Cleveland; treasurer, S. M. Finch, Lima.

CINCINNATI, O.—Citizens of Sharonville, Reading and Avondale, small suburban villages near this city, are working on a project to build an electric railway to connect with the Cincinnati city system. Among those back of the enterprise are Charles Cooper, A. Heineman and S. Browne, of Reading, and Charles Komar, of Sharonville.

CLEVELAND, OHIO.—The Cleveland Electric Railway has filed an amended bill in the U. S. Circuit Court against the city and the Forest City Railway Company asking the court to enjoin the city and the 3-cent fare company from taking possession of the company's Central Avenue line, on which the city claims the grant has expired.

ATHENS, OHIO.—The Nelsonville, Athens & Glouster Traction Company has been incorporated with $10,000 capital stock by J. P. Reynolds, L. E. Carpenter, J. E. Wells, W. J. Stuart, B. C. Wise, Charles Tutt and others.

LIMA, OHIO.—The Lima Electric Railway & Light Company has increased its capital stock from $850,000 to $1,250,000. The company is planning important improvements.

DOYLESTOWN, PA.—A bill in equity has been filed asking that receivers be appointed for the Philadelphia & Eastern Railway Company. The plaintiffs in the suit are William H. Kreider and Thomas Raeburn White, receivers for H. M. Herbert & Co., who contracted the electric line. The road is 36 miles long, and extends from here to [illegible]. It cost more than $1,000,000.

ANDERSON, S. C.—The incorporators of the Anderson-Easley Electric Interurban Railway have applied to the State for a charter. The company will have $100,000 capital. The incorporators are: R. Frank Smith, of Easley, J. J. Fretwell, of Anderson, and others.

NASHVILLE, TENN.—It is announced that negotiations have been concluded in New York for financing the Nashville & Franklin Interurban Electric Railway. The same New York financiers are considering advancing money to build the line to Mt. Pleasant further south, and also from Gallatin to Nashville. These will be the first interurban lines in Tennessee.

LYNCHBURG, VA.—The new power house of the Lynchburg Traction and Light Company, on the James River, three miles above this city, is now in operation. It has a present capacity of 4,000 horse-power. The plant cost upward of $[illegible].

HAMPTON, VA.—The Hampton Roads Railway and Electric Company, of Hampton, was sold at auction on Oct. 6, to [illegible], who was the representative from Philadelphia of the protective committee of bondholders of that city, the price being $[illegible].

OLYMPIA, WASH.—The company which proposes to build an electric railway between Puyallup and Tacoma has recently filed articles of incorporation under the name of the Puyallup Valley Traction Company. It will have its principal office in Tacoma. The capital stock is placed at $[illegible], and the trustees are named as follows: Fred J. Chamberlain, W. D. Cotter, W. H. Elvins, J. E. Stevenson, M. L. Brooks, John Mill[illegible], W. R. Scott, F. A. Chamberlain and Charles [illegible].

FAIRMONT, W. VA.—I. J. Conway, C. L. Conway, of this city, A. B. Overholt, Pittsburg; C. W. Dillinger, Baltimore, and B. W. Overholt, Wooster, will ask for a charter for the Fairmont & Fairview Street Railway Company. It is proposed to build the line from Fairmont to Fairview next spring, at a cost of half a million dollars, and as soon as that portion of the road is completed to go ahead with the building of the line as far as Wheeling.

WHEELING, W. VA.—The Steubenville & Wheeling Traction Company, the subsidiary of the Wheeling Traction Company, recently acquired by deed from the Steubenville, Mingo & Ohio Valley Traction Company all the rights, property and franchises of that company pertaining to the 9-mile line from Steubenville to Brilliant, O., subject presumably to the $150,000 mortgage of 1900. The Belmont County Commissioners have granted a franchise for the extension southward to Martin's Ferry on the condition that the road shall be in operation by Sept. 1, 1907.

BARABOO, WIS.—A committee of the City Council, of which Mayor E. G. Marriott is chairman, has been appointed to confer with N. Wetzel, president of the Dells Company, of Kilbourn, with a view of connecting the Dells of Wisconsin and Devil's Lake with an electric railway. The road, for which the right of way has already been secured, will cost about $50,000.

VANCOUVER, B. C.—It is announced that the British Columbia Electric Railway Company will further increase the capacity of its plant at Lake Beautiful and construct another pipe line from the dam to the power house.

ST. JOSEPH, ONT.—The St. Joseph & Stratford Electric Railway Company has been organized to build an electric railway from St. Joseph to Stratford, a distance of 30 miles. The officers of the company are: N. M. Cantin, of St. Joseph, vice-president and manager; O. Bissonnett, St. Joseph, secretary; Thos. F. Tombyll, treasurer.

◆

New Industrial Companies.

THE SOUTH SIDE ELECTRIC MANUFACTURING COMPANY, of Pittsburg, has been formed and is capitalized at $65,000, to operate a light and power plant.

THE INTERURBAN ELECTRIC EQUIPMENT COMPANY has been formed in Brooklyn, N. Y., with a captital of $4,000. Directors: W. C. Bunn, Thomas Pitt, Brooklyn; C. T. Staines, Newark.

THE H. G. POPE ELECTRIC AND MANUFACTURING COMPANY, of Buffalo, has been incorporated with a capital of $200,000. The directors are H. G. Pope, Ida B. Pope, William A. Peters, New York.

THE COOPER ELECTRIC SAFETY GATE COMPANY has been incorporated in Delaware to manufacture electrical devices, signals and automatic appliances. The capital stock is $150,000, the incorporators being Philadelphians.

THE ARMSTRONG AUDIBLE TELEGRAPH INSTRUCTION COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $40,000. The object of the corporation is to manufacture and deal in mechanical Martin Armstrong, John R. Dwyer, Lewis P. Delani and Hans Wulff, all of and electrical appliances pertaining to telegraphy. The incorporators are: St. Louis, and Claude Wetmore, of Kirkwood, Mo.

AMSTERDAM CORPORATION.—The Amsterdam Corporation of New Haven has filed a certificate of incorporation. The authorized capital is $10,000. The charter allows the company the broad powers occasionally asked asked for by companies of this kind, and includes the right to manufacture and produce electricity, construct and operate works for the accumulation and distribution of electricity for light, heat, power and signaling, construct bridges, buildings, ships, machinery, railroads, tunnels, subways, docks and canals. The incorporators are Louis B. Grant, Ashley T. Cole and William I. Bagnell.

◆

Personal.

MR. J. R. SHIELDS will have charge of an electrical course forming part of the winter programme of evening instruction of the West Side Young Men's Christian Association of New York.

MR. K. B. THORNTON, operating manager of J. G. White & Company, has been appointed manager of the Nassau Light & Power Company, at Roslyn, Long Island. This company is managed and operated by J. G. White & Company.

MR. G. A. NISBET, for several years sales agent for the General Incandescent Arc Light Company, and latterly of the Stanley G. I. Electric Manufacturing Company, has accepted the position of general manager of the Chas. A. Thompson Company, New York. Mr. Nisbet has an extensive acquaintance in the electrical field.

MR. G. F. BROCKMAN, electrical engineer and superintendent of the Hydro Electric Light & Steam Power Company, of Jackson, Ala., has resigned. He was the designer and builder of this installation, about 18 months ago, and has operated it for 14 months, every night, without a shut down of a second, for any cause. Mr. Brockman is visiting Catherine, Ala., Louisville, Ky., and Rockford, Ill.

MR. T. K. WELLS has joined the staff of J. G. White & Company, of New York, and will proceed to the Philippine Islands to take up the duties of superintendent of transportation for the Manila Electric Railway & Lighting Company. Mr. Wells was with the Wabash Railroad and the St. Louis, Iron Mountain & Southern Railroad for 14 years, following which he spent eight years with the Syracuse Rapid Transit Company.

MR. C. L. SEEGER.—The Electric Storage Battery Company, of Philadelphia, is now represented in Mexico by Mr. Charles L. Seeger, whose office is located at Primera de Humboldt No. [illegible], Mexico City. Mr. W. G. Davis, who has for some time been connected with the Electric Storage Battery Company in their Pennsylvania sales office, is now associated with Mr. Seeger in the Mexican office, and his thorough familiarity with storage battery practice enables him to take up all engineering matters in this special field of electrical work.

MR. B. J. JONES has recently become manager of the electrical department of the Cincinnati Gas & Electric Company. Mr. Jones is well known in Chicago electrical circles, having been since 1897 on the staff of Sargent & Lundy, consulting engineers. His first work with that company was that of the direct supervision of the electrical equipment of the South Side Elevated Railroad. He has been prominently identified with a number of the important jobs taken by that firm, and in this connection has come closely in touch with the electrical work of the Cincinnati Gas & Electric Company. He is the inventor of the flat flexible bond and solid terminal, designed to go under the firsh plate, which was sold originally as the Atkinson bond, being made by that company. He is also the designer of many of the details of high tension construction used on the Indianapolis & Cincinnati Traction Company's line between Indianapolis and Rushville, and adopted by the Westinghouse Electric & Manufacturing Company as standard construction for certain classes of single phase trolley work.. Previous to his connection with Sargent & Lundy, Mr. Jones was superintendent of the South Chicago City Railway Company, which position he accepted upon leaving a similar position at Sioux City, Iowa. He was at one time with the Westinghouse Electric & Manufacturing Company.

◆

Trade Publications.

A. L. IDE & SONS, Springfield, Ill., have issued a very neat "Ideal Reminder" filled with memo pads, perforated for ready detachment. The covers are illustrated with views of Ide engines.

INSULATORS.—An interesting and reliable publication on insulation has just been received from the Locke Insulator Manufacturing Company, Victor, N. Y., in the form of a supplement to its "Insulator Book." It is the intention of the company that parties now possessing copies of the "Insulator Book" shall obtain the "Supplement," so as to bring the treatise up to date.

EXAMINATION OF FUEL.—Walter & Renaud, 159 Front Street, New York, has published in pamphlet form an article on "The Commercial Examination of Fuel," which just appeared in *The Black Diamond*. The article describes, in detail, the processes involved in determining the available heat units in various samples of fuel, as applied by this company in its New York laboratory.

SILVER POLISHING BY ELECTRICITY.—Johnson Livingston, Jr., & Company, 113 East Twenty-second Street, New York, have issued an illustrated booklet dealing with electrically-driven polishers for silver, gold and bright metal ware. The motors are of the bipolar single-field-coil type. Each motor is supplied with the necessary cleaning and buffing wheels, including one four-inch and one eight-inch muslin buff, and one three-inch bristle brush.

INDUSTRIAL ENGINEERING.—An interesting illustrated pamphlet has recently been issued by the Industrial Engineering Company of America, 32 Broadway, New York. There are shown various plants, machines and tools in order to give an idea of the character of the work done by the company. Views are given of electric motors, turret lathes, tool grinders, and saw-tooth roofs for machine shops. The designs for all of these were prepared by the company.

HARDWARE.—Catalogue No. 18 of the Yale & Towne Mfg. Company, which has for its title "Locks and Hardware," contains over 200 octavo pages and is neatly bound in green board covers with red cloth back and gold lettering. In addition to cataloguing padlocks, night latches, builders' hardware, door checks, etc., it contains a comprehensive glossary of technical terms and notes of interest on the mechanism and care of locks, lock picking, master-keyed locks, hand and bevel of doors, etc.

SUCTION GAS PRODUCERS.—Oskar Nagel, 90 Wall Street, New York, has recently issued an illustrated catalogue dealing with suction gas producers. In this system air is drawn by the sucking action of the engine over hot water or steam, and then the air, saturated with steam, goes through the fuel bed, being converted thereby into power gas, which, after suitable purification, goes to the engine. It is stated that from 1 to 1.25 lbs. of anthracite or 1.3 to 1.5 lbs. of coke is sufficient for 1 hp-hour, and that a horse-power for 24 hours will cost from 6 to 8 cents.

ELECTRIC LOCOMOTIVES.—The General Electric Company, Schenectady, N. Y., has issued as bulletin No. 4130 a treatise on "Electricity versus Steam for Train Haulage," which consists of an article by L. R. Pomeroy, on "The Electrification of Trunk Lines," and a paper by W. B. Potter on "Developments in Electric Traction," which was read before the New York Railroad Club Jan. 20, 1905. The bulletin is well illustrated, numerous views being given of electric locomotives for railroad work, notably the B. & O. and the N. Y. C. & H. R. locomotives.

STORAGE BATTERIES.—The Dayton Manufacturing Company, Dayton, O., has [illegible] an illustrated bulletin, numbered 130, giving detailed information relating to isolated lighting plants. In the Silvey type B cell, the plates, which are of the pasted type, are piled one on top of another, with two sheets of [illegible] separating material between the adjacent plates. Since the elements lie horizontal, it is practically impossible for the active material to fall from the plates, and the cells do not become short-circuited. In the type SF cell, a positive and a negative plate are joined to one common connector, and are suspended in glass jars. The hard lead grid has a large number of small pockets in which the active material is placed and allowed to harden. Over the whole plate is placed a perforated sheet lead cover so that it is practically impossible for the active material to be forced from the grid.

THE INTERNATIONAL INSTRUMENT COMPANY, Cambridge, Mass., is distributing a desk blotter on which is printed a list of some of the apparatus manufactured by it. The list includes electrolytic apparatus, laboratory switchboards, voltmeters and ammeters, rheostats, physics apparatus, cement tester, etc.

THE COMMERCIAL AUTOMOBILE COMPANY, 1336 Michigan Avenue, Chicago, has issued a circular of the Synnestvedt electric vehicles, which are designed for commercial purposes. Some excellent illustrations show light and heavy delivery wagons, also a plan view of the chassis used on these vehicles.

ARC LAMPS.—The American Arc Lamp Company, Kalamazoo, Mich., has issued an attractive catalogue illustrating and describing its new line of direct-current arc lamps, which are characterized by great simplicity of construction, thereby enabling users to make their own repairs and practically rebuild the lamp when required.

INTERCOMMUNICATING TELEPHONES.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has issued bulletin No. 13, dealing with intercommunicating telephones. This system has been devised especially for the rapid transaction of business between the various departments of a single concern. Each telephone can be equipped with exchange connections, making it possible to carry on conversation with outside parties. The bulletin is an exceptionally neat publication, and is well illustrated. Diagrams are given to show the methods by which the various telephones are connected in circuit.

News of the Trade.

BRASS SHELL SOCKETS. Pass & Seymour, owing to the demand for its new line of double-pole brass shell sockets, have had to increase the output capacity of this department.

THE SUN PORCELAIN COMPANY, Trenton, N. J., reports a very encouraging business for the short time it has been operating. It has found it necessary to open a New York office at 30 Cortlandt Street, to take care of the increasing business in New York and vicinity.

THE APPETON ELECTRIC COMPANY, Chicago, Ill., has opened a New York branch at 227 Fulton Street, where it will carry a full stock of fuse wire and strip fuse links, lock nuts, bushings, etc. This office will be under the management of Mr. A. S. Merrill, who has a large acquaintance in the electrical field.

THE BARRIETT ELECTRIC MANUFACTURING COMPANY announces that Walter Macleod & Co., of Cincinnati and New York, have been appointed sole selling agents for motors and dynamos in connection with railroads in the United States. The Philadelphia Electric Construction Company, of Philadelphia are selling agents for Philadelphia.

THE KILBOURNE-CLARK COMPANY, of San Francisco and Seattle, has moved to a handsome suite of offices at 106-108 Rialto Building, San Francisco, Cal., occupying the ground and mezzanine floors. H. G. Aylsworth is manager and E. B. Parsons has charge of machinery sales. The Coast agency of the National Electric Company is carried by this firm.

THE NATIONAL X-RAY REFLECTOR COMPANY, recently at 185 Van Buren Street, Chicago, has moved to new and larger quarters at 126 Franklin Street. Among the newer specialties of this company is a line of concave and convex ceiling rosettes, 7-in. and 10-in. corrugated cones, two ornamental shades and a 14-in sectional and adjustable corrugated silver-plated glass trough reflector for store windows and picture lighting. Mr. A. D Curtis has recently purchased a controlling interest in this company.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has broken ground for an addition to its present works, which will include eight modern kilns specially designed for insulator work, which will be constructed entirely of reinforced concrete. This plant will be 180 feet square, two stories high, and will include the most modern methods of handling clay, coal, etc. The company states that with the additions which have been made during the past year, this later increase will make its works the largest in the world devoted exclusively to the production of insulators.

THE ELECTRICAL SHOW. The managers of the Madison Square Garden Electrical Show are meeting with very gratifying and substantial co-operation from the electrical industry. Since the announcement of the broad guage plans which have been developed for insuring a great popular success at the Garden next December a great many new contracts for space have been received. Among others the following well known firms have selected their space and are busy preparing attractive exhibits: National Carbon Company, Harry M. Stevens, Eastern Carbon Works, Joseph Goldfinger, New York Telephone Company, Chicago Pneumatic Tool Company, Electro-Dynamic Company, General Storage Battery Company, G. M. Gest, Ovington Manufacturing Company.

CONCRETE BLOCKS. The prizes offered by "Engineering News" and the "Cement Age" of New York for the best papers on "The Manufacture of Concrete Blocks and Their Use in Building Construction," have just been awarded by the jury, which was composed of Messrs. Robert W. Lesley, past president of the American Cement Manufacturers' Association; Richard L. Humphrey, president of the Cement Users' Association; and Prof Edgar Marburg, secretary of the American Society of Testing Materials. The first prize of $250 was won by a paper by Mr. H. H. Rice, of Denver, Col., secretary of the American Hydraulic Stone Company. The second prize of $100 is given to a paper by Mr. Wm. M. Torrance, C. E., of New York City, assistant engineer in charge of concrete-steel design for the Hudson River Tunnel companies.

DATA FOR ELECTRIC DRIVES. Manufacturers who plan the application of the motor drive to machines and machine tools are often at a loss because of the lack of information necessary to supply to the electrical manufacturer. The Northern Electrical Mfg. Company, Madison, Wis., offers to send prospective purchaser quotations on motors for application to machines and machine tool drive upon learning of the class of work to be accomplished and the voltage of the power circuit from which the current is to be taken. The Northern Company has had extensive experience in all kinds of manufacturing plants applying motor drive for increased output, and is usually able to determine upon the proper sort of motor equipment to be applied upon learning of the conditions.

THE NEW YORK TELEPHONE COMPANY is rapidly perfecting the details for its exhibit at the Madison Square electrical show. The space chosen by it is the circle in the center of the promenade, directly in the middle of the Garden. This circle is some 30 feet in diameter and over it will be hung an enormous blue bell covered with incandescent lights. This bell will be of the same bottom diameter as is the space, and will extend up almost to the roof of the Garden. In the booth itself there will be among other interesting exhibits a model telephone central. This central station will, like almost all the other exhibits in the Garden, be in use. Every exhibitor will have his telephone in his booth connected to this exchange, and during the show all the Garden business will be carried on through it. The same idea of making practical exhibits is being carried out very largely in the plans of those who have already signed contracts, and instead of being an unusual matter to find a working exhibit as is the case in most shows, it will in the case of the Garden Show be an unusual matter to find one that is not a working exhibit.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 3, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

800,619. REVERSIBLE GALVANIC BATTERY; Charles B. Askew, Chicago, Ill. App. filed Aug. 24, 1903.

800,625. INDUCTION COIL FOR IGNITING EXPLOSION MOTORS; Jules Carpentier, Paris, France. App. filed Feb. 8, 1905. In order to economize current, the coil is arranged to give only a single spark, whether the motor is run fast or slow. For this purpose an auxiliary coil of fine wire is shunted across the primary circuit, and serves to hold the interrupter armature attracted after its initial break.

800,638. STORAGE BATTERY; William Gardiner, Chicago, Ill. App. filed June 11, 1904.

800,653. METHOD OF AND APPARATUS FOR COMMUNICATING BETWEEN STATIONARY POINTS AND MOVING OBJECTS; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 8, 1902. A train telegraph system involving a single telegraph wire extending longitudinally between the track rails. The train carries a compass needle in proximity thereto, the movements of which, under the influence of induction from the wire, make and break a local relay circuit on the train.

800,654. AUTOMATICALLY STEERING MOVING OBJECTS; Isidor Kitsee, Philadelphia, Pa. App filed Feb. 28, 1903. Particularly adapted for steering Whitehead torpedoes. A large compass needle is controlled by the earth's magnetism, and energizes one or another of a pair of solenoids, which operate the steering gear.

800,656. TELEGRAPHIC TRANSMITTING TAPE; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 10, 1905. A transmission code for automatic fast telegraph lines. The code is designed to give simple impulses of alterate polarity under all circumstances in order to avoid "choking" of the line. The dot is represented by a single impulse and the dash by two impulses which follow one another and are always of opposite polarity, whatever that may happen to be.

800,657. TELEPHONIC TRANSMISSION; Isidor Kitsee, Philadelphia, Pa. App. filed June 14, 1905.

800,658. SPACE TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed June 17, 1905. A wireless telegraph scheme adapted for moving trains. The antenna is carried by the train in the manner of a trolley pole, and a tappet on the track causes a motor to draw down the pole whenever a bridge or obstruction is passed.

800,675. TELEPHONE-RECEIVER; Hermann G. Pape, New York, N. Y. App. filed June 16, 1904.

800,677. SOUND-AUGMENTING RECEIVER; Hermann G. Pape, New York, N. Y. App. filed June 16, 1904.

800,747. KEY FOR TELEPHONE SWITCHBOARDS; Frederick H. [illegible]ridge, Chicago, Ill. App. filed Dec. 12, 1902.

800,755. CONNECTION SWITCH MEMBER; Frank R. McBerty, Evanston, Ill. App. filed Dec. 7, 1904. A mechanical construction of line wire support so arranged that a telephone instrument may be cut into the wire by a simple spring jack. The casing is formed with an integral hood which protects the contacts for the spring jacks.

800,756. PROTECTIVE APPARATUS FOR ELECTRICAL INSTRUMENTS; Frank R. McBerty, Evanston, Ill. App. filed Dec. 7, 1904.

800,76[illegible]. TROLLEY POLE; Andrew L. Prentiss, Buffalo, N. Y. App. filed Oct. 18, 1904. A pneumatic retriever for trolley poles in which the valve which actuates the retrieving cylinder is controlled by a rod extending lengthwise through the pole. The harp is hinged to the pole so that its upward movement when the wheel leaves the wire, moves the rod and opens the retrieving valve.

800,[illegible]67. TELEPHONE TRANSMITTER; Philip J. Spies and Rudolph C. Deuben, Chicago, Ill. App. filed Nov. 1, 1902.

800,791. APPARATUS FOR PURIFYING WATER OR AGING LIQUIDS; Frederick K. Bowden, San Jose, Cal. App. filed June 5, 1905. Comprises a simple glass bottle with a platinum wire fused through the bottom thereof and a second wire forming the other electrode projecting through the cork.

800,[illegible]. THERMOMETRIC RHEOSTAT; William H. Bristol, New York, N. Y. App. filed Apr. 18, 1905. The resistance wire is hung within a mercury thermometer so that as the temperature rises, the mercury will short circuit and eventually totally cut out the resistance. The leads fused through the glass are of considerably larger cross section than the resistance, in order to avoid a burn-out or short circuit.

800,816. MOTOR CONTROLLER; Samuel S. Neu, New York, N. Y. App. filed Oct. 10, 1904. A system for economizing current for small motors, particularly where a large number are constantly in use as in factories.

It is customary to throw the armature current through series field windings to act as a magnetic brake in stopping the machines, a shunt winding being always in circuit from the mains. The present patentee has a cut-out in such shunt winding which operates automatically as soon as the motor has come to rest, so as to save exciting current when motor is not in action.

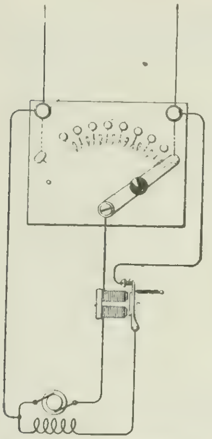
800,820. THERMAL CUT-OUT DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed July 27, 1904. A spring jack switch is normally under tension to be withdrawn. It is retained in position by a wax plug having a thermal coil therein.

800,821. THERMAL CUT-OUT DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed July 27, 1904. In this patent the same wax plug is used, but is disposed in a different relation with respect to the switch members.

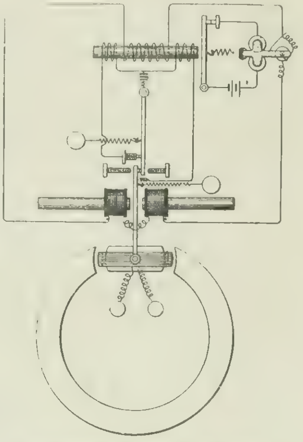
800,822. FUSE DEVICE; Charles Rolfe, Adrian, Mich. App. filed Jan. 20, 1902. A thermal cut-out for individual subscribers sets designed to be supported on the outside of the building. An insulating tube contains a fine wire fuse in series with the line circuit.

800,823. ELECTRICAL PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. A thermal cut-out for individual subscribers sets having spring arms which tend to separate. They are held normally together by connecting piece having a detent. The detent is held rigid by a strip of solder which is melted under excessive current by a small filament of graphite.

800,824. ELECTRICAL CIRCUIT PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. Involves practically the same construction, except duplicated so as to apply to a large number of circuits.



800,816. Motor Controller.



800,844. Quadruplex Telegraphy.

800,825. FUSE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. Relates to details of the terminal connections of a fuse wire enclosed in a protecting tube.

800,826. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. Modifications of No. 800,823.

800,827. ELECTRICAL PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed May 18, 1903. Modifications of No. 800,824.

800,828. ELECTRICAL PROTECTIVE APPARATUS; Charles A. Rolfe, Adrian, Mich. App. filed May 18, 1903. Substantially like No. 800,823, except includes a lighting arrester formed of the usual carbon blocks separated by mica strips.

800,829. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed Sept. 25, 1903. In order to make the thermal protector capable of resetting itself, the detent which holds the spring arms together is in the form of a star wheel positioned by a lump of solder. The wheel rotates to release the blades, but presents a new point for engagement with the spring blade when the solder cools.

800,830. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed July 30, 1904. In this case the detent which holds the spring arms together yields when the solder melts to permit the separation of the arms, but is instantly repositioned by a supplemental spring.

800,831. ELECTRICAL PROTECTIVE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed Dec. [illegible], 1903. Modifications of the above.

800,832. ELECTRICAL PROTECTIVE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed Dec. 29, 1903. In this case a star wheel is used, but is normally held by a detent which is released by the fusion of the solder.

800,833. ELECTRICAL CIRCUIT PROTECTOR; Charles A. Rolfe, Adrian, Mich. App. filed July 28, 1904. Modifications of No. 800,830.

800,834. WEATHER TRAP FOR ELECTRIC WIRES; William H. Roney, Chicago, Ill. App. filed Nov. 3, 1904. A design for admitting high potential wires into buildings. The wire enters through an opening in the wall having a protecting hood, and is led upward through a horizontal insulating diaphragm within the hood.

800,843. CONTROLLING DEVICE FOR MOTOR VEHICLES; Victor E. Chamberlin, Indianapolis, Ind. App. filed Mar. 17, 190[illegible]. A controller designed to perform all the operations of an electric vehicle from a single lever adjacent to the driver's seat. Various positions of the lever operate the motor at varying speeds, set the magnetic brakes, or reverse, as desired.

800,844. QUADRUPLEX TELEGRAPHY; Stephen D. Field, Stockbridge, Mass. App. filed Aug. 20, 1904. The purpose of the invention is to avoid the fluttering or false signal which is caused by the reversal of the line current upon the neutral relay. The patentee cures the difficulty by so arranging the neutral relay that its armature must make a complete excursion, no matter how the line current varies after it has once started. For this purpose a supplemental coil is employed, which exerts a momentary inductive influence, urging the armature lever to complete its excursion and thereby perpetuate the signal intended.

800,854. WIRELESS TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 8, 190[illegible]. A detector for wireless telegraph systems in which a vibrating lever is arranged in a bath of water of such purity as to insulate local current, but form a free medium for the passage of the antenna current.

800,855. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed June 30, 1904.

800,856. RECEIVING DEVICE FOR ELECTRIC TRANSMISSION; Isidor Kitsee, Philadelphia, Pa. App. filed June 14, 1905. Another form of detector in which a glass vessel containing ether or ether mixed with acetic ether has a heat coil including the antenna circuit fused therein. The expansion of the liquid by the heat coil raises its surface sufficiently to close a local circuit therethrough.

800,857. ELECTRIC FURNACE; Fredrik Adolf Kjellin, Saltsjobaden, Stockholm, Sweden. App. filed July 6, 1905.

800,873. ELECTRICAL MEASURING INSTRUMENT; Edwin F. Northrup, Philadelphia, Pa. App. filed Nov. 19, 1904. A U-shaped permanent magnet of cast iron has a disc armature pivoted between its pole pieces which carries a pointer. The pointer projects upward through an opening in the upper pole piece, and indicates upon a scale thereon.

800,902. SYSTEM OF ELECTRICAL DISTRIBUTION; Rufus N. Chamberlain, Depew, N. Y. App. filed Jan. 12, 1904. A central station system involving generators, boosters and storage batteries for the purpose of maintaining a constant line potential regardless of the load. The booster has differentially acting energizing coils and a counter electromotive force generator operates to resist the current through one of said coils.

800,907. ANTISEPTIC TELEPHONE MOUTHPIECE; William B. Curtis, San Francisco, Cal. App. filed Apr. 18, 1905.

800,909. CONTROLLER REGULATOR; Cyrus P. Ebersole, Keokuk, Iowa. App. filed July [illegible], 1902. The controller arm has a series of ratchet teeth and a detent which is successively moved out of engagement with the teeth by cams. The motion is sufficiently sluggish to prevent a too rapid motion of the controller.

800,916. HIGH POTENTIAL SWITCH; Edward M. Hewlett and William L. R. Emmet, Schenectady, N. Y. App. filed Jan. 15, 1900. The switch members depend horizontally from a supporting frame, and the oil bath tank is also hung from said frame so as to be readily removable for the inspection of the switch blades.

800,940. TELEPHONE TRANSMITTER; Jerome Prince, Milford, Mass. App. filed Aug. 18, 1902.

800,946. POLARIZED ELECTRIC BELL; Samuel C. Shaffner, Mobile, Ala. App. filed July 13, 1903. A hollow magnetic coil has a permanent magnet pivoted to extend longitudinally therethrough, so as to be alternately deflected by an alternating current through the coil. The bell clapper is fixed to said permanent magnet.

800,984. PROCESS OF PURIFYING METALS; Henry M. Chance, Philadelphia, Pa. App. filed June [illegible], 1905.

800,993. TURN DOWN INCANDESCENT LAMP; Samuel E. Doane, Cleveland, O. App. filed Nov. 16, 1904. Relates particularly to a protecting plate or cap for the switch members of a turn-down lamp. The protecting cap acts as a sort of hood and allows the actuating cords to be pulled without producing any opening through which a shock may be obtained when the lamp is handled.

801,034. TELEPHONE-RECEIVER; William J. Murdock, Boston, Mass. App. filed Jan. 3, 1905.

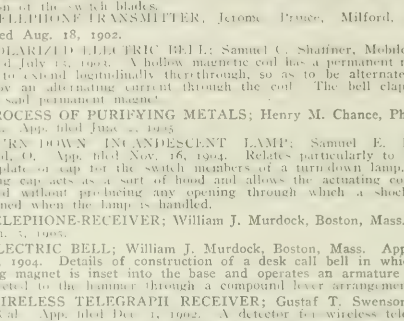
801,035. ELECTRIC BELL; William J. Murdock, Boston, Mass. App. filed July 21, 1904. Details of construction of a desk call bell in which the operating magnet is inset into the base and operates an armature which is connected to the hammer through a compound lever arrangement.

801,118. WIRELESS TELEGRAPH RECEIVER; Gustaf T. Swenson, San Pedro, Cal. App. filed Dec. 1, 1902. A detector for wireless telegraph systems in which a graphite brush bears against a shaft continuously rotated by clockwork. The antenna current bridges the microscopic gap for the local circuit, and the rotation destroys the bridge when the antenna current ceases. It has a pad to prevent vibration of the graphite brush.

801,130. TELEGRAPH AND TELEPHONE LINE AND THE LIKE; John C. Barclay, New York, N. Y. App. filed June 3, 1905.

801,132. ELECTRICAL MEANS FOR DETECTING AND ANNOUNCING CONTACT BETWEEN TWO CONDUCTING BODIES; Mark Barr, Kensington, England. App. filed May 31, 1901. A circuit is completed between the tool and the work holder when cutting contact is made, through a telephone receiver. The character of the sound indicates whether or not the tool is in proper cutting contact.

801,165. RAILWAY SIGNALING SYSTEM; Herbert B. Taylor, East Orange, N. J. App. filed May 13, 1905. Details of an overlap signal system having insulated track rail sections and a pair of magnets at each station acting normally opposed to one another, one of which is controlled by the adjacent section, and the other by the section ahead.



800,873.—Electrical Measuring Instrument.

801,173. PRINTING TELEGRAPH; John C. Barclay, New York. App. filed Mar. [illegible], 1905. (See Current News and Notes.)

801,180. CABINET FOR TRANSFORMERS USED IN X-RAY APPARATUS; Monroe S. Crowson, New York, N. Y. A form of casing for induction coils having a bakelite cover which fits over the coil and a base plate secured to the bottom thereof by non-metallic fastenings.

801,186. MAIN DISTRIBUTOR FOR TELEPHONE EXCHANGES; Georg [illegible], Munich, Germany. App. filed May 31, 1905.

801,190. ELECTRIC SEMAPHORE; Clayton F. Frederickson, Denver, Col. App. filed [illegible]. Details of a semaphore arm operating mechanism. Devices for locking the semaphore arm in its raised position, and circuits for indicating to the tower house when it has been dropped to danger position.

801,196. SELF-LOCKING INSULATOR; Charles L. Mathian, Carlisle, Ky. App. filed Dec. [illegible], 1904. The insulator has an elongated hole extending transversely therethrough for the wire, and an inclined slot through which the wire is admitted. The inclination is such as to prevent the withdrawal of the wire when the insulator is in working position.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, OCTOBER 21, 1905. No. 17.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7005 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.......1130 Monadnock Block
PHILADELPHIA OFFICE.......929 Chestnut Street
CLEVELAND OFFICE.......412 Cuyahoga Building
EUROPEAN OFFICE..........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **579,500.**

NEW YORK, SATURDAY, OCTOBER 21, 1905.

CONTENTS

Editorial 677
The Western Union Telegraph Annual Report 680
Do We Need Better Illuminating Engineering? 680
Wireless Litigation Favoring Fessenden 681
Indiana Telephone Men Meet 682
The New York Central New Haven Electric Traction Situation 682
Cost of Coal Handling 685
Current News and Notes 686
Electrical Engineers of the Times. XXXII. Mr. H. W. Fisher 688
Electrical Supply in Hartford 689
A Proposed Phase Regulator and Its Applications. By P. G. Watmough, Jr. 691
Speed-Time Curves for Automobile Motors. By Frank B. Rae 693
The European Single-Phase Railways 696
The Cascade Converter 698
Congress of Swedish Engineers. I. By Arvid Westerburg 699
Recent Electrochemical Developments 700
LETTERS TO THE EDITORS:
  How Can the Ball Roll? By William Hallock 700
  Wireless Telegraphy in Mexico. By Gesellschaft fur Drahtlose Telegraphie 700
  Belgian Single-Phase Railway. By Marius Latour 701
Digest of Current Electrical Literature 701
Book Reviews 705
General Electric at the Portland Exposition 705
Day-and-Night Electric Signs 706
Automatic Belt Tightening Idler 706
Interior Automatic Exchange Telephones 706
The Appleton Conduit Bushing 707
Controller for Variable Speed Motors 707
A New Watt-Hour Meter 707
A New Contact for Carbon Brushes 708
Burt "Unit Type" Oil Filter 709
Industrial and Commercial News 710
General News of the Week 713

ELECTRIC TRACTION INTO NEW YORK.

One of the most momentous decisions affecting the future of heavy electric traction was that made by the New York Central Railroad when it adopted direct-current locomotives for its through business in the electric zone and multiple-unit for its suburban traffic. This enabled it at once to secure maximum dispatch and economy in handling train service and passengers, and the extreme of minimization as to the dead movement of locomotives and cars. As a corollary came the double decking of the immense new Grand Central Depot, involving, as we understand, the operation of the locomotives on one tier and the multiple-unit suburban cars on the lower deck. This work of the Electric Traction Commission of the New York Central Railroad has indeed carried us far into the heart of the new regime, with incalculable benefits promised to every passenger, and one cannot but wish brilliant success and full fruition for such courageous plans and decisions. Second only in importance, it seems to us, in its bearing on the electric railway future, has been the recent decision of the New York, New Haven & Hartford Railroad to adopt electricity also, but to employ alternating-current apparatus. We have been swift to applaud this exhibition of faith in the newer type of apparatus and current, which seem destined in the long run to bring the solution of many problems hitherto beyond the capacity of the electrical arts; and it can be safely said that perhaps the performance of no single piece of apparatus will be watched more intently at the present juncture by electrical engineers than the single-phase locomotive now under construction and soon to be under test as the initial equipment. At this stage, however, a situation arises which it is difficult for an outsider to formulate definitely, but the character of which can be fairly well determined from the trenchant communication of Mr. Frank J. Sprague appearing elsewhere in our pages.

The situation as thus defined by Mr. Sprague involves the tremendous—perhaps insuperable—difficulties of operating the two types of apparatus within the New York Central electric zone, and more particularly the serious troubles predicated upon any attempt to operate the direct-current multiple-unit suburban trains of the Central in conjunction with the alternating-current locomotives of the New Haven on the lower tier of the splendid new terminal depot, upon which so many millions of dollars are now being spent with the essential underlying purpose of securing the utmost comfort and convenience of the traveling public, with due regard to the economy and efficiency of operation that must be the keynotes of every great railway system. Awaiting further light on the subject, which certainly must be forthcoming, we should hesitate to say that the difficult problems thus brought to light are incapable of harmonious solution, but the vivid discussion of the subject by Mr. Sprague, as is usual with all his treatment of great questions, strikes at the roots of the question, and while compelling to prayerful consideration begets as to decision a hesitancy that only a further flood of light can remove from one's mind.

EUROPEAN SINGLE-PHASE RAILWAYS.

In our issue for September 23 was given an account of the single phase railways now operating in this country. On page 696 of our present issue we supplement that account with a brief outline description of the single-phase railways of Europe. In comparing the various equipments now installed, one is impressed with the fact that the frequency adopted in Europe varies from 17 to 42 cycles, while in this country 25 cycles is used exclusively There can be no doubt that the lower the frequency the better the commutation and the higher the power factor with the compensated-series type of motor; and that where the frequency can be selected without any regard to the use of the output from the power station for any purpose other than the motors themselves, the adoption of a frequency as low as 17 cycles, as first proposed by Mr Lamme, is to be desired. For the operation of electric lamps a frequency as high as 40 cycles is desirable, and a frequency higher than 25 cycles is necessary for general illumination. To the fact that the motors are required to use current from the same source of supply of electric power as the lamps may be attributed the adoption of the higher range of frequency on the Stubai Valley and Du Borinage-Vicinaux Railways. It would seem, however, that the cases in which the electric railway must receive its power from an electric lighting plant will be exceptional and not general, and that for the sake of uniformity a frequency corresponding to that of motor circuits rather than of lamp circuits is in many respects preferable. It is significant that between the two extreme frequencies—that best suited for use exclusively with commutator motors and that best adapted for combined lighting and railway work—there has been found a satisfactory mean frequency suitable alike for general power distribution, for stationary motor work, and for the operation of alternating-current railways.

An encouraging feature of the numerous single-phase railways now in operation resides in the fact that the anticipated troubles at the commutators of the various types of motors with almost no exception have failed to appear. Difficulties have arisen on almost all of the railways, and the motors have contributed their share, but the troubles have been due more to faulty insulation or to too economical design than to any inherent defect in the motors themselves. For high-frequency current, such as demanded by certain kinds of lamps, the compensated-series type of motor seems not to be well adapted; but the transformer motors of the compensated-repulsion type appear to operate quite satisfactorily with such current and not to be exceptionally well adapted for current at the extremely low frequencies. At first glance it would appear that for combined direct-current and alternating-current operation the series type of motor possesses some marked advantages over the transformer type of machine. It is worthy of note, however, that the transformer motors have recently been operated satisfactorily when fed with direct current, a compensating winding being used for the purpose of counterbalancing the armature magnetomotive force. The evidence at hand would seem to indicate that not one of the types of commutator motors which have been seriously proposed for alternating-current railway work will need to be abandoned or materially modified to overcome any inherent defect, and that with the logical frequency of 25 cycles, which has been selected as standard for this country, and is gaining favor as a standard in Europe, excellent results can be obtained from either the compensated-series or the compensated-repulsion motors.

ILLUMINATING ENGINEERING.

Mr. Cravath's paper which we abstract elsewhere gives an effective answer to any question that might be urged as to the propriety of raising scientific illumination to the rank of a special branch of engineering. Considering the fact that electric lighting, to say nothing of other forms of illumination, is intrinsically a technical art and that the aggregate sum spent yearly, with central stations alone, for such light has now reached something like $70,000,000, it ought to be sufficiently obvious that technical advice as to the best methods of utilizing electric light is of the utmost importance. As a matter of fact, we know of no branch of business in which so large a sum total is expended with so little intelligent direction. Buildings are usually designed with scant reference to the lighting system. Every one assumes tacitly that wiring can be put anywhere and the most that the ordinary architect concedes to the necessities of the case is a meagre allowance of distributing ducts arranged frequently without any technical advice and often so placed as to guarantee inefficient distribution. The outlets in the rooms are insufficient in number and badly arranged at that; and even in large public buildings in which much care and thought should be given to lighting the results are often almost ingeniously bad. The Auditorium Theatre of which Mr. Cravath gave a picture, while in itself one of the most commodious buildings in the world and possessed of exceptionally good acoustic properties, is lighted so as to give a maximum of glare with a minimum of useful illumination. Illumination is a thing by which to see and not merely an artistic accessory or a subject for accidental consideration. In so far as light is a commodity for which good money has to be paid it behooves the user not to waste it, and in so far as it is a necessity of modern life it should be so used as to produce helpful, not hurtful, results. It is a good thing to realize that at the present time probably not less than $20,000,000 worth of light is wasted annually by unskillful use. To save this dead loss to the community is the task which the illuminating engineer has undertaken to accomplish. The difficulty is that the profession has as yet no well-recognized position. The average architect thinks himself quite capable, however guiltless he may be of electrical knowledge, of planning the lighting of any building on earth, and wants no help for which he will have to pay. The result is that his clients suffer to the aggregate tune of many million dollars per year. On the other hand, the ordinary consumer of light is satisfied if the effect is brilliant, irrespective of whether he can see properly. If he finds seeing difficult he damns the electric light as unhygienic or unsteady, or unreliable, or as anything in fact excepting an illuminant foolishly used. In fact the general public is pardonably but sadly ignorant of the principles of illumination. It still believes that the greater the number of brilliant lights visible in a building the better the illumination as a matter of course, whereas all things considered the best illumination is that which gives the required facility of seeing with the fewest visible lights.

Before the illuminating engineer can hope to have his profession taken into full and regular standing there must be a long campaign of education which has now only begun. The man who pays the lighting bill must be brought to realize that a waste of light is a waste of money, and that skill in arranging artificial lighting will save money just as surely as skill in planning the heating system will save coal. Next he must be educated to the point of understanding that the old methods of lighting produce bills instead of good illumination. And this is true even when lighting is deliberately intended to play an important part in decorative effects. This lesson was taught wonderfully well by the work of the late Mr. Stieringer in exposition lighting. He will remain as the great pioneer in illuminating engineering—a man with an instinctive genius for producing beautiful effects with the minimum effort and material, and with a marvelous intuition for putting just the right amount of light in exactly the right place. And there is acute need for men like him not only to deal with great problems, but to reform the lighting practice now in vogue and to teach the everyday economical use of illuminants. The trouble with the situation is that every architect and every wiring contractor is familiar with the average bad methods and generally unfamiliar with good ones, while their clients and customers know no difference. The illuminating engineer, therefore, must not only study but create his profession, and this is uphill work. The time will come when his work will be properly appreciated, but for the present we fear he will have rather poor pickings, as does the electric heating engineer. The first step forward will come when some owner or architect is shrewd enough to put the lighting of a fine public building into the hands of a first-class man. One chance for a really brilliant success such as would thus be given will put the whole art on a new basis. Until then there is precious little to serve as a standard of merit, or to inspire progress, for ordinary illumination may be stigmatized as either wasteful or ineffective—and rather too often it is both.

◆

Heterodoxy in Electric Power Transmission Doctrines.

Among the semi-popular lectures delivered in the meetings of the British Association at Johannesburg was one by Prof. Ayrton on "The Distribution of Power," an abstract of which is published in a recent number of the London *Electrician*. Prof. Ayrton is always an entertaining lecturer. The printed abstract of his lecture well maintains his record, but the principal interest in the lecture is its rank heresy, as regards electrical transmission doctrine. It is a plea for the superiority of the direct current over alternating currents, for long-distance, high-tension power transmission. At the present time there are numerous alternating-current power transmission systems in successful operation at pressures up to 60 kilovolts and distances up to 200 miles. There are, on the other hand, very few direct-current power transmission systems. Two only are referred to in the abstract of the Ayrton lecture, namely: the Combe-Garot to Le Locle system in France, which was installed in 1895 at a pressure of 14 kilovolts over a distance of 30 miles, carrying about 2,000 kw; second, the St. Maurice-Lausanne system in Switzerland, which was installed in 1902, at a pressure of 23 kilovolts, over a distance of 35 miles, carrying 3,400 kw. Both of these are Thury systems employing a constant direct current with generators in series at the transmitting station and motors in series along the circuit. The voltage at the generating station is increased as the load increases. It is stated that both of these systems have given satisfactory service, and as noted in our Digest columns for February 13, 1904, the company operating the Lausanne system, which receives the power on direct-current motors and distributes locally by three phase currents, declared that they had never had an interruption of the direct-current service; although they had experienced stoppages owing to troubles in the alternating-current distribution. It is stated in the abstracted lecture that another Thury direct-current transmission system is in course of construction in France from Moutiers to Lyons, a distance of 114 miles, to carry 4,500 kw at a pressure of 60 kilovolts.

Upon these particular systems in France and Switzerland rests the entire direct-current case from the standpoint of practical experience. They show that the constant-current system can certainly be carried at least up to as far as 150 amp. and 23 kilovolts. It remains to be seen whether the pressure can be carried successfully by dynamos in series up to 60 kilovolts. Moreover, it is very doubtful whether such a system is capable of meeting the requirements of general power distribution, as distinguished from delivering power in bulk. That is to say, granting that power may be delivered to direct-current motors in series at a receiving station or stations, it is probable that as in the case of Lausanne it would be necessary to distribute the power through an alternating-current network of mains for city consumers. The comparison would, therefore, be narrowed to the use of motor-generators in the receiving stations as against transformers, with high-tension, alternating-current transmission lines. Meanwhile the pressures employed in alternating-current transmission lines have successfully reached 60 kilovolts; and 67.5 kilovolts is said to be in early contemplation. As for surges in transmission lines, they may occur in direct-current as well as in alternating-current lines. Resonance is a phenomenon peculiar to alternating-current lines, but it has ceased to have terrors for the electrical engineer. While, therefore, the experience with the coming 60-kilovolt Lyons system will be watched with great interest, we do not look for any revolutionary change in the industry of electric power transmission from alternating to direct current.

◆

The Cascade Converter.

A description of a combination of an induction motor and a synchronous converter, which presents numerous points of theoretical interest, is to be found on page 668 of this issue. The form wound secondary coils of an induction motor are connected directly to the alternating-current terminals of a synchronous converter, the armature of the converter being mounted directly on the shaft of the rotor of the induction motor. The equipment possesses simultaneously the characteristics of four machines, namely, a frequency converter, a synchronous motor, a synchronous converter and a direct-current generator. The advantageous features claimed for the machine reside in the fact that it may be fed with alternating current of any frequency and at any electromotive force, and that it will deliver direct current from a commutator operating at a frequency best adapted for satisfactory performance. To just what extent the machine will prove more economical in construction and desirable in operation than a motor generator set, we are not directly concerned at the present moment. The chief interest centers in the inherent characteristics of the machine. As connected in the circuits, the input machine is a true induction frequency converter, the frequency of the current in the secondary depending directly upon the slip of the rotor from synchronism. A distinction between the performance of this machine and that of a simple induction motor is found in the fact that the slip is constant independent of the load, and that the power is transmitted from it partly electrically and not wholly mechanical. The slip assumes a value such that the secondary frequency is equal to the frequency of the e.m.f. generated in the armature of the synchronous converter. The load is determined by the demand for current from the brushes of the synchronous converter, and the torque required thereby is supplied simultaneously by the action of the secondary current on the field of the input machine and by the action of the armature current on the field of the output machine.

The e.m.f. in the secondary of an induction motor when the rotor is stationary bears to the e.m.f. of the primary the ratio of the respective turns of the secondary and the primary coils. This e.m.f. varies directly with the slip, and at each value of the slip it possesses a definite determinable value. If the input and output machines have an equal number of poles, then the normal operating value of the secondary e.m.f. of the input machine is just one half of the value when the rotor is stationary. Since the operating e.m.f. of the output machine when the alternating current leads are on open circuit, depends upon the strength of the stationary field, it would seem that there is a definite field strength to correspond to the normal operating conditions of the equipment. Since the output machine is similar in all respects to a synchronous motor, it is to be expected that an excess of excitation of its fields will cause the machine to draw from the source of supply a component of current, leading with respect to the e.m.f., and of a value such as to restore the magnetism threading the armature approximately to its normal value. Such leading current flowing in the secondary of the input machine should have the effect of assisting in supplying the exciting magnetomotive force of this machine, and thus of removing the lagging exciting current from the primary windings and thereby improving the power factor.

The Western Union Telegraph Annual Report.

The annual report of the Western Union Telegraph Company was presented to the stockholders last week. The discontinuance of race reports last year cut down the earnings of the Western Union Telegraph Company $215,755. The expenses increased $483,654, so that the decrease in net revenue for the year ended June 30, was $699,409. In regard to the loss caused by stopping the race news, President Clowry says:

"There was a large increase of revenue from message business, but the loss resulting from the discontinuance of race reports shortly before the beginning of the fiscal year made a decrease of $215,755 in the total earnings. Owing to the conditions under which the race service had been handled a proportionate decrease could not be made in the expenses, which show an increase of $483,654, of which amount $300,000 represents the cost of handling the increased message business."

During the year 67,477,320 messages were sent over the Western Union wires, against 5,879,282 sent thirty-eight years ago. The average cost per message to the company was 27.3 cents and the average toll was 31.6 cents.

In poles and cable 874 miles and in wires 20,152 miles were added to the plant. There were 356 new offices established. Of the total of 1,184,557 miles of wire on June 30, 306,736 were of copper.

In dividends $4,868,083 was paid out of the net revenue of $7,188,064. The cost of new construction was $1,288,279 less than in the previous year. This is the income account compared with 1903-4:

	1905.	1904.
Gross revenue	$20,033,635	$20,249,390
Operating expenses	21,845,570	21,361,915
Net revenue	$7,188,065	$7,887,475
Interest on bonds	1,227,200	1,157,700
Net profit	$5,960,865	$6,729,775
Dividends	4,868,084	4,868,071
Surplus	$1,092,781	$1,861,704
Previous surplus	14,881,429	13,019,725
Total surplus	$15,974,210	$14,881,429

The surplus, after the deduction of operating expenses and bond interest, amounted to $5,960,865 for the year, or 6.12 per cent on the $97,370,000 capital stock. Of the company's real estate in New York President Clowry says:

"Purchases have been completed of the properties 14, 16 and 18 Dey Street, west of and adjoining the company's main building at the corner of Broadway and Dey Street. These properties are available for extension westwardly on Dey Street of the present main building when the necessities of the business require it."

At the annual stockholders' meeting Harris C. Fahnestock and Thomas H. Hubbard were elected Directors to succeed Charles Lockhard and A. R. Brewer. James H. Hyde, Chauncey M. Depew, and J. Pierpont Morgan were re-elected.

The surplus available for dividends was $5,960,865, equivalent to 6.12 per cent on the outstanding stock. The company is paying 5 per cent on the stock; therefore, there was a margin over dividend requirements of 1.12 per cent against a margin of 1.91 per cent in 1904 and a margin of 2.32 per cent in 1903.

Gross earnings showed a decrease of $215,755, equal to ¾ of 1 per cent. Operating expenses increased $483,655 or 2.2 per cent while net profits decreased $699,410, equivalent to 8.8 per cent.

The important change in the balance sheet is the increase in funded debt of $3,000,000, issued according to the terms of the mortgage, making the entire $20,000,000 of the funding and real estate mortgage gold bonds authorized in 1900, now outstanding. The company now has a surplus of $16,003,000. In order to show how this surplus is invested the following statement of quick assets and quick liabilities is given:

Quick assets.	1905.	1904.	1903.	1902.
Securities (at purchased cost)	$13,[illegible],740	$12,034,345	$11,450,416	$9,[illegible],288
Real estate	4,957,432	4,852,606	4,705,130	4,70[illegible],13[illegible]
Receivables	2,859,576	2,221,813	2,156,375	2,3[illegible],172
Cash	4,0[illegible],726	2,844,103	2,958,016	2,065,320
Total	$25,549,483	$21,952,867	$21,268,927	$19,46[illegible]
Quick liabilities.				
Accounts payable	$4,213,832	$4,238,690	$3,906,244	$2,843,744
Excess quick assets	$21,335,651	$17,714,177	$17,362,683	$16,616,836

It is seen, therefore, that the company's net quick assets amount to $21,335,651, showing that all the large surplus and more, too, is invested in them. The increase of $3,621,474 in net quick assets is largely due to the proceeds of the $3,000,000 bonds disposed of during the year.

Do We Need Better Illuminating Engineering?

The Electrical Section of the Western Society of Engineers at Chicago opened its session with a meeting October 13, in which the above subject was taken up by J. R. Cravath, in a paper which was illustrated by about forty lantern slides.

In introducing the subject the author stated that he surmised that the subject of the paper would be received with widely different mental comments by those into whose hands it might fall. Those who made some study of illuminating engineering would answer the question emphatically in the affirmative. Those who had given no attention to the subject would ask first of all what was meant by engineering in connection with so simple a thing as illumination. The answer to the first question was simple. A full answer to the second would require a treatise. He believed, however, that enough of an answer could be presented within the limits of the evening's paper so that the average person would be convinced not only that the efficient use of artificial light requires considerable special engineering knowledge, but that there is a great need for the application of such engineering knowledge at the present time.

The author defined the term illuminating engineering as commonly used at present as applying to that special branch of engineering which has as its aim the efficient use of artificial light. It does not concern itself with production and distribution of light-producing energy, but with the utilization of light after it is produced in order to secure the best illuminating effects from an economical, artistic and hygienic standpoint. Its work consists mainly of the selection of the proper illuminant, the proper location of the lighting units, and their proper equipment as regards reflectors, shades and globes. As in most other branches of engineering, the fundamental principles of this branch are simple and easily mastered; but the knowledge of ways and means of accomplishing practical results and the technical data on these ways and means can only be obtained and kept in shape for ready use, as in other engineering branches, by long-continued work and study and by some concentration of effort along special lines.

The author then took up the discussion of some thirty concrete examples of lighting, showing that there is room for much more careful application of illuminating engineering than is now usual. The lantern slides with which this part of the paper was illustrated were taken from photographs of Chicago theatres, public buildings, residences, etc., many of which were of recent construction, and most of which, the author pointed out, could be materially improved as to the artificial illumination. In many cases the results were shown to be poor from an economical standpoint, as the useful illumination could be increased decidedly by small changes. In other cases both the economical and hygienic results were bad, as the arrangements were such as to be disastrous to the eyesight. Among the subjects taken for criticism were the Auditorium Theatre, the new La Salle Street Station, Orchestra Hall, lobbies of the Stratford and Majestic Hotels, Second Presbyterian Church, First Christian Science Church, two well-known lodge rooms, several hotel and residence bedrooms, dining-rooms and living rooms, completing the series with some examples of office desk lighting.

After having discussed these examples, the author called attention to the importance to the engineer of knowing just what results various types of reflectors, shades and globes will give, for on these he is largely dependent in his efforts to economically direct and diffuse the rays of light. To give this information, photometric curves are the most valuable and heretofore the most common source of information. In this connection the author brought before the society and made public for the first time a rough method of testing and recording performances of reflectors and globes, and of determining certain other matters that he had tried and found very useful for certain practical purposes.

Two model rooms were fitted up side by side exactly alike as to colors of walls, floors and ceilings. These rooms were designed to have dimensions approximately one-third the size of rooms 13 ft. square and 9 ft. high. By equipping these rooms with incandescent lamps of equal candle-power in different reflectors and mounted in the different positions found in practice, many valuable comparisons could be made and the results recorded by taking a photograph of the rooms as a pair, taking care to shield the source of light from the camera to avoid halation. This method of testing had obvious limitations and was not to be considered as a substitute for photometric tests. It also had some obvious advantages that photometric tests did not, in that the reflections from the walls and ceilings were given more value and the results were more easily understood and appreciated by non-technical persons. He selected for presentation as lantern slides the negatives from some of the most interesting and instructive tests in his collection. These tests illustrated in a very striking manner the distribution of light around an incandescent lamp with different reflectors and globes. Part of these tests were made to bring out the contrast between reflectors giving widely different distribution of light, while others were taken to compare reflectors intended for the same specific purposes.

The paper was discussed at length. Mr. Albert Scheible called attention to the fact that part of the present awakening as to scientific illuminating engineering was due to manufacturers who made globes and reflectors, the general use of which depended upon a technical knowledge of illuminating engineering. The Holophane Glass Company, which was the one he referred to, had found it necessary, in marketing its product, to educate electrical men and others in the science of illumination. He thought perhaps Mr. Cravath had taken into account too much the engineering and utilitarian side of the question without considering sufficiently the artistic. He thought both should be considered.

Mr. Cravath replied that he wished it distinctly understood that he did not advocate sacrificing the artistic for the sake of economy, but that usually the two could be combined, and this was one of the important points that he wished to bring out by his paper.

Mr. Harold Almert, speaking from the central station manager's standpoint, said that he wished something could be done to educate the artistically-minded woman who insists on putting colored paper shades several thicknesses deep over the lamps and then complains because she gets but little light and her electric light bills are so high. He also gave an experience of his several years ago with street lighting. He carefully planned the lighting of a Chicago boulevard so as to avoid as far as possible the great contrast between the light under the lamps and midway between. The matter of proper reflectors and enclosing globes was carefully gone into. When the job was finished he had the assurances of several authorities who saw it that it was the best lighted boulevard in the world. After an absence of several years he now noted that the present management had been studiously striving to make the mistakes he had tried to avoid; clear glass globes were being substituted for opal, so that now the boulevard presents a blinding glare from one end to the other.

Mr. W. Jac Marland described some of his experiences as contract agent for the Brooklyn Edison Company, and expressed the opinion that there is great opportunity for the work of the illuminating engineer, especially in large cities. It had been his policy when connected with the Brooklyn Edison Company to investigate consumer's complaints from an illuminating engineering standpoint, and in very many cases found complaints by customers were due to poor arrangement of lighting. He mentioned one case specifically where a very costly portrait had the appearance of having a cast in one eye, due to the streaked light thrown from the reflector placed over it. The owner of the painting was about to return it to the artist to have the defect corrected.

Some little discussion took place as to how far the artistic as against the economical and utilitarian should be considered in illuminating engineering. President S. G. McMeen summed up the situation very aptly by saying that it was the part of the engineer to lay clearly before his client various plans combining in different degrees economy and artistic effect, leaving it to the client to say how much economy he was willing to sacrifice for the sake of the artistic.

French Cable Dispute.

The Venezuelan Government telegraph department has offered to pay the French Cable Company for the use of the French lines since they were seized several weeks ago, indicating a disposition on President Castro's part to give way to pressure by the French Government. The company's representative refused to accept the offer on the ground of having no instructions to do so.

Wireless Litigation Favoring Fessenden.

The Fessenden liquid barretter patent has been adjudicated and sustained. In the issue of the Electrical World and Engineer for September 19, 1903, the new Fessenden system was described and illustrated, including views of his liquid barretter. Many claimants for this invention have appeared from time to time. Their claims were briefly reviewed by Mr. Collins in an article that appeared in the Electrical World and Engineer March 11, 1905. This article refers to such men as Wilhelm Schloemilch, Frederick K. Vreeland, Dr. Lee De Forest and E. H. Smythe as rival claimants. To these names must be added that of Captain Ferrie. (See the Electrical World and Engineer for May 6, 1905.)

It will be remembered that the liquid barretter is an improvement over the solid wire barretter formerly used by Prof. Fessenden. The liquid barretter was developed as a result of experiments for the purpose of adapting the prior Fessenden wire barretter for use in connection with a liquid. It consists of a cell comprising a suitable liquid and suitable electrodes, one of them, usually the anode, having only a minute surface exposed to the liquid, the wireless signals being caused by increase of current in a battery circuit in response to the action of received oscillations which pass through the electrodes and cell in parallel with the battery circuit. The minute electric surface may conveniently be the wire of which the wire barretter was made.

We give below a review of the decision of the United States Circuit Court for the Southern District of New York in the suit of the National Electric Signal Company vs. De Forest Wireless Telegraph Company, et al. The patent in suit was the Fessenden patent reissue No. 12,115, of May 26, 1903. The receiver in dispute is the one stated to have been used by the De Forest Wireless Telegraph Companies in the Russo-Japanese war. It is said that the London *Times* and Captain James, its war correspondent, employed this receiver so successfully in the Sea of Japan that the Russian and Japanese Governments insisted that its use be stopped.

Prof. Fessenden in his patent illustrated a number of forms of the invention. One of them showed the two fine terminals; another a single terminal; another a glass-covered terminal, in which all but the part covered by glass was immersed in the liquid.

His Honor, Judge Hoyt H. Wheeler, in rendering his decision, discussed the most pertinent defences raised in the case and drew a distinction between them and the patent in suit. The De Forest and Smythe detector patents, Nos. 716,000 and 716,203, were copiously quoted in the opinion. The court said as to these defenses:

"It [referring to the testimony] also seems to show that the De Forest and Smythe receivers operated by bridges formed by the local circuit between closely parallel electrodes broken by the aerial impulse to give the signal, while this [the device in suit] does not appear to operate by the making or breaking of any such bridges, but by a fluid path between the electrodes at variable distances."

The court also held that a so-called "thin" or V-shaped edge of one electrode "parallel to the plane surface of the other," referred to in De Forest patent No. 716,203, operated by means of the making and breaking of the metallic bridges instead of by means of a fluid path.

The court held claims eleven, twenty-three and twenty-five of the patent valid and infringed, not finding it necessary to pass upon any of the others. Claim eleven, which is as follows, will give an idea of the breadth of the opinion:

"An electrical receiver consisting of a liquid and an extremely fine terminal projecting into the liquid, substantially as set forth."

Numerous publications were cited by the defendants in the suit, including prior patents to Fessenden, to Pupin for his electrolytic rectifier, to John Stone Stone, British patents to Schaefer, German patents to Neugschwender, many foreign and domestic publications.

It was claimed also that the invention was made by a former employe of Prof. Fessenden, Mr. F. K. Vreeland. As to the Vreeland defense the court held that his work was an employe's step in Prof. Fessenden's continuous investigations. The files of the Electrical World and Engineer were freely drawn upon by both parties to the suit both for alleged anticipatory matter and for illustrations of complainant's and defendants' systems.

One of the contentions disposed of by the court was that of the theory of the operation of the device. The Fessenden patent describes both the thermal and the polarization effects. Many writers have claimed that the device operated solely on the polarization theory.

The court held that any question of theory of action was immaterial in a patent case, and that the device sued infringed the claims of the patent, no matter what its mode of operation might be.

The record in the case is voluminous. It contains nearly 4,000 pages of testimony and exhibits. In the conduct of the case a large corps of counsel participated on each side. For the complainant appeared Messrs. Kenyon & Kenyon, William H. Kenyon, William F. Bissing, Esq., and George C. Dean, Esq., all of this city, and for the defendants appeared Philip Farnsworth, Esq., and Richard N. Dyer, Esq., the latter representing the interests of Frederick K. Vreeland.

It may be of interest in this connection to note that after a long series of tests of the liquid barretter between Forts Wright and Schuyler, in Long Island Sound, the government purchased two sets of apparatus, including the receivers, for use with their work in Alaska. Some of the difficulties which had been encountered were set forth by Gen. Greeley in his address at the last annual dinner of the American Institute of Electrical Engineers. Gen. Greeley stated:

"I put in a cable which cost $60,000 across Norton Sound; three separate years the ice carried out the cable, and it was then my duty to do something with the wireless telegraph."

Speaking of the results obtained, after considering the Fort Wright to Fort Schuyler system, including the liquid barretter, General Greeley says:

"And there is to-day across Norton Sound a signal corps system of wireless telegraphy in its seventh working month, over the 107-mile route, without a moment of interruption. Over this system thousands of words are sent to and fro each day, and on one occasion no less than thirty-five successive messages passed across this intervening space of 100 miles, and without there being a call for a 'repeat.' You telegraph men know what kind of service that is. This work has excited a great deal of interest in Alaska on account of our continuing to work during the past winter over the 107 miles of ice."

We are informed that the Fessenden system has for two years been in constant working operation overland between Washington, Philadelphia and New York.

Indiana Telephone Men Meet,

The first meeting of the Seventh District of the Indiana Independent Telephone Association, comprising Boone, Hamilton, Hancock, Hendricks, Johnson, Morgan, Shelley and Marion counties was held at Indianapolis October 11. There are 62 independent telephone companies operating in this district, and about 50 were represented. W. W. Mendenhall, of Westfield, vice-president for the district, presided. H. B. Sale, secretary and general manager of the Indianapolis Telephone Company, welcomed the representatives to the city and said the meeting was called to complete the organization in the most important district and stronghold of the independents in the state. Mr. Sales said the greatest trouble which the independent companies have heretofore experienced, has been the lack of organization. The proper thing for the independents of Indiana to do, now is to strengthen the weak members in the organization by giving them, as well as the people, to understand that the independent movement is a permanent and substantial thing, and will be, as it has been in the past, the greatest commercial and financial institution in the state. "There is invested in independent telephone property in Indiana," he said, "over $15,000,000, this for legitimate installation of telephones and toll lines. For this expenditure the independent companies have 170,000 telephones in operation against less than 30,000 by our competitors." Mr. Sale referred to the magnitude of the United States Independent Telephone Company recently organized in the East, the character of the men behind it, and explained the direct and indirect results and moral support such a movement will give to the independent movement.

Charles S. Norton, secretary of the Indiana Independent Telephone Association, explained the purposes of the association and the plan of organizing the several districts as branches of the State Association. Following Mr. Norton's statement the organization was perfected with Mr. M. L. Hawkins, of Noblesville, chairman of the executive committee, and Mr. Will Hough, of Greenfield, chairman of the committee on by-laws and rules.

The principal topic for discussion at the meeting was the advisability of adopting a "uniform system of accounting." The plan was generally indorsed as not only a time and money saver but in order to secure accuracy and simplicity. The advisability of merging all the independent companies of the Seventh District and operating them from one head was suggested, but this was stoutly opposed by the smaller companies' representatives.

The New York Central—New Haven Electric Traction Situation.

Mr. Frank J. Sprague has contributed this week to the *Street Railway Journal* a discussion of the critical situation that exists between the New York Central and New York, New Haven & Hartford railroads as to the adoption of different electric traction systems. The communication is given in full below:

AN UNPRECEDENTED RAILWAY SITUATION.

"After a most thorough investigation on the part of the New York, New Haven & Hartford Railroad's Electrical Commission," certainly a most astonishing preamble in more ways than one, yet so reads the trade notice which announces the placing of an order for 25 alternating-current locomotives, under conditions not stated, for operating both the through and suburban and passenger service on the New York and Stamford division.

Speaking, in my individual capacity as an engineer, and also from a railroad equipment and operating standpoint, I venture to assert that under the existing circumstances, and in view of certain special limiting conditions, this decision is an error of more than ordinary magnitude—one which no engineer knowing the facts should have urged, and one which, instead of advancing the application of electricity to trunk line service may very easily seriously interfere with it.

A discordant note this, I know, in that chorus of praise with which the technical press is resounding because of the "brilliant and progressive action" of the New Haven road, and yet I am led to this conviction after full consideration of all the factors of the problem, and without, I trust, shutting my eyes to any advantages which may accrue from all-round successful alternating-current operation. Such as are my conclusions, however, it seems but proper to state them with the same candor which I have always observed in speaking of engineering problems, for unless the wisdom of this action by the New Haven Company is promptly challenged it is likely that erroneous conclusions affecting trunk line operation may become temporarily settled convictions.

In what I have to say I disclaim any intent to speak for the Electrical Commission of the New York Central & Hudson River Railroad, of which I have been and am an active member, for whatever their individual opinions, and whatever may be that body's present or future official action it will undoubtedly be confined to problems affecting joint operation of the roads, and embody only those ideas to which all of its members can subscribe. Even less do I assume to speak for the railroad company in matters affecting its relations with another company operating over its tracks, but the public announcements made from time to time concerning developments on both the Central and the New Haven roads afford ample basis for my comments.

Furthermore, my criticisms are not dictated by any spirit of antagonism, practical or theoretical, to alternating-current development, concerning the possibilities of which I have well-defined notions, and the bearing of which upon railroad equipment I can, I think, perhaps judge as clearly as most engineers. I regret, however, that so seemingly bold a step has been taken where alternating-current operation must necessarily be handicapped by various physical, engineering and operative conditions over which neither the New Haven road nor the contracting company can have any control, which the nature of things makes it impossible to change, and which will surely interfere with the full fruition of the hopes of those who have committed themselves to this proposition; and further that it should be supported by some assertions concerning direct-current operation which will not bear inspection.

Generally speaking, I assume a trunk line railroad's chief concern is as to the methods by which it can best meet conditions which are forced upon it, from both a financial and an operative standpoint, how it can improve and lower the cost of its service, and benefit its stockholders; and that it is not directly concerned in experimental development for the benefit of other companies, whether railroad or manufacturing. In fact, because of the necessity of maintaining effective and safe operation, it should be slow to commit itself to any radical departures save for the gravest of reasons.

The first queries which naturally arise are: Why has the New York & New Haven Railroad decided to adopt electricity at all, and what has determined the limitation of the particular zone selected?

Is it because the company has suddenly become convinced that the economy of electric locomotive operation is such as to warrant it in embarking at great expense in a more or less experimental venture, or is it so certain of it that it intends ultimately to adopt electricity throughout its main line, and meanwhile is willing to try it on its own as well as some one else's dog first, even at some possible great inconvenience?

I venture to assert that neither assumption is tenable, for not only is the latter most improbable, but even the first is not a strong enough motive to lead to the present action by the New Haven Company. The simple truth is that the New York Central and Hudson River Railroad was, primarily, because of a grave disaster in the Harlem tunnel, quickened into a more serious consideration of plans already under advisement, and being compelled by legislative act to locally abandon steam, had for practical operative reasons to further consider whether an extension of its proposed operation by electricity was not only feasible but necessary. The electrical zone thus determined necessarily included not only the yards, tunnel and viaduct in New York City, but, so far as relates to the operation of the New Haven trains, of the section of the Harlem road to Woodlawn, at which point the trains of that company deflect to its own tracks. Hence for that dozen miles it became necessary that provision should be made for the operation of all trains by electricity, no matter what the New Haven Company might otherwise have wished to do, and Woodlawn being impracticable as a point of change of motive power the operation had to be carried to some natural terminal division of suburban traffic, either New Rochelle, Portchester, or Stamford, where change could be conveniently made on trains intended for more remote destinations, just as the Central had decided for North White Plains and Croton.

The limited zone of present operation having been evident for more than two years, what would have been the ordinary procedure? Naturally, one would say, through executive and technical representatives to promptly enter fully into the investigation, and, if possible determination of plans which would affect joint operation, and which might further be acceptable for individual operation.

The New York Central Railroad took up this problem in a manner which I think has commended itself to the commonsense of the community, and ought to the engineering and railroad world, by bringing together in a commission outside independent technical advice and its own constructive and operative officers, and reinforcing them with all that was necessary for effective work. In spite of the criticism which those who have not this responsibility upon their shoulders are lightly given to express, I, for one, save in one particular, where the better decision had to be subordinated to external conditions, am satisfied with the results, whether measured by first costs of installation, determination of engineering facts and possibilities, or practical railroad operation. And, if I mistake not, the example thus made by the Central will not only help raise the standard of electrical engineering, but establish a precedent for the safe and economical determination of problems of vital concern reaching every operative department of a railroad.

No sooner had this commission undertaken its responsibilities than it generalized a harmonious plan, making use of every advance which had been made or seemed reasonably sure of fruition in electrical equipment and operation, and planned for a reliable and economical service to satisfy alike the public and the railroad company. The broad question of whether alternating or direct current should be used on motor equipments had at the time to be settled in favor of direct current, not only because of the unpreparedness of the manufacturing companies to reliably undertake the solution of problems of paramount importance by alternating-current methods, but also because of special engineering and other limitations. In my own mind there has not been a shadow of doubt of the wisdom of this decision, and that the results will be fully equal to those anticipated, in spite of any claims based upon what is hoped to be accomplished by other means now some three years later. And now what of this problem of the New Haven road, and how is it going to affect plans already formulated and being actively carried out?

Let us briefly consider the character of its service, and to what extent it meets with that favored condition advanced quite forcibly, although sometimes on mistaken premises, as specially adapted for demonstrating the advantages of alternating-current operation, namely, a long line with relatively infrequent units.

Operating in one direction there are in the twenty-four hours of a week day a total of sixty-seven trains run on passenger schedule, of which the runs of five end at New Rochelle, eight at Portchester and nine at Stamford, leaving forty-five for points beyond this division. Thirteen of the latter are scheduled not to stop at Stamford, and thirty-two of the sixty-seven are essentially local trains making frequent stops.

On the Mt. Vernon-Stamford section the schedule of these locals varies from twenty-three to twenty-seven miles an hour, and the station distances average 1.65 miles apart, while intervals between train stops vary from four to six minutes, quite comparable to the conditions on the express service of the Interborough system.

Woodlawn, the point of departure of the New Haven from the Harlem tracks, is a flag stop for four trains only, and Mt. Vernon, 1.6 miles farther on—or 13.63 miles from the Grand Central Station—is practically the first suburban station on the New Haven road.

As further illustrating the character of this service, it may be noted that in addition to the starts at 42d Street Station, these sixty-seven trains make only twenty-three starts below Mt. Vernon, but two hundred and eighty-nine in the 19.85 miles beyond, excluding, on the one hand, possible stops at the draw bridge over the Harlem, and on the other movement of trains in the yards at New Rochelle and Portchester.

The train movement is variable, intervals at stations in one direction varying from seven minutes to nearly three hours. But considering traffic in both directions, while at times there are no trains in motion on the Mt. Vernon-Stamford division, and for a period of about three and one-half hours when there is but one train at any moment, for the remaining time there is an average of a train every ten minutes, and sometimes as many as eight trains in the section. Any freight movement is, of course, an addition. The road, therefore, can hardly be classed as a long rural road with infrequent service.

About four months ago the New Haven road's expressed determination was to limit its electrical movement of trains over the equipped tracks of the Central; three weeks ago, after a period of three years of vacillation, during which time there was but a single attendance of any representative of the road at the meetings of the Central's Electrical Commission, a second attendance is accompanied by the announcement of the adoption of alternating-current locomotives, the intention to extend operation from Woodlawn to Stamford, the abandonment of multiple-unit suburban train operation, the handling of all trains by electric locomotives, and a possible call for electric power not alone on the direct-current third-rail section, but for a single-phase alternating-current supply to an overhead trolley on the balance of the division.

In eleven months the Central hopes to begin electric operation. It has taken that company two years to have developed by two great manufacturing companies an electric locomotive which can perform such part of its service as must be so operated, and months must elapse before any number are ready for use, despite the fact that they are built for a single purpose, and are to be operated on a single plan. The development of this locomotive has been accompanied by a running test of nearly 25,000 miles under every conceivable load and operative condition, on a track specially set apart day and night for this purpose.

Now by some wizard performance, the development of a new locomotive on other plans, designed to be operated both by alternating and direct currents, to have a double system of contacts, and control both for single and multiple unit locomotive operation, is promised in time to meet the already established conditions. Just here, and to have at first hand an authoritative expression as to proposed methods, I will quote from a paper presented at the recent meeting of the Philadelphia Convention of the American Street Railway Association by Mr. Charles F. Scott, as follows:

"While single-phase cars can be arranged to operate from a direct-current trolley wire, it handicaps in some measure the single-phase equipment. The addition of resistance to the car equipment and the extra switches and the like for enabling the change to be made in the current supply are obviously objectionable. It is best, therefore, to keep single-phase equipments free from operation on direct current if it be practicable to do so. When it is found necessary for them to operate from an existing direct-current trolley wire, the motors are connected two in series for 500 volts, and if there be four motors the two pairs may be connected first in series and then in parallel as in ordinary series parallel control. The transformer is cut out, and the control apparatus and motors operate substantially the same way as those on an ordinary car.

"Current may be taken from one phase of a two-phase or a three-phase generator. Current from the several phases of a polyphase generator may be used for operating different divisions of the railway.

"A polyphase motor taking power equally from each phase of the high-frequency circuit may drive an alternator, either single-phase or polyphase, for furnishing current to the single-phase railway.

"Trolley voltage [on direct-current operation], however, has been limited to approximately 500 volts on account of the limitation of the direct-current motor." The pertinence of these remarks will be apparent later.

Assuming, for the sake of argument, that an alternating-current locomotive of sufficient capacity to handle the New Haven trains can in the time required be developed, how will the introduction of alternating-current operation affect the elaborated plans of the Central?

That road is actively engaged in carrying out plans involving an expenditure of nearly sixty million dollars, much of it made possible by the advances in electrical development, and over ten millions is being invested in electrical equipment alone. Increase of capacity, however defined and elaborated, has been the keynote of its plans, and anything which threatens to impair, or in any way interfere with the full measure of its accomplishments must be subjected to rigid scrutiny, and if the threat becomes a fact, should meet with prompt and unceremonious rejection.

In what particular then does the proposed introduction of alternating-current locomotive operation into this territory promise to better or even equal that already provided?

The plans of the Grand Central Station show a terminal designed to obtain the maximum dispatch and economy in handling train service and passengers, and the minimum dead movement of all equipment. To accomplish this a double-track level is being provided, the upper for trains drawn by locomotives originating from points outside of the electric zone, and the lower to accommodate the movement and storage of suburban trains operated on the multiple-unit plan, this lower level being provided with a loop, storage tracks and the necessary cross-overs, and also for a possible, though improbable, connection with the Interborough system.

This loop is of 135 feet radius, less than that at the Brooklyn Bridge station of the Interborough, and on which it is manifestly impracticable to effectively operate any locomotive handling a ten or twelve-car train. This method of operation, designed for the New York Central trains, should without argument govern the operation of all trains which come into this terminal, and yet the proposal to use alternating-current locomotives means the abandonment of a multiple-unit train operation, at least on this section, by the New Haven road.

Assume that on second thought it recognizes the necessity of altering its conclusions so as to meet the imperative demands of terminal station movement and the traffic requirements of the public, what are the technical facts?

Simply that not only every locomotive, but every motor car—and in a suburban train of any length there must be several if not all motor cars where high schedule is attempted—must, according to present plans, be equipped with bow collectors for overhead trolley contact 22 feet above the traffic rails, and third rail as well as overhead collectors for operation on the direct current zone, must pass through a tunnel of only 15 feet in height and over special switch work in terminal yards, and must be provided with means for throwing one or other of these sets of collectors into operation and two distinctive systems of control, one for alternating current and the other for direct current operation.

When considering the difficulties which must be inevitably experienced in the change over from one system to another, and especially if the attempt is made to operate the suburban trains on the multiple-unit system, one wonders why, instead of adding to them by an overhead trolley from Woodlawn to Stamford, a properly constructed and protected third-rail operated at a moderate potential was at least not adopted for this experimental equipment.

To say nothing of the increased weights, and the liability of trouble and delay because of the extra apparatus and complications, and even assuming that these can, despite Mr. Scott's inference, be ignored, what will be the result in the matter of economy when operating in the direct current zone, and what bearing will it have upon the capacity of conductors and supply at the Central's sub-station nearest 42d Street?

The alternating current motors proposed are designed to work at a maximum of about 250 volts when at full speed, and when in the direct current zone they must be coupled in series in pairs because of the higher potential. Locomotives, although equipped with four motors, can then be operated only with the two groups in series and parallel relation, and motor cars if equipped with only two machines must be operated with fixed relation of motors. The result will be that for locomotive operation there will not be the advantage of the direct-current four-motor series control provided on the Central's locomotives, and no corresponding two-series control for motor cars. Locomotives will, therefore, require an increase of over 100 per cent in current up to about twelve miles an hour, which constitutes a considerable part of the yard movement, and there will be a similar increase of direct-current requirements for two-motor suburban motor cars up to speeds of twenty or twenty-five miles an hour. In fact, the conditions will be worse than indicated, because if the motors are designed for 250 volts individual operation two in series will not be sufficient for the direct-current zone, where the regular potential will range from 600 to 650 volts.

No wonder, then, that in spite of local requirements, and the fact that the multiple-unit has become an accepted tenet of such character as to preclude the possibility of successful criticism, the New Haven road commits itself to the abandonment of that method of train operation, one of the strongest reasons and most legitimate excuses for the use of electricity.

Even its locomotives, be they ever so successful, would introduce an additional cause for trouble and complaint on account of the extra number and yard space required and because of the inability to pool the equipment.

Furthermore, should there be delay in providing them, it will mean a like inevitable delay in commencing electrical operation by the Central, because of the inadvisability of joint electrical and steam operation in the tunnels, a condition to which a long-suffering public will register an emphatic and justifiable protest.

In the matter of current supply, what must it be, especially in view of the limited time remaining before electrical operation will begin at 42d Street? Either there must be a single supply from the power houses of the Central for both alternating-current and direct-current operation, or direct-current supply for 12.05 miles by the Central's power house, and single-phase alternating-current supply for 19.85 miles from an independent station. In the latter case it is manifestly impossible to get the highest economy because of the great variation of load, and because only one part of the work, and that the more severe, will be performed by the independent station. Joint supply of the direct-current division is simply out of the question, because in order to meet the necessary conditions it would have to be through independent sub-stations, practically similarly equipped, and supplied by independent high tension lines from the New Haven plant, which duplication, because of physical conditions, is impracticable.

The proper determination of the relative amounts of energy used by the equipments of the two companies under the complicated conditions of train operation, with supply from three main power stations and the necessary duplicate sub-stations feeding a common working conductor, would be most difficult. Nor could there be under such conditions of supply from independent corporations that effective control of current supply vital in times of emergency.

It must be remembered that the New York Central, while providing space for future increases of equipment, has established two power houses considerably removed from each other, one at Port Morris, and the other at Glenwood, near Yonkers; that these two stations generate polyphase currents which are transmitted to eight sub-stations, where they are converted into continuous current at 650 volts pressure which is delivered to the working rail; that at these sub-stations storage batteries of great capacity are to be installed, and in order to insure reliable operation of the rotaries under the extreme variations of load due to the heavy train demands, extraordinary care has been taken to maintain a practical minimum of voltage variation and freedom from sharply fluctuating loads at the main stations.

Furthermore, these two main stations are tied together, and the sub-stations are supplied by a system of high-tension conductors of minimum number, so that either joint or independent operation of stations can be effected with the least delay and the greatest freedom from confusion and trouble.

While normally, at least during times of heavier traffic, both stations will be maintained in operation, the reduction of fluctuations and the reserve capacity afforded by the batteries is such that in an emergency one station could just about take care of the Central's service, and in case of a total temporary breakdown of the high-tension lines the batteries will have reserve capacity enough to carry the entire load for a short period. It will be seen, therefore, that a fundamental idea of the Central's equipment is that of insurance because of the great volume of traffic and the vital necessity of maintaining continuity of operation. If called upon to supply three times as much power as originally contemplated outside of its own necessities, there would, unless the capacity of both stations is increased, and also the number or capacity of certain of the high-tension feeders, be imposed upon it a demand which it will not be prepared to meet. The fact that two-thirds of this special demand would be of a sharply varying character, without any relief whatever from storage battery equalization would certainly tend to interfere with the attainment of results which have been considered fundamental.

But assuming that alternating-current supply is made from the Central's main station, how can it be done?

There are several theoretical possibilities: Single-phase, all from one section of the machines to step down transformers which in turn supply the trolley wire, or single-phase from all windings to independent transformers, from each of which a section of the road will be supplied.

Neither of these plans is permissible, because in view of the size of the train units there would be serious unbalancing of the phases, with consequent irregularities and unreliability in operation of the rotaries, especially when accompanied with material drops of potential, to say nothing of the possible overloading and burning out of some part of the windings, or the necessity of operating an excess amount of machinery.

An alternate plan, supply by all phases to transformers connected upon the three-phase, two-phase plan, the two phases supplying different sections of the road, is likewise objectionable for the same reasons.

An independent supply from machines specifically set apart for the New Haven's service cannot without great cost be made effective because of the existing system of distribution and switchboard arrangements. Only a limited supply of this sort could in any case be possible from the equipments now being provided.

A remaining possibility resides in the use of polyphase motors, which in turn drive single-phase generators to supply the trolley wire, so as at all times to make equal use of all phases. This seems to be the only practical method when rotaries are also to be operated from the same source, and when train units of the size under consideration are to be operated. This, of course, means the introduction into the sub-stations of that moving machinery so much deprecated by critics of direct-current operation.

Every specific condition surrounding this proposed equipment seems, therefore, to militate against that directness and simplicity of equipment essential to the claim of alternating-current operation, and which under more favorable auspices would have a fair chance of being demonstrated.

What, then, is to be gained, and by whom? The New Haven Company must make a serious expenditure, lessened possibly by utilizing current from another company in the direct-current zone, but this necessarily rendering less efficient the supply from its own station, if it has one for the alternating current division, and it turns over its tracks and equipment, as well as operation, to an experiment in the hope of demonstrating such economy in electric locomotive operation as will warrant the enormous expenditure necessary for any serious extension of electric service on its main line.

The passengers seem to have been lost sight of, for there is no promise of a single additional train or higher schedule, or any improvement in service, save abolition of smoke, which nuisance seems to have assumed gigantic proportions.

The Central, when it fully comprehends the meaning of the proposed equipment, may find sufficient warrant to view with equanimity the entire disarrangement of its plans and the prostitution of its service to what may be fairly termed a craze for experimental development applied without regard to consequences, but I doubt it.

On the general subject of alternating-current and direct-current operation, I beg to add a word affecting, as it vitally does, conductor capacity and sub-station distances, it is unfortunate that Mr. Scott should make a statement to the effect that 500 volts has become the standard, and by inference must necessarily be the limit for direct-current operation, for the Central's rail supply will be at 650 volts, its direct current motors are guaranteed for 750, the Berlin Elevated and the Zweisimmen Montreux roads are built for 800 to 850, reliable companies in Europe are supplying direct-current motors wound for 1,000 volts, and it may be safely assumed that in spite of apparent difficulties turbine operation of comparatively high direct current dynamos is not an impossibility.

By all means let us have the utmost which can be gotten by either system, let every improvement and advance possible be attained. Every engineer stands ready to welcome accomplished facts, and to help in the progress of the art, but for the best interest of that progress it is vital to avoid not only unwarranted claims, but adverse statements which will not bear critical analysis.

Cost of Coal Handling.

In a paper read by Mr. Charles H. Parker before the recent Lake Champlain meeting of the Association of Edison Illuminating Companies, some figures are given as to the cost of handling coal at the South Boston plant of the Edison Electric Illuminating Company, of Boston. This plant consists of a tide-water pier with two unloading towers, an open-air storage yard with a traveling barge for handling coal in the yard, bunkers of a limited capacity at the boilers, and a system of conveyors connecting all of the above. The coal conveying apparatus is operated throughout by electric motors, varying in size from 10 to 100 hp.

Among other interesting information given in the article is an estimate of the deterioration of coal in the open storage yard. This is estimated to be 6.5 per cent, or taking into consideration that the coal contains 2.2 more moisture in the winter months than in the summer months, due to the ice and snow brought into the station with the coal, the net loss by weathering is placed at 4.3 per cent. The load factor of the station for the winter months was .566 and for the summer months .553.

It was found that unloading from a barge having large and well placed hatches, an average of 90.5 tons could be handled, but with small hatches the capacity fell to 30.4 tons per hour. The cost of handling coal per ton from various vessels was as follows: From lighters, 5.27 cents per ton; barges, 8.04 cents per ton; steamers, 9.30 cents per ton; schooners, 15.04 cents per ton.

Taking into consideration all factors of cost, including cost of unloading coal to bunkers, to storage yard, from yard to bunkers, handling coal in the yard and cost of repairs to all coal machinery, the average cost of handling per ton was 15.35 cents, and the average kw-hours per ton of coal unloaded was 3.71. The total kw-hours required to unload the coal was about ½ of 1 per cent of the station output, which value will be considerably reduced as the result of improvements now being made.

A Striking Picture.

Mr. O. P. Austin, in a communication to the *National Geographic Magazine*, says: "In 1805 the world had not a single steamer upon the ocean, a single mile of railway on land, a single span of telegraph upon the continents, or a foot of cable beneath the ocean. In 1905 it has over 18,000 steam vessels, 500,000 miles of railway and more than 1,000,000 miles of land telegraph, while the very continents are bound together and given instantaneous communication by more than 200,000 miles of ocean cables, and the number of telephone messages sent aggregate 6,000 millions annually, one-half of them being in the United States alone. The world's international commerce, which a single century ago was less than two billions of dollars, is now 22 billions, and the commerce of the Orient, which was less than 200 million dollars, is now nearly 3,000 millions."

CURRENT NEWS AND NOTES.

THE HARVARD MASSACHUSETTS TECH. MERGER.—According to a Boston press dispatch the corporation of the Massachusetts Institute of Technology on October 11 voted to discharge the conference committee and withdraw from further consideration of the proposal to merge the Institute with Harvard University.

A. I. E. E. IN BOSTON.—The Boston branch of the American Institute of Electrical Engineers held its annual meeting recently in the Lowell Building, Institute of Technology, when the following-named officers were elected: Chairman, C. A. Adams; secretary, H. D. Jackson; executive committee, C. L. Edgar, James I. Ayer, C. B. Burleigh, Dr. Kennelly, R. Fleming.

ST. CLAIR TUNNEL.—It is said that the reason for the delay of the Grand Trunk Railway Company in equipping the St. Clair tunnel with electricity is because the company is anxious to investigate the feasibility of Niagara power. The Board of Railway Commissioners for Canada, nearly a year ago, recommended the electrification of the tunnel, but this work has not yet commenced.

A. I. E. E. MEETING.—The 200th meeting of the American Institute of Electrical Engineers will be held at No. 44 West Twenty-seventh Street, New York, at 8.15 p.m., Friday, October 27, 1905. The general subject to be discussed at this meeting is "Lightning and Lightning Protective Apparatus." The following papers will be presented: "Some Experiences with Lightning Protective Apparatus," by Julian C. Smith, of the Shawinigan Water & Power Company, Montreal. "Performance of Lightning Arresters on Transmission Lines," by A. J. Neall, electrical engineer with the Westinghouse Electric & Manufacturing Company, "Lightning Arresters on Italian High-Tension Transmission Lines," by Philip Torchio, chief electrical engineer of the New York Edison Company.

ELECTRIFYING SWISS RAILWAYS.—The Swiss Government is giving serious consideration to the electrification of its steam railroads, for which purpose it has splendid resources in its water powers, and in the ability of its electrical engineers and manufacturers. It has a special commission on the subject, the secretary of which, Dr. W. Wyssling, of Zurich, in company with Mr. Charles Wirth, engineer to the Swiss Railway Department, has been making a tour of inspection in this country. They visited Pittsburg and Schenectady, the single-phase roads out West, the third rail section of the Long Island Railroad and other places of pertinent interest. Their report will be confidential, but will have an encouraging and optimistic tone. The two gentlemen sailed for home, via Genoa, last week, well pleased with their trip.

IOWA TELEPHONE ASSOCIATION.—The Southeastern Iowa Independent Association had its convention on October 10. The meeting was well attended and enthusiastic. Another meeting will be called in about 60 days to hear the report of a committee appointed to revise the constitution and by-laws to conform with the State and National-Interstate Associations' constitutions. The programme was as follows: President's address, J. C. Thorpe, Fairfield, Iowa; "Reorganization," S. S. Lichty, Vinton, Iowa; "Clearing House Methods," Charles C. Deering, Boone, Iowa; "Party Lines," W. D. Dunsmore, Oskaloosa, Iowa; "Toll Lines and Service," Frank McNally, Washington, Iowa; "Are Our Rates in Harmony with Our Investment?" Howard Herr, Ottumwa, Iowa; "Our Association: What is the Ideal?" O. H. Seifert, Eddyville; "What of the Future?" J. S. Bellamy, Knoxville; "Round Table for Everybody"; "Does the Bell Love the Farmer?"; "Respecting Each Other's Territory"; "Toll Lines," and "Exchange Accounting."

MUNICIPAL OWNERSHIP is all the cry in the New York mayoralty campaign. Mr. W. R. Hearst, of the New York *Journal*, has been nominated on an independent, straight-out municipal ownership "platform," and Mr. W. Ivins, the Republican candidate, is out flat-footed for municipal ownership in every aspect, shape and form, as follows: "In the matter of municipalization of our public franchises, except on the point of the compensation payable on the reassumption by the public of such franchises, I will listen to no adverse party interest. The principle is no longer open to discussion. I will appeal to the Legislature for the passage of a law condemning all existing gas plants, under the right of eminent domain, with power on the part of the city to enter into immediate possession, leaving the question of value to subsequent determination by commission. In this way the people will have relief at once, whereas any other method means indefinite delay. I will push the construction of a municipal electric and power plant, and enforce the rights of the city in respect to the underground electric conduits." The Socialist party of New York has denounced the Hearst campaign as fraudulent, it being thus characterized: "Of all the issues of the campaign, the one humbug, the worst humbug, is municipal ownership under William R. Hearst." In his utterances, the Tammany or Democratic candidate, has said that he could not approve a "confiscatory policy" of municipalism.

VALUE OF TELEPHONE FRANCHISE.—In a special report to Controller Grout, presented to the Board of Estimate, Engineer Harry P. Nichols, of the finance department, estimates the value of a New York telephone franchise at $7,750,000 for twenty-five years of operation. As soon as the Legislature took from the Aldermen their powers in franchise granting matters the Atlantic Telephone Company applied for a franchise to operate an independent telephone system in the five boroughs, promising connection with the outside cities of the United States. When the application was made to the Board of Estimate it was referred to the controller, as the law directs, that a price might be fixed. Mr. Nichols is in charge of the franchise bureau of Mr. Grout's department, and the papers were sent to him. The company made this offer: The charges to be never in excess of 5 cents per call where there is no guarantee by the subscriber to pay a fixed sum per annum. A rate of $66 per annum for unlimited service where telephone is in private residences. A rate of $108 per annum for unlimited service where telephone is located in place of business. As a return to the city for the privilege of operating for twenty-five years: First, to pay to the City of New York for the first two years a sum equal to 1 per cent, for the next three years a sum equal to 2 per cent, and for the remaining twenty years a sum equal to 4 per cent of the gross receipts from service rendered in the city. Second, to furnish and install in various municipal offices telephones to a number not in excess of 500. In addition to payment for franchise, the company would have to pay duct rental in the conduits. .

CARNEGIE SCHOOL OF TECHNOLOGY.—A special dispatch from Pittsburg of October 15 says: "When the Carnegie School of Technology opens for business to-morrow morning there will have been launched an educational enterprise which the founder purposes shall be ultimately the greatest of its kind in the world. More than 7,000 young men and women from every part of the globe have made application for admittance as students. The great majority of these are from the United States, but France and Germany are liberally represented. Great Britain, China, Japan, the Philippines and Greenland also are asking for admission. Only one of the great group of buildings planned has been completed, and the total expenditures to date aggregate $3,000,000. Mr. Carnegie has agreed to give ten millions for buildings alone and as much more as may be necessary. One-third of the seven thousand applicants were rejected outright because they could neither read nor write. Many of these expected Mr. Carnegie to pay their railroad fare and living expenses for the school year, and some even thought the philanthropist would provide for their families while they were procuring an education. After a sifting process there were left 1,723 eligibles, and because of the limited accommodations to start with only 120 have been accepted for the beginning of active work. At first there will be no women, because there is as yet no provision for them. The tuition will be $20, Mr. Carnegie insisting on this nominal sum because he does not wish the students to feel that they were attending a charity institution. All books, tools and material will be furnished free of charge, the only expense to the students besides tuition being their board and lodging. The school is primarily intended to fit students for the practical things of life. Among the branches to be taken up at the start are mathematics, elementary and applied electricity, mechanical engineering, chemistry, physics, architecture and foundry work."

TROLLEYS BOUGHT BY STEAM.—The Boston & Maine Railroad stockholders have voted to purchase the Danvers and the Newburyport Railroads. Bond issues of $10,458,000 for purchase and refunding purposes and 42,037 shares of new common stock were authorized.

WIRELESS BETTING.—The chief of police of Chicago fears a development of betting by wireless telegraphy and proposes to establish an interference station to prevent it by "jamming." This neat little plan would, however, interfere very decidedly with legitimate operations also.

FRANKLIN INSTITUTE PROGRAMME.—The Franklin Institute programme of lectures for the season of 1905-1906 includes Dr. F. A. C. Perrine, of New York, on "Power Transmission"; Charles E. Waddell, electrical engineer, Biltmore estate, Biltmore, N. C., on "Forest Denudation and Its Effects," and H. F. J. Porter, of New York, on a subject to be announced.

UNDERWRITERS' ASSOCIATION.—The annual meeting of the Electrical Committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York City, on Wednesday, December 6, 1905, at 10 a.m. As in the past, the meetings will be open to all interested in the matter of rules for the installation of electric wiring and apparatus, as contained in the National Electrical Code.

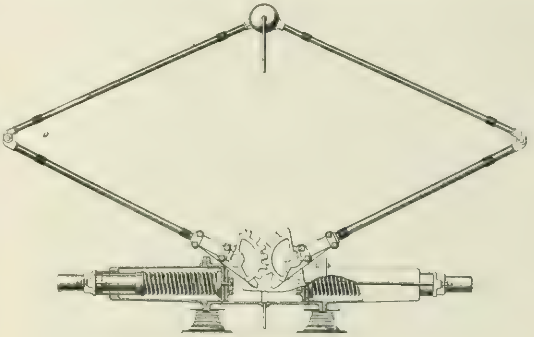
HYDRO-ELECTRICITY IN FRANCE.—Two new hydraulic electric stations are to be built in Lyons, France. In one a 200-ft. head in the Romanche River will afford 10,000 hp, which will be transmitted as three-phase current over a line 90 miles long. The other plant, at Moutiers, will supply 5,000 hp direct current at a potential of 57,000 volts, to be carried 110 miles on overhead bare copper wires. Where it enters the city the conductor will be placed underground in armored cables. The current will be transformed to a lower voltage by five motor-generators.

ALABAMA FREIGHT TROLLEY.—It is stated from Birmingham, Ala., that an important enterprise has been inaugurated by the granting of franchises to J. M. Dewberry and others, of Birmingham, for the building and operation of an electric freight and passenger line through the counties of Jefferson and Tuscaloosa to the Warrior River in the latter county. This road will carry Birmingham freight to the Warrior River, whence they can be floated to Mobile, giving the district its long-desired all-water route to the Gulf. The tonnage of the district is very heavy.

STEEL CARS.—The first all-steel car built in England was brought out early last month by the Brush Electrical Engineering Company, Limited, and its appearance is expected to answer fully some of the unfavorable advance comments in England on this type of car. It has been only a couple of years since the steel passenger car was introduced for roads operated by electricity. The American Car & Foundry Company built about 300 for the New York Subway and about 125 for the Long Island Railroad, 125 for the New York Central and 300 are in process of construction for the London underground road, and with a few less important orders a total of about 1,000 have been manufactured or have been contracted for. It is believed that this is only the beginning of a great change to take place during the next five years.

SIGNALING THROUGH CABLES.—A patent issued October 10 to Sir Oliver Lodge and Dr. Alexander Muirhead, of Birmingham, England, relates to the transmission of signals through submarine and similar cables. The object of the invention is to increase the rate of signaling. The inventors employ a condenser and inductance in series in a local circuit suitably proportioned in relation to each other as to give an oscillatory discharge. The current surges are conveyed to the cable either by reason of a part of the local oscillatory circuit being itself in series between the cable and the earth, or inducing an oscillation in a conductor which is in series. The surge used for signaling is sent on the depression of the key to discharge the condenser. The recoil surge in the opposite direction is depended upon to effect a suitable curbing of the signals so as to enable a high rate of working to be maintained.

BOW TROLLEY.—Two patents were issued on October 10 to H. P. Davis and C. Aalborg for trolleys for high-speed electric railways. According to one of these, the inventors propose to use a boom, which is moved up or down by means of compressed air. On the end of the boom is pivoted a bow, which is held against the trolley wire both by means of the compressed air and by means of springs, which allow the bow to assume an inclined position in one or the other directions, depending upon the direction of motion of the car. The second patent relates also to a pneumatically-controlled bow collector. In this case, however, the bow is raised always in a vertical plane, the movement being restricted by means of a so-called "lazy-tongs" construction, as shown in the accompanying illustration. The central portion of the bow is cylindrical in form, and is so mounted as to rotate in service.



MUNICIPAL LIGHTING PLANTS.—With regard to the well-known book by Past President Francisco, of the National Electric Light Association, Secretary Eglin has issued a note to the members as follows: "The new book by Mr. M. J. Francisco, entitled 'The Business of Municipalities and Private Corporations Compared,' has been received at this office, and is a very convincing argument against municipal ownership of electric lighting plants. Mr. Francisco's former book, 'Municipalities vs. Private Corporations,' of which the new book is practically a revision and enlargement, was found by many of the members of the National Electric Light Association to be of very great benefit when combating the municipal ownership idea in their respective cities and towns. Mr. Francisco's statements are always carefully verified, and ought to carry the strongest conviction that up to the present time city ownership of lighting plants has proved in almost every instance a gigantic failure, and is likely to do so wherever undertaken."

MEETING GAS ARC COMPETITION.—In the discussion of illumination which took place at the meeting of the Electrical Section of the Western Society of Engineers in Chicago, October 13, Mr. Harold Almert, who has the supervision of a number of central station properties controlled by the L. E. Myers Company, of Chicago, told of a method he had found of meeting the strong competition for store lighting that is being put up in some places by gas companies offering gas arcs with cheap gas. This applied to places where stores had formerly a few electric arc lamps on a flat rate, burning a certain number of hours every evening. In such cases Mr. Almert suggested to customers who were dissatisfield and were considering going over to gas arcs that several more electric arc lamps be placed in the store and that all be placed on a meter basis instead of a flat rate. In this way the customer was able to frequently obtain a very much more brilliantly lighted store without much or any increase in lighting bills, and the threatened competition was kept out. The company's flat rates for arc lighting were of course based on burning a fixed number of hours each night, this number of hours answering the requirements of stores which close the latest. With the lamps on a meter basis, the customer could put them out as he pleased. Such a plan evidently increases the peak of the central station load without much corresponding increase in revenue, but under the circumstances it appears that some such concession is necessary to meet competition.

LIGHTING AT LOWELL, MASS.—Chief Hosmer, of Lowell, Mass., has taken a rather original position in his new specifications for street lighting. The bids will exclude electric lighting altogether. If this is carried out Lowell will occupy a unique position among American cities.

TOPEKA CITY PLANT.—It is proposed to sell the municipal electric lighting plant at Topeka, Kan. Mr. Frank B. Simms, of the city council, says: "It seems to me that this plant is a mighty big expense to the city considering the benefit we get out of it. We will have to enlarge the plant to give adequate service to the city and that will cost probably $15,000. Then we will have to pay about $5,000 more for new lamps. If we can dispose of this plant to some corporation that will do the city lighting at a reasonable figure it seems to me that it would be a good business proposition."

CLOCK OPERATION BY WIRELESS.—It is stated in German papers that Dr. Max Reithoffer, professor at the Vienna technical high school, has, jointly with the court watchmaker, Karl Morawetz, submitted to the common council of Vienna a plan for an electric system of clocks run by wireless electricity. They propose to furnish the chronometric and electric apparatuses, including clocks, to the city free of charge, and to make the trials. The city has only to furnish the current, the cable connections, etc., and give the use of suitable buildings. The common council has appropriated $600 for making experiments.

PROTECTING NIAGARA FALLS.—At Cleveland, Ohio, on October 6, the American Civic Association, at its session here, adopted resolutions calling upon the governing powers of the United States and Canada to do something to save Niagara Falls from what was termed "commercial vandalism." A committee was directed to send telegrams to President Roosevelt and Governor-General Earl Grey, requesting that they appoint a joint commission to suggest the best way of preserving the Falls for the benefit of future generations. A visitor to the Falls last week remarked that he had never seen them in fuller flood at this season of the year, all the enterprises together not having made apparently the slightest impression.

THE ENGINEERS' CLUB has just issued a handsome and interesting brochure giving an illustrated preliminary description of the new club house to be erected on East Fortieth Street, New York, flanking the new Public Library and looking out on Bryant Park. A simple, admirable account in some detail is given of the arrangements and there are plans of all the floors. The frontispiece is an elevation of the building in colored perspective. There will be 66 bedrooms, three electric elevators and an isolated lighting plant. The club is already the recipient of several generous gifts for the mechanical equipment. The new home will probably be ready next summer and will be occupied in the fall. The membership is about 1,250, and there is a long waiting list.

A ZOSSEN MODEL.—Mr. Edward D. Adams, the well-known financier of this city, and representative of the Deutsche Bank, has been presented by the Siemens & Halske Company, of Germany, with a superb model of its high-speed car with which such brilliant demonstrations were made on the Zossen military road sometime ago, using three-phase current. The model is exact in every detail of outward construction, and a great many of the working parts are also reproduced with closest exactitude. The scale is 1:20. The model was made by the apprentice force, which was sent into the field to make its measurements from the actual car itself as it stood on the track, without the working drawings. It is particularly interesting, in this model, to study the bow contacts for the three overhead wires, these having proved very successful in the final operative tests.

Electrical Engineers of the Times.—XXXII.

MR. H. W. FISHER.

Henry Wright Fisher was born at Youghal, Ireland, in 1861. His ancestors on his father's side were importers and millers of grain, and his grandfather was the first to introduce Indian corn into Ireland at the time of the Irish famine, thus preventing much suffering and starvation. In 1871 he was taken to the Argentine Republic, where his father had been entrusted with the management of a colonial enterprise financed by a London corporation. He was there about three years, receiving, during this period, instruction from an elder sister. On account of the poor educational advantages, his father, at the solicitation of American friends, brought his family to North Carolina where he purchased a plantation and became general manager of the Jamesville & Washington R. R. & Lumber Company, which some years previously had been organized by the late Richard S. Waring, of Pittsburgh, who also founded the Standard Underground Cable Company. In 1879 he attended the West-town Boarding School, near Philadelphia, staying there three years and receiving sufficient instruction to enter Cornell University in 1884. He was graduated in 1888, receiving recognition of work done in the University by election to membership in the Sigma Xi Society.

For a short time after graduation Mr. Fisher was connected with Bergmann & Company and the C. & C. Motor Company, both of New York City. In December, 1888, he entered the employ of the Standard Underground Cable Company in charge of its engineering work in New York City, and in October of the following year he became chief electrician of that company. Mr. Fisher at once commenced to increase the testing facilities of the laboratory and to conduct a great variety of experiments with a view to obtaining needed data relating to electric wires and cables. This work has been continued ever since, and a large amount of useful information has been accumulated. For three years in the early part of the last decade Mr. Fisher was also connected with the Central District & Printing Telegraph Company, of Pittsburg, for which he designed a testing laboratory and located many defects in cables, etc. His present title is Chief Engineer of the Standard Underground Cable Company.

HENRY W. FISHER.

Mr. Fisher has visited most of the large cities and many smaller towns of the United States on engineering duty for his company. When its Oakland and Perth Amboy factories were under construction he undertook, in addition to his regular work, the duties of superintendent of the Pittsburgh factory, thus adding to his knowledge a thorough understanding of the practical manufacture of wires and cables. About 1900 he designed cable testing apparatus for the new factories and the construction department of his company, which proved of so much value that they are now regularly manufactured for the market by a firm of instrument makers.

Mr. Fisher has devised new methods of locating faults, several of which have been described in these columns, and has been granted several patents relating to cables and cable apparatus. He presented a paper on "Spark Distances Corresponding to Different Voltages" before the International Electrical Congress at St. Louis, and has contributed to the Transactions of the American Institute of Electrical Engineers, the Engineers' Society of Western Pennsylvania, and the Pittsburgh Academy of Science and Art—of which three societies he is a member—and to the technical periodical press. He is ex-president of the Engineers' Society of Western Pennsylvania and vice-president of the Pittsburgh Academy of Science and Art.

Electrical Supply in Hartford.

FARMINGTON RIVER, in falling 55 ft., develops the greater part of the electrical energy consumed in Hartford, Conn. Two widely different factors go far toward determining the percentage of the total demand for energy that can be drawn from the river, namely, the fluctuations in the rate of water discharge and the changes in the electric load. Between the different months of a year the electric load at Hartford, as in other cities, swings through a nearly regular cycle of changes with a minimum value about June and a maximum about December.

This series of changes in load demands is fortunately nearly in step with the varying rate of river discharge on the Farmington, as well as many other northern streams, so that with the certain rise of winter lighting loads there comes a nearly equal increase of the volume of water available for power. In addition to changes of load that come and go with the seasons, Hartford has presented for some years the problem of a rapidly increasing electrical output, for which no single generating plant can be expected to provide.

The ways in which the variations and increase in the demands of consumers has been met at Hartford are illustrated by the curves (Fig. 1). By these curves the energy output in kilowatt-hours per month of the Hartford Electric Light Company from January, 1898, to July, 1905, is represented. One curve represents the output generated by steam power, another the output generated by water power and the third and highest curve the total output.

For the curve of total output the most notable feature is its rise from about 200,000 kw-hours in January, 1898, to some 1,420,000 kw-hours in the corresponding month of 1905, representing an increase of more than 600 per cent during seven years. It may be noted that this rise of output has gone on at a nearly uniform rate throughout the period named, as is shown by the fact that the December peaks of the curve lie in a nearly straight line. Another point worth noting is that the variation between summer and winter demands is coming to represent a smaller percentage of the total load. Thus for July, 1898, the output was some 330,000 kw-hours and for December of the same year the number was about 600,000 kw-hours, an increase of 81 per cent. In July, 1904, however, the output was fully 970,000 kw-hours, and in the following December some 1,440,000 kw-hours, an increase of only 48 per cent.

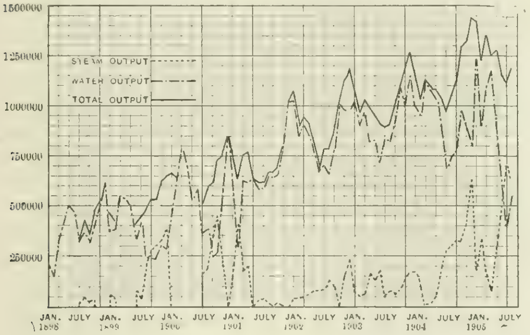


FIG. 1.—ENERGY OUTPUT PER MONTH IN KILOWATT HOURS.

Comparing the water power curve with that of total output, it appears that the two coincided during the first six months of 1898, and in several shorter periods before the middle of 1900, as well as a few weeks in 1900. Perhaps the most interesting feature of the curve representing output from water power is its nearly parallel course with the curve of total output, showing that the rate of river discharge has varied approximately with the demand for electric energy during the months of each year. Since July, 1901, the similarity of the curves for water power and total output has been especially marked. In this same period, however, the curve of total output has been drawing away from that for water power, because of the increasing electric load. This movement has led to the erection of the new steam power station at Dutch Point.

Two electric water power plants on the Farmington River, each entitled to its entire discharge, supply energy for the system of the Hartford Electric Light Company. One of these plants, that at Windsor, began to operate in November, 1891, and the other, near Tariffville, was started during November, 1899. With these dates in mind the relations of the curves can be better understood. Though the first water power plant was able to carry the entire electric load during most of the time from January, 1898, to the middle of 1899, it fell rapidly behind in the second half of that year, so that the output from steam power was more than 360,000 kw-hours during December. But the second water power plant that had been started in November of the last-named year, raised the capacity of water-driven generators to 2,700 kw, and these generators did all the work of the system from February to July, 1900. Owing probably to lack of water it was necessary to deliver some 450,000 kw-hours from steam power in November of this year, but the two water power plants carried almost the entire December load which called for 850,000 kw-hours in that year.

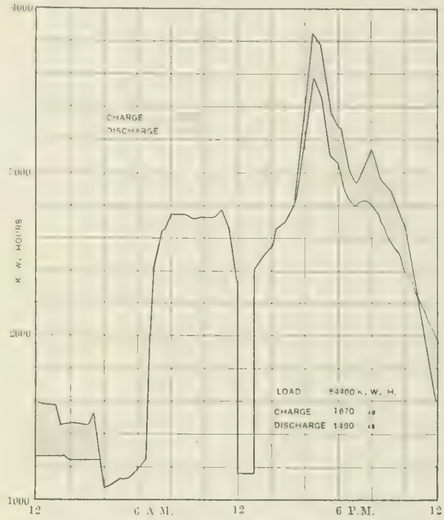


FIG. 2.—WEEK-DAY LOAD CURVE, DECEMBER, 1904.

Since the last-named date the water power plants have generated much the greater part of the energy output, but the energy drawn from steam power has necessarily increased in amount with the rising load, and was up to substantially 700,000 kw hours in July, 1905, when the two water power plants sent out only 400,000 kw-hours. This is much the lowest output from water power in any month since February, 1901. To meet these conditions the Hartford

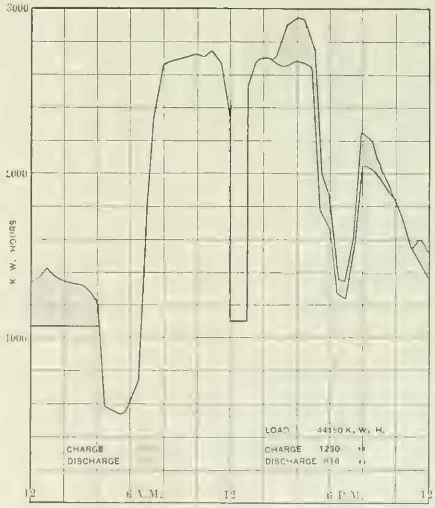


FIG. 3.—WEEK-DAY LOAD CURVE, JULY, 1905.

Electric Light Company decided on a large increase of its steam power capacity, and this has led to the construction of the new station on the bank of the Connecticut River at Dutch Point. With this new plant in operation the Pearl Street station, where the old steam plant was located, goes out of use for generating purposes, and its 1,500-kw steam turbine has been removed to Dutch Point.

Freed from the operation of a steam plant, the Pearl Street station retains its place as the chief center of distribution for the Hartford electric system, and receives energy from the two water powers and from the steam turbines in the new plant. At Pearl Street the regulation of the voltage for the distribution circuits is carried out.

Since the appearance of the general account of the Hartford electric system, published in the Electrical World and Engineer, March 8, 1902, the notable growth of supply from that system dating back to 1892, and there fully described, has gone on at an increasing rate. According to the figures presented in the above issue, the connected load of arc lamps was 1,824, in December, 1901, and now it is 1,984. In the year named the commercial incandescent lamps numbered 72,085, and now the corresponding number is 115,656, an increase of 60 per cent. To these figures must be added 3,848 meridian lamps and 3,804 Nernst lamps now in use. At the earlier writing the capacity of connected motors could not be stated, but it is now 5,474 hp.

Parts of these loads are operated with service transformers that number 365, and have a combined capacity of 5,740 kw, so that the average capacity is about 16 kw. Nearly all of the commercial output is sold on a meter rate and 3,479 meters are installed for the service.

The general scheme of feeders and distribution is shown in Fig. 4. All transmission and distribution lines at Hartford radiate from the general distributing station on Pearl Street, not far from the business center of the city. Energy comes to this sub-station over three underground cables, one of which connects with the new steam power plant at Dutch Point, and each of the other two joins one of the 10,000-volt, 60-cycle, three-phase transmission lines that run to the water powers on the Farmington River.

The junctions between the cables and the 10,000-volt lines are made in terminal houses where there are no transformers. Power at 2,400 volts is generated at Dutch Point and passes to the distributing station at this pressure. At this station the three-phase current from the two water powers is transformed to two-phase, and then mingles with the two-phase current from the steam power plant, in the distribution system. Series circuits carry the arc street lamps and are operated by constant-current transformers. Commercial service to both lamps and motors is supplied by single-phase and two-phase current of 2,400 and 220 volts, and by direct current from a 220-volt, three-wire system. This three-wire system is underground and covers an area about 0.6 mile square, which includes the business center of the city. Beyond the limits of the three-wire system distribution is effected with 2,400-volt, single-phase and two-phase circuits which supply banks of transformers at intervals, and from these transformers 220-volt circuits radiate.

It is the practice of creating many minor distributing centers, instead of carrying the 2,400-volt lines to every building, that leads to the rather large average size of service transformers noted above. Some of the 220-volt secondary systems cover considerable areas. At East Hartford and also at Windsor the territory so covered is

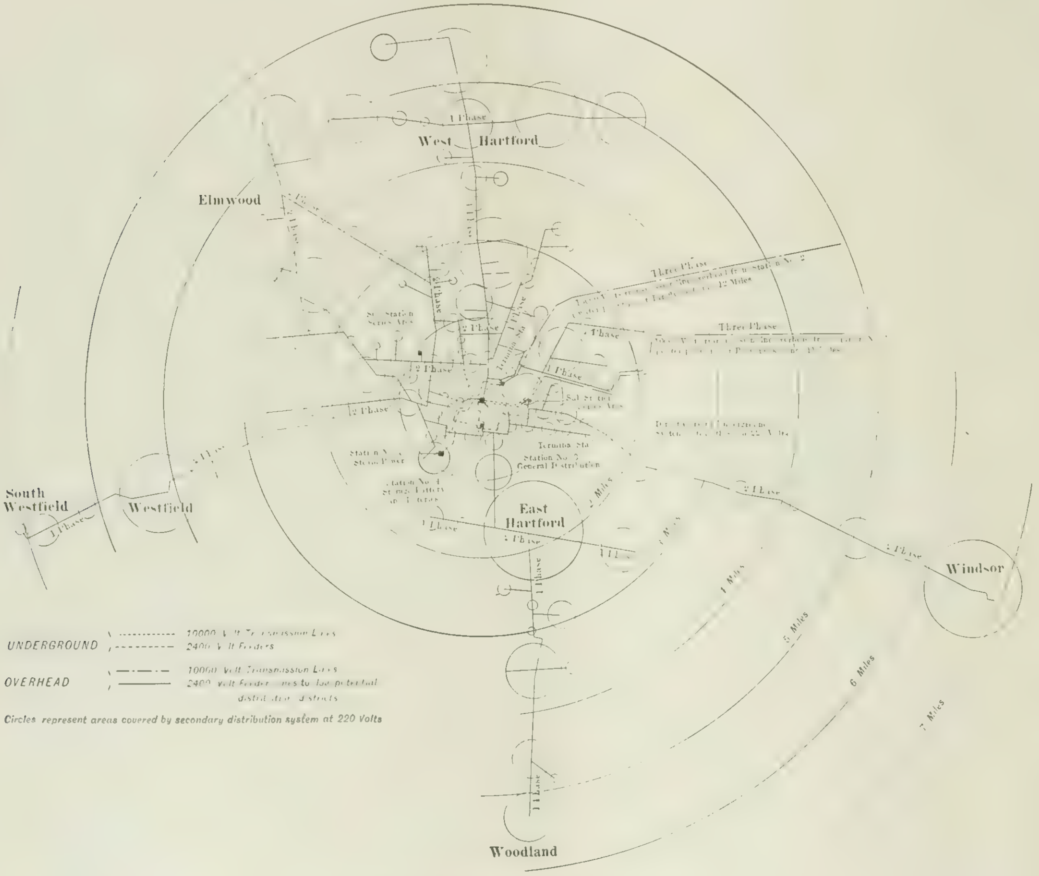

1 Phase
West Hartford
Elmwood
Three Phase
Three Phase
2 Phase
1 Phase
Sub-Station Series Arcs
Terminal Sta
Station No. 3 General Distribution
Station No. 4 Storage Battery
East Hartford
South Westfield
Westfield
Windsor
Woodland
2 Miles
4 Miles
5 Miles
6 Miles
7 Miles
UNDERGROUND
10000 Volt Transmission Lines
2400 Volt Feeders
OVERHEAD
10000 Volt Transmission Lines
2400 Volt Feeders to potential distribution districts
Circles represent areas covered by secondary distribution system at 220 Volts

Fig. 4.—Scheme of Feeders and Distribution.

in each case about 1.3 miles across. In Wethersfield the 220-volt system covers an area fully one mile wide.

The lengths of the 2,400-volt lines running to the outlying centers of distribution vary up to seven miles from the main distributing station in Hartford. Windsor, the most distant point supplied by the Hartford system, is seven miles from its center. South Wethersfield is six miles, Woodland is five miles and West Hartford is four miles away.

In total extent the 2,400-volt and 220-volt distributing circuits of the Hartford Electric Light Company now run up and down the Connecticut River a distance of fully 13 miles and east and west on both sides of that river a distance of ten miles. The expansion of the service area partially accounts for the rising curve of energy output.

On a weekday of December, 1904, the minimum load on the Hartford electric system was about 1,080 kw, and occurred at 4 a.m., while the maximum load was some 3,840 kw, at 4.30 p.m. (see Fig. 2). The storage battery carried about 240 kw of this maximum. For the 24 hours of the day in question the entire output of the electric system was 54,400 kw-hours, so that the average load was 2,266 kw, or 59 per cent of the maximum. In December, 1901, the maximum load of the Hartford system was about 2,840 kw, or 74 per cent of that in the corresponding month of 1904, and the average load for 24 hours was 1,341 kw, or only 59 per cent of the like average for the December day of 1904. It thus seems that the average day load increased almost 70 per cent in three years.

On a weekday of July, 1905, the minimum load of the Hartford electric system was 540 kw, at 5.30 a.m., and its maximum load was 2,960 kw at 4 p. m. (see Fig. 3). The total output for this day was 44,190 kw-hours, so that the average load during the 2.4 hours was 1,841 kw, or 62 per cent of the maximum load. At the time of maximum load on this day the battery output was about 270 kw. In July, 1901, the weekday load reached a maximum of 13.90 kw, or 47 per cent of the maximum on the corresponding day of 1905. For the July day of 1901 the average load during its 24 hours was 1,040 kw, or 75 per cent of the maximum, and this average load was 56 per cent of the like average on the July day of 1905.

These large percentages of average to maximum loads indicate the importance of the electric motor load on the Hartford system. As the average December load increased 70 per cent in three years, and the average July load 77 per cent in four years, it seems that the output of the Hartford system will double in five years from 1901.

Mr. Robert W. Rollins, general manager of the Hartford Electric Light Company, has made it possible to publish these interesting facts.

Electrical Hoisting Plant.

A recent issue of *Mines and Minerals* contains a brief description of an electrical motor-operated hoisting plant at Cobbinshaw. The plant has been designed for hoisting 80 tons per hour from a depth of 420 ft. The description is taken from a full report which has been prepared by Mr. Robert McClaren, H. M. I. M. The shaft is vertical and is three-quarters of a mile from the power house, where three-phase current is furnished at 440 volts and 50 cycles. The hoisting plant comprises two double drums with a direct-current motor, all on the same shaft; a motor-generator set with a fly-wheel between the motor and generator; an exciter set, an electrically-driven small air compressor with a receiver to furnish air for the brake. The motor of the generator set receives the current from the power house and drives the generator. The generator is a shunt-wound, direct-current machine designed for a speed of 750 revolutions a minute and furnishes current for the hoisting motor which is of the same type. The fly-wheel is 6½ ft. in diameter and weighs 13,000 pounds, and its function is to store energy so as to either aid or relieve the power line. The hoisting motor runs at a maximum speed of 57 revolutions a minute and is capable of furnishing 200 brake hp. The current for the field coils of the generator is separately supplied by a small 10-hp, three-phase motor driving a direct-current dynamo. The drums are 8 ft. in diameter each and 2 ft. wide. The brakes are of the post type, the uprights being of H section, 8 in. by 6 in. One brake is actuated by hand and the other by compressed air, the one with air being considered an emergency brake which comes into action automatically in case of an overwind. The load on each cage is 2,700 pounds net, and the hoisting speed about 23 ft. per second.

A Proposed Phase Regulator and its Applications.

By P. G. Watmough, Jr.

Only the general principles and applications of this device are here presented, the actual constructional details being immaterial for the purposes of this article. Briefly speaking, the apparatus consists of a selective device, responsive only to phase displacement, in combination with, and actuating a relay mechanism, which controls or varies the field exciting current supplied to the generator or other alternating-current apparatus whose phase displacement it is desired to adjust through the medium of its field excitation.

Any form of selective device or phase indicator may, of course, be used, the one here proposed consisting of two magnetic field members placed concentric with each other; these are marked *G* and *H* in Fig. 1. The inner field or element is pivoted so that it can rotate through a considerable angle; this mechanical detail is not shown in the drawing.

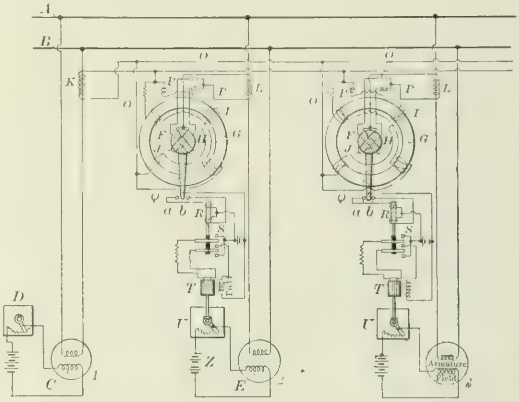


FIG. 1.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC EXCITATION.

Polyphase field windings, preferably arranged for diphase currents, are placed on each member, so that a rotating field flux may be obtained in each structure when the windings are suitably energized. It is proposed to use a single-phase source of current to supply each polyphase circuit, the necessary two-phase effect being obtained by means of inductance and resistance suitably connected in series with the proper coils.

If connections are made so that both rotating field fluxes revolve in the same direction, the magnetic structures will tend to maintain a fixed and stationary relation with respect to each other, the exact points of opposition being determined by the interaction and relative phase displacement of the fluxes circulating in each member.

Any phase difference between the current in the windings on member *G* and the current supplying the coils on *H*, will produce a corresponding displacement between the interlocked rotating fluxes, resulting in a torque tending to cause member *H* to shift its position relative to *G*, by an angular amount dependent upon the aforesaid lag or lead between the currents. An index arm mounted on *H* and arranged so that it will swing over a graduated scale, will thus directly indicate the phase displacement existing between the currents energizing or exciting the two field structures. These currents may be derived from independent circuits or may be derived from the currents flowing in different branches of the same circuit.

If one field member is energized by a current due to the impressed e.m.f. of the circuit, and the other member is energized by the current flowing therein, then the instrument becomes a power-factor meter, for it measures the phase difference between the e.m.f. wave and the current wave.

In order that the instrument may be used as a phase regulator, the swinging index arm is equipped with a contact device arranged to close one or other of two relay circuits, the energizing of which sets in motion a motor that is suitably geared to the field rheostat of the machine whose field it is desired to control.

The arrangement and mode of operation of the apparatus are more fully set forth in the description of the several applications to which the instrument may be put, which are herewith presented:

First, as a phase indicator or power-factor meter, the general mode of operation of which is outlined above.

Second, the automatic maintenance of zero phase displacement between generators or other alternating-current apparatus operating on the same circuit. The phase displacement here referred to is that caused by unequal excitation. The displacement due to the speed variation of the prime movers, being of an oscillating character, will exert no appreciable influence on the phase regulator if the latter has a greater period of oscillation than the former. This relation can readily be obtained. Phase control by speed variation is discussed later.

The most economical operating condition requires that the excitation current of each machine should be adjusted to that value which will produce equal terminal e.m.f's in the several machines on the circuit, under which condition the energy or load currents flowing in each machine will be of the same phase, and no wattless magnetizing or demagnetizing currents will circulate between the several machines.

In explanation of the general mode of operation of the apparatus, Fig. I may be referred to. *A*, *B* represent the bus-bars or line; *C*, *E*, separately excited fields; *D*, field rheostat, hand control; *F*, phase regulator; *G*, *H*, field members of regulator; *I*, *J*, polyphase windings; *K*, *L*, current transformers; *O*, resistance coil; *P*, inductance coil; *Q*, contact arm; *R*, relay, plunger and coils; *S*, reversing switch; *T*, motor armature; *U*, field rheostat; *Z*, any source of excitation. The encircled windings, 1, 2 and 3, represent single-phase, alternating-current generators, though the connections might also apply to synchronous motors, or any other synchronous alternating-current apparatus. It is also immaterial whether single-phase or polyphase machines are considered. Should any of the machines, say generator No. 2, have insufficient excitation, its current will be displaced in phase from the current flowing in generator No. 1, due to the lower terminal electro motive force; this phase difference will cause the moving element and contact arm of the phase regulator connected between generators 1 and 2 to assume a certain position dependent upon the amount of phase displacement existing.

If the contacts *a* and *b* are so adjusted that at zero phase displacement the contact arm just swings clear of both contacts, then the above phase displacement and resulting position of the arm, will close one or other of the contact points; one of the local relay circuits is thus energized, which through the medium of relay coil, plunger and reversing switch, starts into action the small motor operating the field rheostat, connections being such that the direction of rotation will cut out resistance, thus strengthening the field of generator No. 2. A corrective force is thus applied to the existing phase displacement, which will be gradually diminished by the increasing field strength, until zero phase difference exists between generators 1 and 2.

When this condition obtains, however, the regulator arm will assume its former position—wherein the contact arm swings clear of either contact—breaking the relay circuit, which thus allows the motor switch to fly open, and hence stops further movement of the rheostat motor.

The field of generator No. 2 is thus held at that value which tends to produce zero phase displacement with machine No. 1, for if the excitation of generator No. 2 had been unduly high, instead of low, as assumed above, a reverse series of operations would have been brought into play, resulting, however in the same final approach to phase unity.

In similar manner, any other machines connected to the same circuit, be they generators, motors or converters, may be held in proper phase relation with machine No. 1, which thus becomes the governing or "master machine" of the circuit; its field may be controlled by hand, or by any automatic means which will tend to hold the desired station voltage.

In stations where there are many units operating together, the above arrangement not only increases the efficiency of the plant—through the suppression of the wattless magnetizing or demagnetizing currents circulating between machines—which result is now approximately obtained by hand adjustment—but it also eliminates the time and attention now required of the switchboard operator in securing the above adjustment.

A third application is for the automatic maintenance of a predetermined power factor between any machine and the circuit to which it is connected. This is one of the most important uses for the instrument, and applies more particularly to the field adjustment of rotary converters, synchronous motors or rotary condensers, the specific object being to automatically adjust the field excitation of the one or several machines operating on the circuit, at such values as will maintain the power factor desired.

To obtain this result only a slight modification of the arrangement shown in Fig. 1 is required; the actual connections, however, are set forth in Fig. 2, where *A'* represents the armature and field circuits of the machine to be adjusted.

In this application the phase difference between the wave of impressed e.m.f. and the current wave in any particular machine, is the function to be controlled. Therefore, all the regulators on the circuit should have one of their magnetic elements, namely, the stationary element, as shown on the drawing, excited by a current derived from the impressed electromotive force of the circuit, the windings on the other member of each regulator being energized by the particular machine to which the regulator is connected, and whose field strength it controls. With these conditions the relative position assumed by the contact arm in any regulator, is obviously due to the phase difference between the impressed electromotive force and the current supplied to that particular regulator; or in other words, is dependent upon the existing power-factor.

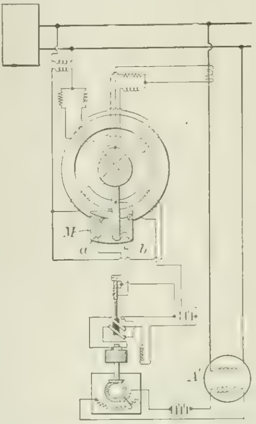


FIG. 2.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC MAINTENANCE OF PREDETERMINED POWER FACTOR.

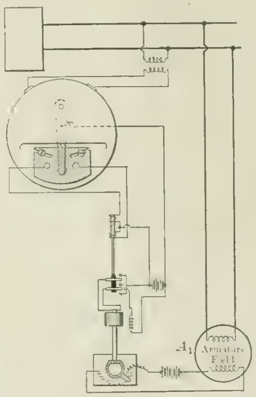


FIG. 3.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC MAINTENANCE OF CONSTANT VOLTAGE.

By referring to the second application it will be seen that the operating conditions are such that the field strength and resulting phase displacement of any machine are automatically held at that value which causes the regulator contact arm to swing clear of either contact. Therefore, by adjusting the contacts, viz., shifting them forward or back, various field strengths and corresponding phase displacements or power-factors may be maintained. The movable insulating plate *M* (Fig. 2) carrying contacts *a* and *b* indicate one arrangement by which the desired adjustment may be obtained.

A fourth application is for the automatic maintenance of constant voltage. Merely the relay and operating mechanism previously described are retained, the selective device or phase indicator being replaced by a voltmeter mechanism, the movable arm of which performs the same service as rendered by the contact arm in the phase regulator, closing one or other of the contact points *a* or *b*, depending upon whether the voltage rises or falls below a predetermined value.

Fig. 3 shows the general diagram of connections. The machine *A'*, whose field is controlled, may be either a generator, rotary condenser, or other synchronous apparatus. In the latter event the voltage regulation is obviously obtained through the action of leading and lagging currents produced by over or under excitation.

A fifth application is for the control of phase displacement due to speed variation. The general arrangement required is shown in Fig. 4; the essential difference from preceding figures, being in to the valves controlling the speeds of the engines that drive the generators whose displacement is to be regulated. Obviously, the same end may be obtained by making suitable connection between the motor and the speed governors that control the engines or prime movers.

From the preceding discussion it is believed that the mode of operation will be apparent, and a brief explanatory statement will, therefore, suffice. Assuming correct excitation on the generator, the phase relation and distribution of the load currents flowing from either machine will be dependent upon the angular speed relations of the machines.

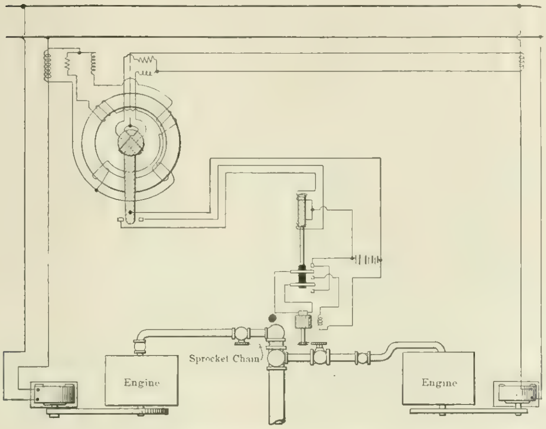


FIG. 4.—DIAGRAM OF CONNECTIONS FOR AUTOMATIC CONTROL OF LOAD DISTRIBUTION.

If the contacts are adjusted so as to clear the contact arm, when the current phases are in unison, then, if from any cause either engine should surge ahead or behind its companion, the resulting phase displacement of the generator currents and consequent movement of the contact arm will start in motion the small motor, its rotation being such as to close the valve of the leading engine and open the valve of the engine which is tending to fall behind. Thus a speed equalizing effect is introduced which tends to maintain the initial load conditions for which the regulator was adjusted.

It will be apparent that actual operating conditions may require combinations of the above applications, thus it might be desirable to maintain a group of several rotary converters in phase unison with each other, utilizing the connections illustrated in Fig. 1; the "master machine" of the group, however, if connected as in Fig. 2 would determine the power factor at which all the rotaries would tend to operate.

Different methods have heretofore been suggested for meeting one or more of the above applications. It is believed, however, that the particular mechanism proposed embraces several points of novelty, especially the idea of utilizing a "master machine" to which other machines on the circuit may be cophased.

Telephony on the Continent.

Mr. H. Laws Webb, the well-known English telephone engineer, recently returned from a month's trip on the Continent, devoted chiefly to looking into telephone progress. He visited Antwerp, Brussels, The Hague, Amsterdam, Rotterdam, Berlin, Munich, Berne and Paris, and inspected the telephone work and exchanged views with the telephone officials at those places. No very rapid development in the extension of telephony is, he states, occurring in any of the Continental countries, but the adoption of message rates in Germany has materially improved the rate of telephone development in that country, both in small places and in the large cities. The Berlin plant is being entirely reconstructed on the common battery system. In general, all new work on the Continent is being done on this system, and with but one exception all the large Continental telegraph administrations have adopted it, and are not extending or reconstructing exchanges with magneto plant.

Speed-Time Curves for Automobile Motors.

By Frank B. Rae.

There are two defects that must be acknowledged in electrically-propelled vehicles: the distance they will travel is not great enough for many requirements, and the cost of maintaining the storage battery is very high for the mileage obtained.

The storage battery is a reasonably efficient converter of electrical energy, but it has a fixed rate at which it may be effectively worked. Current may be taken out of it at a certain maximum rate per square inch of plate, and this rate may not be greatly exceeded. When this rate is exceeded, disintegration of the active material results, the plates fail rapidly and the cost for renewal and repair becomes very high, and in some cases excessive. Makers of storage batteries are careful to state the maximum rate of discharge for the number of plates of a given size contained in the cell to be used; this discharge rate, however, is never maintained in vehicle work, and the makers very naturally decline to guarantee the life of the battery or give any assurance of a reasonable maintenance cost.

The proper discharge rate is constantly exceeded in the operation of the electric automobile to the extent of two to three times whenever the vehicle is started from rest and accelerated to full speed or accelerated from a slow to a faster speed, and as this is a constantly recurring condition of operation in city streets, it follows that the battery is as often subjected to a violent over-discharge rate with consequent damage.

The makers of electric vehicles, or perhaps more properly, the selling department of the manufacturing companies, also have ignored the limitations of the storage battery in rating the mileage of the vehicle. The radius of travel on one charge as stated by the selling agents is usually based upon the total watt-hour capacity of the battery as given by the battery makers; the operation of the vehicle is taken to be upon a level road without stops, and the general assumption is of an ideal condition of road and vehicle operation, which does not obtain in practice. Particularly do they fail to recognize the battery limitations due to a discharge rate above the normal, during the period required to accelerate the vehicle, which over-discharge very greatly decreases the mileage capacity of the battery.

The user of an electric vehicle is, therefore, confused as to what he may reasonably expect of the present design and equipment by the fact that the excess current consumption in starting and acceleration is generally ignored in rating the mileage of the vehicle, and that no approximate cost per year, or per 1,000 miles for battery maintenance can be properly predetermined.

The energy consumed in the operation of electric vehicles is usually stated in watt-hours per ton-mile or per 1,000 pounds-mile, but the number of stops per mile included in such rate or other conditions effecting this rate are not given. The watt-hours required to start and accelerate the total load to speed and the distance to do this, and the watt-hours required to operate the vehicle for the balance of a given distance should be ascertained separately, and the total watt-hours per ton-mile stated for one stop or twenty stops, or for whatever number it may be, within the mile or other distance taken. In other words, the distance which an electric vehicle will travel on one charge is not fairly determinable from a watt-hour per ton rate, unless such rate is stated in connection with the number of stops per mile, as the rate alters as the stops per mile vary.

The motors which are now very generally used by the builders of electric vehicles, and of which performance curves are made by the manufacturers, permit a predetermination of the current input required for a given weight and rate of acceleration and for running at speed; such determination is herein attempted, and is shown graphically in the curves of the accompanying illustration plotted from the calculations.

A controlling factor in predetermining the performance of a road vehicle is the resistance to traction, usually expressed in pounds per ton. This factor varies with the load, the character and condition of the roadway, the kind of tires used, the friction of the motors and gear and also with the speed. For twenty or thirty miles per hour, however, the resistance is practically constant for a given vehicle and load, and if it is assumed that good mechanical construction has reduced friction to a minimum, the variable conditions reduce to load, tires and roadway. One of the larger manufacturing companies gives the following figures as used by it in calculating the performance of vehicles equipped with motors of its make, and while these figures are taken for the purposes of this article they are considered too low for average conditions by at least 15 per cent. They are used below, however, so that the determinations based on them may be entirely fair to the manufacturer:

For trucks and heavy vehicles	5 to 7 m.p.h.	30 lbs. per ton
For delivery wagons, hansoms, cabs, etc.	12 to 15 m.p.h.	40 lbs. per ton
For runabouts and light vehicles	15 to 18 m.p.h.	40 lbs. per ton

This assumes a fair condition of road, asphalt, macadam or good block pavement, in about equal proportions, or the average roadway that the electric vehicle encounters in ordinary operation in city streets.

The curves showing the performance of an electrically-equipped vehicle have been obtained from the following data upon a truck of standard construction and equipment, and from reference to the performance curves of the motors as supplied by the manufacturer.

Total weight of truck, 9 tons (truck 4 tons, load 5 tons); maximum speed (as rated), 6 m.p.h.; gear reduction, 15 to 1; resistance to traction, 30 pounds per ton; rate of acceleration, 1 m.p.h. per second; motors used, two.

The capacity of the motors required for the above weight and speed of truck is $\frac{30 \times 9 \times 6}{375} = 4.3$ hp, and the two motors employed when operating at 800 r.p.m. and 90 volts are rated by the performance curve at 2.4 hp each, but are, of course, capable of a considerable overload for one hour or more, and of a large momentary overload.

For the acceleration taken (1 m.p.h. per second) the tractive effect is $91.23 + 30 = 121.23$ pounds per ton, or $121.23 \times 9 = 1,091$ pounds for the total load. This is equal to $\frac{1,091}{2} = 545$ pounds per motor, exerted at the periphery of a 36-in. wheel. For the gear reduction as above, this tractive effect is equal to a torque on the armature shaft of 63.5 pounds at a radius of one foot.

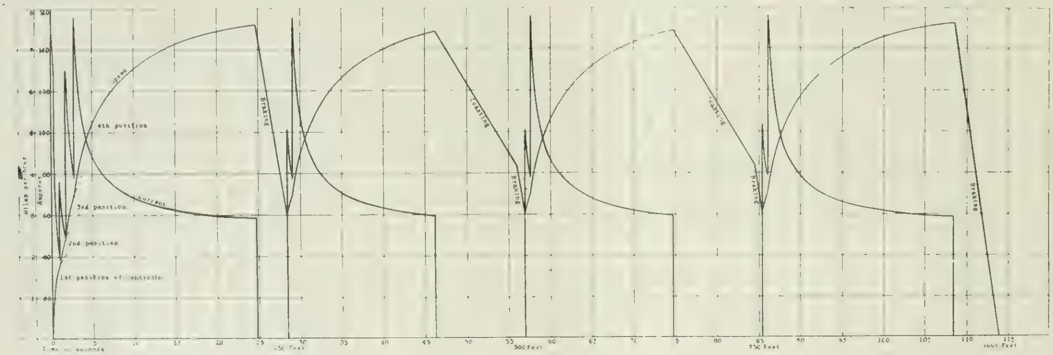
The controlling switch employed for this type of motor effects arate motors, and of both motors, in series and parallel across the battery. For the first position of the switch the full voltage is exerated across the two motors in series, and reference to the performance curve shows that the average tractive effort of 545 pounds corresponds to a current input of 48 amp. and a vehicle speed of 1.52 m.p.h. To reach this speed from rest takes .63 second.

For increasing the speed from 1.52 m.p.h. to 1.6 m.p.h. the average tractive effort operative during the time of increase is 520 pounds per motor less the friction, i. e., $520 - \frac{9 \times 30}{2} = 385$ pounds per motor. The rate at which the truck will accelerate is $\frac{385}{9/2 \times 91.23} =$ .94 m.p.h. per second, and the time to effect the increase in speed is $\frac{.08}{.94} = .085$ second.

A similar calculation for a speed of 1.77 m.p.h. shows that the limit in speed is reached for this point of the switch, and to maintain the average acceleration the second point must be taken, by which the initial acceleration is again made to reach 1.52 m.p.h. per second, with a corresponding increased torque and current input, which acceleration falls, however, to 1 m.p.h. per second and a final speed of 2.07 m.p.h. and a current of 61 amp. Further calculations for a speed increment of .4 m.p.h. or more results in the table from which the curve is plotted:

	Tractive effect per motor for 36 in. wheel.	Total mean current in amperes.	Rate of acceleration m.p.h. per second.	Time difference in seconds.	Total time in seconds.	Feet traveled.	Final speed m.p.h.
First position of controller.	1175	85.	2.55	...	.3	.26	1.
	860	67.5	1.77	.226	.526	.398	1.4
	590	51.	1.11	.108	.634	.232	1.52
	520	46.5	.94	.085	.719	.195	1.6
	435	41.	.73	.233	.952	.575	1.75
Second position of controller.	760	70.5	1.52	...	.952	.575	1.75
	730	74.	1.2	.108	1.06	.29	1.9
	590	64.5	1.11	.153	1.213	.445	2.07
	480	56.5	.84	.274	1.487	.880	2.03
	395	50.	.635	.220	1.707	.765	2.44
Third position of controller.	820	130	1.67	...	1.707	.765	2.44
	725	178	1.44	.250	1.957	.960	2.80
	580	101	1.085	.222	2.179	.95	3.04
	515	93	.93	.172	2.351	.787	3.20
	460	85	.70	.253	2.604	1.225	3.4
	420	80	.695	.144	2.748	.73	3.5
Fourth position of controller.	780	156	1.09	...	...	.73	3.5
	730	148	1.57	.207	2.955	1.108	3.8
	585	128	1.1	.31	3.256	1.804	4.14
	480	113	.84	.55	3.815	3.525	4.6
	395	100	.635	.63	3.445	4.44	5.
	325	89	.464	.863	5.308	6.58	5.4
	275	81	.317	1.262	6.57	10.30	5.8
	250	76.6	.280	.71	7.28	6.13	6.
	135	56	...	...	40.78	400.	7.8

For the traction resistance taken—30 pounds per ton—the final truck speed of which the motors are capable is 7.8 m.h.p. on a level. The schedule speed of the truck, however, is 6 m.p.h., the builders very properly leaving ample margin in the motors and controlling system to take care of an increase in the resistance to traction up to 50 pounds per ton or over, which may be the conditions encountered upon bad portions of the road, and which conditions are thus met without affecting the scheduled speed of 6 m.p.h.



Speed-Time and Current-Time Curves for Automobile Motors.

Upon the basis of 30 pounds per ton, the time to reach a speed of 6 m.p.h. is 7.28 seconds. From the current-time diagram it is seen that the mean current input for the acceleration period is 88 amp., while the maximum current for acceleration to 6 m.p.h. is 156 amp.

It is to be noted here that the battery used by a vehicle of the type considered consists of 44 cells of 19 plates each, having a total potential of 90 volts and a catalogued discharge rate of 63 amp. for four hours, or a total capacity of 252 amp.-hours. The maximum current for acceleration shown by the curve is, therefore, 248 per cent of the the application of the small motor, which is here used to control the speed or driving force of the prime movers. The diagram represents the motor as being mechanically geared, by sprocket chain, rated discharge rate and the mean current during the period of acceleration is 140 per cent of such discharge rate.

The distance traveled in attaining a speed of 6 m.p.h. is 43.6 ft., or .00825 mile, and, therefore, the watt-hours per ton-mile for the period of acceleration is $\frac{16}{.00825 \times 9} = 216$.

The maximum speed that must be attained by the truck in maintaining its schedule speed depends upon the number of stops made; if the stops are sufficiently frequent, the possible maximum speed of 7.8 m.p.h., which the motors will give the truck will not be enough to maintain the schedule speed of 6 m.p.h. The maximum distance that a loaded truck will travel without a stop in city streets may be conservatively taken to average 1,000 ft. The truck will slow up to half speed or less and accelerate to speed again, a probable average of three times within this 1,000 ft. This condition of operation is shown on the curve sheet and illustrates the attempt made to maintain the scheduled speed by running at the maximum speed attainable between points 250 ft. apart, at which several points the truck slows down to 3 m.p.h. and again accelerates to full speed.

The time required to run 250 ft. at the rate of 6 m.p.h. is 28.45 seconds. The rate at which the truck will brake to 3 m.p.h. will depend upon the urgency of the slow-down to that speed, and the retardation has probably a maximum at 1.25 m.p.h. per second. A braking curve is plotted to enclose the speed curve and 28.46 seconds to give the diagram the total area required to represent the proper average speed. It is shown by this diagram that the truck must accelerate to a maximum speed of 7.6 m.p.h. during 24.75 seconds, which is the time that current is maintained on the motors for the run of 250 ft.

From the area enclosed by the current time curve for the required 24.75 seconds it is ascertained that the mean current taken for this time is 69 amp., and the watt-hours are $\frac{69 \times 90 \times 24.75}{3{,}600} = 42.7$.

For the distance, 250 ft. ÷ 5,280 ft. = .473 mile, the watt-hours per ton-mile $= \frac{42.7}{.473 \times 9} = 100$.

For the next 250 ft. the acceleration is from a speed of 3 m.p.h., and to maintain the schedule of 6 m.p.h. the area enclosed by the mile-second curve must be the same as before. The time for acceleration from 3 m.p.h. is of course less than that from rest, and the speed of the truck may, therefore, decrease at the rate of 1.25 m.p.h. per second by cutting off the current earlier than for the first 250 ft. The area of the current-time diagram for this run is thus reduced to a value such as to require 71.6 amp. for 17.75 seconds, and the watt-hours are $\frac{71.6 \times 90 \times 17.75}{3{,}600} = 32$, and the average watt-hours per ton-mile $\frac{32}{.473 \times 9} = 75.3$ This truck performance is duplicated for the succeeding 250 ft., the watt-hours consumed and the rate per ton-mile remaining the same.

At the end of the next 250 ft. completing the 1,000 ft. of distance, the truck comes to a complete stop. The area enclosed by the mile-second diagram must remain the same as before in order that the proper speed be maintained.

A braking rate from the maximum speed to a stop at a rate slightly higher than 1.25 m.p.h. per second is necessary, however, to maintain the required schedule, making the time that current is taken for this 250 ft. 23 seconds. The area embraced by the time-current diagram for this run and stop is such as to require a mean current of 68.5 amp. The watt-hours are $\frac{68.5 \times 90 \times 23}{3{,}600} = 39.4$ and the watt-house per ton-mile $\frac{39.4}{.473 \times 9} = 92.5$.

Should the truck be able to make the total distance of 1,000 ft. without slowing down and the schedule speed of 6 m.p.h. be maintained for that distance, then the total time required is 113.8 seconds. The maintained speed must average 6.25 m.p.h. and the current must be maintained on the motors for 104 seconds.

The average current for this total run for the time the truck is making its average speed is calculated from the performance curve of the motor to be 48.6 amp. There is required a mean current of 51 amp. The total watt hours are $\frac{51 \times 90 \times 104}{3{,}600} = 164$ For the distance 1,000 ÷ 5,280 = .19 mile, the watt hours per ton mile are $\frac{.19 \times 9}{164} = 96$.

The curve and foregoing calculations have shown that for a run of 1,000 ft., in which the truck slows down to half speed and again accelerates three times, and a speed of 6 m.p.h. is maintained, the total watt-hours expended will be 42.7 + 32 + 32 + 39.4 = 146.1 watt-hours.

To accelerate from rest and run the same distance, 1,000 ft. at 6 m.p.h. without slowing down, the energy exypended is 164 watt-hours.

The foregoing shows that an economy in the consumption of energy is effected by using high acceleration and taking advantage of the time the truck travels after the current is cut off to cover distance without power. This same economy has been pointed out in the discussion of electric railway traction problems. The other side of the question, however, as it relates to the electrically-propelled vehicle, concerns the greater loss in radius of action and the increased maintenance cost due to the high discharge rate during the repeated accelerations from a slow speed or a stop to full speed.

While the average current for the 1,000 ft. run with stops is only 71 amp., the battery has been called upon for a maximum discharge of 156 amp. three times in a period of 83 seconds.

The effect of stops and of the necessary acceleration to full speed upon the "watt-hour per ton" rate, and in which the best speed possible is attained, is shown in the following table, in which the total miles that the truck will travel on one charge is determined by dividing the watt-hours per truck-mile into the total watt-hour capacity of the battery (22,680 watt-hours) as stated by the makers:

Stops per 1000′.	Average speed in m.p.h.	Watt-hour per ton-mile.	Total miles on one charge.
0	7.8	71.8	35.
1	7.1	78.	32.2
2	6.5	85.	29.7
3	5.9	91.7	27.5
4	5.7	96.	26.4

The "watt-hour per ton" rate varies 34 per cent from no stop to 4 stops per 1,000 ft., and the decrease in the mileage of the truck is over 24 per cent. It is to be noted again that the watt-hours per ton-mile in the table and preceding calculations are based upon a resistance to traction of 30 pounds per ton. This is evidently too low for average conditions, and the vehicle mileage that is based upon this value will be too low. Both the rate and the mileage, however, will be found to vary for the stops made, in approximately the percentage given.

Power Station for the London Post Office.

From the London *Electrical Engineer* it is learned that the new Post Office power station which is being erected on the south side of the Thames, near Blackfriars Bridge, will contain machinery having an aggregate capacity of about 2,000 kw. Electric power will be provided for pneumatic tube work, lighting, elevators, fans for ventilation, for the operation of stamping and obliterating machines and for charging batteries for telegraph and telephone work. At present this power is obtained from the plant in use at St. Martin's-Le Grand, and from the power station at Mount Pleasant, but the Post Office authorities consider that the larger engines and boilers in the St. Martin's building are a source of considerable risk and inconvenience. In addition, the present position does not admit of the extension which the immense amount of work devolving on the Post Office machinery necessitates.

The European Single-Phase Railways.

ALTHOUGH the majority of the long distance electric railways in Europe are operated by either direct-current or polyphase motors, and while European engineers have for a great while advocated the adoption of polyphase motors for general traction purposes, it is worthy of note that numerous single-phase railways have been installed in that country since the announcement by American engineers, notably Mr. Lamme, in his now historical Institute paper, that a solution of the interurban traction problem was to be found in the use of a single-phase commutator motor. We give below an outline description of several of the single-phase roads which have been in successful operation, together with a brief notice of some roads which are now being equipped with single-phase motors. Our columns from time to time have contained matter descriptive of the various roads here dealt with. It is the intention of this article to bring the descriptions down to the present date, to record information which is not elsewhere available, and to discuss the results of experience with the different types of equipment.

SPINDLERSFELD.

This is an experimental line, installed by the Allgemeine Elektricitats Gesellschaft, near Berlin, Germany. It is 4.2 km. in length, the trolley e.m.f. being 6,600 volts, and the frequency 25 cycles. The road was placed in operation in June, 1903. There are two 52-ton motor cars in use. Each car is equipped with two 110-hp Winter-Eichberg motors. The motors are four-pole machines and weigh 2,300 kg. They are designed for an air gap of 3 mm. A regular train consists of two motor cars and three trailers. The trolley wire is principally of the double-catenary construction. Two trolley poles are used. These are raised by means of air cylinders. Each pole has a direct mechanical lever connection which locks the door of the high tension compartment when the pole is raised. When the pole is down and the door is open, a mechanical switch short circuits the high-tension line inside of the main fuses. The roof of the car is covered with a well-grounded netting and rail, the whistle cord and all piping being securely grounded. The height of the trolley conductor is 4.5 meters, and it is supported from the catenary at intervals of 3 meters.

Figs. 1 and 2.—Murnau-Oberammergau Railway.

MURNAU-OBERAMMERGAU.

This railway is situated in the Bavarian highlands and serves to connect Murnau, a station on the Bavarian State Railway, with the village Oberammergau, noted for the passion play. The line is 23.6 km. in length and is fed with 17-cycle, single-phase current directly at 5,500 volts. It was placed in operation in January of the present year. The motors, which are of the conductively-compensated series type, were supplied by the Siemens-Schuckert Company. They are ten-pole machines, designed for 270 volts. The air-gap is 2 mm. on each side. The normal armature speed is 540 r.p.m.

There are four cars, each equipped with two 80-hp motors. Each car weighs about 35 tons. The motors are subjected to voltage control, ten taps being provided for this purpose on the secondary of the main transformer. Both the controller and the transformer are mounted beneath the car, the controller being operated by means of a large wheel geared to a connecting shaft. A solenoid blow-out is used in the controller, and the current is always interrupted by the circuit breaker. A recent inspection showed that there had been very little burning in the controller after several months of service, and that the commutators operate with entire satisfaction.

The line construction is in general of a first-class interurban type. The poles are spaced 35 meters apart on straight track and 30 meters on curves. Span wires are mounted on porcelain insulators, held by wrought-iron side brackets attached to the poles. Porcelain strain insulators are inserted in the span wire, so that the trolley is doubly insulated. The insulation is subjected to a test of 32,000 volts under conditions equivalent to a rain storm. On 1.1 km. of straight track, a form of catenary line construction is used. A steel messenger wire is suspended above the middle of the track from porcelain insulators mounted on wrought-iron side brackets. The steel wire supports two trolley wires which are placed in a zig-zag course over the rails in the same horizontal plane. This construction is used in order that the rubbing contact on the bow collector may shift from side to center on each half and yet the resultant pressure will always be central. It is believed that this construction is especially advantageous for high-speed and high-power work. At the stations, road-crossings and yards, a loop connected to the trolley encircles a grounded conductor, so that in case the trolley wire becomes broken at these points, the line will be immediately grounded.

STUBAI VALLEY.

This road commenced operation in August, 1904. It is situated near Innsbruch in the Austrian Tyrol, the length being 18.2 km. The trolley e.m.f. is 2,700 volts, and the frequency 42 cycles. The motors are of the Winter-Eichberg type and were supplied by the Allgemeine Elektricitats Gesellschaft. There are four motor cars, each of which is equipped with four 40-hp six-pole motors, and weighs 21 tons. There are six trailers for passengers and two open and two closed freight cars. A regular train consists of one motor car and two trailers, the rated speed being 24 km. per hour. The motors on each car are connected in two groups, the stators of each group being in parallel and the rotors in series. Each car is equipped with a main oil-cooled transformer weighing 1,100 kg., and two regulating transformers each of which weighs 150 kg. There are two taps on the main transformer, at 400 and 500 volts, respectively, and three taps on each regulating transformer. The taps on the regulating transformers are for supplying variable voltage to the rotors. The controllers are of the same size and external appearance as those used on street cars, and have six steps. On the first three steps a pressure of 400 volts is impressed upon the primary of the motors; on the following three steps the primary pressure is 525 volts. All of the different steps correspond to different taps of the regulating transformer. Any step can be used continuously. It was found that the original motors over-heated somewhat and they are being replaced with machines 30 per cent larger and having about 60 per cent more commutator segments. Each of the new motors weighs 1,200 kg. The rotor is about 18 inches in diameter, the commutator having a diameter of 17 inches. The wheels are 86 cm. (34 in.) in diameter. The gear ratio is 1 to 6. The commutators are sand papered once each week, or after a run of from 1,000 to 1,200 km. A recent inspection showed the commutator which had been in service for 15,000 km. was yet in fair shape although slightly rough. The trolley wire which has a cross-sectional area of 53 sq. mm. is supported from a steel catenary wire having a diameter of 5 mm. at intervals of 4 meters. The poles are spaced not over 40 meters part. Section insulators are used in the trolley wire at intervals of 1 km. The normal height of the trolley wire is 5.5 meters above the rails, except in tunnels where the height is reduced to 3.9 meters. In tunnels the trolley wire is carried on rigid supports from insulated bars about five inches from the arch of the tunnel. Porcelain is used exclusively as an insulating material.

The trolley pole is of the single-bow type. The bows last for a travel of about 4,000 km. For the purpose of insuring safety to the employees and passengers, the roofs of the motor cars and trailers are equipped with grounded iron guard ribs about 18 inches apart. The operation of the road has been regular except for a time last winter when a heavy snowfall blocked the road for three weeks.

FIG. 3.—STUBAI VALLEY RAILWAY.

DU BORINAGE-VICINAUX.

This road, which is located in the southern coal regions of Belgium, near Mons, was opened for service last April. There are 20 km. of single track, consisting of two lines each 7 km. long and a connecting loop with cross lines. A length of 14 km. is being operated at the present time, 5 cars being used. The completed equipment will include 20 cars. A striking feature of the installation resides in the use of a frequency of 40 cycles, the current being obtained from a combined lighting and power plant containing three-phase, 6,600-volt generators.

Each car is equipped with two 40-hp Winter-Eichberg motors.* The motors are designed for six poles. There are six brush holders, each containing three brushes 42 x 7 mm. The air-gap is 2 mm. on each side. The armature winding is series connected, one turn per coil. There are 134 commutator segments, each of greater width than the brush. There are 28 field turns per pole, made up in two separately-insulated coils. Each motor weighs 1,200 kg. without gears.

The trolley electromotive force is 600 volts. Two wires are used to avoid telephonic disturbances. The wires are placed 90 cm. apart and are suspended 6.5 meters above the rails. The poles are spaced 35 meters apart, the wires being held by a bracket construction with insulated span wire and hanger, giving double insulation. Guard wires are used to a considerable extent. Since being placed in service on April 6, 1905, the motors have given very little trouble. The commutators have blackened somewhat, but the insulation has not been impaired. The contacts in the controllers have as yet not been renewed. Those for the stator show scarcely any effect of burning, while the rotor contacts will soon need renewal.

ROME-CIVITA CASTELLANA.

This road is being equipped with compensated single-phase motors by the Westinghouse Company. The line is about 33.5 miles in length. Between Rome and Pont Milvio, a distance of 2.5 miles, the trolley e.m.f. is 550 volts. For the other part of the line the e.m.f. is 6,600 volts impressed directly upon the trolley wire. Each car is equipped with two 40-hp motors designed for 250 volts, 25 cycles. Each car carries one main transformer for primary pressures of 500 and 6,000 volts, and for a secondary pressure of approximately 250 volts; reversing switch; motor cut-out; a complete Westinghouse air-brake equipment, and one bow trolley for high pressure, operated by compressed air. The high-voltage trolley wire is suspended from span wires held on iron side brackets. Double insulation is provided. Two special porcelain insulators, which are fixed to the bracket arm by means of two bolts, are tested with 20,000 volts. Between these insulators is stretched the span wire, in which are inserted two strain insulators tested with 40,000 volts. The circuits at the station are so arranged that in case of short circuit on the line, or a break in the line, the current will be cut off at the same moment at the power station.

OERLIKON LOCOMOTIVE.

This locomotive is just being completed for test upon the experimental line owned by the Oerlikon Company, near Zurich. The line voltage will be 15,000, the frequency 25 cycles. There will be two 200-hp motors of the compensated series type, having eight main poles and eight commutating poles. There are two trucks, upon each of which is mounted a motor geared to a crank which drives through connecting rods. The motors are designed for a normal speed of 650 r.p.m. and an e.m.f. of 350 volts. Speed control is to be obtained by varying the voltage impressed upon the motor, 12 transformer taps being provided for this purpose. The shop tests have shown that the motors operate with 100 per cent overload without injurious sparking at the commutator.

The trolley collector which is proposed for this locomotive is of the special construction brought out by the Oerlikon Company. It consists of a rod about two feet long, which is held against the wire by spring pressure. Any extreme variations in the positions of the wire are followed by shifting the position of the carriage which supports the trolley wire.

VIENNA-BADEN.

This road is being equipped at the present time with Siemens-Schuckert single-phase motors for operation on both direct-current and alternating-current circuits. The road is 25 km. in length, and is double tracked for most of the distance. There will be 30 cars, each supplied with two 40-hp motors. A characteristic feature of the installation resides in the use of a trolley e.m.f. of about 500 volts throughout the whole route, frequent transformer sub-stations being placed along the alternating-current portion of the line between the two cities. It was considered preferable to select the same voltage for the whole system, in order to avoid complication of switching and control apparatus. The motors will be subjected to series-parallel rheostatic control.

HAMBURG ELEVATED.

This railway is being constructed by the German Government, contracts having been recently let to the Siemens-Schuckert Company for the power station equipment and to the Allgemeine Elektricitats Gesellschaft for the car equipments. There will be 50 cars, each supplied with three 120-hp Winter-Eichberg motors designed for 750 volts, 25 cycles. The trolley wire will be supplied with current at 6,600 volts, a transformer being used on each car to reduce the voltage for the motors. The motors are 4-pole machines, having an air gap of 3 mm. on each side, and are designed for a normal speed of 600 r.p.m. Each motor weighs 2,700 kg. alone, or 3,000 kg. complete with gears. The main transformer weighs about 1,000 kg. and the regulating transformers about 200 kg.

The total weight of the electrical equipment will be about 16.5 tons. Double cars, each having three axles, will be used. The weight of each unit with average load of 40 to 45 passengers is 75 metric tons. The total seating capacity of each double car is 140 persons. Each car will be equipped with two trolleys of the bow type. The overhead line will be of the catenary construction, using a grooved conductor of 80 sq. mm. in cross section and a single steel suspension wire 6 mm. in diameter. The conductor will be supported from the catenary at intervals of about 3.5 meters. The height of the conductor above the rail will be 5.5 meters normally, and 4.8 meters under bridges.

Each train will be made up of two or three double cars, controlled on the multiple-unit system. The circuits to the motors are opened between adjacent running points. The schedule speed is 27 km. per hour, with 15 stops, of 30 seconds each, approximately one-half mile apart.

---

* We are informed by a letter which appears on page 701 that these motors are of the Latour type.

The Cascade Converter.

We have had occasion frequently to refer to the cascade rotary converter, and an extended discussion of the theory of the machine may be found on page 230 of our issue for August 5, 1905. We are enabled to give below a detailed account of the design of a 7.5-kw machine which is now being exhibited at the Liege Exposition in the booth of the Ateliers de Construction Electrique de Charleroi. This machine is designed for the transformation of alternating into direct current. It partakes of the characteristics of a motor-generator and of a synchronous converter fed through stationary transformers.

The converting equipment is composed of two machines, which may be designated as the input and output machines, respectively. The input machine consists of a rotor and stator, similar to those of an induction motor. The output machine consists of armature and field structures, similar to those of a rotary converter. The rotor of the input machine is mounted on the same shaft with the armature of the output machine, and the rotor (secondary) winding is connected directly to the armature winding.

The electrical connections of the equipment are indicated in Fig. 1, which shows also the resistances for starting the machine as though it were an induction motor. *Ra* is the starting resistance, *S* is the stator winding (primary) and *R* is the rotor winding (secondary) of the first machine. *G* represents the armature winding of the output machine, *K* its commutator, and *F* serves to indicate its shunt field circuit, while *L* shows the load on the machine.

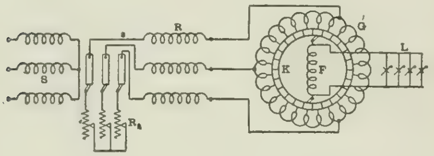


FIG. 1.—CIRCUITS OF CASCADE CONVERTER.

The operation of the equipment presents numerous points which are well worth mentioning. If it be assumed that the input machine has the same number of poles as the output machine, then the normal speed is equal to just one-half of the speed of the revolving field of the first machine (induction motor). Consider the action of the stator circuits of the input machine. When a certain alternating e.m.f. is impressed upon its terminals, the flux must have a value such that its rate of change produces a counter e.m.f. only slightly less than the impressed. When the primary circuits are symmetrically arranged and subjected to polyphase electromotive forces, the familiar synchronously revolving field is produced. This field cuts across the secondary conductors and generates therein electromotive forces having a frequency proportional to the slip from synchronous speed. The electromotive forces generated in the armature of the output machine, due to its motion through the constant field, will be proportioned directly to the speed. It is evident that these two polyphase electromotive forces will have the same frequency at a certain speed of the rotor, which speed will be one-half of that of the revolving field when the poles of the input and output machines are equal in number.

It is interesting to investigate the source of the power received by the output machine. A little study will show that the rotor reaches a definite speed at one-half of the speed of the revolving field, and that no change in "slip" can take place on account of the load, so that the ordinary phenomena connected with the performance of the polyphase induction motor is completely lacking. When current is drawn from the direct-current side of the output machine, a certain component of the power demanded is supplied by current which flows through from the secondary winding of the input machine. This current tends to alter the value of the core flux, and a counterbalancing component of current flows in the primary coil and restores the core flux to approximately its initial value. Thus a portion of the power is transmitted by transformer action. The current in the secondary produces a torque on the rotor due to the presence of the core flux, and hence a portion of the power is transmitted mechanically through the shaft by motor action. The ratio of motor action to transformer action is the same as the ratio between the number of poles of the input machine to that of the output machine.

In comparison with the ordinary rotary converter, the cascade converter possesses the advantage of operating at a lower frequency, and hence its commutation is much better. The input machine can be wound directly for any voltage, and hence step-down transformers are unnecessary. The makers claim that it is much lighter and cheaper than a motor-generator set. It is a synchronous machine, but can be started as a simple polyphase induction motor. It supplies its own exciting current, both during the starting period and during normal operation. On the input side its performance is similar in many respects to an induction motor operating at variable slip near synchronous speed, while on its output side it possesses the characteristics of a synchronous converter.

The constructional details of the machine exhibited at Liege are indicated in Fig. 2. It is designed for an output of 7.5 kw, at 230 volts.

The input machine consists of a three-phase, two-pole induction motor designed for 110 volts, 55.5 amp. per lead, 50 cycles. The dimensions of the stator are as follows:

Outside diameter, millimeters	430
Inside diameter, millimeters	230
Width of core, millimeters	110
Size of slots, millimeters	13 x 26
Number of slots	36
Conductors per slot	6

Each conductor is composed of three wires in multiple, each wire having a diameter of 3 mm. bare and of 3.3 mm. when insulated. The stator coils are connected in star.

The air-gap between the stator and rotor is 1.5 mm. The rotor speed is 1,500 r.p.m. and frequency 25 cycles. Its dimensions are as follows:

Outside diameter, millimeters	227
Diameter of shaft, millimeters	60
Size of slots, millimeters	8.5 x 30
Number of slots	42

There are 13 conductors per slot, each conductor being a wire of 3 mm. diameter bare and 3.3 mm., including insulation. The rotor coils are also connected in star.

The input machine is in reality a combined frequency converter and synchronous motor.

The generator resembles a three-phase, 25-cycle synchronous converter. It is a two-pole machine, designed for 250 volts and 32.7 amp. The dimensions of the armature are as follows:

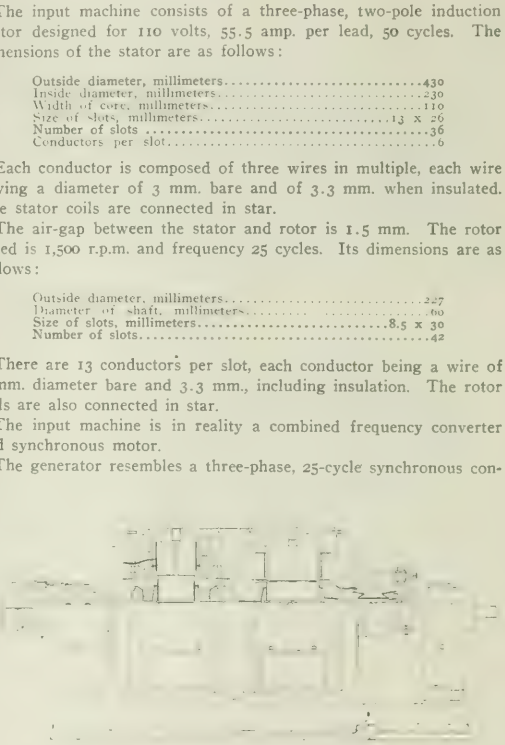


FIG. 2.—CONSTRUCTIONAL DETAILS OF MACHINE.

Outside diameter, millimeters	190
Inside diameter, millimeters	65
Width, millimeters	100
Dimensions of slots, millimeters	7.5 x 19
Number of slots	45
Conductors per slot	12
Diameter of conductor, bare, millimeters	2.1
Diameter of conductor, insulated, millimeters	2.4
Diameter of commutator, millimeters	150
Useful length, commutator, millimeters	75
Segments, commutator	90
Number of brush studs	2
Brushes per stud	2
Size of brushes, millimeters	15 x 30

The dimensions of the field are as follows:

Diameter of bore, mm	106
Size of pole pieces, mm	175 x 155
Section of laminations, sq., cm	160
Section of steel yoke, sq. cm	100
Turns in field coil	4000
Diameter of field conductor, bare, mm	.9
Diameter of field conductor, insulated, mm	1.1

The output machine is in reality a combined synchronous converter and a direct-current generator. Its power as a synchronous converter is supplied from the frequency converter portion of the input machine, while the power to operate the direct-current generator part is derived from the synchronous motor portion of the primary machine. Neglecting the losses in the machine, it may be stated that one-half of the delivered direct-current power is transmitted through the machine on account of the frequency converter-synchronous converter features, and the remainder of the power is due to the synchronous motor-direct-current generator features.

Congress of Swedish Engineers.—I.

By Arvid Westerberg.

The first General Congress of Swedish Electrical Engineers, held in Stockholm September 9 to 11, was opened by the chairman of the organizing committee, Mr. C. Rossander, who expressed his satisfaction that the electrical engineers of Sweden had so largely responded to the invitation to this congress. The number of the members was between 250 and 300.

The officers of the congress were elected as follows: President, Professor K. Wallin; vice-presidents, Messrs. C. Rossander and S. Edström; secretaries, Messrs. A. Westerberg, K. G. Sjöberg and A. W. Nordell, all of Stockholm.

The first discussion of the meeting was on the subject "What has been the experience up to the present with the new Government laws and regulations relating to electrical engineering." Mr. C. Rossander read the introductory paper on the subject, and pointed out that with a few exceptions the new laws and regulations had proved to be of great benefit to the electrical engineering profession and industry. Still some changes would be very desirable. The present law prescribes that anyone who wishes to build an electric line whose voltage exceeds 250 volts has to apply for governmental permission, and that the application shall contain a list of owners of the ground within a distance of 500 ft. This distance Mr. Rossander considered to be much too great and an effort should be made to have it reduced. In some cases permission is also prescribed for low-tension lines, which regulation should be canceled. Further, it is desirable to bring about more rapid action on applications for authority. The following discussion proved that the majority of the members of the meeting agreed with Mr. Rossander, and the meeting passed a resolution adopting his proposition on the first two points named.

The next discussion was on high-tension work. Mr. Victor Ericsson read a paper treating the subject generally, and Mr. Sven Norberg in a paper discussed insulation and rise of potential. The first paper dealt principally with high-tension arrangements in the power house. The oil switch and its combination with overload relays and reverse current relays, momentary or with time limit, were discussed and also the question of fuses vs. automatic switches for high-tension work. The latter were, according to Mr. Ericsson, to be preferred in most cases. The main point of Mr. Norberg's paper was his treatment of rise of potential. He classified this phenomenon according to its cause, under four heads, as follows:

(1) Simple resonance at the third, fifth or higher harmonic wave of the main voltage and the natural frequency of the line, as defined by its self-induction and capacity.

(2) Sudden changes of the amperage in the line whereby there is a rush of electricity, swinging with the natural frequency of the system.

(3) Sudden changes of the potential of the line whereby the charge of current produces results similar to Class 2.

(4) Uneven distribution of potential in the different layers of the windings of transformers, generators or motors.

Mr. Norberg believed that the rise of potential coming under Class 1 might put a limit to the possible distance of electrical transmission of energy, and that the phenomena of Class 2 are likely to put a similar limit to the quantity of energy to be transmitted.

As to devices to prevent rise of potential, it is a good scheme to use starting rheostats in throwing in long lines or large transformers and motors. Still, it is hardly possible at present to prevent rise of potential and therefore protection against it is necessary. Mr. Norberg gave some hints for selecting lightning arresters and other protective devices against abnormal potentials. As a good protection against high potentials under Class 4, he mentioned Thomas' static interrupter.

In the following lively discussion the advantages of the oil switch in preventing rise of potential at throwing in and out of lines were set forth. With it the current is broken when the curve of the current passes through zero and no abnormal potential of Class 2 is likely to arise. One speaker pointed out that there is one important cause of rise of potential that was not mentioned by Mr. Norberg, namely, the existence of a spark-gap somewhere in the machine or in the line. This cause, he believed, was the most common one and the one that made most mischief. The influence of atmospheric electricity in weakening the insulation and causing secondary rise of potential was mentioned by one speaker who had made observations in this connection and had found that transmission lines running through forests were less seldom damaged by abnormal potentials than lines more exposed. Some theoretical points on rise of potential were also introduced in the discussion.

The next discussion was on the subject: "Running in parallel of water power stations at great distances from each other." The introductory paper was read by Mr. E. Andreen. Running in parallel of such stations may be by two methods depending on where the load is located. Either there may be one center of distribution to which point all stations transmit power by separate lines, or all stations are combined with one transmission line along which the different consumers are located. As they may use the current at different times, this case is analagous with the case of a moving load, for instance, of a train running along a line fed by power stations at different points. Mr. Andreen first treated the direct-current problem and then that of alternating-currents. In this latter case all the generator shafts must run in synchronism, as if all the shafts were rigidly coupled with each other. Assuming a straight regulation curve for the turbine governors, or in other words, that the decrease of speed is proportional to the output of the generator, the consequence is that every turbine of the whole system will, at a certain moment, have an output that is proportional to its size independent of the location of the load or the resistances of the line. Therefore, assuming that all the power stations of the proposed Swedish electric railway system were running in parallel, and that a train was starting in Norrland, the northern part, then the southern power station would take part in the delivery of current to this train in the same degree as the station next to the train. Of course very little of the energy sent out from the southern station would reach the train and therefore this system would not be very economical. It has also another disadvantage, namely, the danger of the generators falling out of synchronism, resulting from the enormous wattless currents that would arise.

In order to investigate those Mr. Andreen introduced a new generator characteristic which he named the "V-curve at constant field current." If two generators are running in parallel and one of them has a given output and constant field current, and if further, the voltage of the other one is varied, the voltage of the first generator must follow whether this generator receives lagging or leading wattless currents. If the armature current is plotted as a function of the voltage, a curve of the same general shape as the usual V-curve results. This curve can easily be figured out from the electric data of the machine. From this curve the wattless currents in a system like the above mentioned can be figured. In order to make a system like this practicable, it is necessary to adjust the turbine regulators, at different periods of the day, according to the location of the load at each period. Mr. Andreen suggested the substitution for one large system in parallel many smaller ones combined with double rotary converters for reserve. By means of a booster between these, one could at will throw parts of the load on one system or on the other. The following discussion treated principally of the question of paralleling the water power stations for the proposed Swedish Electric railway system. The difficulties of operating very great districts in parallel were acknowledged and some remedies were proposed. One speaker suggested to make the connections so that each station could be synchronized with either one of its neighboring stations, and to cut up the whole system in smaller ones, each consisting of only two stations. The advantages of using asynchronous generators for large systems in parallel were also set forth.

The next subject for discussion was on: "Lease of electrical power from water power stations." The introductory paper was read by Mr. T. F. Holmgren. It is often the case that a town desires to lease a certain amount of electric power for its pumping stations and its electric central stations. In such cases it is often impossible to tell in advance what amount of power will be necessary and, therefore, the contract is often based on the maximum power consumed. In order to measure this amount one may use different instruments, the two principal types being recording wattmeters and maximum demand wattmeters. The recording wattmeters have some disadvantages; they are not very accurate and sometimes quite momentary overloads are registered similar to overloads that have lasted for a certain time, depending on the thickness of the ink line. Mr. Holmgren described some maximum-demand wattmeters that are in use in Sweden—the Wright meter and the A. E. G. "maximum tariff meter"—but thought that none of them quite corresponds to the requirements of an up-to-date meter. After some words about the guarantees that the power station ought to give regarding voltage and frequency, and those that the consumer should give regarding power factor and uneven load on the three phases, Mr. Holmgren spoke about the price that ought to be charged for electric power. He compared this price with the producing cost of steam power and gave some curves of this cost for different sizes of plant and different working hours of day. The following discussion treated principally the question of recording vs. maximum-demand wattmeters, and the cost figures, given by Mr. Holmgren. Some new types of maximum-demand meters were also described, including one constructed by Hartmann & Braun that indicates the maximum that the consumed energy has reached during each load period. This instrument has the advantage of being very simple and cheap. Another instrument registers the number of kilowatt-hours of the peaks of the load above a certain value; the consumer is charged a fixed price for this amount of energy, and for the remainder has to pay according to the usual meter rate.

Recent Electrochemical Developments.

ELECTRIC FURNACES.

For the production of carborundum, artificial graphite and siloxicon in the electric furnace intermittent processes are used. To make a run the furnace is built up, the charge material being piled up within walls of loose bricks. The highest temperature is in the center of the charge and the walls serve merely to keep the charge in position. After the furnace run is completed, the walls are torn down. This has heretofore been done by hand labor, one brick at a time, and the same was the case with building up the furnace.

A recent patent of F. J. Tone, of the Carborundum Company, points out that this repeated handling of bricks is the cause of considerable expense and difficulty and may be easily avoided by constructing the furnace walls in form of iron frames in which the bricks are permanently assembled. These frames are put in place or withdrawn by means of cranes.

A recent patent of F. J. Machalske refers to the treatment of compounds of calcium in an electric furnace when subjected to the action of methane or natural gas. The reaction results in the production of the hydride with by products. If for instance calcium chloride is treated with methane, the by products are chlorides of carbon.

ELECTROLYTIC PROCESSES.

For the electrolysis of chlorides of alkalies—which represents one of the largest electrochemical industries for the production of caustic and bleaching powder, hypochlorites and chlorates—anodes of graphite and platinum are now very largely used. In a recent patent of H. Specketer it is proposed to use electrodes made from ferric oxide. Ordinary oxide of iron—which is available at a low price—may be used for this purpose. It is fused in an electric furnace and the molten mass is drawn off into properly shaped moulds.

Quite a number of patents relating to electroplating apparatus have recently been granted. Two patents of Meaker refer to a method and details of construction of a tank for coating a wire with zinc. A patent of L. Potthoff relates to details of a cell for galvanizing bars, tubes and other pieces too large to be shaken up as is done with small nails. That indefatigable worker and inventor in metal deposition, Mr. Sherard Cowper-Coles, produces metallic strip or wire by electrolytic deposition in the following way: He uses a cylindrical cathode, around the periphery of which a very fine groove is described in form of a helix. When the desired thickness of metal has been deposited, the cathode is removed from the cell and the metal deposit can then be wound off with facility in the form of a spiral, the metal parting along the groove.

LETTERS TO THE EDITORS.

How Can the Ball Roll?

To the Editors of Electrical World and Engineer:

SIRS:—Some years ago an advertiser claimed that neither wheel need slip in going around a curve, even though they were attached to the axle, provided that axle could take up a position radial to the curve. Now, I should like to ask with reference to the enclosed sketch and description, "How can the ball 'roll'?"

"The lower end of the shaft terminates in a ball and cup bearing, the ball being hardened steel, the bearings sapphire jewels.

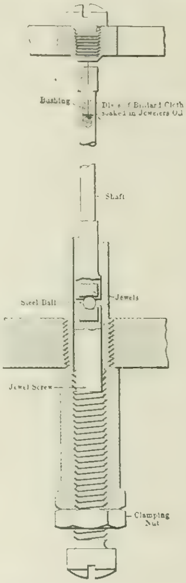


DIAGRAM OF ARRANGEMENT.

It will be readily seen that the shaft resting perpendicularly upon the ball, turns with the least possible frictional resistance, and that the ball rolling, lightly between two highly polished sapphire jewels, at half the speed of the moving element, constantly presents new contact points on both ball and jewels, so that even after long service no wear is perceptible."

I can see how it can spin or revolve upon the same constant axis as the rest of the moving parts, but how can it roll?

NEW YORK CITY. WILLIAM HALLOCK.

Wireless Telegraphy in Mexico.

To the Editors of Electrical World and Engineer:

SIRS:—We note in your esteemed paper of August 26, No. 9, page 340, the following item:

"Wireless in Mexico. It is designed to establish wireless telegraphy in various parts of Mexico, using the Marconi system. Camilo Gonzalez, who is general manager of the Mexican Federal Telegraph Company, will have charge of the installation. The first system will probably be installed in the State of Chihuahua, while other stations will be erected in Jalisco, Tepic, Sonora, Sinaloa and Nueos Leon."

According to information received from our own representative in Mexico, the state of affairs is quite different. The Marconi Company had sent their agent from London to Mexicó, with the intention to show their system to the telegraphic authorities. The general directors of the Federal telegraph assured our representative that no order had been given to the Marconi company. The above mentioned article, however, is written in such a way that one may get the impression that orders for apparatus had been given already.

Berlin, Germany. Gesellschaft für drahtlose Telegraphie.

Belgian Single-Phase Railway.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of September 2, 1905, appeared an abstract of an article by Dr. Dietl, describing a single-phase railway in Belgium, in which it was stated that Winter-Eichberg motors are used on this line. I want simply to remark that according to an agreement made with the Allgemeine Elektricitäts Gesellschaft, of Berlin, two years ago, the single-phase motors of that line are considered to be built under my Belgian patents.

Schenectady, N. Y. Marius Latour.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Commutation Poles.—Friedlander.—An illustrated article on direct-current machines with commutation poles shown at the present Olympia electrical exhibition in London. Such machines are exhibited by the Phoenix Dynamo Manufacturing Company, by the Morris-Hawkins Company, by the British Electric Plant Company, and by Lahmeyer. The latter company exhibits a variable-voltage, direct-current booster with rectangular commutation poles placed midway between the main poles and extending over the whole length of the armature. Each commutation pole is excited directly by the current of the set of brushes which it influences. In most cases the peripheral span of the commutation pole is made from 1.5 to 3 times the slot pitch. The use of a very narrow pole piece, although sufficient for commutation purposes, is not advisable since according to Breslauer such poles are liable to be set into violent vibration by the changes of flux which occur as slots and teeth alternately pass opposite the pole. The author thinks that commutation poles or some equivalent arrangement will shortly become the rule rather than the exception, especially for higher voltages (over 250 volts) and speeds.—Lond. *Elec. Eng.*, September 29.

Dynamo.—Winkelmann.—Some notes on a dynamo built by Dittmar. The special feature is that the magnetic flux is not perpendicular to the direction of the axle in the armature, but is essentially parallel to the axle. The construction is shown in Fig. 1.

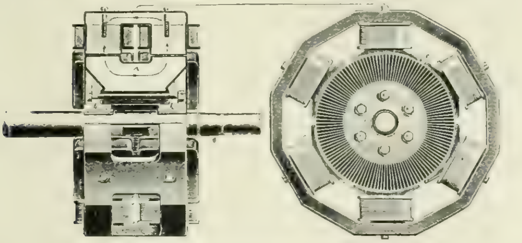


FIG. 1. DITTMAR DYNAMO.

The iron sheets are put together in packages, each package being pressed together by two end discs. Betwen the different packages wedged-formed air spaces are left which are filled with the armature wire. The field magnets are arranged in pairs in such a way that their yoke is parallel to the axle. Opposite to an armature sheet there is, therefore, on one side a north pole and on the other side a south pole. The latest types of these machines are stated to have a capacity 1.5 or 2 times the capacity of machines of normal construction. A motor of 50 hp constant capacity has a maximum diameter of casing of about 720 mm., its weight is 668 kg., the efficiency 85 per cent, the number of revolutions 650 at 220 volts. Of the active material, the armature copper weighs 40 kg., the commutator copper 46 kg., and the field magnet copper 50 kg.; hence the total weight of copper is 136 kg. The armature iron weighs 170 kg., the field magnet iron 225 kg., hence the total weight of active iron is 395 kg. The intention is to apply the same construction to alternators and induction motors, and it is expected that the latter will show a good power factor.—*Elek. Bahnen*, August 4.

Calculation of Transformers.—Pohl and Bohle.—A mathematical article illustrated by diagrams in which the authors give rules for calculating a transformer, if the capacity, the primary and secondary voltages, the frequency and the efficiency are given. The calculation is based on the endeavor to design the transformer so that the price of the material needed in it becomes a minimum. The authors show for the case of the single-phase core-type transformer that this result can be accomplished without long, tedious calculations.—*Elek. Zeit.*, September 28. The first part of the same article in English in Lond. *Elec. Eng.*, September 29.

Lights and Lighting.

Calculations of Mean Spherical Candle-Power.—Wild.—An account of a method by which the mean spherical candle-power of an ordinary incandescent lamp can be calculated with an error not greater than ½ per cent from measurements taken at angles differing by 30°. It is not pretended that measurements every 30° would suffice in the testing of an arc lamp, for example, nor any source of light the candle-power of which undergoes great changes over small difference of angle, but for ordinary incandescent lamps the mean spherical candle-power calculated from measurement at every 30° should be sufficiently accurate for all ordinary purposes. The method is simply to multiply the measured values of the mean circular candle-power at angles of 0, 30, 60 and 90° above and below the horizontal with certain factors, and to add all products together, which gives directly the mean spherical candle-power. These multiplying factors with which the circular candle-power at different angles is to be multiplied, are as follows:

	Multiplying factor.
Angle 90 deg. above horizontal	0.017
" 60 " " "	0.1295
" 30 " " "	0.224
" 0 " horizontal	0.259
" 30 " below horizontal	0.224
" 60 " " "	0.129
" 90 " " "	0.017

The author also gives the multiplying factors for measurements of the mean circular candle-power every 15° and every 10°.—Lond. *Elec.*, September 29.

Fittings.—The first part of an illustrated article on some new designs in electric light fittings shown at the Olympia Electrical Exhibition in London.—Lond. *Elec. Eng.*, September 29.

Power.

Italian Power Transmission.—Some notes on the hydro-electric plant at Cellina from which electric energy is transmitted to Venice, a distance of 90 km. The generating station contains six turbines, driving directly three-phase alternators of 1,800 kw, giving 1,000 volts at a frequency of 50 periods per second, the speed being 315 r.p.m. Three 130 kw. direct current sets give the exciting current. 15 single-phase transformers of 1,000 kilovolt amp. raise the voltage to 36,000 for transmission. These transformers are arranged in groups of three and connected in delta fashion. Later on, if extensions necessitate it, they may be connected in star fashion so as to give a voltage of 50,000. The potential difference at Venice is maintained constant at 27,000 volts. Four groups, each of three transformers furnish current to the transmission line, the fifth group is held for reserve and may be connected to any of the lines. Each transformer is provided on the primary as well as secondary circuit with an automatic circuit breaker, and across the primary terminals Wurts lightning arresters are connected. The transformers are also provided with thermostatic devices which light a red lamp on the switchboard if the increase of temperature should be above 40° C. The transmission line consists of four groups, each of three wires, of 53 sq. mm. cross-section. At Venice the e.m.f. is reduced by transformers first to 6,000 volts and then to 205 volts for the new distributing network and to 2,000 volts for the old one.—*L'Eclairage Elec.*, September 9.

Power Distribution on the Rand in South Africa.—Hammond.—A paper presented before the British Association at Johannesburg. The author points out that lately power distribution schemes have been devised in England in places where no water power is available, but where economy in the cost of generation from aggregation of output in one huge power station is relied upon. So markedly is the economy attained that the "most progressive of the English Railway Companies," the Northeastern, has found it actually more economical to draw its supplies of electrical energy for the working of 39 miles of railway from a central power distribution company than to erect its own generating plant. The author is impressed with the fact that in such a dense industrial area as that included in the Witwatersrand power distribution undertakings of magnitude are not in operation. He endeavors to show that the working of the mines could be cheapened by the greatly extended application of electric power. Those who are at present using only steam power would find an economy in adopting electric power. Whether the electric power should be produced by each mine or group of mines installing its own plant or by means of centralization of generation in plants serving a number of mines, is purely a commercial question. The author gives in detail estimates of the cost of one big central station with two sub-stations on the East and on the West Rand. In the discussion Jennings said that electric winding is undoubtedly convenient and safe and cheap, but steam could be used much more economically than at present by adopting continuous haulage. Siemens said that the load factor is more important in diminishing the cost of production than the size of the generating units. As the load factor of each mine is already very high (0.5 or more), no great saving could be obtained by the establishment of a single central station, and separate stations have some advantages.—Lond. *Elec.*, September 29.

Magnetic Clutch.—In an article on the electrical exhibition at Olympia, is described a magnetic clutch of Holden, which is applied to an electrically-driven cream separator. The principal advantage is that it renders countershafting unnecessary. The Holden clutch, as shown in Fig. 2, is of very simple character, consisting of a thick disc of wrought iron or of high-permeability cut steel, keyed on the main shaft and having an annular groove into which the magnet coil is placed. The ends of the coil are connected to two grooved rings insulated from each other, current being conveyed to them by carbon contacts. A soft wrought-iron plate is fixed to the pulley which it is desired to drive. Between the magnet face of the disc and this plate a thin steel disc is placed to prevent the adhesion of the two iron faces due to residual magnetism when the current is cut off. Where cast-iron swiveling bearings are used, the pulleys can be very conveniently arranged to revolve on the outside of the bearing. By mounting the step cone on a sleeve the main shafting is relieved entirely of carrying the weight of the pulleys, which not only reduces the bearing friction, but also avoids the friction of loose pulleys on a running shaft when not in use. In a modified form the clutch is used for holding articles to be ground or turned as a holder for portable drills, etc. It is said that the power required by the clutch does not exceed 3 watts per hp transmitted and it can be obtained from the ordinary direct-current lighting circuits.—Lond. *Elec.*, September 29.

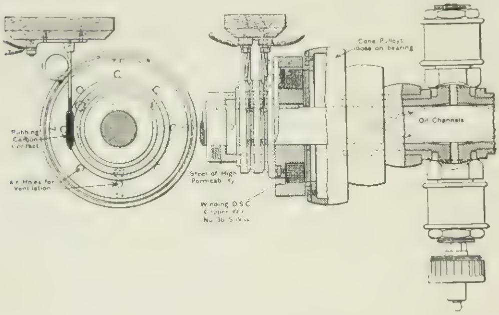

C
Rubbing Carbon Contact
Air Holes for Ventilation
Steel of High Permeability
Winding D.S.C. Copper Wire No 36 S.W.G.
Cone Pulleys loose on bearing
Oil Channels

FIG. 2.—MAGNETIC CLUTCH.

Power Distribution.—Gamlen.—A paper read before the British Institute of Mining Engineers on "Up-to-date Electrical Power Distribution." The author compares gas engines with steam turbines in favor of the latter and deals with power distribution by means of high-tension, three-phase currents.—Lond. *Elec.*, September 15.

Steam Turbine Plant.—A long and fully-illustrated description of the new steam turbine power plant of the Detroit Edison Company, which has an initial rated capacity of 12,000 kw.—*Eng'ing Record*, October 7.

Metallic Packings.—Strohm.—An illustrated article describing the various types of metallic packings used in connection with steam engines.—*Am. Elec.*, October.

Traction.

Roller Bearings.—How.—A paper presented before the British Associatiton. The author states that recent tests on line shafting, electrically-driven and fitted with roller bearings, effected a saving of 24.4 per cent of the power required to run the motor and countershaft with machines in full work. In tramway and railway vehicles the author states that a series of tests has also proved the "starting effort" to be 3 pounds per ton of load, corresponding to a saving in electrical energy equal to 50 per cent of journal friction, equivalent to 1 per cent per car-mile. On the Birmingham electric tramways a saving of 24.3 per cent of tractive force per ton of load was attained; and at Southport the average energy consumption by roller-bearing cars was 0.55 kw-hour per car-mile, with a mean speed of 10.3 miles per hour, as against 1 kw-hour per car-mile and a mean speed of 8.6 miles per hour. In the discussion of the paper Bayley-Marshall said that the reference to the Liverpool Overhead Railway was to some experiments that he had carried out to see if it were at all possible to increase the carrying capacity of the railway. The net result was that they were now able with roller bearings to run a three-car train with one-minute service, as against a two-car train using ordinary bearings. Godwin said the life of roller bearings was about 10 years, but this life would be much shortened by the sand and grit inherent in tramway work. Beare asked if the difficulty of parallelism in the rollers had been solved. Bayley-Marshall replied that with rollers made as parallel as was possible by human hands, "crossing" yet took place. He thought, however, that the "floating-cage" method, in which the rollers were rigidly gripped, had really overcome the difficulty.—Lond. *Elec.*, September 15.

Railway Signals.—Hamilton.—Notes on signaling on the Cape Colony railways.—Lond. *Elec.*, September 15.

Installations. Systems and Appliances.

Insulated Versus Bare Neutral Wire.—Erens.—For three-wire systems the Association of German Electrical Engineers laid down the rule in 1899 that the neutral wire must be earthed and that no fuse should be inserted in it. Later on it has become practice to place the bare neutral wire without insulation in the earth, and it has been claimed that this method is cheaper, causes less troubles in telephone lines, gives a greater guarantee of safety of service and yields a better balancing of voltages if the two halves of the network are unequally loaded. The author discusses these arguments and shows that with the use of the bare neutral wire the saving in first cost is small in comparison with the total cost. With respect to telephone disturbances he claims that the bare neutral wire has no advantage over the insulated metal wire. With a bare metal wire one is not sure that there will be no disturbances due to the earthing of the outers. If the insulated neutral wire is properly dimensioned it is possible to prevent any large disturbing voltage difference in the two halves of the network in the same way as is the case with a bare metal wire. On the other hand, the insulated neutral wire has the following advantage. If in a cable network with a bare neutral wire, a small earth, say, of 20 amp., occur, such losses of current cannot be detected at all, since this stray current does not differ in any way from the current paid for by consumers, both currents passing from the outer to earth. If, however, the neutral wire is insulated and earthed at the station, it is easy to watch continually the insulation resistance of the network. It is only necessary to insert an ammeter in the earth connection of the neutral wire. If then, at any place of the network, an earth occurs on an outer, then (if the balance of the cables are in good condition) the earth current must pass through the ammeter. If the ammeter is placed on the switchboard the attendant will see at once whether the cable network is in good condition. The only objection to this method is that if on both outers a ground occurs simultaneously, only the difference of the two currents corresponding to the two earths will pass through the ammeter, and if by chance the two earths on the two outers should be equal no current will pass through the ammeter. However, it is easy to determine the insulation resistance of each outer by the following simple means: In Fig. 3 K_1, K_0 and K_2 represent the positive, neutral and negative cables of the three wire network, $r_1 r_2$ are the insulation resistances of the outers which are to be determined. The neutral wire, K_0, is connected to earth by means of a large copper conductor, in which the ammeter, A, is inserted. The ohmic resistance of this earth connection can be made negligibly small. If there occurs an earth on each outer the currents passing on this account between the two outers and earth may be i_1 and i_2, respectively. Then only their difference, i_0, will pass through the ammeter, A. If now the voltages of the two outers against earth are measured and found to be P_1 and P_2, one has the three equations: First, $i_0 = i_1 - i_2$; second, $P_1 = i_1 r_1$; third, $P_2 = i_2 r_2$. The author then connects one of the outers, for instance, the positive one, through a resistance to earth. The current which will pass through this connection into earth may be J, while simultaneously the current, J_0', is measured in the ammeter, A, and the voltages of the outers against earth are also measured; they may be P_1' and P_2'. The earth currents have now different values. They may be i_1' and i_2', while r_1 and r_2 has the same values as before. This gives three more equations, namely, fourth, $J_0' = i_1' + J - i_2'$; fifth, $P_1' = i_1' r_1$, and sixth, $P_2' = i_2' r_2$. In this way there are obtained six equations for the determination of the six unknown values, r_1, r_2, i_1, i_2, i_1' and i_2'. It is thus easy to determine the insulation resistances, r_1 and r_2, and it is thus always possible to find whether the current measured in the ammeter in the earth connection of the neutral wire indicates an earth in one outer or the difference of earths in the two outers. In this way it is very easy to watch continually the insulation resistance of a three-wire network. This is not possible with bare neutral wires.—*Elek. Zeit.*, September 28.

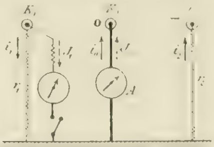


FIG. 3.—INSULATION TESTS.

Automatic Starters.—A note on several types of automatic starting rheostats with liquid resistances. A starter of Lahmeyer, which is specially adapted for large motors driving pumps, compressors and lifts, acts in the following fashion: A lever is operated by a to-and-fro movement and a catch which engages with the inclined teeth of a sector produces the revolution (one notch for each period) of the axle which operates the rheostat. The lever is acted upon by an electromagnet. In this way the starting of the motor goes on slowly, while the breaking of the circuit is sudden. Another starter consists of two discs driven by the motor itself. One of the discs revolves with the same speed as the motor, while the second disc is so geared that it revolves at a slower speed. The second disc produces the progressive starting of the motor while the first disc opens the circuit. The coupling between the discs and the motor is produced by means of an electromagnet. A starter which has the advantage of giving a very progressive increase of the current consists of two containing vessels, one above the other, the higher one containing the electrodes for the starting resistance while the liquid is contained in the lower vessel. When the circuit is closed an electromagnetic device forces a plunger to drop into the liquid which thus gradually rises.—*L'Eclairage Elec.*, August 10.

Electricity in Collieries.—WALKER.—A paper read before the (Brit.) Inst. Min. Eng. and discussing in detail the rules of the British Home Office tending towards the protection of workingmen in mines from shock and towards the prevention of earths in collieries.—Lond. *Elec.*, September 15.

High-Tension Circuit-Breaking Devices.—FERNANDEZ.—An illustrated article describing in detail the operating mechanism of high tension oil switches, together with diagrams of their connections. —*Amer. Elec.*, October.

WIRES, WIRING AND CONDUITS.

Dielectric Strength of Insulating Materials.—SYMONS.—A communication with reference to the recent article of Kinzbrunner. The author points out that it is important to find out why a dielectric breaks down under a high voltage stress; whether the break down is a mechanical rupture produced by voltage stress or is due to the fact that as the voltage increases (Ohm's law holding good) the dielectric conducts more current, until it becomes unable to dissipate its heat so that the material is charred and breakdown occurs. In the case of material such as porcelain, glass and mica if the circuit be broken as soon as the material is punctured the breakdown seems to be the result of mechanical rupture. Especially is this so in the case of mica. To compare materials of different manufacture, in addition to time tests, he designates that voltage which produces puncture immediately upon application as the "disruptive voltage" the circuit being closed on the high-tension side of the transormer. This definition has been found to give satisfactory results, and moreover, with materials of uniform quality, nearly straight line laws result for the ratio between thickness and dielectric strength.—Lond. *Elec.*, September 29.

Cement Foundation for Wooden Poles.—HERZOG.—An illustrated description of the system of Kastler who puts a cement foundation into the earth and mounts the wooden pole within this foundation in such a way that the lower end of the pole is above earth and cannot come into contact with the moisture of the earth. The pole is fixed into the foundation by means of lateral iron rods so that there is an air space of several centimeters between the cement and wood. The system is claimed to result in a great saving in the maintenance of wooden poles.—*Zeit. f. Elek.* (Vienna) September 24.

Telephone Cable.—An illustrated article on a telephone cable which has recently been placed in Lake Como in Italy. It is laid in water about 400 ft. deep. It has two conductors, each consisting of seven tinned 0.55 mm. (0.0217 in.) copper wires, the copper section of each conductor, therefore, being 1.66 sq. mm. (0.00257 sq. in.). Each conductor thus formed is covered with three layers of gutta-percha, bringing the diameter up to 6 mm. (0.236 in.). Both conductors are then filled in and covered with hemp, so as to bring the diameter up to 17 mm. (0.67 in.). On top of this are 18 galvanized iron wires (2.5 mm. = 0.1 in. in diameter), covered by impermeable tape, tarred tape and finally "Clark" compound. The second armoring of the shore ends (where the cable is strengthened), consists of 18 galvanized iron wires, 4.5 mm. (0.177 in.) diameter, and the final covering is composed of two layers of tarred tape, the whole being well impregnated with "Clark" compound. According to the specification, the capacity of one conductor (the other being connected to earth) was not to exceed 0.306 microfarad per mile, the maximum resistance of the conductor at 15° C. was not to be more than 11 ohms per mile, and the insulation resistance between one conductor and the other conductor—which was to be earthed —was to be not less than 620 megohms per mile at a temperature of 24° C. On the test the capacity was found to be 0.292 microfarad per mile, the ohmic resistance 10.2 ohms per mile at 15° C., while the insulation resistance came to 806 megohms per mile at 24° C.—Lond. *Elec.*, September 8.

ELECTROPHYSICS AND MAGNETISM.

Joule-Thomson Effect.—KESTER.—The original Joule experiments, the aim of which was the determination of the amount of work done against the forces of intermolecular attraction when a gas expands without doing external work, were performed in 1844. Joule then devised the porous plug form of apparatus. This same arrangement has been used by the present author to study the effect in carbon dioxide. In the present installment the experimental part of the investigation is given.—*Phys. Rev.*, October.

Electric Wind.—JANUSZKIEWICZ.—A description of an experiment showing that a stream of electrified gas proceeding from a charged fine point is stronger if the point is negatively charged than if it is positively charged. In other words, the negative wind is the stronger.—Lond. *Elec.*, September 29; *Phys. Zeit.*, September 15.

ELECTROCHEMISTRY AND BATTERIES.

Acid Pickle.—BURGESS.—The conclusion of his article on the action of acids on iron and the use of the acid pickle. In the present installment he discusses the uses of hydrochloric and sulphuric acid. —*Electrochem. and Met. Ind.*, October.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Vertical Intensity Variometer.—Von Lukky.—A description of an instrument for measuring the variations of the earth's vertical magnetic field more accurately than heretofore. The instrument consists essentially of an astatic combination of needles hung in a bifilar suspension at right angles to the magnetic meridian. A bundle of thin rods of soft iron is placed in a vertical position broadside on to the needles some distance away. The horizontal intensity has no effect upon the astatic combination nor upon the vertical iron rods. But the earth's vertical field induces a north-seeking pole in the lower end of the soft iron and a south-seeking pole in the upper end. These poles exert upon the needles near them magnetic moments in the same sense, and these moments are proportional to the vertical intensity. The author uses a special device to correct for temperature, in the shape of an auxiliary magnet mounted on the side opposite the soft iron and pointing towards it. It is turned in such a manner that its effect is opposed to that of the soft iron, and its distance is determined by calculation in such a manner that its change of moment balances the changes of moment of the other magnetic bodies. The nearer the compensating magnet is to the suspension the less sensitive is the variometer.—Lond *Elec.*, September 15; from *Phys. Zeit.*, September 1.

Quadrant Electrometer for Measuring Current.—Stewart.—A mathematical investigation with respect to the extensive use of the quadrant electrometer in radioactivity work. Since this use is generally limited to the measurement of small currents through some gas, the analysis of the author is restricted to this particular work. *Phys. Rev.*, October.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wave Measurer for Wireless Telegraphy.—Fleming.—An account of a recent English patent for apparatus for measuring the wavelengths in wireless telegraphy. The instrument consists of a long coil, K_1 K_2 (Fig. 4), of fine copper wire insulated with silk, which is wound in one single layer in closely adjacent turns on a rod, K_3, of ebonite, glass or other highly insulating material. This long helix is supported on insulating stands, such as e_1 e_2 e_3. C_1 is a small air condenser. On the helix, $K_1 K_2$, slides a metal saddle, *D*, padded with tin foil or other flexible metallic material to cause it to make good contact with the surface of the insulated spiral wire. This saddle is connected by a stout wire, *W*, with a good earth plate, E_2. The saddle, *D*, has an insulating handle and fits closely on the helix K_1 K_2. The transmitter may be of any usual type; that shown consists of an induction coil, *I*, which has its secondary terminals connected to a spark gap, *S*, and the spark balls are connected by a condenser, *C*, with the primary coil of an air-core transformer, *T*, the secondary circuit of which is inserted between an aerial wire, *A*, and an earth plate, E_1. When the induction coil is in operation, electric oscillations of a certain frequency are set up in the aerial wire, *A*. To determine this frequency the saddle, *D*, is moved along the helix and tests are made with a small vacuum tube. The oscillations in the aerial wire act through the condenser, C_1, upon the long helix and set up in this helix stationary electric waves which travel along the helix with a certain velocity and are reflected at the saddle, *D*. If the saddle, *D*, is moved to such a position that the distance K_1D, is equal to one complete wavelength of a stationary potential wave upon the helix, then if we hold the vacuum tube above mentioned at the point, V_2, half way between K_1 and *D*, it will not be illuminated, because at that point the electric potential in the air near the spiral is extremely small, but if the vacuum tube is held at points, V_1 or V_3, which are respectively one-fourth or three-fourths of the way from K_1D, it will be brightly illuminated. If, however, the saddle, *D*, is placed at any other position which is not an exact wavelength or multiple of the wavelength, then there will be no such regular distribution of potential, but the vacuum tube will either glow or not glow irregularly in any position. The wavelength is read off directly from the scale *E.*—Lond. *Elec.*, September 29.

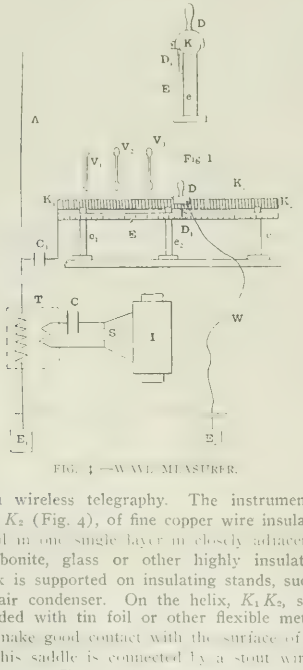


FIG. 4.—WAVE MEASURER.

Trees in Wireless Telegraphy.—Schmidt.—A note on the use of trees as receivers in wireless telegraphy. He has found that in many kinds of trees certain parts of the limbs correspond to certain portions of the root from which they get their nutriment through channels having a smaller electric resistance than neighboring portions of the trunk. In using a tree for receiving wireless telegraphic messages it is preferable to make connection at such portions of the trunk which connect a strong root with the corresponding topmost branch.—*Elek. Zeit.*, September 28.

Financial End of Industrial Engineering.—Dixon.—An article in which the writer describes a method for arriving at the fixed charges on an engineering investment. While the methods used are applicable to all investments, the case of a power plant to be built is assumed.—*Iron Age*, October 5.

Earthing of Wireless Telegraph Aerials.—Monckton.—An account of experiments which taken together with those of others, make it appear that, at any rate for most land stations, an insulated lower capacity would be the best.—Lond. *Elec.*, September 15.

MISCELLANEOUS.

Insurance and Inspection of Electrical Machinery in Great Britain.—An abstract of the annual report for 1904 of the British Engine, Boiler & Electrical Insurance Company. The number of dynamos and motors insured at the end of 1904 exceeded the number insured at the end of 1904 by 20 per cent. On the other hand, the number of breakdowns of insured machines in 1904 exceeded the number in 1903 by 28 per cent. The claims made, therefore, have increased more rapidly than the insurance effected. The cause of this increase is not apparent, unless it be deterioration resulting from greater age. The rate of breakdowns among dynamos was 1 in 12, the rate among motors 1 in 9.3, excluding breakdowns of starting resistance switches, or 1 in 8.2, including them. Beyond question, many breakdowns are prevented by the periodical inspection given by the company, so that among insured machines the rate of breakdown must be still heavier. Some details are given.—Lond. *Elec.*, September 29.

Electrotherapeutics.—Renault.—A summary of the useful applications made of electrical treatments, more especially in the case of workmen's accidents. The author distinguishes direct applications, such as galvanization and faradization and indirect applications, working by the generation of light, heat or mechanical motion. Galvanization consists in the application of direct currents of about 12 to 15 milliamperes for some 15 minutes, the negative terminal being applied to the diseased part. This process is valuable in muscular atrophy occasioned by contusions, dislocations or fractures, and in most diseases of the joints. The author has also found it efficacious in curing fistulæ occasioned by the careless handling of meat, using in this case a copper electrode inserted in the sore and reversing the current several times. "Faradization" is the treatment with alternating currents or with alternating currents superimposed upon continuous currents ("galvanic-faradization"). It is employed both in muscular atrophy and in natural anæsthesia. Other applications are those of alternating currents, high-frequency currents ("auto conduction"), sparking and galvano-cautery. An interesting application is the electric stimulation of muscles for the detection of simulation, the reaction being quite independent of the will of the patient.—Lond. *Elec.*, September 22; from *Archives d'Elec. Med.*, September 10.

Steam Turbines.—Biles. A paper on steam turbines as applied to ocean liners, read before the British Association. The results of tests are said to "completely justify the adoption of the turbine in ocean liners."—Lond. *Elec.*, September 15.

BOOK REVIEWS.

L'Annee Electrique, Electrotherapique et Radiographique. Revue de 1904. By Dr. Foveau de Courmelles. Paris: Ch. Beranger. 372 pages. Price, 3 francs 50.

This is a handy manual containing a general and succinct account of the progress made during the year in the various departments of applied science. Electrochemistry, electric lighting, heating and traction, take up 37 pages. The war in the Far East has afforded material for chapters on the international perfection of submarine cables as well as in some of the multifarious uses of wireless telegraphy in time of war. The influence of light of different colors on the human system is recorded, as well as the therapeutic value of currents of high frequency. The physical properties of radium and the uses made of this new element for the cure of some of the afflictions to which human flesh is heir, are dealt with in the compass of 28 pages.

On page 327 we find Loddy instead of Soddy; on p. 301 Ramsay is spoken of as having discussed helium in the Sun, whereas it was Frankland and Lockyer, who first noticed the helium lines in the spectrum of the chromosphere during the solar eclipse of 1868. Ramsay found the "hypothetical" element in terrestrial substances in 1895.

Causeries sur le Radium et les Nouvelles Radiations. Par Georges Claude. Paris: Ch. Dunod. 132 pages, 44 illustrations. Price, 3 francs.

The title of this little book, "Causeries," indicates the popular style of exposition adopted by the author. If there is a tendency to verbosity, we must hasten to add that it is accompanied by clearness of expression and fullness of matter.

As the volume was written for the lay reader of contemporary science, it aims at giving only a general idea of the advances made in molecular physics during the past few years. The electric action of condensers is explained by means of hydraulic analogues; then follow the classic experiments of Hertz on electric radiation, and in due time the phenomena of X-rays, canal rays and cathode rays. The pregnant discovery of uranium rays by Henri Becquerel in 1896 is taken as marking the beginning of a new era in physical theory, and well it may as it prepared the way for the work of the Curies and the many gleaners in their field of research. M. Claude describes the phenomena of radioactivity with precision and lucidity; his book affords pleasant and instructive reading. Omitting a superabundance of details, it gives just the current topics of physical science needed by every one who claims to have received a liberal education.

High-Tension Power Transmission. A series of papers and discussions presented at the meetings of the American Institute of Electrical Engineers. New York: McGraw Publishing Company. 466 pages. Price, $3.00.

In the year 1902 a Transmission Committee of the American Institute of Electrical Engineers was appointed for the purpose of collecting data respecting present practice in electric transmission at high voltage and of presenting a report to indicate the successful methods in operation in such a form as to be of immediate value to electrical engineers.

The Transmission Committee adopted two methods of procedure. One of these was to send to the various transmission plants in the United States a printed list of questions relating to high-tension transmission, with a request that answers to the questions be filled in and the lists returned. The other method was that of instituting discussions on chosen topics which would bring forth from the engineers taking part in these discussions information in regard to the work in question, which could not otherwise be obtained.

The permanent value of the information brought out through the work of the committee justifies fully the collection of the matter in book form. The papers and discussions have been taken directly from the *Transactions* of the Institute, with such minor changes as were necessary for co-ordinating the different parts. The book contains 23 separate papers by 18 different authors prominent in transmission work. All features of the subject are treated exhaustively, differences of opinion of the various engineers being brought out in the discussions, which are given in full. A valuable part of the volume resides in the collection of data upon line construction, insulators, pins and the like, and the conditions of operation at different voltages and under different climatic conditions. These data relate to present practice in America. The placing of this information in compact and convenient form for reference should prove a valuable addition to engineering literature.

General Electric at the Portland Exposition.

The General Electric Company had a fine exhibit at the Lewis and Clark Exposition, as indicated by the view here shown in Machinery Hall, Fig. 1. This exposition in common with all other recent American shows on a scale of national importance was lighted by Edison incandescent lamps furnished by the company. A unique feature was the extended use of Meridian lamps, some idea of the effect of which can be obtained from Fig. 2.

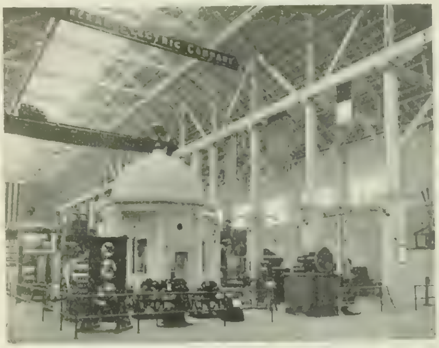


Fig. 1.—General Electric Exhibit.

Announcement is now made that the Superior Jury at the Lewis and Clark Exposition has approved the following awards in the electrical department, relating to exhibits of the General Electric Company, which was the largest manufacturer exhibiting in that department. The highest award granted by the jury is a gold medal. The company received a gold medal for the best exhibit in the electrical department and also gold medals on each of the following features of this exhibit: (1) Curtis steam turbine, (2) meters and instruments, (3) time limit relays and oil switches, (4) switchboards, motor controlling panels; (5) circuit breakers and lightning arresters, (6) direct and alternating current meters, (7) direct and alternating current generators, (8) static transformers, (9) automatic voltage regulators, (10) magnetite arc lamp, (11) alternating and direct current enclosed arc lamps, (12) mercury arc lamps, (13) magnetic starting device for mercury arc lamps, (14) mercury arc rectifier, (15) railway motors and controllers, (16) mining locomotives, (17) searchlight and method of control, (18) progress and development in the art. For its new metallized carbon filament incandescent lamps the company also received a gold medal.

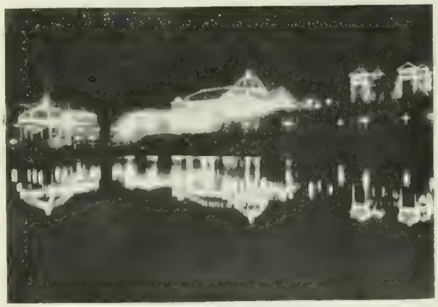
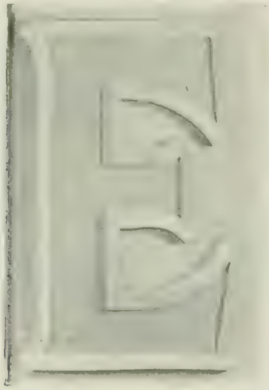


Fig. 2.—Night Illumination.

Day-and-Night Electric Signs.

The accompanying illustration shows a novel and attractive electric sign which possesses numerous features worthy of mention. The letters which serve to form the sign are mounted on zinc sheets which are interlocking, i. e., each sheet locks into the ones immediately preceding and following it; then the joints are hammered down smooth and the entire background of the letters is coated with smalt (the sand-like mixture used by sign makers), and the joints are then invisible. This interlocking arrangement makes it very easy for the central station man or local sign maker to build up the signs from the letters kept in stock or obtained on special order.

The most interesting and characteristic feature of the sign is the translucent fabric built on a woven wire foundation of which the letter proper is made. This fabric so distributes the light received from incandescent lamps arranged behind the sign that it is uniformly diffused over the whole letter, instead of being brilliant directly in front of the lamp and darker in other places. It is claimed that the sign is more economical to build and operate than a bulb sign, and that the letters are distinct at a greater distance than is the case where the letters are built of lamps.



INTERLOCKING LETTER.

The translucent substance is outlined by a raised and gilded carving, the combination making a beautiful and indestructible letter. In the day time these letters on a dark background make the sign conspicuous. Nothing about it indicates that it is an electric sign. There are no letters or outside wiring, and it is stated that the appearance of the sign by day is much more attractive than that of the usual business signs. This interesting advertising device is being placed upon the market by the Day-and-Night Sign Company, Easton, Pa.

◆

Automatic Belt-Tightening Idler.

A newly designed automatic belt-tightening attachment for the standard Crocker-Wheeler Form L motor is shown in Fig. 1. It may be used wherever the limited center distances between pulleys require an increased belt contact on the pulley of the motor. A good example of the attachment is shown with a Lanston Monotype machine in Fig. 2.

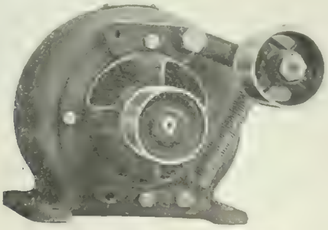


FIG. 1.—BELT-TIGHTENING IDLER.

The device is so designed that it may be attached by the customer at any time to any L motor having a front end shield. Its principal parts are the idler pulley, arm and block, spring-stud and block and the adjustable spring and hook for connecting them.

The idler pulley and arm are pivoted on a stud which may be screwed into either one of two tapped holes in the block. The block itself may be attached to the motor in any one of four positions by a special screw replacing any one of the four machine screws holding the rear shield to the motor frame. Eight locations are thus afforded for the pivot of the idler arm.

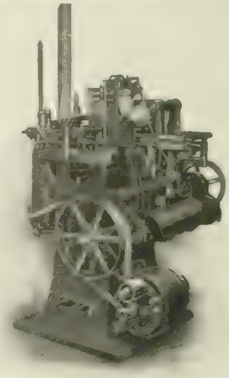


FIG. 2.—MOTOR WITH BELT-TIGHTENING IDLER ON MONOTYPE MACHINE.

◆

Interior Automatic Exchange Telephones.

The Conn. Tel. & Elec. Co., of Meriden, Conn., has placed upon the market an intercommunicating telephone for interior service with many valuable points of interest to every exchange man. This instrument can be connected to the exchange, and is stated to be absolutely non-interfering. One of the many up-to-date features is the new non-interfering exchange trunk button. This device is so arranged that it cuts the telephone from the interior system to the trunk wires so that there is absolutely no chance for interference. With this telephone it is possible to call direct to any point in the system with the receiver on or off the hook. The

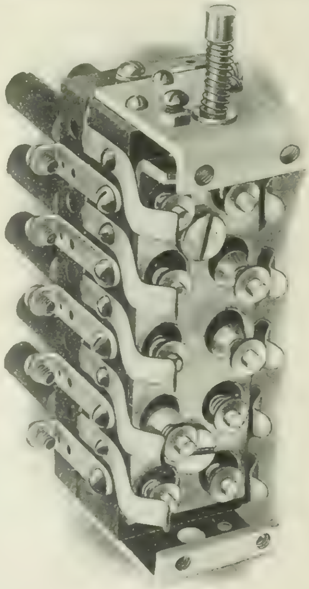


FIG. 1.—MECHANICAL TELEPHONE SWITCH.

buttons are automatically restored when the receiver is returned to the hook, and the telephone is also cut off the line. It is also possible to call any number of departments together and hold a joint conversation. All connections in these instruments are mounted on hard rubber, and all contacts are rubbing and very positive. The plate of this instrument does not enter into the talking circuit. It is constructed of steel, thereby doing away with the wear and tear of the brass cone and brass plate. With this construction chances for poor mechanical construction are eliminated. It is stated that this telephone is now being adopted by some of the largest exchanges, and it is particularly adapted for common battery exchange service.

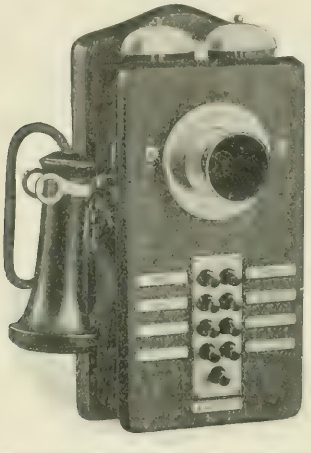
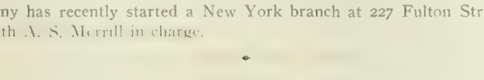


FIG. 2.—INTERCOMMUNICATING TELEPHONE.

◆

The Appleton Conduit Bushing.

A number of schemes have been devised for bushing the ends of iron armored conduit pipe to prevent the sharp corners of the pipe from cutting the insulation of the wires. The principal problem has been to provide something cheap to manufacture and with a clear thread to receive the end of the pipe. Both these conditions have been ingeniously met in the bushing made by the Appleton Electric Company, of Chicago. This bushing, shown in Figs. 1 and 2, consists of a steel hexagon nut into one end of which is forced a brass bushing. The process by which this is done is a secret of the manufacturer. The result is a bushing which is practically as solid as if of one piece and at the same time one in which the threads are clean cut clear to the bushing proper. They are made in sizes for from ½ to 3-in. pipe, and a large stock is kept made up. The company has recently started a New York branch at 227 Fulton Street, with A. S. Merrill in charge.



FIGS. 1 AND 2.—CONDUIT BUSHING.

◆

Controller for Variable-Speed Motors.

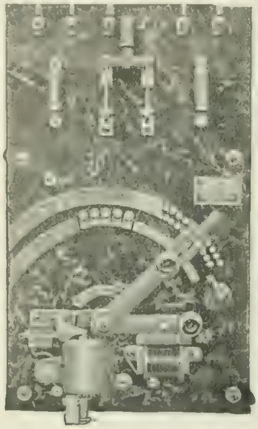
The accompanying illustration shows the latest Ward Leonard speed controller for variable-speed motors, the speed variation being obtained by changing the field strength. The panel consists of an independent, interlocking overload circuit-breaker and a no-voltage release motor-starter with 20 changes of field resistance. This panel has many special features, as follows:

There is but one lever carrying current for both starting the motor and regulating the speed of the motor.

The rheostat starter and speed-controlling lever cannot be left at rest on the starting contacts, but can be left continuously on any of the field resistance contacts, is readily movable in either direction upon the field resistance contacts, and such movement is entirely independent of the "no-voltage" retractile spring.

The "no-voltage" release protective device is responsive solely to the line voltage and is entirely independent of the field current or the armature current.

The "overload" protective device automatically opens the entire circuit whenever, from any cause and under any conditions, a current in excess of that for which the circuit breaker is adjusted is passed through the rheostat and motor.



MOTOR CONTROLLER

It is well known to engineers and motor manufacturers that most of the damage that comes to a motor, rheostat or the machine driven is due to excessive current put through the apparatus in starting or attempting to start it. It is stated that the independent interlocking circuit-breaker completely removes this source of danger. The circuit-breaker will always open before the fuses blow. Thus the cost of fuse renewals is saved.

◆

A New Watt-Hour Meter.

The General Electric Company has recently placed on the market a new type of watt hour meter identical in principle with the earlier forms of the Thomson instrument, but differing widely in structural details.

In general the meter has been made simpler and more compact. The first change in construction to be noted is the method of support. As Fig. 1 shows, the upper lug is key-holed, and the lower right hand one slotted. This permits rapid and accurate leveling as the screw can be inserted and the meter hung thereon approximately level. The final adjustments can then be made accurately.

The cover is fastened with studs and wing nuts and may be moved directly toward the front, permitting the installation of a large number of meters where space is limited. The sealing wire is passed through the wing nuts and their respective studs, necessitating the use of but one wire, and positively prevents tampering without detection. A felt lined groove surrounds the edge of the cover and the leading in holes for the wires are covered with the same material, thereby excluding both dust and insects.

In the meter proper a number of improvements have been made. The register is of the four-pointer type, with large, clear dials registering directly in kilowatt hours in all sizes up to 30 kw. Except in the larger sizes no dial constant is necessary. Where a dial constant is required a decimal constant has been chosen, so that the actual energy unit remains the same, and the correct reading is easily obtained by adding ciphers to the dial reading as the constant requires. The lower bearing is made of carefully selected sapphires, or, in capacities above 50 kw., of diamond. The General Electric Company has recently perfected a method of grinding diamonds in a concave form and obtaining a polish fully equal to that of the sapphire jewel. The shaft is tipped with a brass pivot fitted with a very fine, polished steel point, which, with the jewel cup, forms an ideal bearing surface.

The armature shaft is tubular, thus combining great strength and extreme lightness. On the upper end of the shaft, and very carefully insulated from it, is the commutator (see Fig. 2). This is but one-tenth of an inch in diameter, and with the gravity-controlled brushes, the friction at this point is reduced to a minimum. The gravity-brush control obviates the necessity of a spring adjustment which, even to the most experienced, is a delicate operation.

For protection during shipment and any subsequent transportation the meter is provided with a clamping device which holds the moving element securely in position. This device consists of a brass cap which is normally drawn down and held by the jewel screw against the force of the lifting spring. When drawn down the moving element is free to rotate, but when the jewel screw is backed out the cap is released, and the spring causes it to lift the moving element from the jewel and hold it firmly.

The entire mechanism is assembled upon a skeleton casting which in turn is fastened within the meter casing. By removing four screws and disconnecting the windings from the terminals the mechanism may be removed for inspection and repair.

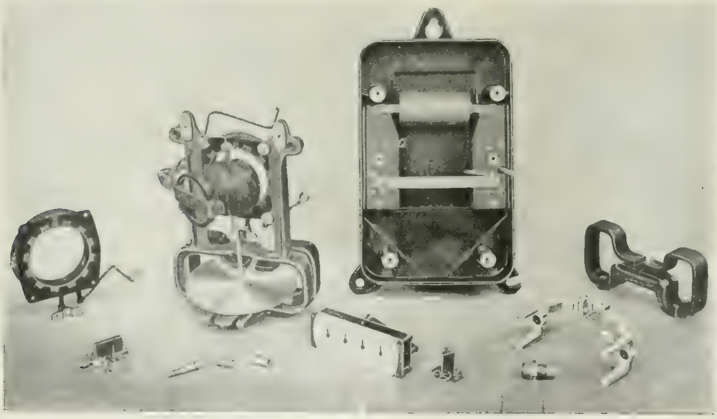
The plane of the field coils is parallel to the back of the meter, hence by the removal of the front series coil and the register and the loosening of the shunt field coil, the moving element may be taken out. This does not necessitate the removing of the magnets and, therefore, the full-load calibration is unaffected.

An automatic link between the worm wheel and the register permits the removal and replacement of the latter without in any way affecting the proper mesh of the gear and worm.

The four magnets are permanently fastened together in sets of two, and each set may be removed from its supporting shelf by the loosening of two screws.

The armature is spherical in shape and revolves within circular field coils. This construction most nearly fulfills the conditions of lowest possible watt loss with highest torque. The armature is wound with very fine wire, upon a paper shell, and the field windings are of copper ribbon. The damping magnets are subjected to a rigid process of magnetization and ageing to insure absolute permanence.

The value of high torque has become universally recognized as the most essential feature of a motor meter. The peculiar design of the field coils and armature of the Type C meter gives the greatest possible torque combined with minimum losses and weight of moving element. It is claimed that the torque of this meter is greater than that of any other motor meter in commercial use.



[illegible] HOUR METER

The friction torque has been reduced to the lowest possible limits by the use of a small commutator, gravity brushes, and an exceedingly light moving element. The combination of high torque with minimum friction is indicative of the "life with accuracy" that must inevitably result. Although designed primarily for use upon direct-current circuits, the Type C watt-hour meter may, like its [illegible] predecessor, be used with entire satisfaction on alternating current circuits regardless of frequency or wave form, and, if properly lagged, it may be used upon inductive circuits without recalibration or adjustment. When meters are required for use upon circuits having inductive loads, the fact should be specified in ordering.

Having no iron in its construction, the Type C meter is not subject to hysteresis action. It is stated that changes in temperature do not affect its accuracy, as the temperature coefficients of both the motor and generator elements are the same, thus compensating for such variations. The liberal rating of this meter and its low losses, permit of operation under a heavy overload for a considerable period of time, without detrimental effects, either permanent or temporary.

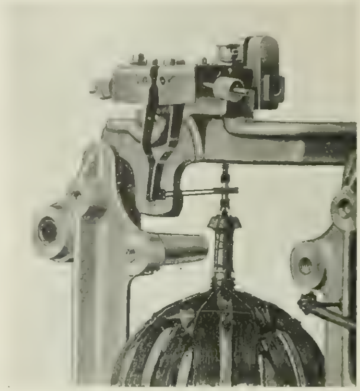
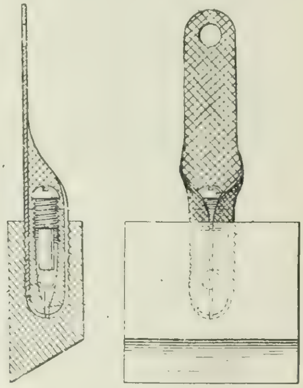


FIG. 2.—INTERIOR OF WATT HOUR METER, SHOWING SMALL COMMUTATOR AND GRAVITY BRUSHES.

The Type C Thomson watt-hour meter is manufactured in capacities ranging from 5 to 600 amp., inclusive, two wire; and 5 to 300 amp., inclusive, three-wire; and for potentials from 100 to 600 volts.

A New Contact for Carbon Brushes.

One of the most satisfactory forms of contacts for carbon brushes is that in which the brush is equipped with a cap and flexible lead permanently attached to the brush. With this form of contact it is the usual practice to throw away the remains of the brush together with all the fittings, including the cap, flexible lead and terminal. When it is considered that some of the modern large generators require from 200 to 350 brushes per year, and that the loss from the discarded brush fittings are valued at from 10 to 15 cents per brush, it will be appreciated that the yearly loss is considerable.



FIGS. 1 AND 2.—HALLBERG CONTACT FOR CARBON BRUSH.

The accompanying illustrations show a new form of contact with which it is possible to substitute a new carbon brush in place of the old one without removing the contact wire from the brush holder, thus limiting the loss to the unused portion of the carbon brush and reducing the renewal cost to a minimum.

By reason of the fact that the pigtail is forced against the sides of the cavity in the carbon brush near the point where the current is collected, the loss due to the resistance of the carbon is reduced to a minimum, as has recently been demonstrated by actual tests. The ordinary form of the new contact for standard brushes is shown in Figs. 1 and 2. It has been found in practice that the expander can be operated by a taper screw to very good advantage, especially on the very small machines which require thin brushes, so that it is unnecessary to use the ball expander illustrated. An examination of the cuts show that it is impossible for this contact to work loose. In fact, the more current the brush has to carry, the greater will be the pressure between the sides of the cavity and the pigtail, due to the expansion from heat of the metal expander.

This form of contact is the invention of Mr. J. H. Hallberg, and has recently been placed on the market by the National Carbon Company, Cleveland, Ohio. It is stated that many of them are now in satisfactory service.

◆

Burt "Unit Type" Oil Filter.

The Burt Mfg. Co., Akron, Ohio, has recently brought out a system for filtering oil in which a number of separate units may be connected to filter the oil used in a large plant. Each unit is independent in itself, and new units may be added as the plant grows, thus keeping the capacity of the oil filter system up to the size of the plant.

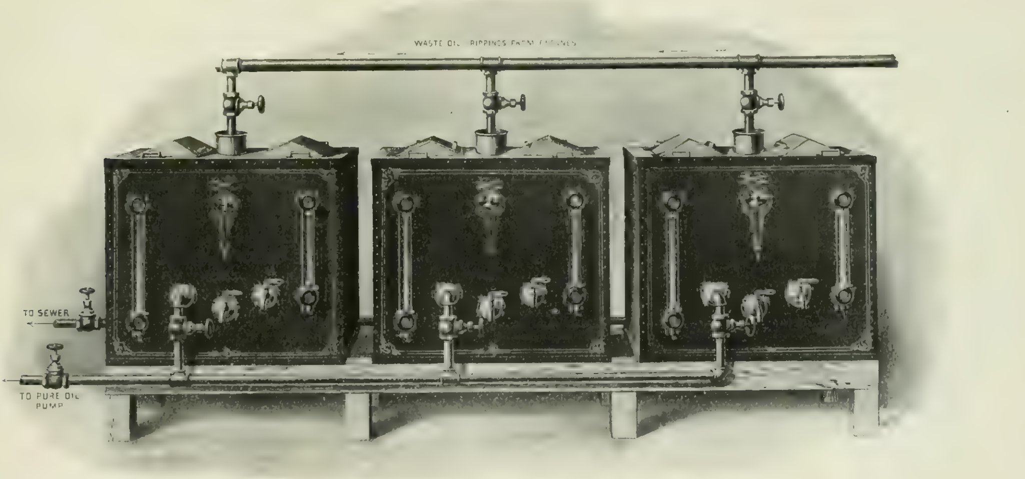
An installation consisting of three units is shown in the accompanying illustration. The dirty oil enters a waste oil receptacle and passes through small perforations, flowing thence horizontally to two filtering cylinders; in passing into these two cylinders the heavy impurities fall by gravity into a sediment pan, being thus finally disposed of and not clogging the filtering cloths or filtering material. The filtering cylinders are wrapped with cloths through which the oil passes before entering the cylinders, and are filled with a quantity of animal bone-black, through which the oil must flow before entering the two tubes which lead from the cylinders to the bottom of the filter. Two plates are attached to the bottom of the tubes by means of which the oil is spread out in a very thin film. It is thus thoroughly washed by the water in the filter and any remaining impurities in the oil drop to the bottom and can be flushed out at any time desired by simply opening the gate valve which connects with the sewer or other waste pipe.

A hot-water chamber surrounds the upper part of the filter containing the filtering mechanism. The water in this chamber is heated by a small steam coil fed with live or exhaust steam from any convenient source. The oil is thus heated before filtering and flows more freely, thereby increasing the speed of filtration and the filter capacity. When heated, the dirty oil spreads out, and most of the dirt and grit then falls into the sediment pan. The bulk of the sediment in this type of filter is at the top, where it can be readily removed without interfering in any way with the supply of pure oil for the oiling system. The filter will handle successfully the heaviest grades of oil, such as lard, gas engine and cylinder oil.

In the construction of the unit type, heavier iron is used than in the regular type of filter, and the body is riveted to a heavy wrought-iron frame. All seams are lapped, riveted and soldered. The upper and lower part of the filter cylinders are made of cast iron, nickel-plated on the top. The tubes leading from the filtering cylinders to the bottom of the filter are of wrought iron. The filter is so constructed that it may be used with or without an oiling system. It can, if desired, be installed and operated at first without being connected with an oiling system, and later on, if an oiling system is added to the plant, pipe connections can readily be made thereto at slight expense.

It is not necessary to shut down a system and disconnect the pipe connections in order to clean the filter. If more than one unit is used it is only necessary to shut off the flow of oil to the filter to be cleaned, the other units being able to handle easily the extra amount. When only one filter is installed, the cloth around one cylinder can be removed instantly; if the filtering material also needs to be removed, one cylinder is unscrewed and a plug furnished for the purpose is screwed into the tube, so as to keep the dirty waste oil from flowing into the filter. The other cylinder continues in operation while the first is being cleaned. Any type of filtering material can be used in the cylinder, such as white waste, sponges, excelsior, raw wool, etc. The manufacturer recommends the use of animal bone-black, which is in use in all oil refineries for purifying oil. This material can be washed with hot water or gasoline and used many times. Filtering cloths may also be used to purify the oil. As any number of cloths may be wrapped around the filtering cylinders, and as in changing them nothing but the cloths need be removed, the latter can be removed while the filter is in operation without changing or touching any pipe connections.

This type of filter is recommended by the makers for use with gas engines of large capacity, as the hot water from the engine cylinders can be used for the purpose of heating the oil. It is also recommended for use with gas or steam turbines, for the reason that an exceptionally large quantity of oil is used on these machines, and the oil being very thin will flow rapidly through this type of filter, owing to the effect of the hot water chamber at the top.



View of a Three Unit Installation

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade was stimulated generally by the cool weather and jobbing was also helped through the medium of reorders. Much delayed business has also materialized through the lifting or abolition of quarantines throughout the central South. Further strength has likewise developed in iron and steel, which are more firmly held or show further advances. Premiums on quick delivery are now almost universal, and contracts far in 1906 are announced for both crude and finished product. The leading implement concerns have bought freely at the West, with sales of 150,000 tons, one third of which was taken by the leading harvester manufacturers. Among the other metals copper has eased slightly on less active demand, Lake closing at 16⅜c. Export trade in all kinds of grain and flour shows expansion. Prices of nearly all commodities are strong or tend upward, reflecting insistent demand. The use for money is still growing. The only flaw in the situation is the growing inability of the railroads to handle the freight offered, and the complaint is practically universal. Railway gross earnings in September were very heavy, increasing 6 per cent over the corresponding month last year, while for the nine months of the calendar year the gain over the corresponding period last year reaches 6.4 per cent. Many individual roads show heavy increases. Lumber, hardware and building material are bringing very high prices. *Bradstreet's* reports 183 business failures during the week, against 189 the week previous and 196 the corresponding week last year. The liabilities of commercial insolvencies during the third quarter of the year are reduced.

LARGE ORDERS FOR RONEY STOKERS.—Three orders of large size have recently been received by the Westinghouse Machine Company, of East Pittsburg, Pa., for its Roney mechanical stoker. One order from the Jones & Laughlin Steel Company, of Pittsburg, Pa., calls for sixteen 114 x 24-inch grate stokers; one from the Lehigh Valley Traction Company, of Philadelphia, Pa., calls for eight 130 x 20-inch grate stokers, and another from the Pressed Steel Car Company, of Pittsburg, Pa., covers six 100 x 20-inch grate mechanical stokers. These stokers are of the inclined rocking grate type with removable fuel plates, and are provided with the actuating mechanism for automatically controlling the motion of the grate bars and the supply of fuel. They will be capable of burning low grade bituminous coal efficiently and without smoke. In addition to these orders, smaller ones have been received from the Brown Shoe Company, of St. Louis, Mo.; the Water, Light & Gas Company, of Hutchinson, Kan.; William Wanton Dunnell, of Aponaug, R. I.; Pennsylvania State College, State College, Pa.; Pennsylvania Heat & Power Company, Wilkinsburg, Pa.; Merchants' Light, Heat & Power Company, Canton, O.; Schlitz Brewing Company, Milwaukee, Wis., and the United Shoe Machinery Company, Beverly, Mass.

LONG TROLLEY IN MISSOURI.—The St. Louis, Hillsboro & Southern R. R. Company is about to take bids for the equipment, etc., as well as the construction of the line. The road, which will be about 40 miles in length, will run through the foothills of the Ozark Mountains from South St. Louis to Hillsboro, the county seat of Jefferson County, Mo. The company is incorporated for $1,200,000, the bond issue being $1,000,000. It expects to start grading at once. The equipment will consist of steam and water power. The road will be standard gauge, and the company intends to do freight, express and passenger business. Mr. Henry M. Bowen, formerly with H. M. Byllesby & Co., of Chicago, is the general manager, with offices at 415 Locust Street, St. Louis. The financial part is all arranged for. It is the intention to extend the line 168 miles further south than the present terminus, through a rich lead, zinc, coal and timber country.

RECENT STURTEVANT SALES.—Among recent sales of mechanical draft equipment made by the B. F. Sturtevant Co., Boston, Mass., are those for the boiler plant of the Baltimore & Ohio R. R. Company, Chillicothe, Ohio; Chesebrough Manufacturing Company, Perth Amboy, N. J.; Hillside Coal & Iron Company, Mayfield, Pa.; Castle Realty Company, New York City; Diamond Ice Company, Wilmington, Del.; Athens Water Works, Athens, Ohio; St. Paul Gas Light Company, St. Paul, Minn. The Boston Elevated Railway is to replace its present somewhat antiquated design of economizers by large machines of special construction manufactured by the B. F. Sturtevant Co. Two of these will be installed at the central power station on Albany Street and the third at the East Somerville power station.

THE CANADIAN WHITE COMPANY, LIMITED, has been awarded the contract for erecting at Hamilton, Ont., the new head office building for the Federal Life Assurance Company. Messrs. Finley and Spence, of Montreal, are the architects. This building will be an eight-story, modern steel construction, fireproof office building, and will represent the latest type of building of this class. The White Company has the entire contract, and will have the building ready for occupancy not later than August 1, 1906. The company has also been awarded the contract for the construction of the street car sheds for the Montreal Street Railway Company. Messrs. Marchand and Baskell are the architects.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Sonora, Ky.; Minneapolis, Minn.; Moosminsaskhechewan, N. W. T.; Pattersonville, N. Y.; Des Moines, Ia.; Seward, Ill.; Sublette, Ill.; Little Valley, N. Y.; Beloit, Kan.; Milbank, S. D.; Wheeling, W. Va.; Linn Grove, Ind.; Brooten, Minn.; Abbott, Tex.; Vertrees, Ky.; Fayette, Idaho; Hammonton, N. J.; Chenoa, Ill.; Tiskilwa, Ill., and Swedesboro, N. J.

POWER FOR BILLIARD FACTORY.—The Brunswick-Balke-Collender Company, Chicago, one of the largest manufacturers of interior finishings, store and office fittings and billiard tables, is about to build two large plants, involving an expenditure of $700,000, at Muskegon, Mich., and at Long Island City, N. Y. The Muskegon plant will comprise a power house 50 x 100 feet, with 300 hp in boilers and 250 hp in engines, dynamos, motors and other electrical power units. The plant at Muskegon will be used exclusively for the manufacture of billiard tables.

NATIONAL CARBON.—A financial dispatch from Chicago says: The directors of the National Carbon Company will meet in Cleveland about October 20. The regular quarterly dividend of 1¾ per cent on the preferred stock will be declared, but the question of paying another dividend on the common is not decided. The company paid 1½ per cent on the common stock last January, but the surplus left after this payment was small as shown in the last annual statement. There is a strong local opinion that the surplus of the company should be increased.

COAL MINING PLANT.—The Rock Island Coal Company, Hartshome, I. T., is to install the following equipment at its mines: 100-kw electric plant, including engine, 125-hp return tubular boiler and two chain mining machines, at Mine 7, Hartshome; additional 100-kw electric plant, including engine, two 125-hp return tubular boilers, box car loader and conveyor to boiler room, electric locomotive and slope hoist. Mr. Edward H. Coxe is superintendent.

PLANT FOR PITTSBURG TROLLEYS.—Mr. L. E. Safford, manager of the Pittsburg office of Clark Brothers & Company, of Belmont County, N. Y., has an order from the Pittsburg & Allegheny Valley Street Railway Company for two 660 hp gas engines and one 250 hp gas engine, direct-connected to two large electric generators for a large power plant to be erected by the street railway line at Leechburg, Pa.

VENTILATION OF BUILDINGS.—The two most important buildings being erected in the retail districts of New York and Chicago are to be ventilated throughout by American Blower Company apparatus. Eighteen large fans and heaters and tempering coils containing an aggregate of about 60,000 feet of one-inch pipe will be used in equipping the Altman Building in New York and the Marshall Field Building in Chicago.

BIDS FOR FIRE ALARM SYSTEM.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until November 28, to furnish at the Mare Island Navy Yard, Cal., an auxiliary fire alarm system. Blank proposals will be furnished upon application to the navy pay office, San Francisco, or to the Bureau. Address H. T. B. Harris, Paymaster General, U. S. N.

BIDS FOR REMODELLING PLANT.—Bids will be received until October 24 by the Department of Correction, New York City, for furnishing material and installing a new switchboard and remodelling the electric light plant in the power house on Hart's Island. Address Francis J. Lantry, Commissioner.

MOTORS FOR CHICAGO.—The South Side Elevated has ordered eighty electric motors from the Westinghouse Electric & Manufacturing Company.

AMERICAN LOCOMOTIVE.—Mr. C. A. Coffin, president of the General Electric Company, and E. C. Converse, a director of U. S. Steel and active in the affairs of the Allis-Chalmers Company, have been elected directors of the American Locomotive Company, succeeding Geo. W. Hoadley and W. Seward Webb. Adams, of the Boston News Bureau, says: "A director of the Lake Shore states that in his opinion every steam locomotive at present in use will be in the scrap heap in 1910. This explains in large measure the recent activity in American Locomotive stock. Much of the recent buying has been for the account of General Electric people, and at the next meeting General Electric interests will be elected to the directorate. The importance of the substitution of electricity for steam as a motive power to the copper and steel trades is too tremendous to be appreciated by the ordinary mind. Copper and steel men are as vitally interested as the railroad men. There will be a ready market at good prices for every pound of copper that can be taken from the ground in the next few years, and it is difficult to see what it is to prevent the greatest boom in the steel trade next year that we have ever known."

NEW FACTORY FOR NATIONAL-ACME.—Plans are being prepared and building operations will commence at once on a four-story (with full basement) brick and steel factory addition to the plant of The National Acme Manufacturing Company, at Cleveland, O. It is hoped to have the building in readiness for occupancy early in 1906. The four-story addition built during the past summer afforded only slight and temporary relief to the crowded condition of all departments, and the present capacity will be more than doubled when the improvements under way have been carried out. The company builds "The Acme Automatic," the only multiple spindle screw machine on the market, and manufactures also the product therefrom. The field for the machines is world-wide, recent orders having been booked for deliveries to Europe, Asia and South America. The demand which has been created both for these machines and their product is well reflected in the rapid and substantial growth of the business. The company maintains branch offices in New York, Boston and Chicago, and is ably represented in Europe by Messrs. Schuchardt & Schutte and Alfred H. Schutte.

STEADY WATER POWER WANTED.—The De Lamar's Copper Refining Company, of Chrome, N. J., is considering the installation of an electrochemical industry in the Middle West, and is looking for a desirable location near some company that has a hydro-electric power plant and can furnish current for the purpose. The location should be somewhere between Kansas City, Chicago and St. Paul. The amount of power required is not over 500 kilowatts, but this would be a steady load 24 hours and 365 days a year. We should be glad if any of our central station or power plant readers who can meet these requirements would communicate with Mr. H. A. Prosser, general manager of the company.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has been awarded a contract for the construction of a complete electrical subway system for the Dayton Lighting Company, Dayton, O. This plant has recently been acquired by new interests, who are rebuilding and re-equipping the entire plant. The contract given to Mr. Gest is for subway installation for the whole city, covering 20 miles of streets, and involving over one million feet of conduit. The system is to be modern and up-to-date, the amount involved being in the neighborhood of $250,000.

ADDITIONAL EQUIPMENT FOR IRRIGATION PLANT in Guanica, Porto Rico, consisting of a 320-hp Fitchburg engine, 250 kw 6,600-volt General Electric generator, transformer, motors, rotary converter and switchboard, and Walker Electric Company panel boards have been purchased by the Guanica Centrale, 44 Wall Street, for addition to its large high-tension electric transmission plant installed in 1902 by Percival Robert Moses, consulting engineer, 320-322 Fifth Avenue, New York City.

PRICES OF STEEL SHAFTING.—Representatives of concerns manufacturing steel shafting met last week and made no change in the present schedule of prices. The members reported that the demand for shafting and other machinery is very active.

THE IDEAL STOKER, 114 Liberty Street, New York, has secured a contract for the installation of Ideal stokers at the Bayonne, N. J., works of the Para Recovery Company.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was quiet and dull, speculative interests having apparently regarded the warnings of leading bankers against maintaining a bull market in the face of narrow money conditions. Despite the continuance of high interest rates the money market showed a slightly better tone. There was some manipulative activity, particularly in industrial specialties, but the share market tended to settle lower. Considerable attention was paid to the traction group, the unfavorable annual report of the Metropolitan Street Railway system having apparently been discounted in advance. The United States Steel stocks, in spite of very favorable intimations regarding the current earnings of the corporation, eased off with the general list, but on Friday showed a strong tendency to recover. Common closed on Saturday at 38, which is a net gain of [illegible], and preferred at 104½, a net loss of a like amount. Metropolitan Street Railway dropped to 125, but regained some of the loss and closed at 12[illegible], which is [illegible] point below last week's closing quotation. Interborough Rapid Transit, on the curb market, made a net gain of 3[illegible] points on the week's business, closing at 214. Brooklyn Rapid Transit closed at 72¼, which was near the highest figure of the week for that stock, and a net advance of [illegible] point. Dullness characterized the electric securities. Allis-Chalmers, both common and preferred, lost a fraction in the net result of the week's trading, the former closing at 17⅝ and the latter at 60⅜. Little business was done in General Electric, which closed at 179[illegible], a net loss of 1 point. Westinghouse is 1[illegible] points lower than our last quotation, the closing price being 168. Western Union remains at almost the usual figure, the last quotation recorded at the close of the week being 93[illegible], and Mackay Companies is ½-point less, the closing quotation being 46. The market for outside securities was irregular as to prices, and there was a continued heavy trading in bonds. There was another break in Chicago Subway. The general list was quiet, with some strength in copper shares. Most issues, however, were fractionally changed compared with a week ago. The closing quotations on the Stock Exchange on October 17 are given in the following table:

NEW YORK

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
Allis-Chalmers Co ...	17¾	17⅝	General Electric ..	180½	179
Allis-Chalmers Co. pfd	60⅜	59¾	Hudson River Tel		
American Dist. Tel.	32	33	Interborough Rap. Tran	213	214¾
American Tel. & Cable	92	92	Mackay Cos.... ...	46⅜	46
American Tel. & Tel.	138	137	Mackay Cos. pfd.	74¼	72½
Brooklyn Rapid Transit	71⅝	72¼	Marconi Tel		.
Electric Boat	30	30	Metropolitan St. Ry	127	125⅝
Electric Boat pfd.....	70	70	N. Y. & N. J. Tel.		
Electric Lead Reduction..		..	Western Union Tel	93⅝	93
Electric Vehicle.	16	15½	Westinghouse com.	167½	168
Electric Vehicle pfd..	23	23	Westinghouse pfd..........	..	.

BOSTON

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
American Tel. & Tel.	137⅛	137¼	Mass. Elec. Ry. pfd........	57	56
Cumberland Telephone ..	121	122	Mexican Telephone.	1⅞	1¾
Edison Elec. Illum.... ..	249		New England Telephone. .	136	138
General Electric..	179	179	Western Tel. & Tel.	14	14
Mass. Elec. Ry....	14	13¾	Western Tel. & Tel. pfd	95	95

PHILADELPHIA

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
American Railways...	52⅛	52	Phila. Electric	8⅞	8¾
Elec. Co. of America	11¼	11	Phila. Rapid Trans .	27¾	28⅛
Elec. Storage Battery	82	* 82	Phila. Traction...	....	.
Elec. Storage Battery pfd. .	.	.			

CHICAGO

	Oct. 11	Oct. 18		Oct. 11	Oct. 18
Chicago City Ry	..	..	National Carbon	61	.
Chicago Edison....	160		National Carbon pfd	.	
Chicago Subway.	..	41	Union Traction........	..	12⅜
Chicago Tel. Co ...		137	Union Traction pfd..	..	..
Metropolitan Elev. com		.			

* Asked.

YADKIN RIVER POWER.—T. W. Stephens & Co. Wall Street, New York City, are offering for public subscription $4,500,000 first mortgage 6 per cent gold bonds of the Whitney Company. The company was formed to build and operate a hydraulic power plant on the Yadkin River in North Carolina. There are some 257 mills within eight miles of the power house. The Whitney Company will supply 50,000 hp. The company is named after Mr. George I. Whitney, of Whitney & Stephenson, Pittsburg. Gross earnings of $630,000 are estimated, and operating expenses $97,000, which with interest on bonds of $270,000, would leave $263,000 surplus

MISSOURI VALLEY ELECTRIC COMPANY.—Official announcement has been made of the formation of the Missouri Valley Electric Railway with a capitalization authorized of $7,500,000, of which $5,000,000 is to be issued; and $7,500,000 of 5 per cent 30-year bonds, of which $5,000,000 is to be issued. This company will be controlled by Cleveland capital. The new line will run from Kansas City to St. Joseph, with connections into Leavenworth and Atchison. The total length of the line will be sixty-six miles. It is the intention to double track from Kansas City to Leavenworth, which will make the total length of track ninety-five miles.

MESSRS TUCKER, ANTHONY & COMPANY have just sold five electric traction properties in the Middle West, four to the United Gas Improvement people and one to Chicago & Alton Railway interests, and have successfully organized, or financed, built and managed twenty-eight different street railway, electric light and power companies in the past ten to twelve years. Of these twenty-eight properties, they have sold all but twelve, and it is a remarkable record that in every case the properties have been sold at a profit to the underwriters and the stockholders.

A JERSEY TROLLEY TUNNEL.—The Hudson Street Railroad Company has filed articles of incorporation in the County Clerk's office at Jersey City. The capital stock is $3,000,000 and the object of the company, as given in the papers, is to construct and operate street railway lines in Hudson County. The names of the persons interested and the directors and officers elected indicate that the company is a consolidation of the Morton and Cortlandt Streets tunnel interests and those allied with them in New York. At a meeting of the stockholders these directors were elected: Pliny Fisk and William M. Barnum, members of the banking house of Harvey Fisk & Sons; Walter G. Oakman, president of the Hudson companies which are building the tunnels; William G. McAdoo, president of the Hudson & Manhattan Railroad Company; Andrew Freedman, director of the Interborough Rapid Transit Company, and David Young, of Newark, a former official of the North Jersey Railroad Company. The directors elected these officers: President, William G. McAdoo; vice-president, Andrew Freedman; secretary, K. B. Conger; treasurer, William C. Kinney. The lines to be built by the company will connect with every town, city and township in Hudson County and will connect with the tunnels at Fifteenth Street and Exchange Place, Jersey City. President McAdoo gave out the following statement about the new company: "The Hudson Street Railroad Company was organized for the purpose of increasing and improving the local transportation facilities throughout the principal cities and towns of Hudson County, with a view to operating these lines in connection with the tunnels now being built under the Hudson River. The new lines are so planned as to tap the tunnels at points back from the water front, so that fast time can be made through the congested business districts in Jersey City and Hoboken, and this, coupled with the fact that the new lines will have superior track construction and most modern equipments, will result in reducing the time between the residential and business districts of New York and New Jersey, to practically one-half of that now required to get across the river."

INDEPENDENT TELEPHONE BONDS.—The United States Independent Telephone Company is putting $17,000,000 of its five per cent thirty-year collateral trust bonds on the market. This company proposes to combine a number of the prominent independent telephone companies of the country, and it also claims to have a franchise which will permit it to do a telephone business in the city of New York. The circular describing the bonds states that the company is capitalized at $50,000,000 and owns control of the New York Independent Telephone Company and the Stromberg-Carlson Telephone Manufacturing Company. It is also stated that 413,030 shares of the company have been issued or are under contract to be issued and that 412,970 of these shares will be deposited under a voting trust agreement for a period of seven years, and after the performance of all existing contracts there will remain 86,970 shares of stock unissued. The collateral trust mortgage is for $25,000,000, and the right to redeem the bonds at $1,150 and accrued interest per $1,000 bond at any interest period is reserved. Messrs. Haskins & Sells, certified public accountants, have made a report under date of September 23, 1905, covering the financial operation of the Stromberg-Carlson Telephone Manufacturing Company, from which it appears that the net earnings of the property for the year ending December 31, 1904, amounted to $864,469.18. It also appears from the report that the net earnings for the first six months of 1905 amount to $467,036.91. Messrs. Haskins & Sells estimate that the net earnings for the year 1905 will be approximately $900,000.

PADUCAH CONSOLIDATION.—The Paducah Light & Traction Company, formed by Stone & Webster, to take over the public untility concerns of Paducah, Ky., as noted last week, has an authorized capital of $2,000,000 five per cent thirty-year bonds, of which $575,000 is issued, $625,000 reserved to retire bonds of subsidiary companies, and $800,000 reserved for future improvements; $1,000,000 five per cent non-cumulative preferred stock, of which $600,000 is issued, and $1,000,000 common stock, all issued. This company will control the entire street railway, commercial electric lighting, gas and steam heating business of Paducah, Ky., which has a population of 28,000 and is a substantial commercial and manufacturing center in western Kentucky, 226 miles from Louisville, and 165 miles from St. Louis. Four divisions of the Illinois Central system have terminals and large shops there. There are 140 manufacturing plants in the city, and the agricultural territory tributary to it is particularly well suited to the growing of tobacco. It is estimated that a wholesale business of $10,000,000 per annum is transacted in the city. The street railway system consists of 12 miles, with adequate power house. The street railway franchise does not expire until 1924, the steam heating franchise in 1922 and the gas franchise in 1916. The financial plan provides for placing approximately $300,000 in the treasury of the company to be expended on improvements and additions. The securities of the company have all been underwritten.

NEW JERSEY TELEPHONE.—At a meeting of the stockholders of the New York & New Jersey Telephone Company on October 25 the proposal to increase the capital stock from $15,000,000 to $50,000,000 will be voted upon. It is certain that only a part of the additional $35,000,000 capital stock authorized will be issued; at the present time only $13,770,100 of the authorized $15,000,000 is outstanding. How much will be issued has not been decided. The reason for the increase is said to be the rapid development in business and the resulting necessity for large additions to the plant. Large stock interests in the company are held by the American Telephone & Telegraph Company and the New York Telephone Company. Charles F. Cutler is chairman of the board of the New York Telephone Company and the New York & New Jersey Telephone Company. The latter is sole licensee of the American Telephone & Telegraph Company for Brooklyn, all of Long Island, Staten Island and ten counties in New Jersey. The statement in the circular issued to stockholders contains the following paragraph: "Should the stockholders act favorably upon the recommendation of the directors it is their purpose to offer the new stock and the unissued stock to shareholders from time to time in proportion to their holdings in such amounts as the requirements of the business may demand." The stock is quoted around 170.

DIVIDENDS.—The Tampa Electric Company has declared a semi-annual dividend of $5 per share, payable November 15, to stockholders of record on Nevember 4. The directors of the Toledo Railways & Light Company have declared the regular semi-annual dividend of 1 per cent on the capital stock of the company. Directors of the Milwaukee Electric Railway & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable October 31. A regular quarterly dividend of 1¼ per cent has been declared on the common stock of the Columbus Railway Company, payable on November 1. The directors of the Michigan State Telephone Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable November 1. The Union Traction Company, of Troy, N. Y., has declared the regular quarterly dividend of 1¼ per cent. A semi-annual dividend of $2.50 has been declared by the Edison Electric Illuminating Company, of Brockton; also a semi-annual dividend of $4 by the Lowell Light Corporation.

A LONG TROLLEY.—The Buffalo & Rochester Traction Company, incorporated at Albany with $3,500,000 capital, has for its purpose the construction of an electric road from Depew to Rochester. The company has obtained control of the Buffalo and Depew road, and will extend this line for 60 miles, taking in Batavia, Leroy, Caledonia and intermediate points. Herbert B. Bissell, a director of the company, says: "This road has nothing to do with the New York Central, and that railroad has no interest in our company whatsoever." Mr. Bissell has been prominent in other trolley and street railway enterprises.

CHICAGO TELEPHONE.—Advices from Chicago say: "Reports that Chicago Telephone will increase its dividend rate are denied by officials. It has extended its business by 19,000 telephones since January 1, and has now in operation 135,494 stations. The present payroll of over 5,000 employees is the largest in the history of the company. The next annual statement will be excellent, but operating expenses will show the effects of the higher cost of copper and all raw materials."

PACIFIC GAS & ELECTRIC COMPANY.—The Pacific Gas & Electric Company, with a capital of $30,000,000, has been incorporated in California. This is the company formed by N. W. Halsey & Co., of New York, to take over the California Gas & Electric Corporation and the San Francisco Gas & Electric Company. The directors include John Martin, Frank G. Dunn, E. J. De Sabla, John A Britton, Cyrus Pierce, George W. Levis and L. Foster Young.

RAILWAY CO. GENERAL for the year ended June 30 shows as follows:

	1905.	1904.	1903.	1902.
Income for year	$38,215	$45,901	$75,532	$24,618
Expenses, rentals, taxes, etc.	14,473	7,482	7,445	6,748
Net profits	$23,742	$38,419	$68,087	$17,870
Previous surplus	124,377	85,957	17,870	......
Total surplus	$148,119	$124,376	$85,957	$17,870

NEW YORK CITY RAILWAY.—The annual report of the New York City Railway shows $20,888,124 gross earnings, but a deficit of $2,796,942. The mileage of track was 494 miles, of which 395 was electric. The company still operated 3,849 horses. The number of passengers carried was 420,225,742, to which should be added 191,693,530 transfers.

BULLOCK INCREASE OF CAPITAL.—The Bullock Electric Manufacturing Company, Norwood, Cincinnati, O., has increased its capital stock from $500,000 to $3,000,000, one-half of it being 6 per cent preferred stock.

General News of the Week

The Telephone.

SAN FRANCISCO, CAL.—The Home Telephone Company, of Alameda County, has won its fight in the Common Council for permission to bid on a telephone franchise in Oakland. Bids will be opened Dec. 4. Among the requirements will be the expenditure of $850,000 during three years after the franchise is granted, and giving a guarantee bond of $100,000, besides furnishing the city 50 free telephones. Another provision is that the city shall have the privilege of buying the plant on the expiration of the franchise. The company is composed of substantially the same persons composing the Home Telephone Company, of San Francisco.

CHICAGO, ILL.—The Chicago Telephone Company's monthly instrument statement shows a gain of 2,024 telephones installed during September.

TAYLORVILLE, ILL.—The Christian County Telephone Company has been organized with a capital of $10,000, by W. W. Taylor and W. B. Adams.

BLOOMINGTON, ILL.—A State association of the sub-licensees of the Central Union Telephone Company has been formed at a meeting at the St. Nicholas Hotel, under the name of the Illinois Sub-License Telephone Company. President, G. W. Schlosser, Gibson City; secretary, A. M. Howell.

CHICAGO, ILL.—The Chicago Telephone Company is completing the laying of its conduit system on the West Side. The work on the underground system will end at the corner of Galena street and Downer Place, where connection with the conduit leading from the exchange on the Island to River street, will be made. The conduits were laid in Galena street as far as Highland avenue, and down South River street and up to Lake street.

FRANKLIN, IND.—Louis Holwegg, president of the New Long-Distance Telephone Company, has purchased the Franklin Telephone Company's property and will make extensive improvements.

MILAN, IND.—The Milan Telephone Company, of Milan, Ripley County, has incorporated, with a capital stock of $1,000. The company will build an exchange and system in Milan and Ripley County.

ANGOLIA, IND.—The Steuben County Electric Telephone Company has increased its capital stock from $5,000 to $50,000, with a view of making improvements and extending lines to supply the demand for telephones.

TERRE HAUTE, IND.—The Citizens Telephone Company of this city has been sold to the Kinloch telephone people of St. Louis. W. P. Igams and Fred. Smith, principal stockholders, are said to have manipulated the deal.

FT. WAYNE, IND.—The Ft. Wayne Home Telephone Company has just issued a new directory which contains the names and numbers of 3,300 subscribers in the city, 230 on country roads and 152 at New Haven. The company now gives service to the farmers in every direction from the city.

PRINCETON, IND.—The Princeton Home Telephone Company has absorbed the Patoka exchange, with its 700 subscribers, and the Patoka exchange has been done away with. The Princeton Company is moving into a new exchange building where a new switchboard of large capacity has been installed.

EDENSBURG, IND.—The City Council has declined to grant a fifty-year franchise petitioned for by the Citizens' Telephone Company. The fact that the company's franchise has three years yet to run created a suspicion that the company sought an extended franchise with a view of selling to the Bell telephone people—a consummation the Council wished to prevent.

FLAT ROCK, IND.—Adam May is a patron of the Flat Rock Telephone Company. May's house was burned several months ago and at the time he had a telephone in his house. When he obtained other quarters, the telephone was placed there. When he rebuilt his house he notified the company to put in a telephone. The company refused to move the one from his temporary headquarters, and May has asked the Circuit Court for a writ of mandate to compel the company to put him in a telephone.

VINCENNES, IND.—It is not improbable that the Bell Telephone Company may obtain control of the independent lines in Knox County outside of Vincennes, because of the difficulty between the Vincennes Telephone Company and the different lines throughout the county. For some time past the Vincennes Company has been levying a tax of $2 per year for each telephone to talk to Vincennes subscribers, while it refused to be taxed for the privilege of talking with the outside company's patrons. The Bell Company, learning of this fact, has agreed to put in a free system, and this may result in the independent outside companies withdrawing from the Vincennes Company and becoming associated with the Bell.

INDIANAPOLIS, IND.—Upwards of $4,000,000 have been expended on improvements and extensions by the Independent Companies of Indiana during the present year. Among these improvements may be mentioned the entire rebuilding of the Shelbyville Mutual Telephone Company's plant; the large amount of new cable placed by the Crawfordsville Telephone Company; the extension of lines and installing of 500 new telephones at Columbus; the $15,000 expended at North Vernon, in the improvement and extension of lines; the installing of new circuits by the New Long-Distance Company to Franklin, Greenwood, Veedersburg and as far south as Bedford. The Lafayette Telephone Company is expending $75,000 on improvements, and Kokomo has added over 300 telephones and much new equipment has been installed.

GROVE, IA.—A new telephone line is being put through Grove by a company made up of farmers.

CELMAN, IA.—The Clinton County Telephone Company has been incorporated with $15,000 capital.

KIMBALLTON, IA.—The directors of the Marne & Elk Horn Telephone Company have decided to build several new lines.

MINEOLA, IA.—The Mineola Telephone Company has sold its plant to the Independent Telephone Company, of Council Bluffs.

ELKHART, IA.—The Farmers' Telephone Company, with headquarters at Dallas Center, Ia., will extend its lines by building a line from this city to Maxwell, the work to commence at once.

WATERLOO, IA.—J. R. Stewart has become associated with Messrs. Shoemaker and Parker as owner of the Traer, Reinbeck and Gladbrook Telephone exchanges and the toll lines belonging thereto. Mr. Stewart is president, James H. Shoemaker, of Waterloo, secretary and treasurer; Robt. L. Parker, of Gladbrook, manager. The new company will be known as the United Exchange Company, and is capitalized at $35,000.

IOLA, KAN.—The Missouri & Kansas Telephone Company will rebuild the local plant and convert it into a central energy system.

MATTAPOISETT, MASS.—A local company is to be formed in this town to establish telephone service.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company of this city has increased its capital from $2,000,000 to $3,000,000.

YPSILANTI, MICH.—The Ypsilanti Council has accepted the proposal of the Michigan State Telephone Company to place its wires underground.

BENTON HARBOR, MICH.—The Twin City Telephone Company in this city and the Bell Company in St. Joseph have decided to put their wires in the business portions of these two cities under ground.

MANISTIQUE, MICH.—Through the efforts of business men in Manistique and Escanaba, the Michigan State Telephone Company may be induced to undertake the construction of a long-distance telephone line this fall.

BEARDSLEY, MINN.—The Gopher State Telephone Company has increased its capital stock to $50,000.

HELENA, MONT.—The Rocky Mountain Bell Telephone Company is installing a central energy system here.

MOUNT WASHINGTON, MO.—The Missouri & Kansas Telephone Company will erect a telephone exchange at Mount Washington.

ST. LOUIS, MO.—Negotiations are under way at Detroit with St. Louis men representing the new United States Independent Telephone Company, for the taking over of the Detroit Independent Telephone Company, as a part of the merger of telephone lines in large cities from Kansas City to New York. C. Marquard Forster, president of the Kinlock Telephone Company; Max Koehler and Sam B. Jeffries, of St. Louis, are in Detroit to close the deal. A dispatch from Detroit states that in addition to taking over the old independent plant there, the St. Louisans will construct a large new plant, at a cost of $5,000,000. Among those interested in the deal are said to be, in addition to those named above, Thos. H. Wagner, J. H. August Meyer, Arthur W. Lambert, Henry Koehler, Jr., and at least one Kansas City capitalist, Joseph J. Helm, of the City Home Telephone Company. The company will be incorporated with a capital stock of $2,000,000.

TRENTON, N. J.—The Cream City Telephone & Telegraph Company has been formed with a capital of $125,000, by Norman Malcolm, of Chicago, and W. W. Dennison, of Orange, N. J.

NEW YORK, N. Y.—The West Valley Telephone Company has been formed with a capital of $3,000 by Christian Ehman and William H. Procter.

LITTLE VALLEY, N. Y.—The Citizens' Telephone Company, of this place, has been incorporated with a capital stock of $30,000. The directors are: S. N. Wheaton, A. F. Darrow and E. E. White, of Little Valley.

TICONDEROGA, N. Y.—The Ticonderoga Home Telephone Company has been incorporated with a capital of $25,000. The directors are J. A. McLaughlin, Putnam; R. N. Clemons, Dresden; D. C. Bascom, Ticonderoga.

PETTISVILLE, O.—Pettisville is soon to have a local telephone exchange as the Mutual Telephone Company has just been organized.

SPRINGTOWN, PA.—A new telephone company has been organized in this city to be known as the Franklin Telephone & Telegraph Company; capital, $500. It was incorporated by H. S. Funk, president, and H. H. Funk, secretary.

TERRELL, TEX.—M. A. Joy, of this city, has made application to the City Council for a franchise to operate a telephone system.

CANADIAN, TEX.—The Stockman Telephone Company has been organized with a capital of $250,000 by George Gerlack and D. N. Young.

WEATHERFORD, TEX.—The Riddall Telephone Exchange, which has been in operation here for the past two years, has been purchased by Charlie Clark and J. R. Thomas.

OGDEN, UTAH.—The Bell Telephone Company will shortly install a new $50,000 switchboard in this city.

SEATTLE, WASH.—The Sunset Telephone Company is to erect two buildings in Seattle to cost between $12,000 and $15,000. The laying of underground conduits and other work will represent an investment of at least $25,000.

BELLEVUE, WIS.—The Bellevue Telephone Company has increased its capital stock to $10,000.

MARINETTE, WIS.—The automatic exchange of the Wausau Telephone Company has been put into commission.

Electric Light and Power.

BENSON, ARIZ.—It is proposed to organize a company under the name of Benson Light & Water Company, with a capital of $[illegible]. Dean Merrill is interested.

CLIFTON, ARIZ.—The two large mining camps of Clifton and Morenci, [illegible], Arizona, are to have electric power to operate with smelters. The [illegible] Company, Grant, New Mexico, owners of the smelters, is preparing to undertake the project.

SAN FRANCISCO, CAL.—The Hecla Power Transmission Company's reserve steam plant at Butte, Mont., will be supplied with boilers and auxiliaries by Charles C. Moore & Co., of San Francisco. The Westinghouse Electric & Manufacturing Company will construct the generators.

SAN FRANCISCO, CAL.—Charles C. Moore & Co., of San Francisco, have secured a general contract amounting to about $[illegible] for the complete plant required by the Tonopah Mining Company of Tonopah, Nev. A [illegible]-stamp mill is provided. A great deal of the machinery, including the hoists, will be operated by electric power.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation is installing one of the three frequency-changers, which are to be located in the new gas-engine reserve plant near San Francisco. It is the intention to start up the new frequency-changer in November and deliver current to the railways so that the engines can be shut down in the Eleventh and Bryant Street power station, which is being converted into a substation.

SAN FRANCISCO, CAL.—The Bellingham Bay Improvement Company has sold to Stone & Webster, of Boston, its water rights, machinery and improvements at Nooksack Falls, Wash. The machinery, including two Westinghouse [illegible]-kw. three-phase generators for the 60-mile transmission to Bellingham, was ordered two years ago and stored at the power site. Stone & Webster, who control the Puget Sound Power Company's [illegible]-hp plant at Electron, Wash., will install one of the generating units at Nooksack Falls at once, spending about $200,000 on the transmission. Several additional units will be put in later, the ultimate capacity of the plant being 25,000 horse-power. The Bellingham Bay Improvement Company, which is controlled by D. O. Mills, spent about $[illegible] in preliminary work.

MAYO, FLA.—The Town Council has granted Clarence H. Ellis and associates a franchise for the construction of an electric light plant and water works.

COLUMBUS, GA.—The City Council is considering the cost of a municipal electric light plant.

MOUNT VERNON, ILL.—A largely attended meeting was held Oct. 2, to take action on the increased scale of charges made by the Citizens' Gas, Electric and Heating Company, for its utilities, the company having refused to adopt the scale of charges recently made by Ordinance of the City Council, which had come to the rescue of the people. The people will tender the old scale of charges. A committee of citizens has been appointed to represent the public and to defend any suit brought by the company, and public subscriptions will be taken up to pay counsel in case of litigation.

GREENWOOD, IND.—The Citizens' Water & Light Company has been incorporated at Greenwood, Ind., with $25,000 capital stock. The directors are David E. Demott, John W. Henderson and James A. Craig.

WEST TERRE HAUTE, IND.—The Town Trustees have granted the West Terre Haute Light & Power Company a franchise to construct and operate an electric light plant. Claude Erwin is one of the incorporators.

SCOTTSBURG, IND.—Messrs. Smith and Shea have been granted a franchise to construct a combined electric light plant and water works. Bids will be invited for the construction of the plant as soon as plans have been prepared.

MATTHEWS, IND.—The La [illegible] Glass Company is having installed in its factory an electric light plant of 500-light capacity. The work is being done by the Reynolds Electric Company, of Marion. The company is also installing steam pumps and a steam heating plant. Manager Strom says he will produce gas from coal at the factory for less than 12 cents per 1,000 cu. ft., the price paid for natural gas.

HUNTINGTON, IND.—The Huntington Light & Fuel Company is installing two 200-kw. 60-cycle, 2,300-volt General Electric generators and switchboard to replace its 125-cycle, 1,040-volt apparatus. The company will furnish current to the Erie Railroad for light and power in the shops at Huntington. The company has also just closed a contract to supply steam for heating the court house now being erected at Huntington.

CHARLES CITY, IA.—A. L. Dodd, of Charles City, and F. O. Martin, of Floyd, have purchased the electric light plant and intend making improvements to it.

WEBSTER, IA.—Mr. R. B. Leroy, in behalf of outside capitalists, has offered the city of Webster, Ia., $[illegible] for the erection of water, heat, light and gas plants and a street car franchise.

FORT DES MOINES, IA.—Bids will be received by L. Hardeman, Quartermaster U. S. A., Fort Des Moines, until Nov. 6 for furnishing and installing electric light fixtures, watt meters, etc., transformers and wiring for electric lighting, in the buildings at Fort Des Moines.

LEWISTON, ME.—The Lewiston & Auburn Electric Light Company will make a further reduction in rates to all its customers, upon meter service. The reduction is from 10 cents per kilowatt hour to 9 cents per kilowatt hour.

ELLSWORTH, ME.—The City Council has taken action which will enable a company of which W. H. Buhler, of Boston, Mass., is the head, to build a dam across Union River. The company proposes furnishing power to the industries of Ellsworth, Bar Harbor and vicinity. The probable cost of the proposed plant is $1,000,000.

SOUTH HANSON, MASS.—[illegible] Gas & Electric Company, with W. L. [illegible] [illegible].

SOUTH HADLEY, MASS.—The Holyoke Water Power Company, of Holyoke, has petitioned the selectmen of South Hadley for permission to erect poles and string wires from Holyoke to South Hadley Center.

CADILLAC, MICH.—The Cadillac Water & Light Company has been [illegible].

GRAND RAPIDS, MICH.—Bids will be received by the Board of Public Works until Oct. [illegible] for a direct-connected unit consisting of engine, alternator and exciter. [illegible] Secretary Saml. A. [illegible], and will be forwarded on application.

BELLE PLAINE, MINN.—The Council has voted to install a municipal light plant.

LEROY, MINN.—The electric light plant, recently destroyed by fire, will not be rebuilt until spring, but it is stated that a dynamo will be installed in the mill to furnish current in the meantime.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company is preparing to place its wires underground in this city.

COLLINSVILLE, MO.—The Collinsville Gas, Electric & Refrigerator Company, of Collinsville, Mo., has been incorporated by Chas. E. [illegible], of Belleville, John H. [illegible] and W. E. Hadley, with a capital of $50,000.

CHATHAM, N. B.—The town will apply to the Legislature for power to issue $[illegible] bonds for the construction of an electric light plant.

GRAND ISLAND, NEB.—The Grand Island Electric Company has been incorporated with a capital of $[illegible] by Arthur F. Vila, G. H. [illegible], Irving F. Baxter and others.

RENO, NEV.—The entire territory north of the Southern Pacific tracks and the town of Sparks has been placed on the distributing system of the old Washoe Power & Development Company, and soon all customers in Reno will be using current from the plant of the old Washoe Company, near Laughton's. As soon as the transfer is made the city of Reno will take its entire current from this plant. The substation of the Reno Company in the western part of the city will be closed down and the Floriston power will be used all together for Carson, Virginia and other towns in that section.

KEENE, N. H.—The stockholders of the Citizens Electric Company of this city have voted to increase the capital stock of the company from $35,000 to $50,000.

ATLANTIC CITY, N. J.—The City Council has granted the Atlantic City & Suburban Electric Company a franchise to supply light, heat and power.

ALBANY, N. Y.—The Tremont Mills Utility Company, of New York, has been incorporated with a capital of $500, to supply electricity for light, heat and power. The directors are: S. K. Jacobs, C. A. Jacobs and E. L. Jacobs, of New York.

ROCHESTER, N. Y.—The purchasing agent has been directed to procure estimates of cost of an electric light plant for the court house. The work has not yet been authorized. W. Gillette is the clerk of the Board of Supervisors.

SYRACUSE, N. Y.—The Syracuse Lighting Company is about to close a contract with the Niagara Falls Power Company for [illegible] horse-power. It is said that this is done for the purpose of forestalling competition. The transmission company, which is now engaged in securing rights of way, has reached as far as Monroe County. By March 1, power from Niagara Falls is expected to be operating the Rapid Transit railway system in Syracuse, where a large sub-station will be built.

OBERLIN, OHIO.—The Oberlin Gas & Electric Company has been taken out of the receivers' hands and refinanced by J. C. Hill, of Elyria; A. E. Hay, of Oberlin, and others. The company will install a heating plant and will make important improvements to the lighting plant.

ROSEBURG, ORE.—The citizens have voted to issue bonds for an electric light plant and water works.

ALBION, PA.—The question of constructing water works and an electric light plant is under consideration here.

ANDERSON, S. C.—Jos. E. Sirrine, of Greenville, has prepared plans for the electric power plant which is to be constructed at Hatton Shoals on Tugalo River, to develop 5,000 horse-power for the Hatton Shoals Company, of which R. S. Ligon, of Anderson, is president.

GAFFNEY, S. C.—The fine water power—Gaston Shoals,—on Broad River, near Gaffney, it is reported, will soon be developed. It was recently sold to John B. Cleveland, of Spartanburg, S. C., and others by the Gaffney Manufacturing Company. Electrical power for several towns will be available.

CHATTANOOGA, TENN.—The contract, together with the $100,000 bond which have been made between the Chattanooga Tennessee River Power Company and the Government for the building of the lock and dam for the power plant on Tennessee River, it is stated, have been approved by the War Department. [illegible] [illegible], New York, N. Y., is the consulting engineer.

ORANGE, TEX.—The Orange Ice, Light & Water Company has been incorporated with a capital of $60,000, by Saml. C. Trimble, W. H. Stark and F. B. Curry.

COALVILLE, UTAH.—A power plant of [illegible]-hp capacity is projected in this city by the Intermountain Electric Company, the plant to be auxiliary to those already in operation in the Cottonwoods. The new plant will furnish electrical energy for practically all the towns in Summit County. The company has a capitalization of $1,500,000.

PROVO, UTAH.—The Telluride Power Company contemplates the early establishment of a second electric power plant, to be located at a point on the Duchesne. The plan is to provide electrical energy for mining purposes and also for distribution in Salt Lake, Park City, Mercur, Eureka, Price and Bingham. The company has made application to the state engineer for 61 feet of water in the Duchesne.

MONTPELIER, VT.—The Bolton Falls plant of the Consolidated Light & Power Company is to be doubled next spring. The present capacity is 2,000 horse-power and water turbines and machinery will be put in to make the output about 4,000 horse-power.

TACOMA, WASH.—The Nisqually Power Company has been incorporated with a capital stock of $[illegible], by R. L. McCormick, Geo. S. Long and others. The company's saw mill will be operated by electricity.

LA BARCA, MEX.—Francisco Castellanos proposes to establish an electric light and power plant at La Barca.

VERA CRUZ, MEX.—An electric power plant will be installed on the Laguna de Catemaco, State of Vera Cruz, by Juan Simon Rodriguez.

CITY OF MEXICO, MEX.—Ignacio Sardana will install a large electric power plant on the Rio del Salto. He has made application to the federal government for a concession.

CULIACAN, MEX.—Diego Redo will install an electric power plant on the Tamazula River, in the State of Sinaloa. The power will be transmitted to industries and towns of that section.

SAN IGNACIO, MEX.—Jose H. Rico, president of the Guadalupe de los Reyes Mining Company, has made application to the federal government for a concession to install and operate a large electric light and power plant near San Ignacio.

CITY OF MEXICO, MEX.—Luis F. Reyes, of the City of Mexico, will establish an electric power plant in the State of San Luis Potosi, at a waterfall on the Los Naranjos River. The electric power will be transmitted a considerable distance.

CORDOVA, MEX.—George G. Bergman, of the City of Mexico, has applied to the federal government for a concession to install a large electric power plant on the Blanco River, near Cordova. The electric current will be transmitted to towns and industrial centers in that region.

GUADALAJARA, MEX.—Compania Industrial de Guadalajara, which operates two electric power plants situated on the Santiago River, near Guadalajara, will compete with La Electra Company for business of furnishing electric lights and power in Guadalajara. It is stated that its plants will be enlarged and other extensive improvements made.

MERIDA, MEX.—The Merida Electric Light Company and the City Council are involved in a dispute over the delay by the company in placing its wires underground. The Council has informed the company that if it does not fulfill its obligations in the matter within six months the Council will proceed to bury the wires and charge the work to the company. Furthermore the company will be fined for its delay.

VERA CRUZ, MEX.—H. B. Tanner, of Indianapolis, Ind., and associates have purchased 30,000 acres of land in the State of Vera Cruz, which they will cultivate in sugar cane. Contracts have been awarded for machinery for a [illegible]-ton sugar refining plant, to be operated by electricity, developed from water power. From 5,000 to 10,000 horse-power will be developed and about $400,000 expended for mill and power plant.

MONTREAL, QUE.—A by-law is before the City Council requiring that all overhead electric wires in the city be put underground.

The Electric Railway.

BIRMINGHAM, ALA.—The city of Bessemer is about to grant a franchise to the Birmingham Railway, Light & Power Company to continue its electric car lines to the town of Jonesboro, five miles beyond Bessemer. The line will then be 23 miles in length.

WASHINGTON, D. C.—A. H. Simms, of Washington, will apply to Congress at its next session for a charter for a new electric railway in the District of Columbia. The proposed road will run through the city and northeastern suburbs and will be about 12 miles in length.

DOVER, DEL.—All the rights, privileges and appurtenances belonging to the Delaware Electric Traction Company, incorporated here some years ago with the intention of constructing an electric railway from Smyrna to Milford, Del., were turned over to new directors who will, within a few days, secure a new certificate of incorporation under the name of the Smyrna, Kent County & Delaware Bay Traction Company. The new board of directors organized by electing [illegible], president; Dr. Thomas C. Moore, secretary; Alfred Tilghman, treasurer. As soon as the preliminaries are completed, a certificate of incorporation will be filed with the Secretary of State, which will give the new company power to begin the construction of the road.

LA SALLE, ILL.—The Illinois Valley Railway Company is building 7 miles of line from Marseilles to Seneca, and is surveying and expects to construct [illegible] miles next spring in a westerly direction to Princeton.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has decided to extend its line from Robison Park to Garrett and Auburn.

INDIANAPOLIS, IND.—The Indianapolis Union Railway Company has approved plans for a heating and lighting plant for the union station, to cost about $75,000.

BROOKVILLE, IND.—The Richmond, Brookville & Cincinnati Traction Company has secured nearly all of the right-of-way through Franklin County and is now asking for a franchise in this city.

INDIANAPOLIS, IND.—The "Electric Cycle Line" is the name of an electric railway being promoted by J. N. Crabb and others to encircle Indianapolis. It is stated that a company is being formed to build the road.

COLUMBUS, IND.—Owing to the contention arising among farmers on either side of White River, it is thought possible that two interurban roads may be built in making the Seymour extension of the Louisville & Indianapolis line.

INDIANAPOLIS, IND.—The Keystone Construction Company, of Philadelphia, has [illegible] and taken over from George W. Townsend the contract for the construction of the Indianapolis & Western Electric Railway's line, between Indianapolis and Brazil.

WABASH, IND.—The Fort Wayne & Wabash Valley Traction Company, operating [illegible] miles of interurban road, has sent to farmers along the line an offer to furnish power to run the machinery on farms. The company proposes to furnish motors and build a line for a distance of one mile on each side of the track at cost, if farmers will agree to pay a reasonable sum per year for the power.

DALTON, MASS.—The Pittsfield Street Railway Company is negotiating with the Cranes of Dalton with a view of securing power with which to operate the line to the paper town. Messrs. Crane are constructing a fine new power plant which will be of great service to different enterprises in this region.

NORTHAMPTON, MASS.—A plan is being considered for building an electric railway through the Berkshires to this city and possibly to points farther east, so as to connect the eastern part of the State of New York, with the western section of Massachusetts. It is proposed to build the new system under an old charter which dated back to 1874, and which granted the Boston, Hoosac Tunnel & Albany Railroad rights to construct a road in this section. One of the projectors of the enterprise is J. J. Lape, of Rensselaer, N. Y.

SAULT STE. MARIE, MICH.—The Sault Ste. Marie & Les Chenaux Interurban Railway Company has been organized for the purpose of building an electric railway from Sault Ste. Marie to Cedarville, a distance of about 35 miles, and at that point it is expected that a connection will be made with a boat line running to the Les Chenau Islands and a connection with the Detroit & Mackinac Railway at Cheboygan. The company has not yet been incorporated. Hon. C. H. Chapman, Sault Ste. Marie, is one of those interested.

FLINT, MICH.—The power plant of the Detroit, Flint & Saginaw Railway at Bridgeport has been completed and the road is now operated with its own power, instead of depending on the Saginaw Valley Traction Company for power. The new power plant has a capacity of 500 kilowatts. Two engines, each of 350 horse-power, have been installed, and are direct-connected to generators of 250-kw each. These are Fleming tandem-compound engines. There are two boilers equipped to furnish superheated steam. In addition to the machinery already installed reserve space remains for another battery of two boilers and another engine.

DETROIT, MICH.—The Detroit-Bay City Traction Company has filed a trust mortgage for $3,000,000 to the Ross Construction Company, of Chicago, to cover a bond issue of that amount and has let a contract for the construction of the road, which will extend from Detroit to Bay City. A subsidiary company, known as the Wayne Construction Company, of Detroit, has been organized to carry on the work in Michigan. The contract calls for the completion of the road by Oct. 1, 1906. Construction work will begin at Bay City, run east to Akron and thence south to Caro. The entire length of the road will be 112 miles. The power house will probably be located at Lapeer and sub-stations at Pontiac and Caro. The officers of the company are: President, E. H. Whitcomb, Davenport; secretary, L. H. Rothwell, Detroit; treasurer, C. H. Christian, Detroit.

RAVENNA, O.—E. R. Merrell, acting for Cleveland parties, is securing right of way for an electric railway from Ravenna to Alliance, which will be eventually extended to Cleveland.

SANDUSKY, O.—It is reported that the Lake Shore Electric Railway is planning to build a line from Sandusky to either Clyde or Fremont. Another company is planning to build from Fremont to Sandusky.

ENID, OKLA.—The Enid City Council has granted a street railway franchise to Daniel S. Robert, of Baltimore. It is also proposed to connect the neighboring towns with interurban lines.

TYLER, TEX.—John A. Wallace, of Chicago, Ill., is promoting an interurban electric railway between Dallas and Tyler. The road will be about 125 miles long.

HOUSTON, TEX.—D. P. Shepard, of Houston, and associates have been granted a franchise to construct an electric railway over certain roads of the county, adjacent to the city of Houston.

SAN ANTONIO, TEX.—It is announced that sufficient funds have been subscribed by the people of Campbellton, Pleasanton and other places to insure the building of an interurban electric railway from San Antonio to Campbellton, a distance of about 50 miles. W. A. McCoy, of Campbellton, is promoting the enterprise. The road will carry both freight and passengers.

MINERAL WELLS, TEX.—At a meeting of the stockholders of the Fort Worth & Mineral Wells Electric Railway Company, which was organized here recently, the following officers were elected for the ensuing year: President, Cicero Smith; vice-president, D. M. Howard; secretary and treasurer, H. N. Frost; general manager, Albert Stevenson. It was decided to commence surveying a line to Fort Worth at once.

SOUTH BEND, WASH.—J. W. Mackenzie, of Portland, and L. M. Dooly, of Hoquiam, have applied to the City Council for a franchise for a street car line to run from South Bend to Raymond.

VANCOUVER, WASH.—Articles of incorporation of the Vancouver & Suburban Railway Company have been filed. The incorporators are W. H. C. Sugg, John H. Sugg, M. R. Sparks, E. E. Bend, E. M. Green, E. E. Waite and W. S. Wood. The capital stock is fixed at $2,500,000.

EL ORO, MEX.—El Oro Mining & Railroad Company has decided to install an electric power plant at a cost of $20,000.

AGUASCALIENTES, MEX.—The stockholders of the Aguascalientes Street Railway Company have ratified the proposition to increase the capital stock to $500,000. The officers elected were: Leon Sigonet, president; John Douglass, vice-president and general manager; Dr. Guadalupe Ortega, secretary and treasurer.

Obituary.

JOHN I. SABIN

MR. JOHN I. SABIN.—We noted last week at the moment of going to press the sudden death of Mr. John I. Sabin in San Francisco. It had been mentioned in our pages also a week or two ago that Mr. Sabin, who had not been well for some time, was contemplating a rest of some six months, it being his intention to go to Europe and to indulge in traveling, automobiling, etc. This holiday, however, was not taken soon enough to effect improvement in his health and save his life. Mr. Sabin was born in New York State on October 3, 1847. He entered the United States Army as a telegraph operator in 1864 and from the earliest period was noted as a skillful and talented electrician. The Pacific Coast attracted him as a field for effort, so that he became an operator for the Western Union Telegraph Company, in San Francisco, as far back as 1867. He had already secured advancement and prominence in the telegraphic field when the invention of the Bell telephone changed the course of life for him as it did for so many other young and energetic operators. He took an active part in organizing the pioneer Bell telephone system on the Coast in 1878, and the remarkable development of the telephone in that section of the country was in large measure due to his fertility of resource and combative, progressive spirit. On the death of Mr. Ladd, he succeeded to the presidency. By this time his work had become known far beyond the circles of the Bell telephone system. About five years ago the development of independent telephony in the Middle West had brought about a crisis in the affairs of the Central Union and Chicago Telephone Companies operating under the Bell patents, and it was felt that a strong man was needed to stem the tide and restore the "old line" companies to their former position. Mr. Sabin was selected for this onerous task and somewhat reluctantly moved from San Francisco to Chicago, where, as president of the Chicago Telephone Company from May, 1901, to May, 1903, he rendered brilliant and distinguished service, so that to-day the Bell system in Chicago is one of the first for rate of growth, magnitude and general efficiency. Mr. Sabin's health, however, was affected by the strain, and he does not seem ever to have been the same man since, although the administration of the great network of the Pacific States Telephone Company has shown no signs of weakness or hesitancy at any moment. In fact, it is claimed for it today that Mr. Sabin has secured the highest percentage of telephones to population to be found in the whole of the United States. Mr. Sabin was widely known in the electrical field outside of telephony, and was universally liked, there being a great fund of kindliness and good humor beneath the force and strength which enabled him to make so deep a mark on the telephone industry of America during its first quarter century. His loss will be seriously felt by his friends and in the councils of the organization that he served so faithfully and so wisely. Mr. Sabin's direct work is understood to have brought him a large fortune. The funeral was held Oct. 13 under Masonic auspices. The interment was private.

◆

Personal.

R. J. HAYWARD

MR. R. J. HAYWARD who has recently accepted the position of general manager of the Mexican Light & Power Company, City of Mexico, was graduated in 1885 from the University College, London, where he received instruction under Professor A. B. W. Kennedy. After graduation he entered the Crompton Works, at Chelmsford, England, where he served an apprenticeship of three years, and was afterwards appointed works superintendent, holding that position until 1894. In this year Mr. Hayward went to Salt Lake City, Utah, to take a position as general manager of the Salt Lake & Ogden Gas & Electric Light Company. In November, 1899, he was appointed electrical engineer of the Union Light & Power Company, its successor. When four years later this company was consolidated, the new corporation taking the name of the Utah Light & Railway Company, Mr. Hayward accepted the position of electrical engineer and retained the position until September last, when he resigned to take the management of the Mexican Light & Power Company. While with the Salt Lake plant Mr. Hayward interconnected widely-separated hydro-electric and steam power stations and operated them in parallel. A transformer station of 6,000-kw. capacity was erected to receive current from seven water power plants, whence it was transmitted to the city and there distributed for railway, lighting and power service. For a time Mr. Hayward maintained a separate office as consulting engineer in Salt Lake City and during this period his firm, Hayward & Grey, designed and erected the Bear River power plant for the Utah Sugar Company. He was also consulting electrical engineer for the Pioneer Electric Power Company, of Ogden, and was frequently consulted in connection with many of the large hydro-electric power projects in the Rocky Mountain States. In his new position as general manager of the Mexican Light & Power Company, Mr. Hayward will have direct supervision of nine power stations of the company and its transmission lines and large distributing system. About 100,000 horsepower is at present utilized or being developed from water-power and steam plants, including the large Necaxa station. The power is used for lighting and general power purposes, for the operation of the street railways in the City of Mexico, for pumping the city water, and for mining, while an increasing quantity is being used for heating and cooking service.

MR. R. A. SMITH, of the firm of Osler & Hammond, of Toronto, has been elected a director of the Commercial Cable Company.

MR. FRED. DE LAND is contributing to the Belle Vernon, Pa., *Enterprise*, a series of illustrated articles on the evolution of the subscriber's telephone, dating from the opening of the New Haven, Conn., exchange in 1878.

MR. W. [illegible] MARLAND has just moved from New York to Chicago to take charge of the Chicago office of the Gould Storage Battery Company. We can imagine no centre of restless activity where Mr. Marland would be more at home than the Metropolis of the West.

MR. J. M. WORDEN, who has been receiver of the electric light plant at Ladysmith, Wis., has given up all connection with the industry, and has gone into the general merchandise business. Mr. A. E. Foster is his successor.

MR. GEO. K. WOODWORTH, for the past four years the examiner in charge of wireless telegraphy and long distance telephony in the Electrical Division of the U. S. Patent Office, is now associated with Alex. P. Brown, Esq., of 31 State Street, Boston, Mass., under the firm name of Brown & Woodworth, attorneys at law. Mr. Woodworth will make a specialty of electrical patent matters in the Patent Office and in the U. S. Courts.

◆

Trade Publications.

GAS AND ELECTRIC PORTABLES.—Catalogue 26 of the [illegible] & Kintz Company, Winsted, Conn., is a profusely illustrated treatise on gas and electric portables, electroliers and newels.

MAGNETO TELEPHONES.—The Kellogg Switchboard & Supply Company, Chicago, Ill., has recently issued an extremely neat catalogue, designated as bulletin No. 8, dealing with magneto telephones. Each part which goes to make up a complete telephone set is described in detail and well illustrated, and the function of each is explained at length.

WATTMETER FOR TESTING PURPOSES.—The General Electric Company in bulletin No. 4420 describes the Thomson high-torque induction watt-hour test meter. This meter has been developed to meet a demand for some instrument by means of which tests may be made more quickly than with indicating instruments, and yet at the same time without in the least decreasing their reliability.

ELECTRIC DRILLS.—The Chicago Pneumatic Tool Company, 95 Liberty Street, New York, has just issued special circular No. 52, devoted to air cooled Duntley electric drills. These drills are constructed along entirely new lines. Each drill is equipped with three small motors within one casing, and is designed for operation from any incandescent lamp socket where the current is of proper voltage.

RAILWAY SWITCHBOARDS.—Bulletin No. 4417 of the General Electric Company treats at great length of generating station and substation switchboards for continuous-current railway systems operated from three-phase generators. In addition to the descriptive and illustrative matter dealing with the switchboards and their component parts, the bulletin contains eleven full-page diagrams of connecting circuits.

HIGH-EFFICIENCY INCANDESCENT LAMPS.—The General Electric Company, Schenectady, N. Y., has just issued bulletin No. 4419, dealing with the new 2.5-watt lamp. These lamps are now offered to the trade in three sizes designed to consume 125, 187 and 250 watts, respectively. It may be of interest to learn that these lamps are listed at a price which corresponds to the equivalent of about 7.5 cents per 16 candle power.

DIRECT CURRENT GENERATORS AND MOTORS.—The Northern Electrical Manufacturing Company, Madison, Wis., has issued a comprehensive catalogue, designated as bulletin No. 51, dealing with Northern ring-type generators and motors for power and lighting service. These machines are equipped with detachable pole pieces, which are bolted to a machined field ring. Each detail of the machine is treated at length and well illustrated.

MACHINE OIL.—An exceedingly clever advertising device has just been received from [illegible], [illegible] Centre Street, New York. A semaphore automatically indicates danger as the cover of a folder, on which is shown a locomotive, is opened, and one is directed to be sure he is right before going ahead. It is pointed out that poor oil is a danger signal, and advantage is taken of the opportunity to explain the good qualities of [illegible] mineral machine oil.

THE AMERICAN ARC LAMP COMPANY, of Kalamazoo, Mich., has issued a well-printed catalogue describing its enclosed arc lamps. This company is the successor to the Lea Electric Mfg. Company, formerly of Elwood, Ind. It has taken the old lamp and improved it, and it is claimed that the cost of maintenance has been reduced very materially, in some instances being cut to one-half. The lamps are made for direct-current circuits of 110 or 220 volts. They burn from 150 to 240 hours, depending on the style of lamp. The illustrations show different types of lamps, both standard and miniature, and an alternating current lamp in both sizes, besides some brass and copper covers. At the back of the catalogue are cuts illustrating the mechanism of the lamp, and calling attention to the self-locking switch with which the lamps are equipped. There is also con tained within the catalogue an interesting description of the mechanical features of the lamp grouped according to the things spoken of. The catalogue closes with a description of the Ideal arc lamp. It is an admirable publication and is worthy of careful reading by any one interested in the subject of arc lamp lighting.

News of the Trade

MR. EDWARD E. PIERCE, of Narragansett Pier, R. I., has purchased the construction business formerly conducted by John C. Petteplier, at Daytona, Florida, and will maintain both offices during the business seasons.

OSTHEIMER BROTHERS, Burd Building, 900 Chestnut Street, Philadelphia, are the representatives in the United States of the Wireless Telegraphy Company, Ltd. (Telefunken System) and are placing the apparatus on the market. They welcome inquiries as to apparatus, prices, instruction, etc.

AMERICAN TRANSFORMER COMPANY notes the removal of its factory to 143-153 Miller Street, corner of New Jersey Railroad Avenue, Newark, N. J. This change has been made necessary by the steady growth of its business and the company feel that with the increased space and conveniences acquired in the new building, even better results than in the past can be obtained.

THE SWITCHBOARD EQUIPMENT COMPANY, which recently moved to Bethlehem, Pa., was represented in New York City, last week, by Mr. C. C. Badeau, who came to the city on a business trip. The company has established an office at 30 Cortlandt Street, New York, in charge of Mr. H. M. Badeau, who is prepared to talk about the merits of the circuit breaker which this company makes.

SWISS CLOCKS.—The exhibit being prepared for next December by the Magneta Clock Company of Zurich, Switzerland, is bound to attract much attention not only because of the interest that will naturally be aroused by a Swiss exhibit at the New York Electrical Show, but because of the many interesting features of its electrical time control which will be graphically illustrated by many sectional models.

THE VANDYCK CHURCHILL COMPANY is hard at work preparing its very interesting exhibit for the Madison Square Garden Electrical Show. It will be on hand with a widely assorted line of up-to-date motor-driven machine tools. The interesting part of this exhibit is that the Vandyck Churchill Company will make the exhibit practical by showing all its tools in actual operation with machinists running each tool and turning out the product exactly as it could be seen in an up-to-date machine shop. Needless to say, the tools it will show will be of the very latest design.

THE L. B. ALLEN COMPANY, 1332 Columbia Ave., Chicago, Ill., has experienced so good a business that it has found it necessary to make another increase in its capacity for manufacturing the Allen products. These include a soldering stick, a soldering paste, soldering salts and a commutator compound. The Allen products have been on the market for a long time. They have given so much satisfaction, as evidenced by continued orders from old customers, that the Allen Company has found it rather a consistent thing to increase its quarters at regular periods.

THE NEW YORK TELEPHONE COMPANY is busy perfecting plans to extend the scope of its exhibit at the Madison Square Garden Electrical Show. Beside the huge Bell sign, studded with purple-blue incandescent lights, which will surmount the center space in the Garden, and the model switchboard exhibit, it is now understood that the telephone people will add as a further attraction a line of theatrophones. This feature will possess great novelty to the New York public who have rarely had the opportunity of listening "on tap" to a dozen different plays and operas over the telephones.

KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, Mr. J. F. Stevens, president, will hereafter be represented in New York by Mr. Arthur Orquan, with headquarters at 114 Liberty Street. This gentleman is well known to the electrical trade in New York, and is familiar with the Keystone apparatus. He is supplied with a complete set of samples and literature, and bids fair to meet with great success in his efforts to sell these instruments. The company is planning for active representation in every large city in the country, and has already arranged to cover several points. It is also in press a new catalogue to supplement, but not to replace, No. XII.

MOLONEY ELECTRIC COMPANY, of St. Louis, Mo., well known as successful manufacturer of transformers of all sizes for all classes of electrical work, has appointed the Electro-Dynamic Company, of Hanover Building, 11 Pine Street, New York City, as its Eastern representative. It is believed that this will lead to a large increase of sales of Moloney transformers in this part of the country, as the new agent for it is not only a standard and well-established concern, but has shown remarkable aggressiveness and energy of late years in the introduction of its own specialties, of which the "Interpole" motor is the latest. The Electro-Dynamic Company will welcome inquiries from all users of transformers in its territory.

NEW YORK ELECTRICAL SHOW.—We are asked to announce on behalf of the management of the Madison Square Garden Electrical Show in December that it cannot any longer guarantee reservation of space to intending exhibitors. In explanation of this stand it reports that it has on hand enough applications for reservation to fill the Garden twice over, and in justice to itself and to the exhibitors who have already signed contracts for their space it feels that it is now necessary to establish the rule of "First come, first served." Substantial progress is reported by the managers of the show. During the past week the Electro-Dynamic Company, Magnet Wire Company, Waterbury & Co., Vandyck Churchill & Co., Gold Car Heating Company, all of New York, the Stowe Mfg. Company, of Binghampton, N. Y., and the Magneta Clock Company, of Zurich, Switzerland, have added their names to the already long list of concerns that have signed contracts for space at the Garden.

THE RYDER WIRE & FIBRE MFG. COMPANY, of New York, was recently incorporated with a capital stock of $200,000 to manufacture all kinds of wire and fibrous fabrics, iron steel and copper wire rope and insulated wire. The president and treasurer of the company is G. L. Valentine, who was formerly president and treasurer of the Magnet Wire Company. The fabrics will be manufactured under the patents covering products and machines of H. Ryder, who is vice-president of the company and who was formerly manager of the Ryder Belt & Cordage Company, Buffalo, N. Y. The wire rope the company purposes to produce will be made by a new process by which the torsion is entirely eliminated, and it is claimed that by this method the strength and lasting qualities of the rope is increased about 10 per cent. The materials the company will manufacture will be made of fine wire, about which is spun fibre, and when these fine strands are woven into either a rope or a covering for any material which undergoes a high pressure or hard usage the strength and lasting qualities are doubled. In making such specialties as air brake coupling hose, fire hose, automobile tires, etc., the strength is increased fully 100 per cent. For automobile tires it is especially valuable in that it makes the tire puncture proof and at the same time will stand a very high air pressure and on account of its rough surface will overcome skidding.

EASTERN CARBON WORKS.—The manager of the Eastern Carbon Works, Mr. E. J. Wilson, reports that he is preparing for the Madison Square Garden Electric Show, to be held in New York from December 11 to 23, a complete line of their standard and general forms of carbon work which are now so favorably known in the electrical industry. A special feature of the exhibit will be the Eastern dry batteries, noted for high voltage, amperage, life, uniformity and efficiency, beside possessing exceptional recuperative power. These batteries are made in various forms for telephones, electric bells, annunciators, gas lighting, automobiles, launches, gas engines, and all similar work. The various carbon products of the firm are to be made the medium of a unique display. They include cylinders, porous cups, batteries, plates, discs, boxes, rods, smelting electrodes, brushes and various specialties. Very much in evidence will be the Eastern flash light, a handy little lamp which has earned for itself a reputation in many fields. No up-to-date night watchman would now think of going his rounds without one, and on railroads and in many engineering capacities, employees are finding it equally indispensable. One interesting example of the great value of this carefully and effectively constructed appliance is its use by sportsmen. It is not only an essential part of the outfit of the automobilist, but it is in increasing request by hunters in deep forests and by campers on the mountain and by the seashore.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 10, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

800,885. ELECTRIC COOKING APPARATUS; Gustav Teuber, Laasphe, Germany. App. filed Apr. 27, 1905. A cooking utensil or kettle having a spiral resistance wire between the inner and outer walls. The inside wall is corrugated to register with the resistance spiral, which gives a larger heating surface.

801,199. PROCESS FOR THE PRODUCTION OF METALS OF THE ALKALI GROUP BY ELECTROLYSIS; Edgar Arthur Ashcroft, Weston, Via Runcorn, England. App. filed Oct. 3, 1903.

801,201. REVERSING SWITCH; Isaac F. Baker, East Orange, N. J. App. filed June 28, 1904. The shaft is spring pressed to a certain angular position, from which it can be moved in either direction. It carries an insulating sleeve upon which are two adjacent spiders which have conductors out of contact with one another, but which overlap so as to occupy a single plane of rotation. The stationary contacts are disposed around the casing within such plane.

801,214. SYSTEM OF MOTOR CONTROL; Frank E. Case, Schenectady, N. Y. App. filed July 2, 1904. The controller cylinder is connected to the handle by a spring and a magnet controlled detent permits movement of the cylinder only at a prescribed rate. A lever on the controller handle can be manipulated to lock the handle and cylinder together when desired.

801,224. AUTOMATIC ELECTRIC MOTOR STARTER; William M. Cumnaskey, Newark, N. J. App. filed July 20, 1904. The usual contactors are closed by springs when not opposed by more powerful magnets. The magnets are successively de-energized by a dashpot controlled switch, the action of which can be arrested at any desired point or contact of its series.

801,225. TROLLEY AND TROLLEY SUPPORT; Harry P. Davis, Pittsburg, and Christian Aalborg, Wilkinsburg, Pa. App. filed Jan. 3, 1905. (See Current News and Notes.)

801,226. TROLLEY FOR ELECTRIC RAILWAY VEHICLES; Harry P. Davis, Pittsburg, and Christian Aalborg, Wilkinsburg, Pa. App. filed Mar. 6, 1905. (See Current News and Notes.)

801,238. MEANS FOR CONTROLLING CIRCUIT BREAKERS; George H. Hill, Schenectady, N. Y. App. filed Aug. 8, 1904. A form of circuit breaker adapted to be located beneath the car remote from the controller. In addition to the usual overload trip there is another trip operated from the controller and also a resting a resetting magnet.

801,239. CONTROL APPARATUS; George H. Hill, Schenectady, N. Y. App. filed Mar. 1, 1905. Each of the contactors is directly controlled by an an dash-pot which permits the contactor arm to initially move quickly to avoid sparking. The contactor arm must make its full movement, however, in order to close an auxiliary switch which permits the actuation of the next contactor of the series.

801,243. ELECTRIC MEASURING INSTRUMENT; Frank Holden, Rugby, England. App. filed Jan. [illegible], 1904. A watt meter for large currents in which the field coils are formed of punched copper plates bolted together to form a multiple circuit across the terminals. The rotary member carrying [illegible] shunt coils is hung between the plates.

801,[illegible]. ELECTRICAL CONTROLLER; Henry D. James, Pittsburg, Pa. App. filed Feb. [illegible], 1905. In order to prevent a too rapid actuation of the controller, a solenoid is wound with differential coils, one of which is shunted across the armature terminals and the other across the applied e.m.f. Until the coils neutralize one another, a detent is not released which permits the resistance to be cut out.

801,250. SUPPORTING CLAMP FOR ELECTRIC CONDUCTORS; James R. Kearney, Topeka, Kan. App. filed Dec. 15, 1904. Support for two conductors at a right angle turn. Cross arms are secured to the usual post and carry insulators which respectively support the conductors and guy wires connected thereto.

801,25[illegible]. ARMATURE CROSS CONNECTION FOR ELECTRICAL MACHINES; Chester B. Mills, Wilmerding, Pa. App. filed Oct. 20, 1904. The cross connections are made at the end remote from the commutator and comprise both spiral and helical strips, each of which accomplishes a part of the angular advance through which the cross-connection must be made.

801,260. BASE CUP FOR INCANDESCENT LAMPS; William D. Packard, Warren, O. App. filed Sept. 14, 1903. In order to adapt very large incandescent lamps to the usual form of socket, a porcelain cup is formed to protect from the usual threaded shell, and the lamp is in-set into this cup.

801,261. ELECTRIC LIGHTING SYSTEM; Granville F. Palmer, Boston, Mass. App. filed Nov. 16, 1903. An arrangement for cutting out any desired set of lamps upon the line. At the different distributing stations a cut-out switch is provided which can be thrown from the central station by a special alternating current operating circuit. For this purpose a pawl and ratchet controlled switch is placed at each station which can be stepped into any desired position by successive impulses from the central station.

801,265. CONDUCTOR TERMINAL; Raoul Prugger, Wilkinsburg, Pa. App. filed Jan. 3, 1905. The terminals project in such a way that the castings which are used to connect the terminals with the line can be swung around so as to join both terminals to a single line wire if desired.

801,285. ELECTRIC CONTROLLER; Robert Wellens, Pittsburg, Pa. App. filed Dec. 29, 1904. The controller has the usual spaced segments, and a continuous ring concentric therewith. The carbon blocks constituting brushes on the controller arm are pressed against both by an equalizing lever.

801,287. MACHINE FOR TAPING COILS; George P. Whittlesey, Washington, D. C. App. filed Apr. 16, 1902. The transformer core is laid horizontally upon a wheel-shaped structure of which the spokes may be made to revolve when desired to turn the core through any angle. The winder occupies a fixed relation between certain spokes.

801,288. QUICK BREAK ELECTRIC SWITCH; Herbert C. Wirt, Schenectady, N. Y. App. filed Mar. 5, 1902. The switch blades are independent of the operating handle and connected thereto by a spring so as to become disengaged from their contacts with a snap after a certain movement of the handle.

801,296. PROCESS FOR THE PRODUCTION OF MOLDED BLOCKS OF SILICON CARBID; Friedrich Bolling, Frankfort-on-the-Main, Bockenheim, Germany. App. filed Mar. 14, 1905.

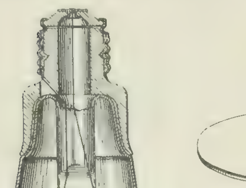
801,308. LOCK FOR AUTOMATIC TELEPHONE-SWITCH SHAFTS; John Erickson, Chicago, Ill. App. filed Dec. 31, 1904.

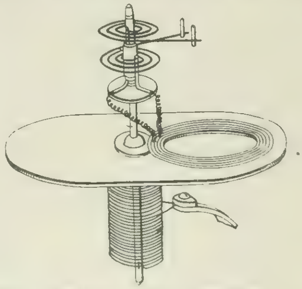
801,335. TROLLEY; Eugene J. Parker, Providence, R. I. App. filed Dec. 23, 1904. The connection of the harp and pole is made in such a way that the pole is substantially tangential to the front surface of the wheel. The purpose is to deflect guy wires and obstructions from catching upon the wheel. The wheel is also capable of a swiveling movement.

801,355. SELF PROPELLED VEHICLE AND METHOD OF CONTROLLING THE SAME; Ernst J. Berg, Schenectady, N. Y. App. filed Apr. 20, 1904. The vehicle has a gas engine generator which is connected in an unchanging circuit with the motors. For the purpose of regulating the speed of the vehicles the engine speed is also controlled. For heavy grades and bad roads the motors are thrown into series relation.

801,378. MANUFACTURE OF ARTICLES FROM FUSED MATERIAL; Edward Hart, Easton, Pa. App. filed Dec. 4, 1902.

801,394. SIGNALING; Francis L. O'Bryan, South Framingham, Mass. App. filed June 29, 1905. At each block of the system is a synchronous motor operated by a three-wire system. Each motor has a sliding gear whose position is controlled by a governor, and at a certain speed the gear at each block will mesh with the signal operating device. The signalling is done by varying the periodicity of the three-phase current.


801,260.—Base Cup for Incandescent Lamp.


801,419.—Electric Measuring Instrument.

801,419. ELECTRIC MEASURING INSTRUMENT; Elihu Thomson, Swampscott, Mass. App. filed Feb. 15, 190[illegible]. A watt meter having the usual damping disk with a flat coil thereon which lies wholly within the plane of the disk. The disk rotates in a narrow gap between permanent magnet pole pieces in the usual way.

801,467. ELECTRIC FUSE OR CUT-OUT; Benjamin S. Luther, Boston, and Leonard E. Buchanan, Woburn, Mass. App. filed Mar. 6, 1905. The usual tube or casing has an opening at one side in which is inserted a small charge of gunpowder and a plug. When the fuse blows the plug will be ejected in order to indicate the blow out.

801,487. CONTROLLER; Leonard A. Tirrill, Lynn, Mass. App. filed June 3, 1904. A controller particularly designed for cranes, etc., in which the cylinder has a resistance element wound directly thereon in a spiral form, and its rotation is effective to cut in or out a varying portion of the spiral.

801,480. PROTECTING METAL SURFACES; Friedrich Uthemann, Langfuhr, near Dantzic, Germany. App. filed Oct. 8, 1904. In order to protect the interior of copper tubes from the action of sea water, a network of iron is placed within the tube which itself corrodes away, but is effective to deposit a protecting oxide upon the copper.

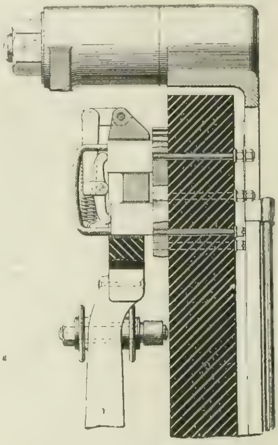
801,494. COVERING FOR CABLES AND SIMILAR DEVICES; Otto Wilhelmi, Kusnacht, Switzerland. App. filed Mar. 31, 1905. A protecting casing formed by weaving metal strips lengthwise through the cloth covering which project at intervals through the cloth in staggered relation.

801,500. SIGNAL SYSTEM; Valentin Chisholm, Rockland, Me. App. filed Apr. 14, 1905. An apparatus to enforce the employee to cross railroad track in front of his car and look out for approaching trains. A gate swings into the path of the approaching car which can only be raised by manipulating a device across the track.

801,532. DEVICE FOR INCREASING THE ADHESION BETWEEN WHEELS AND RAILS; Robert C. Lowry, Seattle, Wash. App. filed Dec. 5, 1904. Electromagnets are arranged to form complete magnetic circuits through the wheels and a portion of the track.

801,536. FACE PLATE FOR ELECTRIC SWITCHES; Norman Marshall, Newton, Mass. App. filed Jan. 19, 1905. A form of ornamental stock fixture which can be assembled in various ways so as to produce different kinds of switches, according to any specified requirements.

801,543. RAILWAY SIGNAL; Frank P. J. Patenall and George H. Dryden, Baltimore, Md. App. filed May 23, 1905. An opaque disk has a diametrical slot therein through which the light passes from a lamp behind the disk. The danger, caution and safety signals are respectively indicated by the angular position of the slot.


801,285.—Electric Controller.

801,588. TRANSFORMER CUT-OUT; John P. Hetherington, Logansport, Ind. App. filed Dec. 15, 1904. A motor is arranged in such a way as to throw the cut-out switch when the load on the transformer is reduced.

801,580. TRANSFORMER CUT-OUT; John P. Hetherington, Logansport, Ind. App. filed Jan. 4, 1905. A modification of the above in which the motor cuts out a large or small transformer according to the condition of the load.

801,637. ELECTRIC ARC LAMP; Emile Batault, Geneva, Switzerland.. App. filed July 19, 1902. The carbons approach one another by gravity until the arc is struck after which they are separated by a small hot air motor which is driven by the current of hot gases from the arc. The motor is locked against rotation when conditions are right, and released when the carbons burn away.

801,718. TROLLEY HARP; Charles L. Hooper, Rochester, N. Y. App. filed Dec. 27, 1904. The harp contains a pair of spring blades which bear against the wheel and make electric connection therewith. Each of the spring blades has an additional tension spring at its extremity.

801,733. AUTOMATIC BLOCK SIGNAL SYSTEM; Ross Logsdon and Eliza S. Stotts, Perry, Ia. App. filed Jan. 18, 1904. The semaphore arms are actuated mechanically by a tappet adjacent to the rails and simultaneously by an electrical trip. They are also restored by mechanical and electrical means.

801,774. CONDUIT FOR ELECTRIC CABLES OR CONDUCTORS; Thomas E. Devonshire, London, England. App. filed Nov. 5, 1904. The successive sections have ends which nest or dovetail together, so as to produce a sealing ring. The sections themselves are formed of expanded metal and concrete.

801,778. TELEPHONE SYSTEM; Charles Edward Egan, Chicago, Ill. App. filed Sept. [illegible], 1899.

801,779. TELEPHONE SYSTEM AND APPARATUS; Charles E. Egan, Chicago, Ill. App. filed Sept. [illegible], 1904.

801,780. TELEPHONIC APPARATUS; Charles E. Egan, Chicago, Ill. App. filed Aug. 16, 1905.

801,782. PROCESS OF FORMING NITROGEN COMPOUNDS; Alexander McGow, Allegheny, Pa. App. filed Dec. 9, 1902.

801,794. ELECTRIC SIGNAL DEVICE FOR RAILROADS; Ephriam H. B. Knowlton, Superior, Wis. App. filed Apr. 27, 1905. Trolleys are laid adjacent the usual track rails through which a signaling circuit is made to the locomotive cab to indicate the condition of the switches, etc.

801,801. FIELD COIL SUPPORT; Neil MacNeale, Cincinnati, O. App. filed Dec. 7, 1903. The pole pieces flare slightly at their lower ends, but not enough to prevent the coils being slipped thereon. Metal stampings are afterwards placed in such positions as to prevent the withdrawal of the coils.

801,800. SIGNALING THROUGH SUBMARINE AND LIKE CABLES; Oliver Joseph Lodge, Birmingham, and Alexander Muirhead, London, England. App. filed Apr. 25, 1905. (See Current News and Notes.)

801,823. AUTOMOBILE; Ernst J. Berg, Schenectady, N. Y. App. filed May 2[illegible], 1905. In an automobile having a gas engine driven generator a primary ignition circuit is made to points on the generator commutator having a less potential difference than the terminal voltage.

12,393. LEADING-IN WIRE FOR INCANDESCENT ELECTRIC LAMPS; Thomas A. Edison, Llewellyn Park, N. J. App. filed July 12, 1905. This is a reissue of a patent issued Jan. 13, 1801, relating to the use of some other metal in connection with platinum for the leading-in wire.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, OCTOBER 28, 1905. No. 18.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE	1139 Monadnock Block
PHILADELPHIA OFFICE	929 Chestnut Street
CLEVELAND OFFICE	402 Cuyahoga Building
EUROPEAN OFFICE	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **592,500.**

NEW YORK, SATURDAY, OCTOBER 28, 1905.

CONTENTS.

Editorial ... 719
The Single-Phase Plans of the New Haven Railroad ... 722
Kansas Gas, Water, Electric Light & Street Railway Association ... 722
Electrical "Open Shop" ... 723
Independent Telephone Affairs in Indiana ... 723
Important Telephone Deal in Indianapolis ... 723
The New German Tariff ... 723
Production and Use of Platinum ... 724
Fifth Avenue Stages, New York City ... 724
Current News and Notes ... 725
Electrical Engineers of the Times. XXXIII. Mr. James E. Davidson ... 728
Development of the Necaxa, Mexico, Water Power ... 729
Dynamo Heating Time Constants. By A. Press ... 735
Some New German Electric Projection Apparatus. By C. J. Smith ... 736
Congress of Swedish Engineers.—II. By Arvid Westerberg ... 737
Recent Electrochemical Developments ... 739
New Telephone Patents ... 739
LETTER TO THE EDITORS:
The Application of Electric Power to Agriculture. By Northern Electrical Manufacturing Co ... 740
Digest of Current Electrical Literature ... 740
An Electrical Piano Player. By S. Chester Lyon ... 744
Modulating Electric Lamps. By W. J. Phelps ... 746
Quick-Opening Self-Packing Radiator Valve ... 746
Doublejoint Desk Fixtures ... 747
Portable Direct-Current Voltmeters and Ammeters ... 747
Welded Flanges for Steel Pipes ... 747
Holophane-Pagoda Ball ... 748
Key-Socket and Shadeholder ... 748
Waterproof Receptacle for Lamps ... 748
Cable Clamp ... 748
Industrial and Commercial News ... 749
General News of the Week ... 752

THE NECAXA TRANSMISSION PLANT.

Our leading article this week deals with the great power transmission system that is just being finished for work around the City of Mexico. It is notable not only for its size, which is initially 30,000 kw, and likely to be doubled, but for some bold construction features of rather exceptional interest. To begin with, it involves the diversion of one stream to join with another in the formation of an artificial storage lake three square miles in area retained by a dam 177 ft. high. This construction is a remarkable feat in itself in its magnitude. More and more as time goes on this matter of artificial storage becomes important. Without it the available power of a stream approximates to the minimum rather than the average flow. In regions which are damp and well wooded even the minimum flow is not to be despised, as it is a reasonably large fraction of the average; but in a dry and sparsely forested district the minimum flow is degraded into insignificance and any serious effort at power development must depend on storage. Every bit of water at high head is valuable, and storage becomes not only very valuable but relatively easy. In many regions it is being studied and practised even to the extent of storing practically the whole year's rainfall, and the Necaxa storage system may be regarded as typical of modern necessity in hydraulic engineering.

The electrical plant, too, is possessed of very unusual features, particularly in its use of vertical shaft generators driven by impulse wheels. The reason for this construction is not altogether obvious, since it involves some unusual precautions in the matter of bearings, without any especial gain. The voltage of the generators, too, is unusual, although probably justified in view of the local distribution, and the frequency of 50 cycles, although standard continental practice, is exceptional in plants on this side the Atlantic. Probably considering the length of the proposed transmission and the existing load to be supplied, the lowered frequency is well chosen, in fact in itself preferable to the usual 60 cycles. We shall be interested in the performance of the wheels, which are of foreign make and unusual construction. Regulating nozzles under the head in use at Nacaxa involve some very nice engineering details, and we shall be glad to learn of their successful operation as a rebuke to the bad habit of throwing away water quite unused. The exciter equipment is out of the ordinary in including both wheel-driven and motor-driven exciters. Just what the special function of the latter is to be we fail yet to see. They have an obvious economic value in a steam-driven station, but of all prime-movers, impulse wheels probably show the smallest gain in efficiency with increasing size, so that the motor driving scheme seems somewhat peculiar till explained.

In the transmission lines the engineers have pushed the tower plan of construction to its limit and therefore Necaxa will be a good plant to watch. With complete duplicate tower lines there should be little difficulty in preserving a high degree of continuity of service. The long spans thus secured certainly are useful in reducing the number of points to be insulated. In working at 60,000 volts the more insulators the more trouble. It therefore behooves one to be particularly sure of his insulators, especially on a tower line where a broken insulator is pretty certain to shut down the circuit on the spot. The insulators for this plant are of good appearance, but the test reported of 120,000 volts for a 60,000-volt plant is most certainly too low to insure an adequate factor of safety. If the line is regularly to be worked at 60,000 volts the insulators ought to be able to stand up at 150,000 and preferably at 180,000. It has been pretty well shown by experience that 2 is too small a factor of safety for the insulators on an overhead transmission line. We expect that the margin in fact will prove to be better than is assured by the tests. A big plant located so far from its base of supplies as is Necaxa must be almost fitted up for manufacturing purposes, so that the complete machine shop equipment becomes here a matter of necessity, and there must also be rather complete provisions for electrical repairs upon a large scale. So important a plant as this is likely to be a powerful factor in industrial development and must prove of particular value in enabling the El Oro gold fields to utilize the full advantage of the most modern methods and machinery. The vicinity of the City of Mexico is a most favorable region for the transmission of power, and with the advent of current from the Necaxa plant Mexico should be one of the most thoroughly "electrified" cities in the world. The plant is particularly fortunate in securing Mr. Hayward as general manager. It is a place where his long experience in high-voltage work can be utilized with most telling effect.

◆

Free Lamp Renewals.

When at the meetings of State electric light associations the subject of free lamp renewals is brought up, the general lack of sympathy with the idea on the part of the smaller central stations is made clearly evident. Probably a partial reason for this attitude is that the advocacy of free renewals has formed part of the business policy of some lamp manufacturing companies, thus giving rise to a suspicion that reduction of selling and other expenses on the part of these, rather than increase of profit to central stations, is the real motive which has prompted such companies to enter the domain of central station economics. Whatever truth there may be in this presumption, the facts remain that all of the larger central stations of the country have definitely adopted the policy of free lamp renewals, and there are excellent central station business reasons in its favor regardless of the size of the central station. The argument against the policy of free lamp renewals, as set forth by managers of smaller central stations, is that its adoption means an increase in expense without any tangible return. The weakness of this argument lies in the fact that it neglects factors which, though not apparent at a casual glance, yet very materially affect central station returns. Central stations are in the business of competing in the field of illumination with kerosene, gas, gasolene and acetylene gas, and there is not a central station in the United States but has some such competition. What the central station is attempting to deliver is light, and by users and prospective users the company is judged by the light it furnishes for a given amount of money. The kerosene lamp is a very serious competitor of the small central station because the amount of light it gives for a given expenditure is very large. In the small town Mr. A, who has kerosene lamps in his house, will compare the quality of his illumination and cost thereof with Mr. B, who has electric lights, and it is easily seen that a central station company whose circuits are filled with a lot of inefficient lamps purchased by customers of hardware dealers under guarantees of long life and giving perhaps half-rated candle-power, is likely to suffer severely in such comparison. The competition to be met by the electric light companies in the large cities against Welsbach burners and "gas arcs" is as nothing compared to the competition of good, efficient kerosene lamps and gasolene plants in the smaller towns where pennies count for more than they do in the cities.

To meet this situation the small central station is called upon to give the very best light possible for the money, to see that its customers have their lights placed to the best advantage and equipped with good reflectors or globes where such are needed, and that the lamps are burned at a good candle-power. There seems to be no feasible way of attaining this end except by taking the renewals of lamps out of the customers' hands and furnishing them high-efficiency lamps free. If a customer has to buy his lamps he will buy them at the cheapest place. Frequently the sale of lamps drifts into the hands of local merchants, who sell cheap low-efficiency lamps, which the customer thinks are ideal because they last so long without burning out. If the company attempts to control the matter by selling customers lamps at a little below cost, it may run into the difficulty that with high-efficiency lamps customers are likely to complain of the short life obtained, and the local merchant selling low-efficiency lamps may even be able to convince them that "It pays to pay a little higher price and get a better lamp, because it will last so much longer!" It is extremely difficult to make customers see that the high-efficiency lamp is the cheapest one for them to buy when cost of power is counted. While the method of selling high-efficiency lamps to customers by the company at a little below cost is much better than no attempt to control the lamps which go on circuit, much the more satisfactory way for all concerned is to take the whole matter out of the customers' hands, even going to the extent of renewing all lamps which are burning dim or which the customer thinks arc not up to proper brightness. A boy with a cheap photometer can test hundreds of these returned lamps in an hour, and if they have not fallen below a certain candle-power they can be returned to service later. In this connection it may be pointed out that the commercial success of the Nernst lamp was greatly accelerated by the adoption of the policy of maintenance by central stations instead of leaving the maintenance to the customers and local supply houses. This question of free lamp renewals is one of the many which are becoming vital to the central station under the present-day central station business situation. The period of development is rapidly drawing to a close, and business questions which in the past were dismissed with generalities as to "local conditions," etc., must now be faced by managers who wish to feel secure in their positions.

◆

Submarine and Supermarine Telegraphs.

The recent completion of another submarine cable across the Atlantic, as announced in our columns recently, emphasizes the opinion of those who conduct intercontinental telegraph traffic that wireless telegraphy across wide oceans is not yet an earnest competitor with the cables. Nevertheless, an ocean cable costs more than a thousand dollars per mile; whereas a wireless telegraph system has only to expend money upon terminal plants, the circumambient ether being still rent free.

The fact is that the volume of telegraphic traffic between different parts of the world is so great that no single circuit can handle it. Even if wireless communication were established between a pair of stations across the Atlantic, this would only be the equivalent, at present, of one cable circuit worked simplex; whereas there are now more than a dozen transatlantic cables working duplex. Since these have cost collectively many millions of dollars, it is clear that they have only been laid as a matter of commercial necessity. It will be necessary for wireless telegraphy to be able to send not only one stream of messages across the Atlantic, but a number of coincident or simultaneous streams of non-interfering messages, before the cable will be unable to earn a livelihood.

It is early yet to predict the future lying before wireless telegraphy. It is only a few years old, while wire telegraphy is nearly a century old, if we consider experimental work, and seventy years old if we consider only commercial work. Already wireless telegraphy has come into commercial use in places where cable telegraphy has been placed at a disadvantage. Whatever be the distant prospect of wireless telegraphy, we may be certain that in the near future it will greatly aid and supplement wire telegraphy. When the electric light came into the field of illumination it did not extinguish gas lighting, as some had feared. It has won and occupied its special field. Similarly, wireless telegraphy will have a large field to cover in placing vessels at sea in electric communication with the land. Gradually, with the progress of the wireless art, we may expect to see longer distances covered in competition with cables; but for years to come we may expect to see the wireless masts bring messages to the great intercontinental cable system of 230,000 miles total length, far more frequently than they rob the cables of messages.

AIR-GAP RELUCTANCE.

The *Journal* of the Western Society of Engineers has recently published a paper by Mr. C. H. Smoot, Jr., abstracted in the Digest, upon the subject of air-gap reluctance in dynamos, as determined experimentally through the medium of an electric analogy. An able mathematical article by Mr. F. W. Carter appeared in our issue of November 30, 1901, in which formulas were derived for the computation of the reluctance in any air-gap of known dimensions employing slotted cores. It is well known that the computation of the air-gap reluctance in a smooth-cored armature is very simple. The gap is treated as a plane slab of known length, breadth and uniform thickness. Consequently, the reluctance of the slab, expressed in oersteds, is equal to the thickness of the slab in centimeters divided by the area in square centimeters. When, however, there are slots in the armature core, which is usually the case in modern dynamo-electric machines, the computation is made much more difficult, and was beyond engineering reach a few years ago. Various formulas of approximation were in use, but it was usually considered necessary to depend upon experimental measurements of the reluctance in dynamos, by means of the voltage characteristic observed at low-field excitation, and when the reluctance in the iron of the field and armature might be considered very small compared with the reluctance in the air-gaps.

In November, 1904, a paper on the subject was read by Messrs. Hele-Shaw, Hay and Powell before the British Institution of Electrical Engineers. These gentlemen made an experimental study of the subject with the aid of hydrodynamic models, checking the results by electromagnetic search-coil measurements on actual machines and by the Carter formula. The hydrodynamic method they employed is very beautiful, but calls for great experimental skill. A thin water chamber was formed between a pair of parallel glass plates, and sealed with wax, in such a manner that water could be forced through the chamber in a direction parallel to the glass walls. The flux of water would, of course, be invisible to the unaided eye, but by introducing small spaced jets of colored water into the plain water stream at the entrance, the lines of water flux or stream lines appeared as alternate bands of clear and colored fluid between the glass walls of the chamber. Further, by employing very thin films of water flux between layers of wax on the glass walls, to represent air-gaps or slots, and much thicker films of water where the wax was cut away, to represent the magnetically conducting iron pole-piece or armature teeth, beautiful photographs of the water flux were presented, to correspond with the invisible magnetic flux in dynamo air-gaps of definite dimensions selected from practice. A very satisfactory agreement was found to exist between the air-gap reluctances computed from the photographs of the water flux and those obtained by the Carter formula. The hydrodynamic method of experimenting has the advantage that it is not limited to straight air-gaps corresponding to dynamo-armatures of indefinitely large diameter; but is just as readily applicable to curved air-gaps bent to the circumference of ordinary dynamo-armatures. Moreover, the flux is made immediately visible to the eye, and the photograph of the stream lines is permanent. On the other hand, the total number of streams that can be brought into action in the hydrodynamic model is necessarily limited.

Hele Shaw, Hay and Powell presented a table comparing a number of air-gap correction coefficients for slots of various dimensions, by the water stream line method and by the Carter formula. These correction coefficients are in very fair mutual agreement. They vary between 1.1 (for the case of a narrow slot and long air-gap) and 2.0 (for a wide slot and narrow air-gap). That is, the reluctance of the air-gap is increased by the slotting of the armature, by amounts varying in different practical cases from 10 per cent to 100 per cent. The average coefficient is 1.31, corresponding to an increase in reluctance of nearly one-third, due to slotting. Another reluctance of the air-gap of like dimensions due to the slotting. In has been either used or suggested for a number of years is that of measuring the electrical resistance of a thin strip of metal, such as sheet iron between two copper electrodes applied to its surface, one shaped like a pole-piece and the other like the slotted armature. The increase in electric resistance due to the slotting of the armature electrode would be numerically the same as the increase in magnetic reluctance of the air-gap of like dimensions due to the slotting. In practice, however, it is difficult to establish sufficiently good contact uniformly over the contour of the copper electrodes where they rest on the sheet of iron. But it was suggested in the article of Mr. Carter, already referred to, that a better plan would be to cut the sheet with shears into the form of the air-gap, including slots, and to make contact with the electrodes along the edges of the sheet which correspond to the straight flux paths midway between adjacent poles. The resistance of the strip would then be a measure of the magnetic permeance of the air-gap including slots, while equipotential surfaces on the strip explored and delineated with the aid of a potentiometer, would correspond to the stream lines, or magnetic flux paths of the actual case.

This suggestion has been carried out by Mr. Smoot, who has given in tabular form a number of correction coefficients, compared with those obtained from the hydro-dynamical model and also with those of the Carter formula. All three series seem to be in satisfactory agreement, and conjointly leave little doubt as to the approximate correctness of each. In many cases the flux density carried in the teeth of the armature is brought almost to the saturation limit, and thus a new element of complexity is added to the situation, because if the teeth were completely saturated their reluctivity would be the same as that of air, and the air-gap correction would become markedly increased. In the experimental method using the electric strip model, the fact that the edges of the slots terminate in the non-conducting air shows that the teeth are assumed to have indefinitely large magnetic permeability. In the Carter formula also the magnetic permeability of the teeth is assumed to be indefinitely great. An appreciable discrepancy is, therefore, to be looked for between the observed and computed reluctance of the air-gap over a slotted armature, when the flux density in the teeth is pressed to a high limit. The hydro-dynamic experimental method alone permits of this saturation correction being applied, since the thickness of the film of water in the regions representing the teeth can be narrowed down to a proper value suited to the permeability in the teeth if that permeability can be determined from independent data. Nevertheless, the attempt would probably involve much difficulty, and perhaps practical requirements never call for such a degree of refinement in the determination of air-gap reluctance.

The Single-Phase Plans of the New Haven Railroad.

Last week we presented an important communication from Mr. Frank J. Sprague with regard to difficulties involved in the operation of the single-phase electric locomotives of the New York, New Haven & Hartford Railroad in the direct-current zone and double-decked terminal depot of the New York Central Railroad, at Forty-second Street. We are now favored with the subjoined comment from Mr. Calvert Townley, consulting engineer and assistant to the president of the New Haven road:

It is not my feeling that the arguments for and against the respective plans of the New York Central & Hudson River Railroad Company and the New York, New Haven & Hartford Railroad Company for the electrical handling of their traffic into Forty-second Street can be discussed with profit in the columns of the press, between the engineers of the two companies; neither is it my purpose to reply to Mr. Sprague's comprehensive arraignment of the policy and manners of the New Haven road.

However, as the inference may be drawn that the public is to be incommoded, and the prosecution of a great engineering improvement hindered by the action of the New Haven road in declining to absolutely follow the engineering lead of Mr. Sprague and his associates, I cannot let the article pass unnoticed.

On that score it is proper to point out that the locomotives which have been purchased by the New Haven road will handle that company's trains between Forty-second Street and Woodlawn, receiving continuous current from the third rail in exactly the same manner as it is proposed that the locomotives purchased by the Central Company will handle the trains of that company, and inasmuch as the stub-end track facilities of the enlarged Forty-second Street station will be largely increased over similar facilities afforded by the present station, and inasmuch as these increased facilities will be relieved of a considerable number of the present trains of the Central Company, by transfer to the suburban loop, it is difficult to find reason for alarm at prospective delays or lack of accommodations to the traveling public, or on behalf of the Central Company for inharmonious operation.

That the progress of the art of locomotive design since the purchase of the locomotives adopted by the Central some two years ago has enabled the New Haven road to procure a type which, in addition to operating on the Central's continuous system, is also capable of operating on a single-phase, alternating current, thus widening the possible application of electric traction for future extensions on the New Haven's electrical system, should be a source of gratification rather than of censure or alarm.

Mr. Sprague's unfamiliarity with the up-to-date development of electric locomotives has, perhaps, led him into his dire prognostications of disaster, and while, under the circumstances, an extended argument can be of little avail, I have no doubt that the management of the New Haven road will be quite content to await the practical results which will very soon furnish substantial evidence of the correctness or error of its judgment.

Kansas Gas, Water, Electric Light and Street Railway Association.

The eighth annual meeting of the Kansas Gas, Water and Electric Light and Street Railway Association was held in the Mercantile Club Room, Kansas City, Kan., on October 13 and 14. The secretary's report showed that the total membership on October 13 was 94, including honorary, active and associate members.

Papers on the following subjects were read and discussed: "The Tantalum Lamp," by Prof. B. F. Eyer; "Public Utilities and Municipalities," by Prof. E. H. Bailey; "The High Efficiency of High-Candle-Power Lamps," by J. F. Shaefer; "The Need of Sewage Disposal in Kansas," by R. E. McDonnell; "Co-Operation in Management of Gas, Water, Electric Light and Street Railway Companies," by C. R. Maunsell; "Relative Heat-Producing Values of Natural Gas, Oil and Coal," by Prof. Erasmus Haworth.

In his paper on "Public Utilities and Municipalities," Prof. E. H. Bailey stated that, according to a recent report, there were in the United States the following number of water works, gas plants and electric light plants, of which the indicated per cent were owned by the cities in which they were located:

	Total number.	Owned by Municipality.
Water works	3,320	53.7 per cent.
Gas plants	965	1.5 per cent.
Electric light plants	3,032	15.2 per cent

The large cities in which at the time of the report the water works were owned by private corporations were: San Francisco, Indianapolis, New Haven, St. Joseph, Patterson, Omaha and Scranton. In almost all cities the sewage plants or sewage purification works are owned by private corporations, and such is of necessity the case, on account of the material which they handle, and the importance of the Board of Health having control over the plant as a whole.

It is evident that the tendency to advocate public ownership of the public utilities is due partly at least to the fact that private corporations have not in the past done their best to supply these necessities at a fair rate of compensation, and of good quality. A recent editorial in the Kansas City *Times* upon the railway situation, which treats of this phase of the government ownership problem, was given by Prof. Bailey as follows: "It is a remarkable thing that the railway world, which contains some of the ablest men in the country, should still be so indifferent to the growth of the sentiment favorable to safe and effective regulation, to the elimination of railway influences from politics and to the establishment of the square deal generally between the shipping agencies and the shipper. The systematic opposition of the railways to the proposed rate regulation, to the building of the Panama Canal, to measures designed to abolish the legislative lobby and to all other reasonable efforts to establish an open, frank, business-like system, free from corruption and favoritism, these are manifestations of singular short-sightedness. Those who deplore government ownership, or the agitation of it, should be foremost in encouraging all reasonable steps to avoid it. The present policy of the railroads is directly in line with the promotion of extremely radical agitation. The people, once they are aroused, must be met with fairness or they will go to extremes. That is not a matter of conjecture. It is a matter of human nature, demonstrated by abundant precedent."

From the standpoint of a layman, then, it seems desirable for the private company to give the very best possible service for the money. Using the gas company as an illustration, it may be stated that the gas should be delivered under the proper pressure and should be of the best quality. It is worth while for the superintendent to be something of a scientific man in his way, and for him to make reasonable efforts to prove to customers the value of the gas for heating and lighting, to show that the best approved scientific methods have been used to make it pure and suitable for use as a lighting or heating agent. Let him show, if he deals in natural gas, that it is even better as a heating agent than the artificial gas; that the natural gas cannot be burned in the ordinary fish-tail burner, and why this is true. A little information of this kind will prevent a considerable number of complaints from ignorant people and will make the public friendly rather than inclined to find fault with everything.

Less can be said in this line in regard to electric light service, but even here there is a chance to make the service the best; to keep a steady e.m.f.; to educate the people to use electricity for power, and in some special cases for heating.

In the case of street railways there are so many things that go to make what is called "good service" that they cannot here be enumerated. The fact is that the supply of gas, water and electric lights to the people must be upon a different basis from the supply of potatoes, furniture or neckties. In the latter field, if the goods are inferior, we take them back or get a rebate, or patronize some other house, but when we do not find the gas or water or electricity satisfactory, we are told that "we can go without"—when the company know that usually we cannot go without. Since the corporation that has these necessities to sell has the advantage it would be the best policy to meet the public half way, even at the temporary loss of a little revenue.

The following officers were elected for the coming year: President, W. E. Sweezy, Junction City; first vice-president, S. W. Sterrett, Kansas City; second vice-president, F. B. Aley, Wichita; third vice-president, C. L. Brown, Albine; secretary and treasurer, James D. Nicholson, Newton. The next meeting will be held in Lawrence, Kan., the latter part of October, 1906.

Electrical "Open Shop".

Advices from Boston state that a new organization known as the "Open Shop" Electrical Contractors' Association of Boston and Its Vicinity has been formed. It started with only about twelve members and its formation was announced to the other employers through a letter, which was sent to all the electrical contractors in the district. Part of the communication follows:

> Boston, Mass., October 6, 1905.
>
> Dear Sirs:—On October 3 the "Open Shop" Electrical Contractors' Association of Boston and Its Vicinity was organized, Herbert S. Potter being chosen president and W. E. Clark secretary.
>
> The objects of the association are to assist and protect its members against the encroachments of labor unions, and to promote a bond of good-fellowship among its members, which has always proved so beneficial in the past to all organizations where a united action was necessary to nullify the corrupt effect of an opposing one.
>
> There are over 90 electrical contractors in Boston and vicinity, more than 80 of whom will declare for the "open shop." It only requires the united action of the "open shop" contractors to compel the members of the union to work in peace and harmony with our men when they come in contact with one another in the execution of their duties, which is all we ask.
>
> It costs only your presence and co-operation at our meetings to belong to this association. Our officers serve without salary, and the rooms and other privileges of the Employers' Association, 88 Broad Street, are open to us free of charge, consequently you will not be called upon to pay dues or assessments.
>
> Frederick A. Swan, Chairman,
> *Committee of Ways and Means.*

Mr. Swan, who is treasurer of the Swan Electric Company, says that the response to this letter is most encouraging to the movement, 52 contractors having joined the association up to last week. He claims that they represent 50 per cent of the employers and about the same proportion of the workmen, and he says the reason that there are so few electrical workers out on strike to-day is that they have remained loyal to their employers and left the union. The idea of forming an open shop association was conceived at the time Boston Union, No. 103, of the International Brotherhood of Electrical Workers of America, presented its agreement for a renewal. The employers felt so limited under the terms of that agreement that they decided not to sign it, after the matter had been discussed in a joint committee of the union and the employers. Some of the largest contractors did sign, but it is said that they are large contractors only in the sense that they employ a large number of men during limited periods, while wiring a new building for example, and then let them go. On October 9 the new association had a second meeting at the office of the Employers' Association and had a large attendance.

In view of the difficulty that the members of the new association might experience in getting workmen if their old employes should strike, an appeal for assistance was made to the Employers' Association, and it is said that Albion P. Pease, the secretary of the association, communicated with electrical contractors in Philadelphia, Springfield, New York, Worcester, Lynn, Portland and many other cities, requesting them to refer to Boston such applicants for work as they may not need, with the result that numerous applications from outside cities reached Boston. Some of the applicants are now employed here. But pending the developments along this line, the "open shop" contractors who joined the new association helped each other by exchanging men as emergency arose. In one shop where there were twelve union men employed three men struck, remaining loyal to the union, and nine gave up their membership in the unions to stand by the employer on his assurance that he will never again sign any agreement with any union and will give them work as long as he is in business. As a general assurance of continued employment for the workmen who declined to strike, but remained in the "open shops" the new association compiled a list of all the "open shops" in Boston and vicinity and had them posted in those shops, showing where the men may obtain employment, and from the Employers' Association on Broad Street a list was secured of "open shops" all along the line from Portland to Philadelphia.

Independent Telephone Affairs in Indiana.

The first meeting of the Indiana Independent Telephone Association of the Eighth District, composed of Rush, Fayette, Franklin, Henry, Union and Wayne Counties, was held in Rushville October 20, Vice-President A. C. Lindermuth, of Richmond, presiding. "Operating Conditions" was the principal subject discussed. Resolutions were passed to the effect that the independent telephone companies in the eighth district are to refrain from any further joint service with any company that has a connection, direct or indirect, with any sub-licensee company of the Bell Company. It was stated that there are few Bell telephones in the eighth district, while there are 11,000 independent telephones, or ten to one of the Bell Company. The meeting was attended by representatives of 35 companies. C. S. Norton, secretary of the State Association, says the plan of organizing the districts is working well, and before the end of next year Indiana will have the strongest Independent Telephone Association in the country.

Important Telephone Deal in Indianapolis.

After several days of strenuous effort upon the part of two parties for the control of the Indianapolis Telephone Company and the New Long-Distance Telephone Company, it may be safely stated that the properties have passed to the control of a syndicate composed of James S. Brailey and others, of Toledo, Ohio, and Col. Breckinridge Jones and others, of St. Louis, Mo. There is some difference of opinion as to which party—the Toledo or the St. Louis—got the larger end of the stock, but that matters but little since they will act in harmony in the management of the companies.

The passing of control in these properties is regarded as the most important and beneficial thing that could have happened to the independent movement in Indiana. In addition to the properties involved being valuable and profitable, they formed important links to the great system now being organized between the Eastern cities and the Western cities, with St. Louis as an important point. With this change of control will come a more aggressive policy, needed improvements and extensions which will greatly benefit the independent movement. It is expected that the reorganization of the companies will be brought about within a short time. There will be no amalgamation of the Home Telephone Company, of Toledo, and the Kinloch system, of St. Louis, with the Indiana property. The new company will be entirely independent of these, notwithstanding the new stockholders are largely interested in those companies. The Kinloch Company's lines already extend into Indiana as far as Terre Haute and the Home, of Toledo, has lines into Fort Wayne. The men now in control say there is no intention to form a merger, it is simply a combination for better service and the closing up of every loop-hole open to inroads upon the part of the Bell Company.

The New German Tariff.

The "Monthly Summary of Commerce and Finance," for August, issued by the Department of Commerce and Labor, through its Bureau of Statistics, contains the complete German customs tariff, giving a comparison of the rates of import duty levied in Germany under the old and the new customs tariffs, respectively. The rates are all expressed in marks per 100 kilos, since no ad valorem duties are levied in Germany.

Since the significance of a given rate of duty, however, appears more clearly when expressed in terms of ad valorem rates, a table has been compiled by the Bureau of Statistics, in which the rates of duty at present levied in Germany on the principal articles of export from the United States are expressed in terms of ad valorem rates, based on the German estimates of the import value of those articles in 1903, the latest year for which figures are available.

These rates are followed by figures indicating the per cent of increase the present rates of duty will undergo in the new general and conventional tariffs, respectively. The German rates of duty being fixed specific amounts, it is evident that the estimated ad valorem rate will fluctuate from year to year in an inverse ratio to the value of the product; that is to say, as the price of a given article will rise the estimated ad valorem rate will appear as a smaller percentage, and vice versa.

As regards manufactures, the old rates are for the most part moderate. The duty on sewing machines, representing the highest ad valorem rate under the existing tariff among important articles of export from this country, viz.: 22 per cent, is raised 46 per cent (i. e., to about 32 per cent ad valorem) under the new general tariff, no provision having been made under the conventional. Agricultural machinery, which pays on the average about 4 per cent ad valorem, will be subject to rates from 20 per cent to 88 per cent higher (according to the weight of the machine), so that the ad valorem rate under the new general tariff will range from about 5 per cent to 15 per cent, with no provision for conventional rates. The rates of duty on steam engines and motors of all kinds, which were hitherto the same as that on agricultural machinery, and averaged 4 per cent ad valorem, are advanced all the way from 40 per cent to 1,150 per cent (according to weight) in the new general, and from 40 per cent to 837 per cent under the new conventional tariff. In other words, motive machinery, coming from countries not enjoying the conventional rates will be subject to duties as high as 50 per cent ad valorem, while that coming from favored nations will pay duties ranging from 5½ per cent to 35 per cent ad valorem.

Production and Use of Platinum.

Platinum is in extensive use in the electrical arts, and data as to its production are of interest. The war between Russia and Japan is probably responsible for the fact that the output of platinum in the United States increased from 110 ounces in 1903, valued at $2,080, to 200 ounces, valued at $4,160 in 1904. Owing to anxiety in regard to the fate of the platinum industry in Russia, the price of platinum rose about 10 per cent during 1904. "It should not be understood," says Dr. David T. Day, of the United States Geological Survey, in a recent report on the production of platinum and allied metals in 1904, "that the slight rise of 10 per cent in the price of platinum would serve as any great stimulus to the placer gold miners of the West who furnish the platinum products of the United States, for these miners are comparatively indifferent to a slight change in price. The scarcity of platinum and the consequent rise in price, however, led to much energy on the part of Eastern smelters of platinum in urging upon the placer miners of the West the advisability of saving platinum in cleaning up the hydraulic mines. The increase thus effected is interesting as showing what is possible in the United States in the future."

In the opinion of Dr. Day the outlook for increased production for the year 1905 is good, not only on account of the continued high price of platinum, but because of the investigation undertaken by the Geological Survey of the black sands of the Pacific slope (noted recently in these columns) and of the increased knowledge thus furnished to the miners in regard to the value of the platinum and to simple means of saving it.

The world's total supply of platinum for the year amounted to about 300 kg., or 9,625 troy ounces from South America, and 6,000 kg., or 192,500 troy ounces from Russia. No production of platinum from Australia was reported. A slight product of both platinum and palladium from the Sudbury copper mines continues to come on the market, but it is not profitable to extract all of the platinum and palladium which these ores could furnish. Increased interest in the occurrence of platinum in hydraulic mines and dredges of the Fraser River is due principally to the fact that the natural alloy of iron and nickel previously found in Josephine County, Ore., and in Del Norte County, Cal., has also been found in commercial quantity in the Fraser River at Lillooet. An interesting and new occurrence of platinum in places in Sumatra has been noted by Prof. L. S. Hundeshagen. All the American platinum came from California and Oregon, inasmuch as operations have been suspended in the Rambler copper mine, Wyo., which furnished some platinum the year before.

The imports of platinum into the United States during 1905 showed a decline of more than 8,000 ounces due to European control of the supply, which also, of course, aided the rise in price. The present prices are the highest that platinum has commanded in recent years.

Fifth Avenue Stages, New York City.

The difficult problem of placing automobile vehicles on the famous Fifth Avenue thoroughfare, New York City, as substitutes for the horse omnibuses, has again been attempted recently, and we illustrate herewith the interesting composite vehicle now in operation as an initial experiment with that type. Figs. 1 and 2 show this stage coach, in the production of which several well-known companies have collaborated.

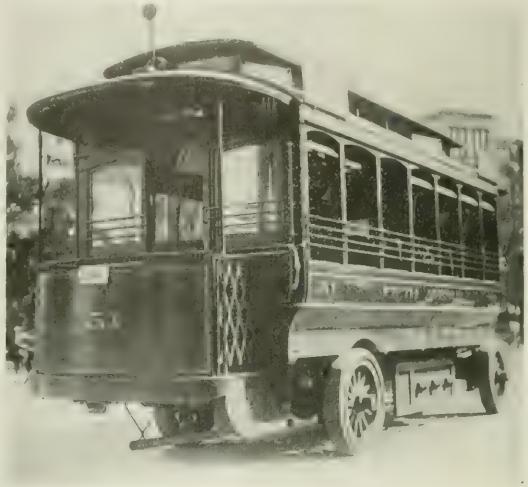


FIG. 1.—AUTOMOBILE STAGE.

This vehicle is equipped with two General Electric 1002 motors, current for which is obtained from a General Electric generator direct connected to a 40-hp Speedway gasoline engine built by the Seabury Co. The car body was built by the J. G. Brill Co., of

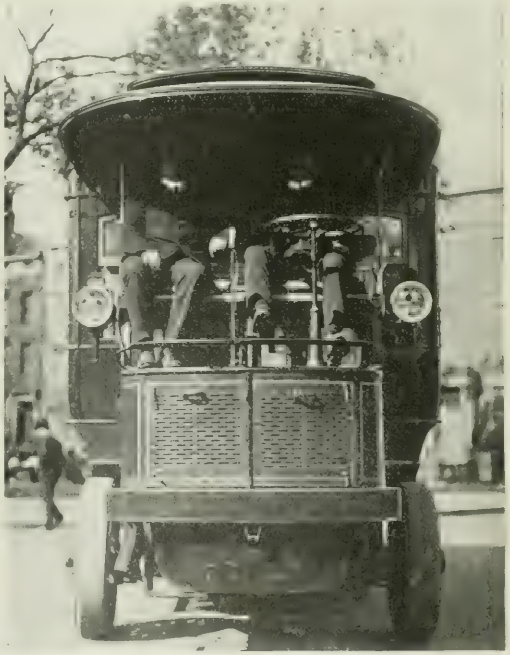


FIG. 2.—AUTOMOBILE STAGE, FRONT END VIEW.

Philadelphia, and the construction work and the chassis are due to the Vehicle Equipment Co., the assembling work, etc., being done at their Long Island City plant. The motors, hung under the frame, drive the rear road wheels by means of sprockets and chains. Beneath the body is a battery box which carries two 10-cell sets of Exide storage batteries. These batteries can be used for starting the engine as a matter of convenience by connecting them with the generator, which can then be used as a motor to rotate the crank shaft. As a matter of fact, however, the function of the batteries is to furnish current for the five incandescent lamps in the interior of the coach and for the outside lights. The battery is not used for driving the motors nor for equalizing the generator load in any way. In addition to the lights, the car has an electric attachment of a disc character, which shows a red sign automatically by day and a red light at night. This is set just above the rear platform and cuts in and out as the car starts and stops. The speed of the stage is 15 miles an hour on the level and 8 miles an hour on 8 per cent grades. It weighs complete about 7 tons. The wheels are equipped with solid rubber tires.

The vehicle provides seating capacity for from 28 to 30 passengers, and the body is of the street car type, conforming to the latest approved practice in being semi-convertible, so that in summer time the windows can be lifted entirely out of sight and stored in the roof of the car. The interior is finished in oak and bird's eye maple, and furnished with cane-covered seats for two persons each extending cross-wise, with an aisle down the center. The vehicle has a regular street-car step and platform, and a gate, which can be closed when all the seating space is occupied, so as to prevent the occupancy of standing room.

No data are yet obtainable as to the results with this vehicle, which, being the first of its kind, is likely to be materially improved as changes are suggested from practice. It is understood that the succeeding vehicles will be somewhat lighter, this being unnecessarily strong and substantial.

CURRENT NEWS AND NOTES.

KANSAS CITY CONDUITS.—A considerable development of its conduit system is being made by the Bell Telephone Company, of Kansas City, and more than three miles of conduit have been laid since last July.

LONG-DISTANCE WIRELESS AT SEA.—The steamer *Caronia,* of the Cunard Line, was in communication with the Marconi Siasconset station at 6.40 p.m. October 23, when she was 217 miles east of that station on her way to New York from Liverpool. From that point to her dock is almost a 24-hour run.

NEW YORK ELECTRIC TRACTION.—Work on the New York, Westchester & Boston Railway's four-track electric road to the Connecticut line is being rapidly pushed in four localities between 177th Street in the Bronx and the outskirts of Mount Vernon, and the contractor, Mr. J. P. McDonald, who has 20 months in which to build the nearly five miles of track, believes that he can complete the grading within one-half of the time set. Altogether the trackage of the road is 117 miles, including the branches.

"NO CONFISCATION."—Alarmed at the sinister aspect of his own campaign, Mr. W. Hearst, the Municipal Ownership candidate in New York City for Mayor, said last week: "There is no plan of confiscation in our programme. Our plan is to retain for your benefit and profit all of the franchises of the future—to make sure that they shall not be given away as in the past." This is different. This is "hedging." He added with truth: "I do not think there is anything unsound about that policy." Whoever said there was?

NEW YORK ELECTRICAL SOCIETY LECTURES.—Among the lectures scheduled by the New York Electrical Society for the season 1905-06 are the following: "Wireless Telegraphy," by William Marconi; "Electrification of the Long Island Railroad," by O. S. Lyford, Jr.; "Newspapers and the Telegraphic Art," by Melville E. Stone; "The Turbine," by C. G. Curtis; "The Place of the Electric Vehicle in Automobilism," by Robert McAllister Lloyd; "Single-Phase Railway Work," by C. F. Scott, and "The Block Signal System on the Subway," by J. M. Waldron.

TELEPHONY IN NEW YORK.—The pace of telephonic growth in New York is tremendous, another proof that good service brings its reward. Early in March, 1906, the New York Telephone Company will establish a new exchange district to be known as "Rector." It will take in the southern part of the exchange district now designated "Cortlandt." To make this change the company will increase its switchboard capacity in the Dey Street building by accommodation for about 10,000 telephones. At present this building has a switchboard capacity of 10,000 and the new installation will double this. For the operating considerations there will be two exchanges each of 10,000, although they will both be in the same building. For several months an addition to the Dey Street building has been under construction, which will double its size. This new building is about completed, thus making the increase of switchboard capacity possible.

WHAT SUBWAYS MEAN.—Mr. J. B. McDonald, the digger of the New York Subway—Interborough Road—said last week: "I am quite sure that when the new underground roads approved by the Rapid Transit Commission are built and in operation the city will be able to tear down its fifty miles of elevated railway structures, restore fifty miles of its ruined streets and give back to its property owners hundreds of millions of dollars' worth of real estate values. The elevated railways were all very well for the time in which they were built. They have done much to develop the city and serve the convenience of the people. But they are a blot upon an otherwise beautiful metropolis. Their ugly structures obstruct and darken fifty miles of our finest streets. They are noisy and make life very uncomfortable for pedestrians. They shut out the light and otherwise help to destroy the value of a hundred miles of buildings, counting both sides of the streets. When the new subways are built and in operation the elevated railway system will have outlived its usefulness, as the old omnibuses outlived their usefulness when the modern street car lines came into existence."

THE LONG ISLAND RAILROAD is slowly but surely being electrified. That way lies its salvation. It now has electrically operated about 40 miles of double track from Flatbush Avenue to Belmont Park; Woodhaven Junction to Rockaway Park, and Jamaica to Springfield Junction. By the beginning of 1906 it is expected that the route from Springfield Junction by Valley Stream and Cedarhurst to Beach Channel will also be operated by electricity. This is all the electrification which it contemplated for the present, and will require an expenditure of about $5,500,000. With the completion of the tunnel under the East River at Thirty-third Street, the remainder of the local lines of the company will be electrified. The company will have 180 cars of steel, of which 138 will be equipped with motors. At present about 80 are in use. The cost of these new steel cars is over $11,000 each. Since the increase of rates on February 1 gross earnings have increased at the rate of $60,000 per year, which will be about sufficient for the payment of charges upon the bonds issued for this electrical alteration. But the benefits of electrification will go much further than that.

THE CHICAGO ELECTRICAL TRADES EXPOSITION.—Mention has already been made in these columns of the formation in Chicago of the Electrical Trades Exposition Company to hold an electrical show in that city the coming winter. The company has as officers and directors a number of prominent men in the electrical trade and central station work in Chicago, the president being Samuel Insull. A circular has just been sent out announcing the plans in detail and giving plans of the exhibit space at the Coliseum, where the show is to be held. It will begin at 7 p.m. Monday, January 15, and continue until 10.30 p.m. Saturday, January 27, 1906. It will be open daily, except Sunday, from 10 a.m. until 10.30 p.m. Rental charges for exhibit space will be $1 per square foot on the main floor, and 50 cents per square foot in the balconies and galleries. Probably the conventions of at least three electrical organizations will be held during the time of the show, and exhibits made at this show will serve all the purposes of exhibits made at these conventions. Much interest is being displayed. The general manager is Thomas R. Mercein, secretary of the Northwestern Electrical Association, whose office is now 464 Monadnock Building, Chicago.

THE BEST OF LIGHTS.—A cable dispatch from Paris of October 21 says: "A new illuminant called lusol is being tried by the Paris authorities with a view to its use in the streets. It is said to be cheaper than electricity, gas or petroleum. Lusol is a product of the gases of cokes of certain mines, is rich in carbon and is said to possess superior illuminating power."

PUBLIC POLICY.—Mr. W. H. Blood, Jr., president of the National Electric Light Association, paid a visit to New York last week on association business. Mr. Blood has appointed as Committee on Public Policy Mr. Arthur Williams chairman; Messrs. Samuel Scovil, of Cleveland, Ohio; Ernest H. Davis, of Williamsport, Pa., and Guy E. Tripp, of Dallas, Texas.

DON'T PAY DUNNES.—It is stated from Chicago that Mayor Dunne has advised those who travel on street car lines for which the franchises have expired to refuse to pay the regular five-cent fare, and trouble is in store for the police and courts. The Mayor's followers are planning to court trouble with conductors over fares in order to embarrass the street railway companies, and will attempt to decide for themselves whether they will pay one, two or three cents a trip. "Mayor Dunne is trying to incite what might be called anarchy in the streets of Chicago," said one of the Aldermen recently. "The same plan was tried in 1883, and it led to riots and disorder." It is obvious that the Dunne plan, if carried out, might well reduce the Mayor himself to poverty and starvation.

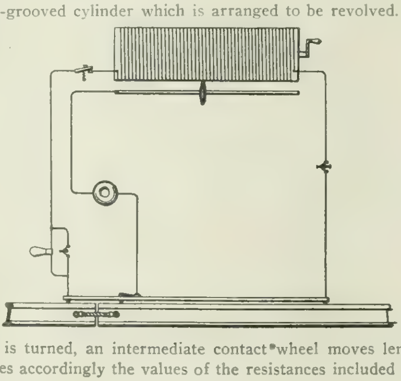
MARSHALL FIELD ON MUNICIPALISM.—Mr. Marshall Field, the great Chicago merchant, has just returned home from an European trip. In the course of an interview he said: "Among my observations abroad I took particular notice of conditions in Paris, where the municipality owns and operates the telephone system. Neither New York nor Chicago would put up for one day with conditions as they exist there." When asked for his opinion on municipal ownership Mr. Field said: "Municipal ownership is a fad, like the silver question was, and we will find that it will drop out of the public mind soon. I predict that within five years we in America shall not hear anything about it. I certainly don't agree with the proposition that municipal ownership would tend to do away with graft. On the other hand, I believe that opportunities for corruption would be greatly increased. Besides, a city under public officials never could be operated as a private corporation. The business of the municipality would fall into untried hands and what would seem everybody's business would prove to be nobody's business. I certainly know enough about the subject, after the campaign in Chicago, on which Mayor Dunne was elected, to know that municipal ownership would be a bad thing for us."

THE MILAN EXPOSITION.—United States Consul Dunning states that American manufacturers have considerably underestimated the relative importance of the Milan Exposition of 1906, which will continue from April to November in celebration of the opening of the Simplon Tunnel, and which will be a world's fair. Since the constantly increasing correspondence of the consulate at Milan seems to indicate a growing desire on the part of American exporters to sell their goods in Italy, Mr. Dunning believes the Milan Exposition affords an unusual opportunity for firms whose products naturally meet with the sharpest kind of European competition. If present tariff movements in more than one country in Europe may be taken to mean anything definite and significant toward American trade, it seems that our manufacturers will require a representation of their goods on the continent in future better than ever before. The exposition is to be on the grand scale, with which visitors to Chicago, Buffalo and St. Louis are familiar. Every branch of art, science, agriculture and the industries will be given ample space and adequate opportunities for exhibition. The entire fair will cover more than 1,000,000 square meters (10,764,200 square feet), of which one-quarter will be covered by buildings, which are already rapidly approaching completion. Japan, Germany, France, Mexico, Belgium, Switzerland, Austria, Great Britain and Italy will be officially represented at the fair, and nearly every other country in the world, including China, and the most active of the South American nations, will be largely represented as to their trades and evidences of their progress in every line of endeavor.

ROOSEVELT ON REGULATION.—In a speech last week at Atlanta, President Roosevelt said: "Undoubtedly there is need of regulation by the Government, in the interest of the public, of these great corporations which in modern life have shown themselves to be the most efficient business implements, and which are, therefore, the implements commonly employed by the owners of large fortunes. The corporation is the creature of the State. It should always be held accountable to some sovereign, and this accountability should be real and not sham. Therefore, in my judgment, all corporations doing an interstate business, and this means the great majority of the largest corporations, should be held accountable to the Federal Government, because their accountability should be co-extensive with their field of action. But most certainly we should not strive to prevent or limit corporate activity. We should strive to secure such effective supervision over it, such power of regulation over it, as to enable us to guarantee that its activity will be exercised only in ways beneficial to the public."

SCIENTIFIC STUNTS.—Prof. W. Hallock, the well-known physicist of Columbia University, has an interesting article in the New York *Times* on measuring the infinitesimal. He defends such beautiful work and says: "In science as in every-day life it is interesting sometimes to do things just for the sake of doing them, just to show that they can be done. There may be serious question whether there is much practical value in the demonstration that an automobile can be run at a speed of over 60 miles an hour for a hundred or more miles, and yet many wish to do it, or see it done. Similarly the skilled mechanic who succeeded in drilling a hole lengthwise through a cambric needle demonstrated his skill and patience, but where was the practical value of what he produced? Such performances come under the head of what the boy calls "doing stunts." The scientist is human and needs his recreation, and sometimes "does stunts." The construction of a "pseudoscope," which reverses the perspective in objects, is amusing, but it proves nothing, and can scarcely be said to advance science. Of a decidedly more serious character are such endeavors as may lead to some fact which is of interest in itself; for example, what is the smallest object that can be seen with a microscope, what is the faintest light that can be seen, what amount of energy must there be in a sound in order that we may hear it? These and other similar questions are of decided interest, although they may not really advance the science of acoustics, for example, more than the pseudoscope does the science of optics."

TESTING RAIL BONDS.—The accompanying illustration shows the connecting circuits involved in a method for testing rail-bonds as proposed by Mr. M. M. Wood in a patent issued October 17. The apparatus operates upon the principle of the Wheatstone bridge. The resistance of the bond is compared with that of a certain length of the rail. A resistance wire of German silver is wound upon a helically-grooved cylinder which is arranged to be revolved. As the cylinder is turned, an intermediate contact wheel moves lengthwise and varies accordingly the values of the resistances included between this contact and the terminal points. A telephone receiver, which is connected in the circuit to the intermediate contact, as shown in the ilustration, serves to determine when the portions of the resistance wire on either side of the point of the contact bar bear the same relation to each other in resistance as the corresponding portions of the rails between the several contacts.



FRANKLIN INSTITUTE LECTURES.—Mr. Oscar T. Crosby, who is one of the Institute lecturers this month, on Monday, October 23, described his interesting travels in Thibet and Turkestan, in which he and his associates had a very narrow escape from death by exposure and starvation.

ELECTRIC SWITCHES AND SIGNALS.—Plans have been approved and contracts let for the installation of an electrically-operated switching plant on the New York, New Haven & Hartford Railroad at Mystic, Conn., similar in construction to that which is nearing completion at Derby Junction.

BOSTON BOAT AND TROLLEY.—The New Line has installed a trolley system in connection with its Sound steamboat service between Fall River and Boston. The run of fifty-three miles by trolley occupies three hours and twenty-seven minutes. The route is by way of Taunton, Brockton, Blue Hills, and the Boston Park system to Post Office Square, Boston. Limited excursion tickets are sold from this city to Boston. The trolley route is very pretty.

TELEPHONE CONSTRUCTION SUPERINTENDENTS.—A meeting of division and construction superintendents of the Cumberland Telephone Company was recently held at Nashville, Tenn. Among the questions discussed were, the best method of cable work, the best plant for the proper handling of toll line maintenance and installation, and how best to provide the local managers and operators to insure the best service for the public. There was a large attendance, and a lunch was tendered the delegates by the Cumberland Company at the Duncan Hotel.

GROWING PLANTS BY ELECTRIC LIGHT.—According to a Washington dispatch the Department of Agriculture has begun extensive experiments into the growing of plants by electric light. Most plants, it is stated, grow only during the day and rest at night, and the experiments, aside from their scientific value, will be made with the object of forcing the growth of vegetables, etc., so that they will work twenty-four hours a day instead of twelve or so under normal conditions. The economic side of the question will also get careful attention to ascertain if the outlay of electricity can be returned at a profit.

WIRELESS IN THE PHILIPPINES.—It is stated that General Greely, chief signal officer of the United States Army, has decided to install a wireless telegraph system between Zamboango and Jolo, Philippine Islands. General Greely, it is reported, was not favorably inclined to a wireless system in the Philippines at first on account of the necessity for experts, but the cable between Zamboango and Jolo has been interrupted so often that wireless seemed to be necessary. For nearly forty miles from Zamboango the bottom of the ocean consists of coral reefs. The strong tides that flow between the islands wear the cables against the coral, and they are frequently cut and rendered useless. It is expected that the wireless system will be in operation in about three months.

WIRELESS NEWS OF SHIPWRECK.—News of a shipwreck at sea came by wireless telegraph on Oct. 15 from the Cunard Line steamer *Etruria*, which sailed from New York for Liverpool on Oct. 14. The *Etruria* found the Swedish bark *Orion* in distress, 500 miles east of Sandy Hook. A crew from the *Etruria* rescued the *Orion's* men and the latter vessel was abandoned. Captain Olson of the *Orion* said he would like his owners in Gothenburg to know that the bark had been abandoned and that all hands had been saved. Captain Potter of the *Etruria* said he would immediately send word ashore. His Marconi operator called up the station at Cape Race and in a few minutes the first wireless report of a rescue one-sixth of the way across the Atlantic had been sent to land. Incidentally it may be stated that the abandoned bark was found later by the steamship *Exeter City* and towed to St. John, N. B., as a prize.

AN ARGUMENT FOR ELECTRIC HEATING.—The central station manager in a suburban town near Chicago has recently been figuring with the owner of a large summer hotel for the installation of electric curling iron heaters throughout. The argument which he used with the proprietor of the hotel will no doubt be of interest to other central station men in getting business, and may assist them in closing similar contracts elsewhere. This manager found that the reduction in insurance premium for the first year on this hotel by virtue of the substitution of electric curling iron heaters for dangerous alcohol lamps would pay for the entire cost of the heaters necessary for the hotel. In most cases the plan called for curling iron heaters in bath rooms. For rooms without bath, portable curling iron heaters could be obtained upon application by the guests. In this way the total number of heaters needed for rooms without bath would not be large.

SYNCHRONIZING IN PEORIA.—Visitors to the plant of the Peoria Gas & Electric Company, during the recent convention of the Illinois State Electric Association, were interested in noting the arrangements for synchronizing three-phase generators. The switchboard is located at one end of this plant and some of the most important generators are a long distance from the switchboard at the other end of the engine room. The intervening machinery prevents the men at the engine from seeing the switchboard attendant. This attendant has a switch controlling one incandescent lamp high in the center of the engine room, which is in sight of every part of the room. With this he can signal to the engineer whether the generator to be synchronized is above or below speed. In the ordinary station routine, however, much use is made of an alternating current arc lamp which hangs near the generator. When the frequency of the generator equals that of the bus bars from which the arc lamp is supplied, the revolving fields appear stationary.

THE GREATEST OF STEAMERS.—The new steamer *Amerika* of the Hamburg-American Line arrived at New York on her maiden voyage on October 20. This ship is the largest in the world as to tonnage, and fitted with every modern convenience for the comfort of her passengers. Her electrical equipment is varied and extensive. There is an electric elevator on the starboard side of the ship, which carries the passengers to and from four decks. The decks are named "Kaiser," "Washington," "Roosevelt" and "Cleveland." The *Amerika* also has a complete telephone system aboard, including a central station, by means of which a passenger in any one stateroom may converse with another passenger in any other stateroom. Her electric light plant is very complete, and among the other electrical features are a Marconi wireless telegraph equipment, submarine bells, electrically-operated bulkhead doors and electric baths. Other features of the great ship include a restaurant, where meals are served *a la carte*; a florist's shop, a gymnasium, etc. The *Amerika* can carry 3,057 passengers. She has a cargo-carrying capacity of 16,000 tons, is 687 ft. long, 74 ft. 6 in. wide and 53 ft. deep and displaces 42,000 tons.

SELF-STARTING SINGLE-PHASE INDUCTION MOTOR.—In the usual form of repulsion motor, the current produced by the alternating flux in the coil short-circuited by the brush under starting conditions is in a direction to give a negative torque to the rotor. If the main short-circuiting connection between the brushes of opposite polarity be opened, the rotor will revolve in the negative direction when each brush covers a sufficient number of segments. When it is desired to place the motor in operation by means of this torque it is advantageous to introduce current into the armature from the source of supply by way of the brushes on the commutator. If the brushes are connected in series with the primary circuit of the motor, the rotor will operate under the torque noted above combined with that due to the series-motor properties of the machine, and it is possible so to adjust the ratio of stator to rotor turns that the series current in the armature will just equal the current in the coils being short-circuited, under which conditions the sparking at the commutator is reduced to a minimum. In a patent issued October 17, to Mr. Robert Lundell, there is described a method by which the motor may be started up from rest as described above, and may be converted into a simple single-phase induction motor when full speed is attained. Each brush is composed of two parts, each of which is designed to straddle or short-circuit a number of commutator bars and armature coils corresponding to somewhat more than 90 electrical degrees. At the time of starting, about one-half of the commutator-bars and armature coils are short-circuited by the brushes. At the time of synchronous running, all of the armature coils are electrically short-circuited, on account of the fact that each double brush is mechanically separated so as to cover somewhat more than 180 electrical degrees on the commutator.

CHICAGO STREET RAILWAYS.—At Chicago, on October 17, Mayor Dunne succeeded in putting the City Council on record on the question of municipal ownership. The Aldermen voted—37 to 27 against it. The Mayor sent to the Council an order directing the local transportation committee to cease negotiations with the street railway companies for a franchise, and the vote was taken to indicate that a majority of the Council favor the passage of a franchise ordinance. The vote showed only one over a majority of the Council, however, and not enough to pass the ordinance over a veto of the Mayor. The Council pledged itself not to pass any franchise ordinance which had not first been submitted to the people and approved by them.

GERMAN ELECTRICAL STRIKE.—A special dispatch from Berlin of October 14, says: "The strike of the electrical workers is ended. At a conference to-day the delegates of the workingmen voted to accept the associated companies original offer of 5 per cent increase in wages. The result is a complete victory for the employers. The decision of the hardware manufacturers to lock out their 20,000 workmen unless the electrical strikers returned to work was the prevailing reason for the strikers accepting the terms offered them. The strike was never popular with the laboring classes generally, who regarded it as more a trial of strength between the employers and the employed than as a measure of necessity, as the public considered the coal strike in Westphalia to be."

MORE TROLLEYS IN JERSEY.—Maps filed in the Hudson County Clerk's office in Jersey City by the new Hudson Street Railway Company show that the company intends to build about 50 miles of trolley connections as a feeder to the tunnel that the William G. McAdoo company is building under the Hudson River to the foot of Morton Street. The tunnel was started with the expectation that the Public Service Corporation, which controls all the trolley lines in North Jersey, would patronize it, but recently the Public Service announced its intention of building a tunnel of its own. The maps filed indicate a purpose on the part of the new company to gridiron the county with its tracks and invade all the territory now served by the Public Service. Lines are mapped out to extend south from Jersey City to Bayonne and north into Hoboken and the cluster of populous towns beyond.

SOCIALISTIC PLAIN SPEECH.—The Socialist Labor party in New York is dead against municipal ownership. Its candidate for Mayor says it is a wisp of hay before the noses of donkeys. At a recent meeting James Connolly, who was introduced as a close student of the municipal ownership question, said: "Hearst has been telling us through his newspapers that great good has been done in Europe for the workingmen by the adoption of municipal ownership. Then why, I ask him, is it that 100,000 working men are coming here from Europe every year? On the same page of his paper I read an article crying out against the influence of pauper labor into this country. They have talked a lot of Glasgow. I believe that Hearst even brought over here one of the city officials to tell Chicago about municipal ownership. I have been in Glasgow and if that's your conception of Paradise, head me for the other place. In that city there are 30,000 houses of only one room each. There have been more strikes on the municipally-owned railroads in Glasgow through the efforts of workers to establish the rights to form trade unions than in any other city in Europe. Municipalism is no cure for the ills that we seek to remedy. It is worse than any of the other isms, and it pleases me to see that none of you have been led astray by its fallacious teachings."

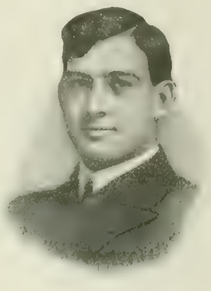
STREET CAR CONDUCT.—The John D. Rockefeller Bible class devoted its time last Sunday to street car ethics. The Rev. W. S. Richardson, the leader of the class in the absence of Mr. Rockefeller, said: "I often wonder whether New York people are more greedy than others. When I see the way persons rush for the cars, shoving every one aside in order to get a seat, I sometimes think they are. I know a very nice young man, one who was always the very acme of politeness. Not long ago I met him while boarding a street car, and was surprised to see how he rushed for a seat, letting women and children stand. I made remarks about his manners, and he said to me: 'I am important to my family. Since I got married I don't give up my seat to anybody in the cars.'" One man in the class said he was a stranger in the city, and was perhaps better able to judge of New York's manners than one who had lived there all his life. He said he found New York men more polite and courteous than he had expected. Dr. Conklin, a member of the class, said he never suspected how kind New York persons are until a few years ago, when he was obliged to use a cane owing to an accident to his leg. Whenever he entered a car, he said, not only the passengers, but even the conductor, showed him the greatest kindness and saw to it that he got a seat

Electrical Engineers of the Times.—XXXIII.

MR. JAMES E. DAVIDSON.

Mr. James Edward Davidson was born at Flint, Mich., November 10, 1879. He is the son of Mr. W. F. Davidson, of Port Huron, a pioneer in central station installation and operation in the State of Michigan, in which state he represented the Thomson-Houston Company for some years as agent. After passing through the public and high schools of Port Huron, Mr. Davidson took a course at the Detroit Business University. As a boy his vacations were spent in the power house at Port Huron, and after leaving school he went at once to work in that plant, of which he became superintendent in 1899.

The Port Huron Light and Power Company's plant, which was described in these columns in the issue dated April 9, 1904 (this article was written by J. E. Davidson), has a capacity of 3,000 kw, and besides furnishing current for street, commercial and residence lighting, supplies power for street and suburban railways as well as for a number of large manufacturing plants. During Mr. Davidson's superintendency a 1,500-kw Curtis turbo-generator was installed, this being the first steam turbine of this make put into commercial operation. In 1902 he was appointed city electrical inspector of Port Huron, a position which he held until his removal to the East.



JAMES E. DAVIDSON.

In the spring of 1905 a syndicate of Port Huron and New York capitalists purchased the plant of the Consolidated Lighting Company of Montpelier Vt., and invited Mr. Davidson to take the management of the business. Upon his acceptance he was made a member of the board of directors, secretary of the company and general manager of the plant. The plant of this company includes a water power station at Bolton Falls and a steam plant at Montpelier. The former, which has a capacity of 2,500 hp, is operated by water power, and the latter is a steam plant of 750 kw capacity. At present a 750-kw steam turbine plant is being installed in the steam station, and the water power plant will soon be enlarged by the addition of a 2,000-hp water wheel and a 1,300-kw generator. These stations supply lighting and power to Montpelier, Barre, Waterbury and surrounding towns, and power is also supplied to the Montpelier & Barre Traction Company. In Barre and vicinity are some of the largest quarries and finishing sheds in the United States, and the additions to be made to the Consolidated plant will be largely to furnish reliable and economical power for quarrying and manufacturing granite.

Mr. Davidson is an associate member of the American Institute of Electrical Engineers, and was secretary and treasurer of the Michigan Electric Association up to the time he left Port Huron.

Development of the Necaxa, Mexico, Water Power.

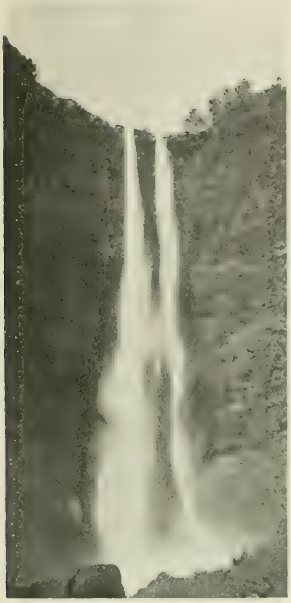


FIG. I.—THE SECOND NECAXA FALLS.

ONE of the most striking and interesting developments of water power that has recently been carried out in the Republic of Mexico is that connected with the utilization of the Necaxa Falls by the Mexican Light & Power Company under the initiative of Dr. F. S. Pearson. This great enterprise has as its field of operation the great central Mexican plateau, where it is developing and conserving the energy of the Tenango and Necaxa Rivers. At a point 100 miles northeast of the City of Mexico these rivers debouch from the mountain chain at a height of about three quarters of a mile above the sea, their joint flow being discharged finally into the Gulf of Mexico. An idea of the region and power is given in Figs. 1, 2, 3 and 4. These two rivers drain jointly an area of about 227 square miles, and on account of the geological nature of the plateau encountered a remarkable succession of waterfalls resulting in a total drop of more than 3,000 feet in a distance of three miles. The plan adopted for the utilization of the water power thus available is indicated roughly in Figs. 5 and 8. The Tenango River has been consolidated with the Necaxa by diversion and their joint flow has been stored in a reservoir lake at Necaxa, as indicated in Fig. 8. From this reservoir by a tunnel and pipe line, as indicated, the water is carried to the first power plant with a total drop of 1,470 feet in a mile. It is thus utilized at the first power house shown in Fig. 8, but will ultimately be utilized again at the end of another drop of 1,100 feet. The two plants are to have a final capacity of not less than 80,000 hp. As indicated in Fig 6, the power is to be carried by a transmission line from the first power house to the City of Mexico, and also far beyond that point to the mining district of El Oro, giving a total line transmission of 171 miles.

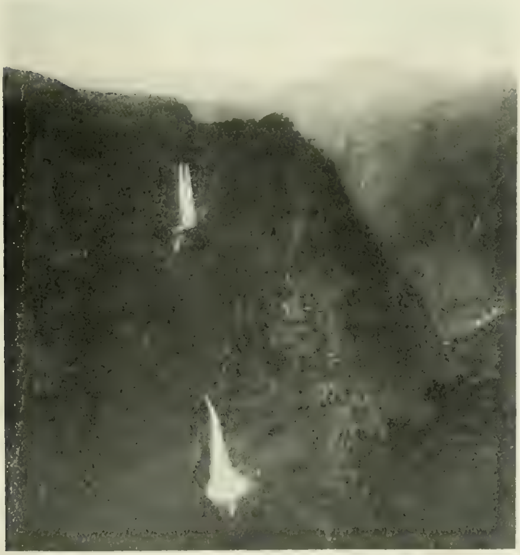


FIG. 2—TENANGO FALLS, MEXICO.

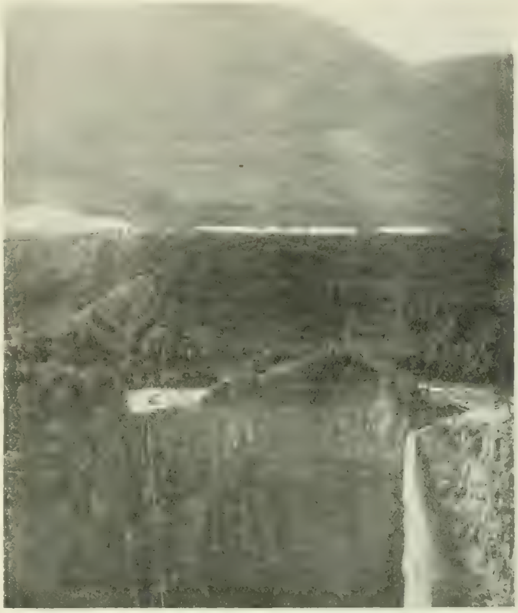


FIG. 3.—GENERAL VIEW OF NECAXA FALLS REGION AND CONSTRUCTION CAMP.

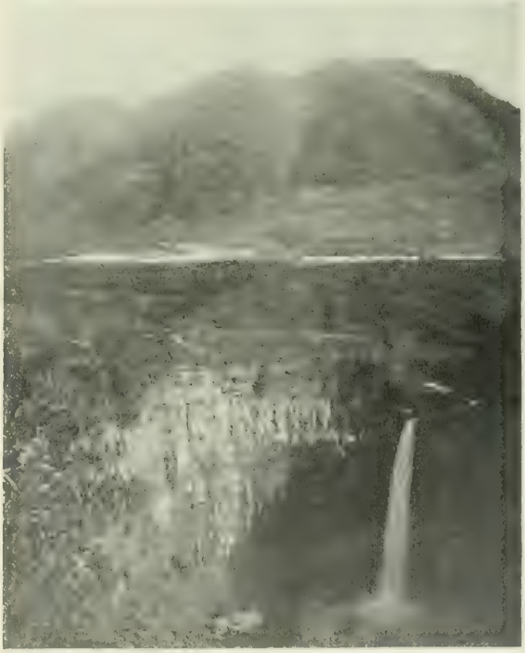


FIG. 4.—TEMPORARY PLANT AND CABLEWAY AT FIRST NECAXA FALLS.

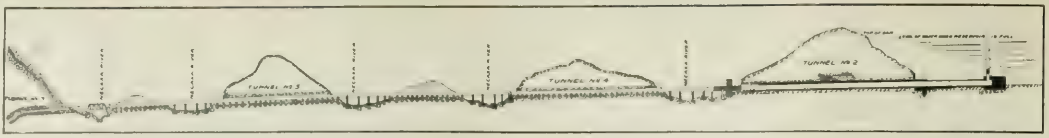


FIG. 5.—PROFILE OF PIPE LINE.

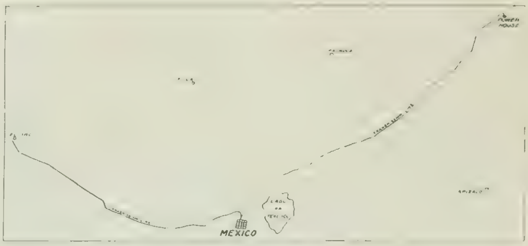


FIG. 6.—ROUTE OF TRANSMISSION LINE.

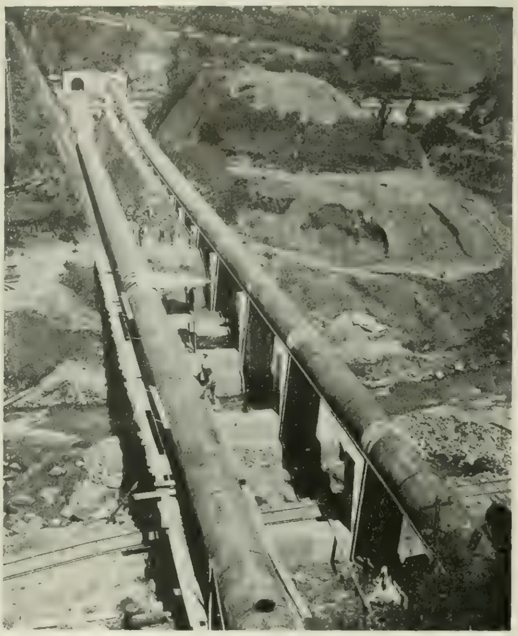


FIG. 9.—VIEW OF THE PIPE LINE FROM TUNNEL NO. 5.

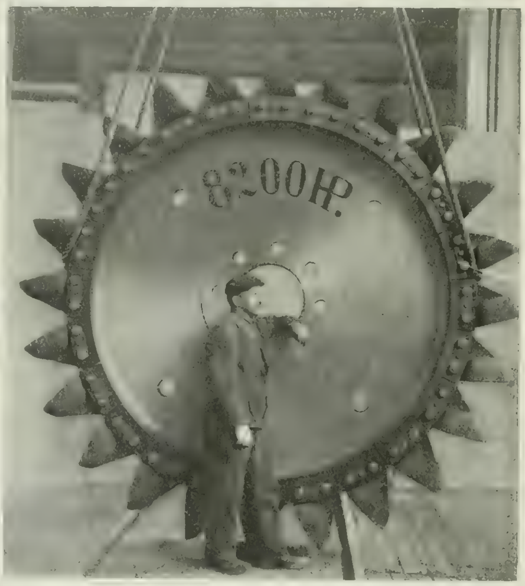


FIG. 7.—IMPULSE WHEEL EMPLOYED AT NECAXA.

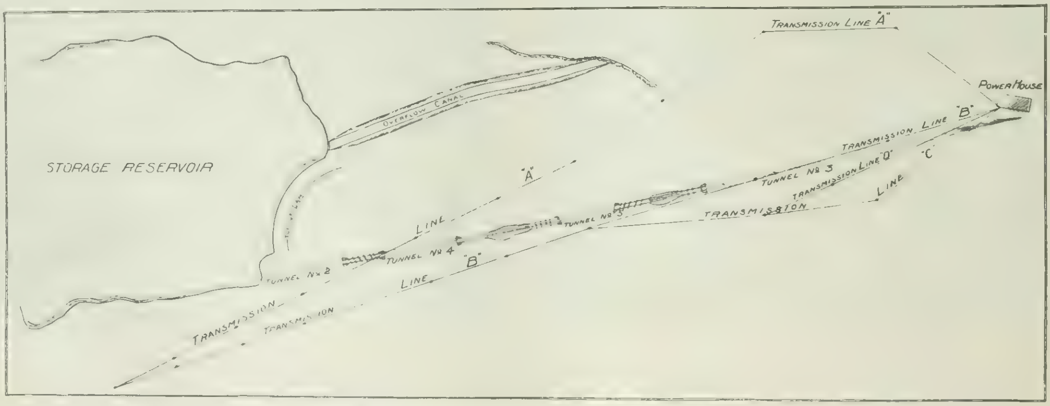


FIG. 8.—MAP OF TRANSMISSION LINES AND PIPE LINE.

DEVELOPMENT OF THE NECAXA, MEXICO, WATER POWER.

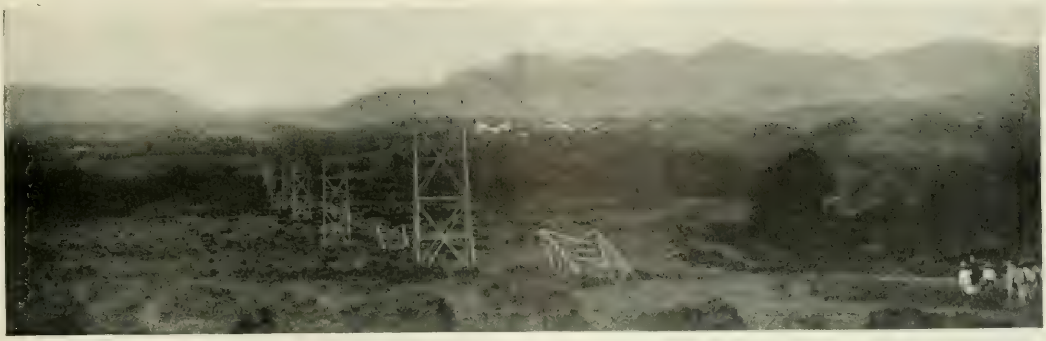


Fig. 10.—General View of Country and Transmission Line

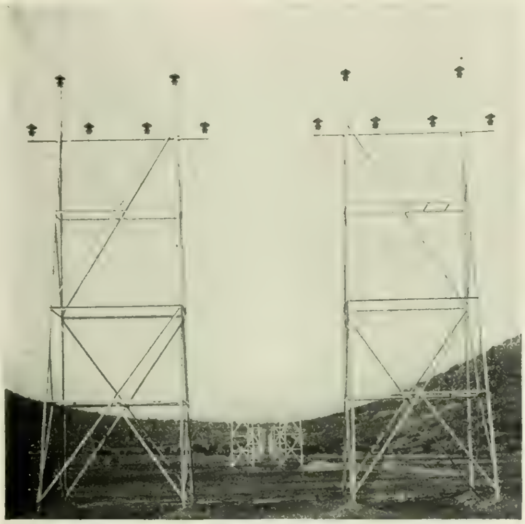


FIG. 11.—VIEW OF TWIN LINE, NEAR MEXICO CITY.

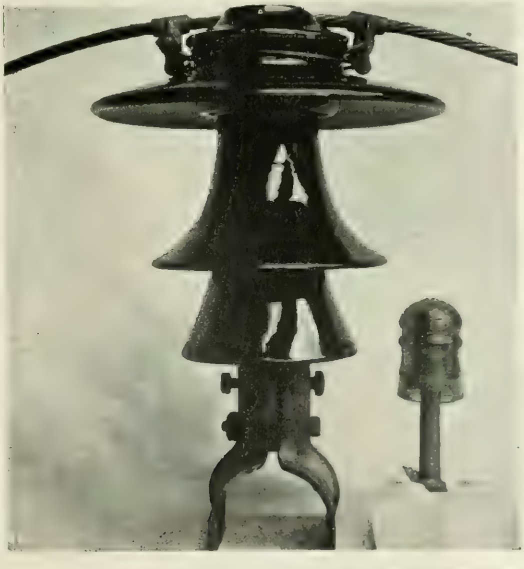


FIG. 12.—COMPARATIVE VIEW OF MAIN LINE AND TELEPHONE INSULATORS.

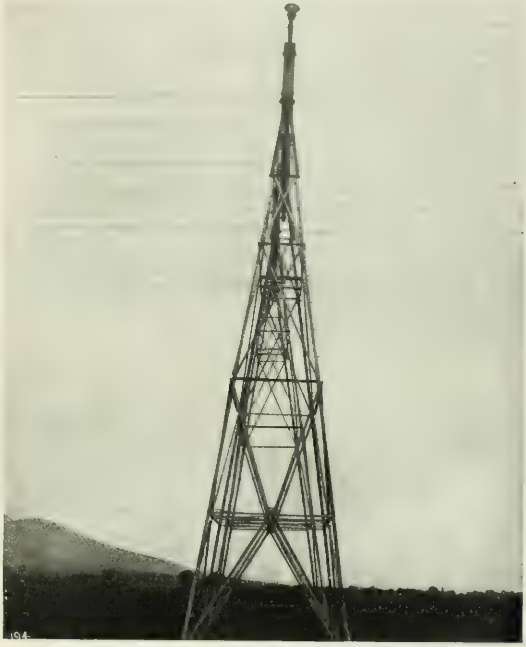


FIG. 13.—SIDE VIEW OF NECAXA TRANSPOSITION TOWER.

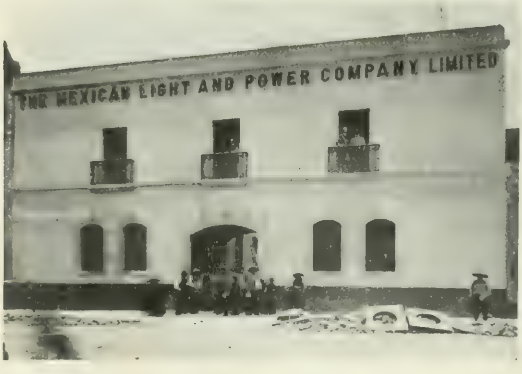


FIG. 14.—NEW SUB STATION FOR NECAXA POWER, CITY OF MEXICO.

DEVELOPMENT OF THE NECAXA, MEXICO, WATER POWER.

The engineering involved is of a most able and ingenious character, and the plant when completed to its full capacity will present many features of surpassing interest. The dam of the Necaxa Lake is of earth 177 feet high and 600 feet long, with a base width of 950 feet and a width of 54 feet at the top. No less than 2,000,000 cubic yards of material were required for the wall, obtained chiefly by blasting. A three-square-mile lake has thus been created from which the impounded water is carried off by means of two pipe lines, as shown in Fig. 9, running in a series of tunnels 1,500 ft. long. Beginning with two vertical intakes with gates at different levels, these pipes end in a receiver from which six seamless steel tubes are carried to the power house itself.

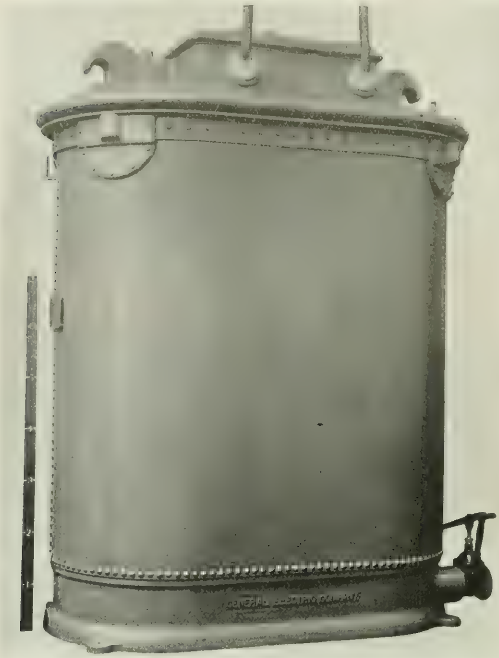


FIG. 15.—NECAXA STEP-UP OIL TRANSFORMER.

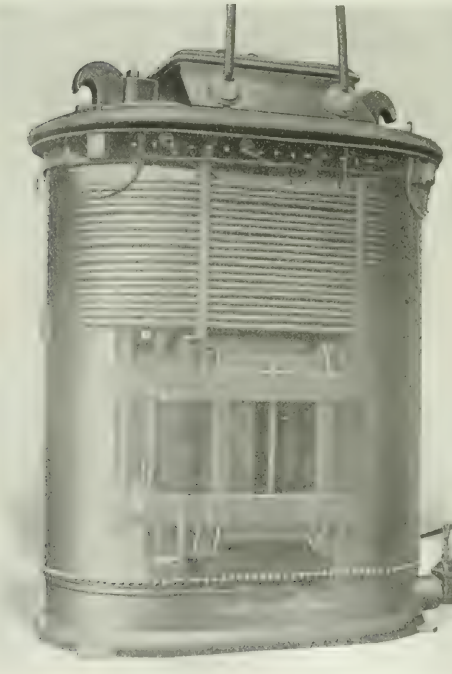


FIG. 16.—INTERIOR VIEW OF NECAXA TRANSFORMER.

The horizontal penstocks are 8 feet in diameter and ⅜ inch thick, passing through the first tunnel, after leaving which they narrow down to 6 feet, and run down stream for 2,800 feet, of which distance the pipes are partly in tunnel, partly in open cut and partly on piers, crossing and recrossing the windings of the river. Then under a head of 180 feet, the penstocks empty into the receiver 22 ft. long and 7 ft. in diameter, out of which proceed the six 30-in. smaller pipes leading to the power house (Figs. 18 and 19). The two halves of the system can be separated from each other, and either part run without interference. All the pipes are connected to the receiver through gate valves. The pipes from the receiver descend a distance of 2,300 ft. to the power house, of which 1,000 ft. is in two parallel tunnels at an angle of 41° from the horizontal. In each tunnel there are three pipes supported on concrete, with anchorages and expansion joints.

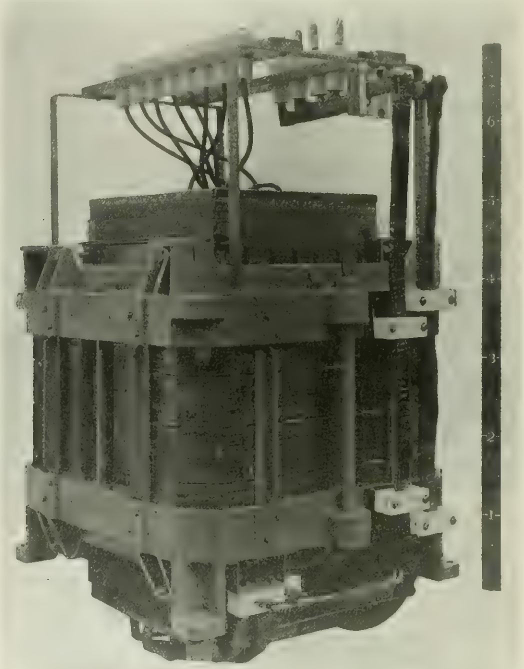
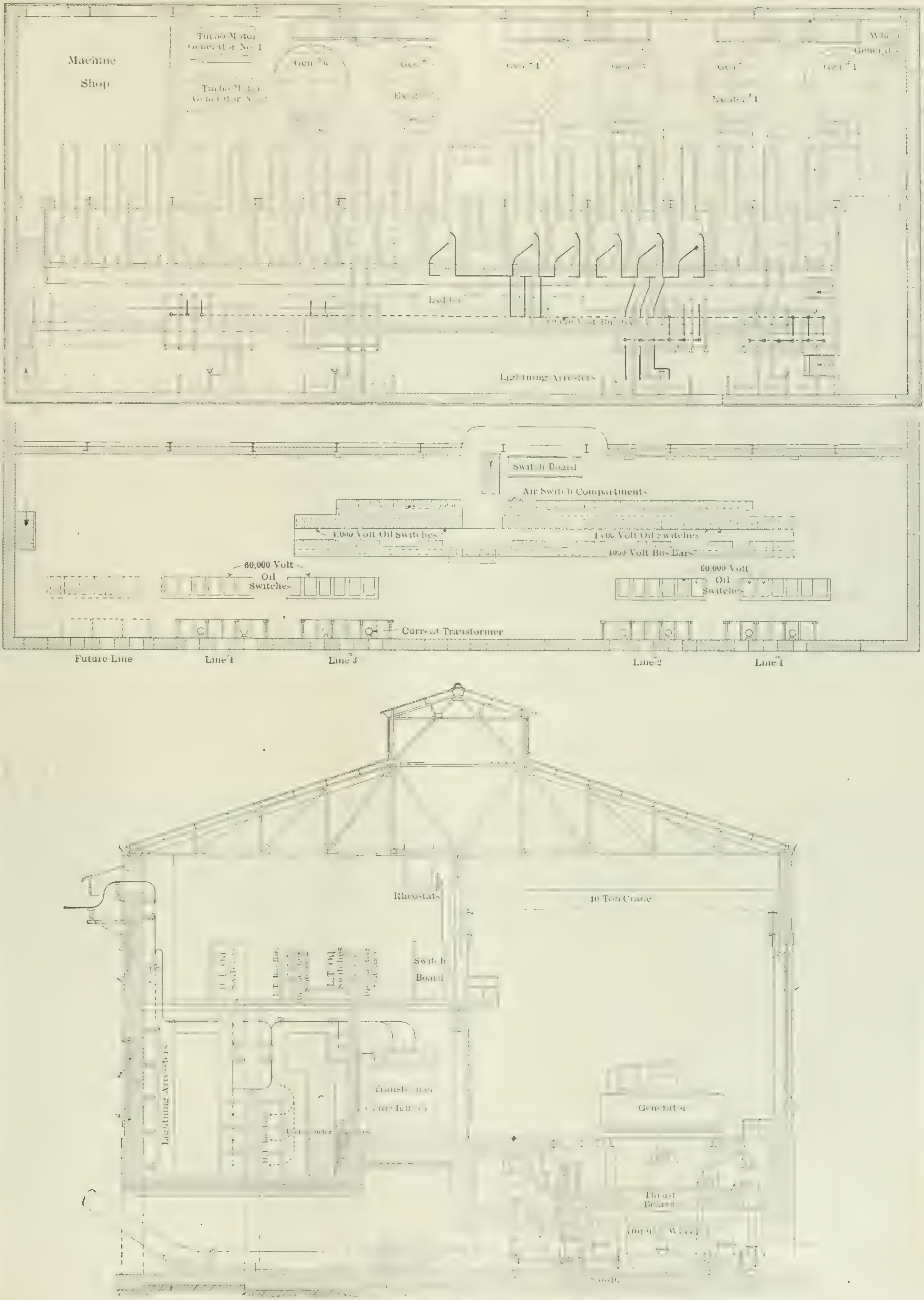


FIG. 17.—CORE OF NECAXA TRANSFORMER.

A vertical relief pipe 240 feet in height and 20 inches in diameter is connected to the upper end of each of the six pipes. It is interesting to note that these pipes are seamless steel tubes made in Europe—with flanges, each piece being forged out complete from one piece of sheet steel. The outside diameter of the tubes is 30⅝ inches throughout, with a variation inside from 0.4 to 0.95 inch, the minimum diameter being 29 inches. Before the flanges were hammered out two cast-steel clamping rings were slipped on to each 30-foot section of tube.

The initial apparatus in the main power station No. 1 has been furnished by the General Electric and Siemens-Schuckert Companies, and comprises six 5,000-kw, 4,000-volt, 50-cycle, three-phase, vertical shaft generators of Siemens-Halske construction. Each generator is driven by an impulse water wheel carrying 24 buckets at its periphery. The wheels (Fig. 7) are those of Escher, Wyss & Co., of Zurich, Switzerland. They are 100 inches pitch diameter,



Figs. 18 and 19.—General Plan and Cross Section of Power House No. 1, Necaxa.

DEVELOPMENT OF THE NECAXA, MEXICO, WATER POWER.

running at 300 r.p.m. and each has two $4\frac{1}{2}$-in. square regulating nozzles fixed on opposite sides of the wheel but operating together.

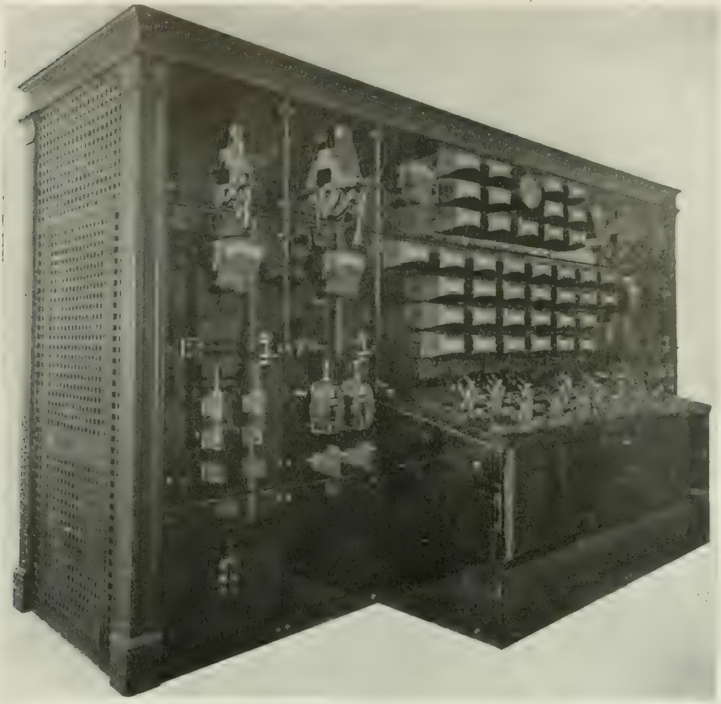


FIG. 20.—THE BENCH-TYPE SWITCHBOARD, NECAXA POWER PLANT.

The current furnished by the generators is delivered to 18 General Electric 2,000-kw transformers stepping up to 60,000 volts, the outfit being divided into six banks of 6,000 kw each. The transformers (Figs. 15, 16 and 17) are oil-immersed and water-cooled. The equipment includes also a fine switchboard of General Electric make, two 250-kw, 125-volt, shunt-wound exciters, direct-connected to three-phase, 4,000-volt induction motors, and three 50-kw, 125-volt, shunt-wound, water wheel-driven exciters. The switchboard is of the bench type, as shown in Fig. 20.

The power house No. 1 in the Necaxa canyon itself is a massive building of steel and masonry, 235 ft. long, 88 ft. wide and 60 ft. high. All the material for its construction, as well as the apparatus for the plant had to be transported with great difficulty and finally to be swung down over cliffs and by means of inclined cableways some 1,500 ft. before it could be assembled at the point of utilization. The power house is equipped with a 40-ton electric crane for handling all apparatus, and special attention has been paid to the machine shop equipment, as it will be readily understood that a plant in such a position is not favorably situated for getting any of its repairs done outside, but must be furnished with the means for grappling with even the largest job of that nature.

The transmission system (Figs. 10, 11 and 13) includes four three-phase, 10,000-kw, 60,000-volt transmission lines, as well as a local power and lighting service. In order to insure stability of construction and permanence, as well as continuity of supply, steel towers have been used for the transmission line, there being two of these carrying the four separate circuits direct into the City of Mexico, and two separate circuits from the City of Mexico onward to El Oro. These steel towers are 40 ft. high on 500-ft. spans or higher when the spans are strung to a length of 1,200 ft. There

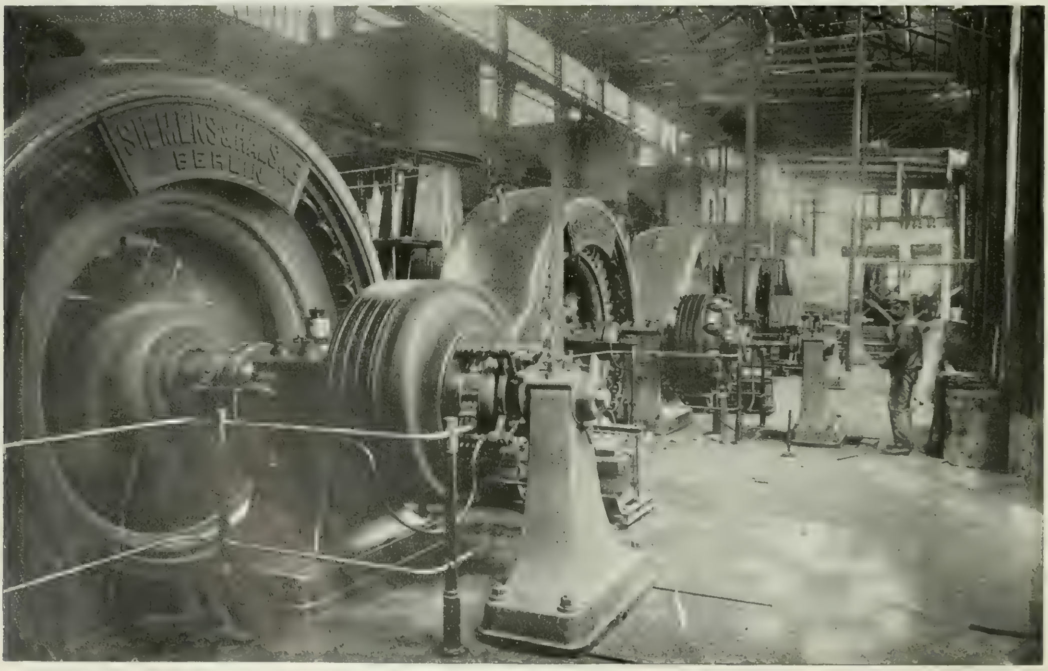


FIG. 21.—THE OLD STEAM PLANT ADJOINING NECAXA SUB-STATION, MEXICO CITY.

are 534 miles of circuit and 1,602 miles of aerial cable. At full load the loss between Necaxa and the City of Mexico is 8 per cent, and from the City of Mexico to El Oro 5 per cent more.

The transmission towers, set 5 ft. in the ground, are built of angle steel, heavily galvanized, with 3 x 3 x ¼-in. posts for the corners spaced 14 ft. apart across the line and 12 ft. along it. The cables are carried 40 and 46 ft. above the ground and are six-strand copper, ½ in. diameter, shipped in lengths of 3,000 ft., and with joints made with 18-in. twisted copper sleeves. They are attached to the insulators by clamps instead of tie wires. The insulators (Fig. 12), made by R. Thomas & Sons, of East Liverpool, Ohio, have been assembled and cemented on the spot, and although receiving a test before shipping, while wet, of 60,000 volts, are again tested when assembled with 120,000 volts potential. The insulator pins are set into the insulators with Portland cement and are 15 in. long, of 2-in. steel pipe, set in drop-forged sockets, mounted on a 4-in. pipe cross arm for the lower cables and 3-in. for the upper. The towers carry also No. 10 copper telephone circuits, 10 ft. below the cables.

The sub-station work at the City of Mexico is connected with a remodeling of the old steam Siemens-Halske station (Fig. 21), to which four Curtis-General Electric turbo-generator units of 500 kw each are being added. The equipment of the sub-station (Fig. 14) includes 12 1,800-kw oil transformers in separate fire-proof compartments with switching and wiring, also in separate cells. The transmission can be at 20,000, 40,000 or 60,000 volts, and the step-down transformers are arranged to furnish current at 1,500, 3,000 or 6,000 volts. The sub-station at El Oro has nine step-down transformers of 1,800 kw each, similar to those in the City of Mexico. In the latter place ordinary city distribution is dealt with, but at El Oro the current is to be used chiefly for mining operations on some of the largest veins and ore bodies of gold in the world.

The work on this great enterprise is now virtually complete, so far as power plant No. 1 is concerned, and as announced in these pages last week, Mr. R. F. Hayward, of Utah, has been made general manager of the company, a position for which his previous engineering practice and experience have richly qualified him.

* * *

Dynamo Heating Time Constants.

By A. Press.

When a dynamo is placed in operation after having been allowed to become thoroughly cold, the internal losses of the machine cause its temperature gradually to approach a certain maximum value above that of the surrounding medium. With a certain constant value of losses being produced within the machine, and a certain unchanging condition of the surrounding cooling medium, it may be stated that the rate of change of temperature at each instant is proportional to the difference between the actual temperature of the machine at that instant and the final maximum temperature which it would attain after the lapse of an infinite length of time. If t represents the time, C the maximum change in temperature, and c the instantaneous temperature, then the following relation may be said to hold:

$$\frac{dc}{dt} = \frac{C - c}{T}. \qquad (1)$$

In this equation T is a constant depending for its value upon the mechanical dimensions of the machine and the facilities for cooling, and may be designated as the heating time constant. It may be shown that T is equal numerically to the time which would be required for the temperature of the machine to reach the final value if all of the heat generated were conserved within the machine, i. e., without any dissipation whatever for this length of time.

Solving the above equation there results:

$$c = C - \frac{C}{\epsilon^{\frac{t}{T}}}, \qquad (2)$$

where ϵ is the base of the natural system of logarithms. Equation (2) is evidently that of a logarithmic curve. It is worthy of note that the subtangent of any logarithmic curve is a constant, and that, with the curve at hand, that constant is T, the heating time constant.

In the accompanying cut (Fig. 1), the straight line represents the rate of increase of temperature which would take place if the heat were not conducted away, the distance T indicating the time to reach the final steady temperature, which temperature under actual operation would be reached only after an infinite length of time. The heating curve is obtained from equation (2). The cooling curve is obtained as the exact inverse of the heating curve, on the assumption that the machine had reached the maximum temperature at the instant when cooling began. In order to calculate the final rise of temperature with a machine which is operated intermittently with a particular time load factor, it is desirable to have a knowledge of both curves.

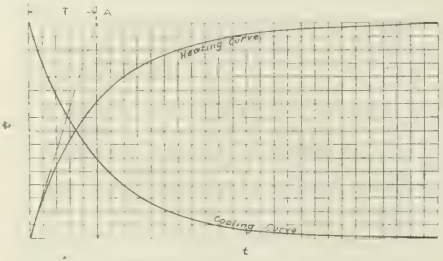


FIG. 1.—LOGARITHMIC HEATING AND COOLING CURVES.

It will be of value to evolve formulas for the time constants of open-type armatures and the corresponding field coils. Assuming that the entire heat generated is conserved within the machine it will be observed that the final temperature rise may be expressed as

$$C = T\,\frac{H\,g}{H\,c} \qquad (3)$$

where $H\,g$ is the amount of heat generated within the machine per unit time, and $H\,c$ is the amount of heat stored in the machine per unit change of temperature, i. e., $H\,c$ is the heat capacity of the machine.

The heat capacity is proportional to the volume, and the volume of an armature may be taken as roughly proportional to D^2l, where D is the diameter and l the length. In a commercial machine the permissible generation of heat depends upon the surface area and the peripheral speed, and the relation may be expressed as

$$\frac{W}{D\,l} = (D\,S + b)\,k \qquad (4)$$

where W is the watts lost, S is the speed in revolutions per unit time, while b and k are constants.

The time constant may be expressed as

$$T = \frac{D^2\,l\,k}{D\,l\,(D\,S + b)} = \frac{k}{S + \frac{b}{D}} \qquad (5)$$

From experimental data on open-type machines, the formula for T may be expressed in minutes as

$$T = \frac{36{,}000}{S + \frac{2{,}000}{D}} \qquad (6)$$

The constants of formula (6) are based on a maximum rise of 40° C. above the surrounding air. If the speed is taken to be zero, formula (6) reduces to $T = 18\,D$, with equation may be said to hold approximately for the armatures of completely enclosed machines.

For the field coils of open-type machines the following formula can be employed:

$$T = \frac{72}{\left(\frac{\Delta}{100}\right)^2} \qquad (7)$$

where Δ is the gross current density in the field copper when expressed in amperes per square centimeter. For a certain maximum temperature rise (40° C.) the current density can be expressed as a function simply of the winding depth, to wit:

$$\Delta = \frac{210}{\sqrt{d}} \qquad (8)$$

where d is the winding depth in centimeters of the field coil at right angles to the axis of the coil.

Combining equations (7) and (8), there is obtained the following expression for the heating time constant of the field coils:

$$T = \frac{7.2}{(2.1)^2}\, d = 16.3\, d \qquad (9)$$

In equation (9), T is again expressed in minutes, the final temperature rise being assumed to be 40° C.

If an "hour-rating" plan is adopted for a certain overload, the final temperature rise (for infinite time) is determinable from the watts dissipated per unit of radiating surface. Thus with the time constant known, and the final temperature rise calculated, the actual temperature rise after a run of an hour can be read off from the logarithmic curve. To this end the curve of Fig. 2 can conveniently be employed. The ordinates of this curve are the percentages of the final temperature rise, while the abscissæ are the ratios of actual time to the time constant as expressed by the quantity $\frac{t}{T}$.

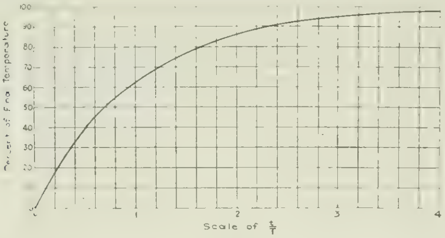


FIG. 2.—PERCENTAGE LOGARITHMIC HEATING CURVE.

* * *

Some New German Electric Projection Apparatus.

By C. J. Smith.

Some of the most interesting and unique devices for electrical projection of transparent and opaque bodies, as well as for colored projection, combined with searchlight and lantern effects, have recently been devised in Germany.

A great deal of important experimental work has recently been performed in color photography, and this subject has attracted the attention of many well-known scientists. After producing the negatives and projecting the views through screens of three different colors at the same time, the pictures are made to appear in their natural colors. The construction of a new three-color lantern is shown in Fig. 1. This three-color projection apparatus was designed by Prof. Miethe and was constructed by the Goerz Actien Gesellschaft, of Berlin-Friedenau, Germany. It consists of three objectives arranged side by side and three sets of slide holders mounted in front of a housing containing three focusing arc lamps.

Through the switchboard shown in the illustration current is supplied to the three projecting arcs from cables connected with binding posts on the lower edge of the marble panel. Above these connectors are three levers which vary the resistance in series with the arc lamp by means of rheostats mounted on the back of the board. The switches controlling the current are mounted in the center of the board and three ammeters of the Siemens & Halske type indicate the amount of current passing to each of the arc light circuits. The current used varies from 10 to 35 amp., according to the density of the negative. If the same amount of current is used in each arc lamp, the three colors (red, green and violet) projected on the screen through the slides balance each other and produce the picture in its natural colors, if the negatives have been taken properly and the lantern slides have been made correctly. Most beautiful sunrise and sunset effects may be produced as well as beautiful moonlight scenes from the same slides by changing the amount of current used in the arc lamps, thereby projecting the red or green colors so as to cause the one or the other to predominate

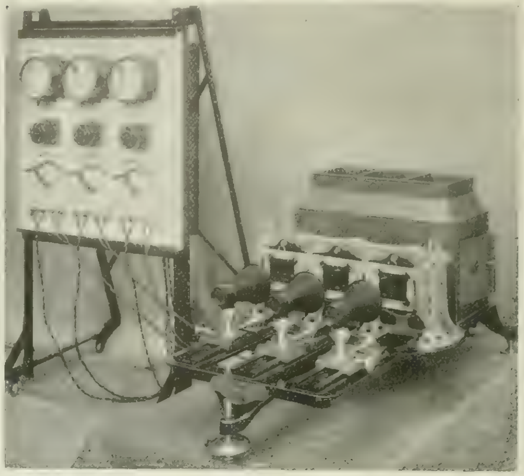


FIG. 1.—MIETHE THREE-COLOR PROJECTION APPARATUS.

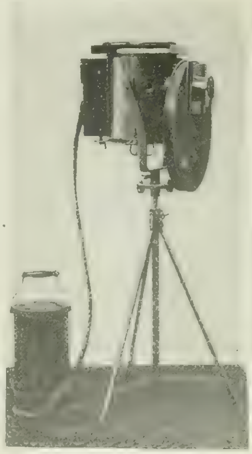


FIG. 2.—LAMP USED AS PROJECTION LANTERN.

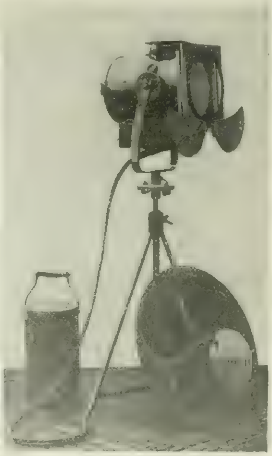


FIG. 3. LAMP USED AS SEARCH LIGHT.

The accompanying illustrations (Figs. 2 and 3) show the arrangement and details of construction of a new combined focusing lamp for color projection, searchlight and lantern service as built at Berlin by the Siemens-Schuckert Werke. By operating this apparatus in the position shown in Fig. 2, stereopticon slides may be utilized as well as revolving color screens of various hues for projection upon a screen or a moving figure. By turning the projection apparatus as shown in Fig. 3, it may be utilized as an ordinary spot light or searchlight for theatre or other similar service with color screens as indicated.

The barrel is of sheet steel 280 mm. in diameters, and is provided with a focusing arc lamp usually operated with a current of 20 amp. The mirror has a diameter of 233 mm. and a focal length of 11 cm., and is of silvered copper construction. The condensers consist of two plano-convex lenses having a focal length of 10.5 cm. and a diameter of 12 cm. The objective is achromatic and consists of four lenses combined with a focal of 12.5 cm. This German projection apparatus is certainly most unique in construction, as it can be utilized with ease in either position shown, and for the purposes above mentioned. It is so constructed as to be fastened to a table by a clamp provided for the purpose, or mounted upon a tripod, as found most suitable for the purpose.

The epidiascope is a most interesting electrically-operated optical device constructed by Carl Zeiss, of Jena and Berlin, Germany, for the projection of objects lying in a horizontal position. The accompanying drawing, Fig. 4, shows the apparatus employing reflected light in the case of opaque objects, while the diagram, Fig. 5, shows the paths of the rays by transmitted light with transparent or translucent objects. As compared with a large projection outfit with an optical bench, the epidiascope is said to possess several characteristic advantages. There is a greater latitude in the shape and size of objects and when reflected light is employed the illumination is more perfect. The transition from operation with reflected light to transmitted light is effected with greater speed and convenience, and the apparatus is easily adjusted for projection upward, while the several components are better protected against dust and improper usage. The epidiascope is about 1.5 meters long with a total height of about 1.5 meters. The width of objects to be projected cannot be more than 30 cm. and the maximum thickness must not exceed 16 cm., while the construction of the apparatus prescribes no defined limits to the length of objects.

A focusing arc lamp is used as the source of light, adjusted according to requirements for a current of either 30 or 50 amp. A continuous current is indispensable to obtain satisfactory results, and, allowing for resistance at the terminals, the potential should be about 65 volts. As however the currents supplied by power-distributing centers are usually of higher potential, either being 110 or 220 volts, this voltage must be reduced by a rheostat.

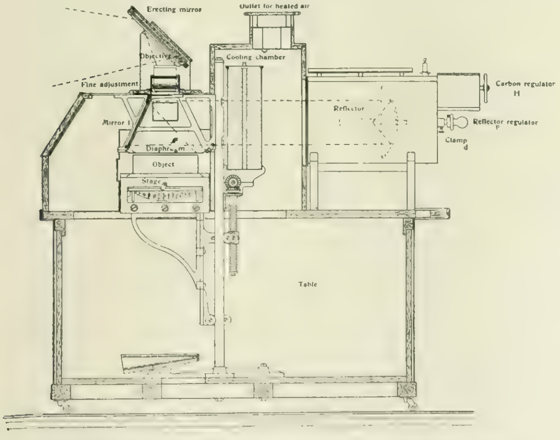


FIG. 4.—DIAGRAM SHOWING PATH OF RAYS BY REFLECTED LIGHT.

The diagram (Fig. 4) illustrates the procedure by reflected light called episcopic projection. The light emitted by the crater of the positive carbon falls upon the parabolic mirror of the lamp and is thence reflected in the shape of a nearly cylindrical pencil. It next passes through the cooling chamber, which if filled with water absorbs the heat rays, then strikes the mirror, *I*, and is by it reflected obliquely from above through the diaphragm and upon the object immediately below. From the object the light is diffusely reflected upward. Of the reflected rays only those which are confined in their passage to the space marked off by the dotted lines reach the objective. The cone of rays traveling upward through the objective meets the erecting mirror and is finally reflected upon the screen. The drawing, Fig. 5, illustrates the procedure by transmitted light called diascopic projection. The mirror, *I*, is here turned back, allowing the pencil of rays to pass to the mirror, *II*. From there it is reflected obliquely downward upon mirror *III*, which again reflects it vertically upward into the condensing lens situated below the object stage. Leaving the condenser, the rays of light pass through the transparent object forming a reduced image of the searchlight reflector near the projection objective. They next pass through the objective and meet the erecting mirror. The latter is shown in the illustration as fitted with a regulator. The position of the mirror as here shown is that required for projecting the picture obliquely upward.

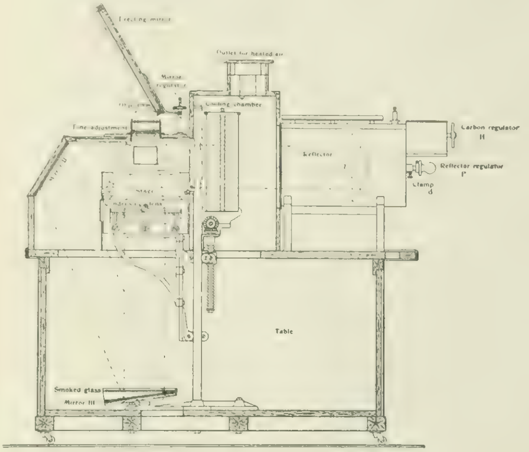


FIG. 5.—DIAGRAM SHOWING PATH OF RAYS BY TRANSMITTED LIGHT.

Congress of Swedish Engineers.—II.

By Arvid Westerberg.

A paper on "Investigations on Iron and Steel for Electrical Purposes," was presented by Mr. F. A. Enström. In order to study the influence of chemical composition and of manufacturing methods on the iron and steel used in electrical machines and transformers, G. Dillner and Mr. A. F. Enström have made, at the Testing Institution of the Royal Technical University of Stockholm, a series of investigations, of which Mr. Enström now gave a short account. The researches had been made on sheet iron and on cast steel. The desired property of the former is a low hysteresis loss, and, in order to keep down the eddy current losses a high electric resistance is valuable. The main requirement in cast steel, which is used for pole pieces, is a high permeability.

The instrument used for the researches was the Du Bois magnetic precision balance, which was accurate within some tenths of a per cent. With this instrument many different kinds of iron and steel, chiefly Swedish and German had been examined. At first, samples were taken from the open market and later special samples, made expressly to contain different percentages of silicon and aluminum were ordered. In casting the silicon steel it was observed that, with a percentage of this element above 1.5, the shrinkage of the steel was so great that cavities were difficult to avoid, while with about 1 per cent of aluminum there was no difficulty in casting the steel. With higher percentages of this element, however, the steel becomes rather thick, and from this cause many of the samples were unsound and unsuitable for testing. A chemical analysis of all the samples was made, the percentage of carbon, silicon, manganese, phosphorus, sulphur and aluminum being determined. The results obtained may be stated as follows:

For sheet iron it was found that the coercive force and the Steinmetz hysteresis coefficient is proportional to the carbon percentage within the range of 0.5 per cent. Thus it is obvious that a small amount of carbon is favorable in laminated iron for armature cores and transformers. As to cast steel, there is not produced any detrimental effect by increasing the carbon percentage, so far as is shown by the present investigations. With the very highest carbon percentage met with, about 0.30, the values of the maximum induction and of the permeability at the usual induction in field poles, cannot but be considered as quite satisfactory. A high percentage of carbon produces an increase in the electrical resistance.

An increase of silicon causes a quite noticeable increase of the coercive force and of the hysteresis energy loss and also of the electric resistance, while the properties of permeability, remanence and maximum induction hardly undergo any alteration. Therefore, for sheet material, silicon should be avoided, while in the case of cast steel some silicon in the material may be advantageous owing to its raising the electric resistance. More than 2 per cent, however, should be avoided, because there will be a tendency to form cavities.

It has been stated that an addition of aluminum quite noticeably reduces the hysteresis loss, whilst it increases the electric resistance, and thus reduces at the same time the eddy-current loss. It has been found, too, that an addition of aluminum will reduce the maximum induction and the permeability for ordinary saturation values. The general conclusion is, therefore, that an addition of aluminum improves sheet material which is to be used for constructing dynamos. As regards cast steel, the matter is different. With such a high percentage of aluminum as is required in order to increase the electric resistance to an effective degree, the magnetic properties will be too much affected, and it must be agreed that the usefulness of aluminum in cast steel is questionable, to say the least. It is of interest, however, to notice the results obtained from the researches on cast-steel rods containing both silicon and aluminum. In this case low hysteresis losses are found, to be ascribed, no doubt, to the influence of aluminum, whilst the influence of this element on the permeability and maximum induction seems to be neutralized by the addition of silicon. The addition of silicon and aluminum together seems thus to tend towards a general improvement of the magnetic properties.

Mr. C. Benedicks has given a formula for calculating the electric resistance of iron from the number of atoms present of any element, which is contained in the iron in solid solution. This formula has been tested, and the agreement between the figures observed and those calculated may be considered very close.

It has been found that, as a rule, annealing improves the magnetic properties in general, and especially decreases the hysteresis loss. As to sheet material that had been annealed in packs, a decided difference amounting to about 10 per cent in favor of the edges was found between the edges and the centre, regarding coercive force and hysteresis loss. These researches prove, therefore, that the general assumption that the edges contain a lower grade of material than the center, is false. The time and temperature of the annealing is very important, 147° F. seeming to be the best temperature.

During the discussion following the reading of the paper, the question of the aging of the material was brought up, and it was pointed out that the aging depends largely on the annealing. If the annealing is carried out at the proper temperature the danger of aging is very small. Regarding the advisability of annealing the laminated packs after punching it was stated that Swedish and German manufacturers have abandoned this method which, however, is still in use in America and England.

A paper was presented by Mr. E. Danielson, dealing with "Single-Phase vs. Commutation Motors." Three types of such motors have characteristics suitable for railway work, viz., the series motor, the repulsion motor and the compensated repulsion motor. After giving a short description of these three types, Mr. Danielson made a comparison between them. The sparking being the greatest stumbling block in the operation of all commutator machines, the first comparison was made in this respect. The cause of the sparking in an alternating-current motor is two-fold: The one that exists in direct-current machines by the rapid change in the direction of the current in the short-circuited winding, and the one that arises by induction through the alternation of the flux passing through the short-circuited winding. The higher the speed of a machine the greater the difficulties which arise at a certain amperage from the first named cause. The difficulties of commutation from the other cause depend at a certain frequency upon the number of flux that passes through the short-circuited winding. When the motor is stationary the latter is the only cause for the sparking. When running the series motor and the repulsion motors operate equally as to the difficulties of the first class, since with each the sparking is inclined to increase at increasing speed. Regarding the second class of sparking a great difference exists between the different types of motors. With the series motor, at increasing speed, the strength of the field and at the same time the lines of force that have an inducing effect in the short-circuited winding decrease and, therefore, this class of sparking decreases at increasing speed. With the repulsion motor the sparking decreases as the speed approaches synchronism, and at synchronism it totally disappears, but when the speed is above synchronism, the sparking increases very rapidly. Therefore, above synchronism the sparking of a repulsion motor increases from two causes, while with the series motor, one cause of sparking increases and the other one decreases, as the speed increases above synchronism.

If the two types are compared regarding the iron losses, the result is analogous. Above synchronism they increase rapidly in the repulsion motors, but decrease slightly with the series motors. The conclusion from these comparisons is that the series motor operates well at speeds far above synchronism while the repulsion motor works best in the immediate neighborhood of synchronism. Consequently the series motor is fit for a lower frequency; and since the tendency to sparking is less at such frequencies, there is a considerable advantage for the series motor. Therefore, regarding sparking, one may say that the series motor for low frequency is the best single-phase commutator motor existing at present.

For railway work the repulsion motor is generally considered best for frequencies above 25 cycles. The difference between the simple repulsion motor and the compensated one lies principally in the compensation of phase that the latter gives. Since in railway work a considerable air-gap generally is required, the compensated type in most cases has to be chosen in order to avoid too great an angle of lag of the current.

Mr. Danielson compared direct-current motors and alternating-current motors, especially regarding their behavior at starting. The direct-current motor requires a starting rheostat; the alternating-current does not, but this advantage of the alternating-current motors should not be exaggerated, and its importance depends upon the frequency. The lower the frequency the more favorable is the relative economy at starting of an alternating-current motor—above 30 periods it is hardly probable that the start is more economical than with a suitable direct-current motor.

Regarding the torque per voltampere at starting, Mr. Danielson gave the following formula for single-phase commutator motors:

$$K = W \frac{P}{n} . C$$

where K = torque in kg at one meter radius.

W = kilo-volt-amperes.

P = number of pairs of poles of the motor.

n = the frequency.

C = a constant.

The size of the constant C depends on the air-gap, the peripherical length of the pole, the shape and numbers of the slots, etc., and is generally between 16 and 24. The value refers to the torque per kilo-volt-ampere at start, which is 1,25 to 1.85 times the torque per kilo-volt-ampere at synchronous speed.

In general, it may be stated that for railway work the series motor is best adapted, if the frequency can be chosen at will, but it has the disadvantage that a transformer of a size corresponding comparable with the size of the motor or the motors has to be carried on board the car or the locomotive. Therefore, it is suitable for large locomotives, for railways where the frequency can be chosen at will, and where considerable variations of speed occur, especially if the trains on a portion of the road should be fed with direct current.

The compensated repulsion motor can be used for the highest frequencies. It can be constructed almost without regard to those factors that generally determine the angle of lag, therefore a mechanically good machine can be made with large air-gap and high-tension windings on the stator. The compensated type is more complicated than the simple type, however, and necessitates a transformer for the compensating current. It is most suitable in those cases where a high frequency must be used and a large angle of lag would be very undesirable, and in those cases where the motors must work with small peripherical speeds or large air-gaps. Finally Mr. Danielson mentioned that the Allmänna Svenska Elektrishka Aktiebolaget is experimenting at present with a large motor which works as a series motor for alternating currents at higher speeds and for direct current, while for alternating current at lower speed it works as a compensated repulsion motor.

Recent Electrochemical Developments.

ELECTRIC FURNACE.

The electric induction furnace for making steel is not such a recent invention as is generally believed. E. A. Colby took out the first fundamental U. S. patents for the same in 1890 and he was the first person to build an induction furnace; while almost simultaneously the engineering firm of Sprague, Duncan & Hutchinson independently experimented with an induction furnace of their own construction. It is now easily understood why those early experimenters experienced difficulties—it was not on account of any inherent weaknesses of the principle of this type of furnace, but because of the backward state of alternating-current engineering in those days. The induction furnace is in principle nothing but an alternating-current transformer, the molten bath forming the single-turn secondary. The difficulty is one of design.

When Kjellin in Sweden began his work with the induction furnace a few years ago, the state of the art was very different; the proper design of ordinary transformers was then well understood. This remark should not be taken as an attempt to minimize Kjellin's work; its importance cannot be denied since he was the first to make the induction furnace a commercial apparatus for the manufacture of high-class steels which are equal in quality to crucible steels and are sold in competition with such. Yet, even now the design of the induction furnace presents difficulties, and a principal one is indicated in a patent recently granted to F. A. Kjellin. It is the difficulty of preventing the insulation of the primary winding from being damaged by the heat of the secondary melting chamber. To overcome this difficulty, Kjellin proposes to water-jacket the primary winding.

In a recent patent, granted to F. Bölling the following method is proposed for making molded blocks and articles of various shapes from silicon carbide. The article is first made of pure carbon, and is then embedded in finely powdered silicon carbide and subjected to strong heat whereby the surface of the carbon article "absorbs" the silicon carbide.

Articles made from fused quartz some time ago made their appearance on the market. They are useful for various purposes of industrial chemistry, since they are little liable to attack by acids and are wholly refractory. Moreover, not only can they stand high temperatures, but their coefficient of expansion is so small that when heated to a very high temperature they may be plunged into water without suffering any injury. Of course, the production of such articles requires a very high temperature. In a recent patent of E. Hart the electric arc is made use of for this purpose. A mold of the desired form is prepared and a small quantity of crushed quartz is first placed in the centre of the mold and fused together by the heat of the arc. Then more crushed quartz is added and fused and the article is gradually built up.

New Telephone Patents.

RECEIVERS AND TRANSMITTERS.

To overcome the breaking of receiver caps of hard rubber or composition, Mr. W. J. Murdock, of Boston, Mass., has devised and patented a receiver with a rigid ring of tough material set in and surrounding the cap to receive the force of sudden blow. Fig. 1 illustrates the idea.

In the usual types of transmitter we find carbon electrodes, carbon granules and a small, narrow air space about the diaphragm. Mr. J. Prince, of Milford, Mass., however, has produced a transmitter almost at direct variance with this. He provides magnetic electrodes, granules of magnetic iron ore mixed with carbon and a large resonating chamber about the diaphragm to increase its sensitiveness. It would of course—at first sight at least—appear to increase its ability to pick up and maintain the natural periods of the diaphragm. This may be overcome to some considerable extent, as the electrode chamber is pressed into the diaphragm itself at its middle. The inventor explains that the magnetic qualities produce internal energy which assists in preventing packing.

Another new transmitter has been patented, this by Messrs. P. J. Spies and R. C. Deuben, of Chicago. Their invention lies in structural details. The aerial face plate carries a ring flange over which slips a clamping ring which clamps the diaphragm to the face of the flange and which is integral with the bridge.

W. B. Curtis, of San Francisco, has worked out a new antiseptic mouthpiece. The usual rubber transmitter mouthpiece is perforated with two rings of holes near its base, and these lead into a chamber which is slipped over the mouthpiece base and is clamped between the flare and the transmitter face. This chamber carries the antiseptic material.

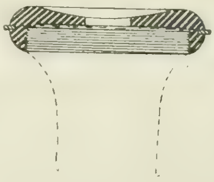


FIG. 1.—MURDOCK RECEIVER.

In order to improve the efficiency of transmission of party lines, a device has been patented by which all signaling apparatus may be removed from the line. This is accomplished by a sealed pneumatic chamber containing a heating coil. This coil is supplied at all stations, save those with receivers off the hook, with current, the heating effect of which expands the air in the chamber. The cover of the chamber, being flexible, bulges under the influence of the pressure and thereby actuates a cut-out switch.

SAFETY CORD AND SET.

Telephones used upon lines strung on poles carrying high-tension currents, a condition often existing along electric interurban lines, at times become most disagreeable or even dangerous, because of leakage to, or static charges induced upon, the telephone lines. To prevent this danger, Mr. F. R. McBerty, of Chicago, has provided a complete protective apparatus for such instruments. All exposed parts of the instrument liable to charge are connected to an extra conductor included in the cords, which conductor is spiraled around the working conductors between them and the outside of the cord. This extra conductor taps the middle or ground plate of an open space cut-out to which the line conductors are connected. Connection to the line is made through a plug and jack. This is a three-conductor type, the sleeve of the jack being grounded. As a further preventative of danger a repeating coil is inserted in the line conductors. This arrangement, shown in Fig. 2, provides about as complete precaution as can be desired. Mr. McBerty has assigned his patent to the Western Electric Company.

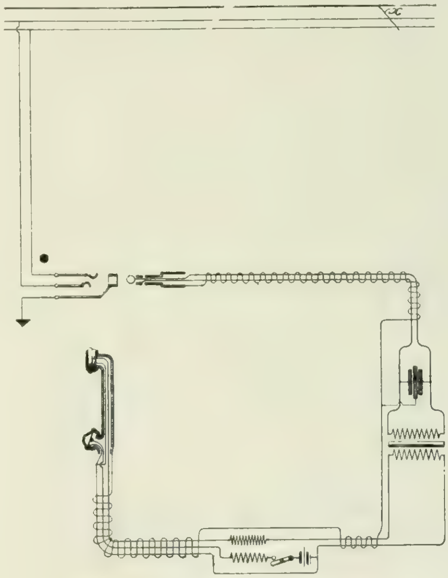


FIG. 2.—M'BERTY PROTECTIVE APPARATUS.

LETTER TO THE EDITORS.

The Application of Electric Power to Agriculture.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of September 16 Mr. E. W. Baker laments the backwardness of American manufacturers of electrical machinery in catering to the farming field. He directs attention to the fact that articles regarding apparatus for electric plowing as referred to in your index are mainly "made in Germany." It is true that American manufacturers of agricultural machinery have not been quick to avail themselves of electrical operation for their product. To our knowledge, however, two Americans are now working on motor-driven plows and a third party, now manufacturing steam traction plows, is inclined to take up experiments along this line.

Most of the articles published on electric plowing in Germany reveal plows which involve the use of a carriage pulled backward and forward over the field by motor-driven drums mounted on trucks and located at opposite sides of the field. An American inventor has taken up the work of an automobile plow, deriving its power from a motor mounted on the plow; the cable conducting the current is trailed along the ground. In this way, a great deal of expense for machinery is obviated and the amount of necessary labor reduced.

If Mr. Baker will review again the published articles on electric motor drive for agricultural machinery in Germany, he will note, if his facilities for investigation are adequate, that the motor-driven equipments, almost without exception, are located on some of the large landed estates, or on independent farms adjoining such landed estates. It is a comparatively simple matter for the wealthy farmer with broad acres to install a central power and lighting plant and distribute his current over any convenient radius, supplying economical power for his own work and that of his neighbors.

The advance of the electric interurban railroad is a far more potent factor in reducing the cost of farm power than the development of water power. If the farmer can secure power from a traction company, he can eliminate the investment necessary to impound the water, the necessary controlling work, water wheels, generators and other machinery. If Mr. Baker will figure the first cost of an independent electric lighting plant, he will find that very few farms and farmers are able to afford the investment, even though its ultimate result will be of great economy. The American farmer is too busy paying for the replacement of his farm machinery, due to careless use and abuse, to be able to afford the cost of his own electric power and lighting station.

As regards the use of power from the lines of the long-distance transmission companies, the farmer will find few opportunities for economy. The number of farms to be served from high-tension lines is small even though such lines cover a great expanse of territory. The line of the transmission company too often traverses rough country unsuited to farming. The expense of transforming the current down to a voltage safe and practicable for farm use bars the farmers effectually from enjoying the convenience of electric-motor drive and the economies due to its employment.

The salvation of the American farmer in the use of electric current lies in installing motors with power from a trolley line. The trolley companies are willing in most instances to dispose of their power to farmers. It gives them a power load which is practically without cost for the production of current, due to the fact that the total of the load compared with the total generating capacity is very slight. As a matter of policy, the promoters of new interurban railroads can well urge the desirability of electric motor drive for farmers by appealing to the farmer's pocketbook and pointing out the economies of electric motor drive for farm work. The right-of-way parties can easily secure concessions from the farmers and farm communities which would not be granted ordinarily, due to ill-founded hostility to traction corporations.

We know of several instances where farmers are considering the installation of a central electric station to serve several farms within a short radius. Such installations would be put on a co-operative basis and would enable each of the farmers to participate in the convenience and economy of electric motor drive and illumination for farm and home.

It is interesting to note the number of farmers in the Dakotas who propose converting the head of water from their artesian wells into electric power. Unfortunately, though this has been actually done, the well drillers give an exaggerated idea of the power available to the farmers; and investigation reveals immediately the minute power available. There are exceptions, of course, but the average artesian well cannot be considered a practical power proposition.

The American farmer need not look to Congress to relieve him from coal bills. What he wants to do is, if possible, to secure power from an interurban railroad. If no electric power is available, the proper thing for a farming community to do is to install its own central power and lighting plant.

The amount of water power available in the United States for farm work is not at all proportionate to the requirements. The scope of the water power plant is limited to a greater extent than that of the trolley company, as the former has greater transmission possibilities than to serve isolated farms. The ordinary water power transmission company does not usually follow lines which would enable it to serve numerous farmers. The trolley line, on the other hand, is projected to reach as much as possible the various communities requiring transportation facilities, and thus passes very near to the farmer, who can thus arrange to use the electric power available. The average farmer's requirements for power will not exceed 15 or 20 horse-power. Thus the long-distance transmission company will operate at a disadvantage when compared with the trolley company, which is far closer to its possible power consumers.

MADISON, WIS. NORTHERN ELECTRICAL MFG. CO.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Determination of Air-Gap Reluctance.—SMOOT.—A paper illustrated by diagrams describing an experimental method for determining the magnetic reluctance of an air-gap of given shape. The method is based on the parallelism which exists between Ohm's law for electric circuits and for magnetic circuits. The author first measures the electric resistance of a metallic template, the outline of which is a section of the air space in question. He then measures the resistance of a simple rectangular template of the same metal. Now the ratio of these electric resistances will be the same as the ratio of the magnetic reluctances for similar sections of air space, hence it suffices to calculate the magnetic reluctances of a rectangular air space, corresponding to the above-mentioned rectangular metal template. By multiplying this magnetic reluctance with the ratio before determined the magnetic reluctance of the odd-shaped space is obtained.—*Jour. Western Soc'y Eng.*, August.

Booster.—FRIEDLANDER.—In an article on direct-current machinery at the Olympia Electrical Exhibition in London, the author describes a reversible booster for charging and discharging batteries, invented by Turnbull & McLeod and built by the Lancashire Dynamo Company. This booster has a completely laminated field structure to allow rapid changes of flux to take place, and is fitted with four field windings: (1) a shunt winding across the booster brushes tending to keep the sum of the battery and the booster voltage equal to the line voltage whatever may be the state of the battery; (2) a main winding in series with the battery and the booster armature, compensating for the booster armature reaction; (3) a shunt winding connected across the mains, and (4) a series winding carrying a current proportional to that of the main generators, and acting in opposition to the current in the shunt winding (3). The combined effect of these windings can be arranged either to keep the output of the main generators constant at any desired value, or else to allow the generator current to rise and fall, within certain limits, in proportion to the external load, while the battery looks after the whole, or the greater part of, the variations from the normal external load—discharging at times of overload and becoming charged when the external load falls below the normal. The booster is capable of giving at 120 volts continuously 200 amp., or for one hour 300 amp., or at 60 volts 400 amp. for five minutes, all at 800 r.p.m.—Lond. *Elec. Eng.*, September 29.

Commutator Grinding Machine.—In a report of the electrical exhibition at Olympia, London, the Philips grinder is described and illustrated. No driving motor is required, the grinding spindle being driven directly by means of a specially prepared rubber friction wheel running on the commutator. The spindle is carried by a strong slide and is absolutely rigid. Bearings of great length are fitted, and the spindle and drum are evenly balanced so as to run at the necessary high speed without causing vibration. When working the grinding spindle moves to and fro across the face of the commutator, and is automatically reversed at each end, and is so constructed that stops can be set as in a planing machine, grinding the surface up to the connecting wires and back to the edge. All the attendant has to do is to watch the feed.—Lond. *Elec.*, September 29.

Lights and Lighting.

Miners' Safety Lamps.—Some notes on the use of electric lamps in mines. Holliday has made experiments which show that a 100-volt, 16-cp incandescent lamp heats a heap of carbon dust into which it is placed, within three minutes to such a temperature that it begins to smoke; with the same lamp it is possible to inflame the heap of carbon dust on which the lamp is placed within 25 minutes. Hall found that the 16-cp lamp placed on carbon dust and partly covered with it increased the temperature in a short time to such a degree that spontaneous combustion may start and the temperature continues to rise until the carbon will take fire even if the lamp has been removed in the mean time. It may, therefore, be that a miner places his lamp down for a few minutes and takes it up without suspecting that the damage has already been done and that fire will start in a short while. Another danger from incandescent lamps when used in an atmosphere containing explosive gases is due to breaking of the globe, so that the incandescing filament will ignite the gases. To prevent this danger Tommasi has devised a safety lamp in which the filament is contained in two globes. The circuit is automatically opened when either of these breaks. This lamp is illustrated.—*L'Eclairage Elec.*, September 23. (See E. W. & E., September 16, 1905.)

Luminescence.—Nichols and Merritt.—An account of an investigation of the luminescence of Sidot blende or phosphorescent zinc sulphide. This material seems specially suited to bring out the relationships that doubtless exist between different types of luminescence; for not only is this substance excited to luminescence by all known exciting agents—light, Röntgen rays, radium rays, cathode rays, etc.—but the stimulating effect of heat and the property possessed by the red and infra-red rays of suppressing phosphorescence, are exhibited in unusual degree. The present paper deals only with luminescence excited by light and by Röntgen rays. There is a remarkable similarity between the effects of ultra-violet light and those of Röntgen rays as exciting sources. In each case the chief luminescence is in the extreme violet, and is of short duration. But in each case also this is accompanied by luminescence in the green, which is relatively faint but of long duration. As is illustrated in numerous other cases, the Röntgen rays, when comparable at all with rays of light, are rather to be compared with ultra-violet light than with the rays of the visible spectrum. The authors also studied the phosphorescence spectrum during decadence. It does not seem that any change occurs in the form of the phosphorescent spectrum during decadence, and the authors are of the opinion that the behavior of Sidot blende in this respect is typical.—*Phys. Rev.*, October.

Luminous Phenomena in Incandescent Lamp Bulbs.—Fuerstenau.—It is well known that electric glow lamps which have not been in use light up with a faint blue light on rubbing them with silk or skin. The author has observed that the green fluorescent spots seen in Tesla and cathode-ray experiments are also seen on the glass of lamp bulbs, and electrodeless tubes when they are rubbed. If, after rubbing, a lamp is held in the hand or attached to a stand, a faint glow commences after 8 or 10 seconds. It proceeds from the foot of the lamp and at the same time the carbon filament glows with a faint yellow color over its entire length. This experiment, however, succeeds only with lamps made highly sensitive by long rubbing. A strong glow may be obtained by holding the rubbed lamp in one hand and approaching the other hand toward it. At the moment of contact the filament shines out brightly. A curious circumstance is that during this secondary glow the filament is as steady as when made incandescent by a current. When cold it is extremely sensitive to disturbances. A fine glow is produced by rubbing the lamp on the sleeve and then suddenly removing it, as in the electrophorus. A sudden redistribution of the electric quantities appears essential to the glow described.—Lond. *Elec.*, October 6; from *Annalen d. Physik.*, No. 9.

Clutch for Arc Lamps.—An illustrated description of a device of British make for the easy manipulation of arc lamps suspended from brackets or lofty ceilings so that by means of a wedge and suspension cord they may be lowered to the ground to be trimmed and again hauled up in position without an unsightly festoon of cable.—Lond. *Elec.*, September 15.

Power.

French Power Transmission.—A fully illustrated description of the Clermond-Ferrand power transmission. There will be six 1,200-hp generating units, but at present only three sets and two exciter sets are installed and in operation. Each turbine is designed for a fall of about 70 to 80 ft., a capacity of about 1,200 hp, and for a speed of 333 r.p.m. Three-phase alternators are directly connected to the turbines by means of flexible coupling. They have a capacity of 1,000 kw at a pressure of 1,000 volts and a frequency of 50 periods per second. For transmission the voltage is raised to 20,000 by means of single-phase transformers. The distribution system comprises a trunk connecting the power house with the principal receiving sub-station at Clermond, a high-tension branch between the sub-stations at Volvic and Mozac, and between Clermond-Ferrand and Pont du Chateau, and finally a series of 3,000-volt branch lines. The distance between the power house and the sub-station at Clermond is about 17 miles straight across country, but the length of the route taken by the transmission lines is about 18¾ miles. The line consists of six wires, of 0.315 in. in diameter, forming two three-phase systems which can work either separately or in parallel. At full load the ohmic loss is approximately 7 per cent (5,000 kw). By adopting metal lattice work on the transmission line it was possible to place them at great distances apart and thus to reduce the cost of insulators and to avoid the payment of rent when passing over private property. Further, each is constructed with a small base, a very important factor in this transmission scheme, since the country through which the line passes is split up into small allotments. The ordinary standard used at Clermond-Ferrand is designed for spans of 328 yards; this distance is the most economical and gives the least weight of iron per mile. The base of the standard measures about 24 in. by 24 in., and there is a distance of 79 in. between the centers of the two sets of wires; the weight of the standard amounts to 1,786 pounds. The type of insulators chosen has been in use on the Paderno-Milan lines for the last five years. The insulator consists of two parts, which, after being tested, are joined together by means of a cement having as a base litharge and glycerine. By this means it is possible to obtain an even thickness of porcelain and, in addition, there are no less than four vitrified surfaces between the wires and the metal bracket, a construction which greatly increases the dielectric qualities of the insulator.—Lond. *Elec.*, October 6.

Bavarian Water Power Plant.—An illustrated article on the utilization of water falls in the Bavarian Alps for the generation of electric power. It seems that there can be developed in that district a total of about 700,000 hp, of which about 10 per cent, namely 75,000 hp, has been developed (while in Switzerland and in the Austrian Alps, 350,000 hp or 15 per cent of the total available power has been developed). The water power plant of the calcium carbide works of Lechbruck is described. It contains four turbines having a total capacity of 2,000 hp (the amount of water being 40 cubic meters per second and the utilized fall 5.3 meters or 18 ft.). The turbines are directly coupled with three-phase generators.—*Elek. Anz.*, September 24.

Single-Phase Versus Polyphase Transmission Lines.—Watson.—For large traction schemes the advantages of single-phase systems with respect to the track work are so incontestable that when the single-phase motor problem has been fully solved there will be no question of using any other system on electric railway schemes of any magnitude. Advocates of the three-phase system have claimed as an advantage a saving of 25 per cent in the copper of the transmission line over the single-phase system. The author criticises this statement. If we assume that a single-phase system with 10,000 volts between its lines is comparable with a three-phase system having the same voltage between its lines, of course the three-phase system has the lower copper cost for the same efficiency. But this is not a fair basis of comparison when an overhead line is in question. The basis of comparison should be that the insulation between any one line and earth shall be the same. The insulators are the determining factor. The author shows mathematically that on this basis an equal power can be transmitted with the same efficiency over a single-phase as over a three-phase system if the weight of copper is the same. In comparing the cost of a three-phase system and a single-phase system, the following points must be considered. On the one hand, the prime cost of single-phase generators is higher than that of three-phase generators. On the other hand there must be considered the cheaper switchboard, fewer insulators and 33 per cent less labor required in erection of the overhead bare cable. As regards the running costs, it will hardly be disputed that the handling of the power station will be facilitated by a single-phase equipment; and with regard to outside maintenance, there would be only two lines to look after instead of three.—Lond. *Elec.*, October 6.

Electric Power Transmission in Metallurgical Works.—Jansen.—The conclusions of his serial discussing in a general way the applications of electric power transmission in metallurgical plants. In the present installment he discusses especially the use of steam turbines and of gas engines operated with blast furnace gas. He also gives several load curves.—*Stahl und Eisen*, August 1 and 15.

Charging Apparatus.—Collischonn.—An illustrated description of an electrically-driven charging apparatus for blast furnaces.—*Stahl und Eisen*, June 15.

Crane.—Egger.—A fully-illustrated description of an electric crane operating with high speed. The load is 10,000 kg. Detailed drawings are given.—*Zeit. f. Elek.* (Vienna), September 10.

Rolling Mills.—Ilgner.—A paper on problems of the electric driving or reversing rolling mills.—*Zeit. d. Oest. Ing. u. Arch. Ver.*, September 22 and 29.

Cleaning Blast Furnace Gas.—Sahlin.—An article on economies obtainable by the cleaning of blast furnace gas. To be used in gas engines, the gas should be as pure as possible, while when used in stoves and under boilers it does not require such a complete purity. Several types of apparatus for cleaning gases are described and illustrated.—*Cassier's Mag.*, October.

TRACTION.

Mountain Railroad in Switzerland.—Regelsperger.—An illustrated article on progress made with the electric railway to the top of the Jungfrau mountain, which has a height of 4,167 meters. On July 25 last a train ascended to the fourth station, Eismeer, situated at a height of 3,161 meters. Originally it had been intended to finish the road in 1905, but it will not be completed before several years. The total length of the line will be not more than 12.2 km., but enormous difficulties have to be overcome. It is an electric rack railroad of the Strub system. The gauge is one meter; the maximum grade is 25 per cent, the minimum radius of a curve in open air is 100 meters and in the tunnel 200 meters. Water power is utilized for generating the electric current. There are 6 turbines, two of 500 hp each and two of 200 hp each, and two 25-hp turbines for supplying the exciting current. Three-phase current has been selected in preference to direct current on account of better efficiency and lower initial cost. The weight of the locomotive with accessories is 13.4 tons. Each locomotive is provided with two three-phase motors made by the Oerlikon Company. Each motor develops 120 hp at 450 to 550 volts, when running at 750 r.p.m., the frequency being 38 periods per second.—*La Nature*, September 30.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Acton.—An article on the electric supply at Acton. The municipality has decided not to erect a generating station of its own, but to purchase electricity in bulk from the Metropolitan Electric Supply Company, and to distribute it in the district under its control. Accordingly, the company supplies two-phase current at 10,000 volts and 60 periods per second, the power being paid for on the maximum demand system. The current is changed into direct current in a motor-generator station which also contains a battery.—Lond. *Elec.*, September 22.

Protective Apparatus.—Neall.—An illustrated article on choke coils, their construction and application for the protection of transmission lines. The static interrupter is also described.—*Elec. Jour.*, October.

WIRES, WIRING AND CONDUITS.

High Tension Insulating Materials.—Kinzbrunner.—An account of a series of tests on the ratio between thickness and dielectric strength of high-tension insulating materials. For presspahn this relation can be expressed by the formula $E = C\sqrt{t}$, where E is the disruptive voltage, t the thickness of the material in millimeters, and C a constant which is equal to the actual disruptive voltage of 1 mm. of the respective material. For different qualities of presspahn the value of C varies between 3,700 and 5,600. From the above law it follows that the thinner the insulating material, the higher its relative dielectric strength (disruptive voltage divided by thickness). For instance, the relative dielectric strength of a piece of presspahn of about 0.1 mm. is about 3½ times as great as that of a piece of about 1.4 mm. thickness. But it would be wrong to conclude that the insulating power of presspahn can be materially increased by laminating it, i. e., by subdividing it into several thin layers. The reason is the law $E_n = E_1 \times n$, where E_n the disruption voltage of n layers of presspahn, E_1 that of 1 layer, and n the number of layers. This shows that the lamination of presspahn will have no effect whatever. Therefore with regard to the disruptive voltage it does not make the slightest difference, whether, for instance, we use one layer of presspahn, 4 mm. thick, or four layers, each 1 mm. thick. On the other hand it may, in some cases, be of advantage to subdivide a material into several thin layers, more especially in cases where the material is subjected to mechanical strains, such as, for instance, in bending through a small radius, etc. Thus, more especially for slot insulations, it would improve the electric resistance of the insulation if several thin layers were employed instead of one thick layer. Insulating papers and Manila paper also obey the law $E = C\sqrt{t}$; C varies for different qualities of ordinary insulating paper between 1,400 and 1,500, and is about 2,200 for Manila. But paper behaves differently from presspahn with regard to lamination. The dielectric strength of several layers of paper is nearly proportional to the number of layers. Paper should be used in very thin sheets, and in as many layers as possible. "Supposing we had to insulate a winding with paper, and that a space of, say, 0.36 mm. is available for the insulation. By using three sheets of paper, each of about 0.14 mm. thickness, the total dielectric strength of this insulation would be about 1,100 volts, while the dielectric strength of 12 sheets of 0.03 mm. thickness would be about 1,600 volts, i. e., nearly 50 per cent more. It must be mentioned that the surface of the paper tested was not glazed, the nature of the surface could, therefore, not have had an influence on the dielectric strength." Fig. 1 shows the relative dielectric strength (perforation voltage divided by thickness in millimeters) as function of the thickness; curve I relates to ordinary insulating paper, curve II to Manila paper.—Lond. *Elec.*, Sept. 29.

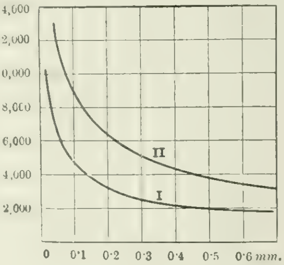


FIG. 1.—CURVES OF DIELECTRIC STRENGTHS.

Slide Rule for Wire Table.—Sakai.—An illustrated note telling how to use the slide rule on the wire table, with various examples.—*Elec. Jour.*, October.

ELECTROPHYSICS AND MAGNETISM.

Electric Conductivity of Flames.—Wilson.—A paper describing a series of experiments on the conductivity of a coal-gas flame for electricity between platinum electrodes immersed in the flame. The author applies J. J. Thomson's theory to his results. It appears that the conductivity of the flame is due to approximately uniform ionization taking place throughout the region between the electrodes, and further that the current is always very far from its maximum possible value even when a potential difference of 600 volts is applied to electrodes only one centimeter apart in the flame. The author then studied the effect due to the introduction of salt vapor into different parts of the flame. The current through the flame is not affected unless the salt vapor comes in contact with the negative electrode when a large increase in the current occurs. Absence of the effect except close to the cathode appears to be due to the non-uniformity of the potential gradient.—*Phil. Mag.*, October.

Radium.—Slater.—A paper on the emission of negative electricity by thorium and radium emanations. In the case of thorium as well as radium, the emanation gives off a quantity of slow negative rays in changing to the excited activity. In air, at the ordinary pressure, these rays are rapidly absorbed, but at the very low pressures used in the experiments of the authoress, the rays reached the electroscope and discharged it. It is extremely probable that the amount of negative electricity given out by the emanation is considerably greater than the positive electricity emitted in the form of alpha rays. If this is the case, the residue from which the excited activity is derived must be formed with a positive charge, and its appearance on the negative electrode in an electric field is explained.—*Phil. Mag.*, October.

Magneto-Optics.—Wood.—A paper on the magneto-optics of sodium vapor and the rotary dispersion formula.—*Phil. Mag.*, October.

Electrochemistry and Batteries.

Hypochlorite Process.—A report by Alexander "upon the manufacture of electrolyzed salt-water (chloride of sodium and chloride of magnesium) for disinfecting purposes." He recommends the distribution of hypochlorite solution throughout the Poplar Borough (for which he is the "Medical Officer of Health") for deodorizing and disinfecting purposes.—Lond. *Elec.*, September 22.

Specific Heats.—Richards.—In a continuation of his serial on metallurgical calculations he gives further data on the thermophysics of compounds, especially specific heats of chlorides, sulphides, silicates, etc.—*Electrochem. and Met. Ind.*, October.

Specific Heat of Gases.—Holborn and Austin.—An account of measurements of the mean specific heat of nitrogen, oxygen, air and carbon dioxide between 20 and 800 degrees.—*Phys. Rev.*, October.

Units, Measurements and Instruments.

Determining the Coefficient of Self-Induction.—Peukert.—A description of a simple method for measuring the coefficient of self-induction of a coil. S in Fig. 2 may be the coil to be tested; it is connected in parallel with non-inductive resistance, R, and with a capacity, C, both being in parallel. If a sinusoidal e.m.f. $e = E \sin \omega t$ acts in this circuit, the current, J, will be in general not in phase with the e.m.f If now the capacity, C, and the resistance, R, are so adjusted that the current, J, and the e.m.f. e are in phase then $L = \dfrac{R}{\omega \sqrt{1 + \omega^2 C^2 R^2}}$. The author produces the sinusoidal e.m.f. in the circuit by means of transformer action, and this gives, at the same time, a simple method of determining whether there is phase difference or not between E and J. The method is shown in Fig. 3. The coefficient of self-induction of S is to be determined. S is placed on one side of the scales, and sufficient weight is placed on the other side to keep the scales exactly in balance. Below the coil, S, a secondary stationary coil is provided which is supplied with an alternating current. The capacity, C, and the resistance, R, are adjusted until there is no attraction between the coils, S and F. In this case there will be no phase difference between the induced e.m.f. and the induced current. The induced current is in quadrature with the inducing current; when the one is zero, the other is a maximum. R and C are, therefore, adjusted until the balance shows that there is no attraction between the two coils; then the values of C and R are read and the coefficient of self-induction, L, is calculated from the above formula. The advantages of the method are that no special apparatus are required, and that the method is highly sensitive, depending on the sensitiveness of the scales. If in the above formula for L the square root in the denominator is nearly unity then the coefficient of self induction, L, is approximately $R : \omega$.—*Elek. Zeit.*, October 5.

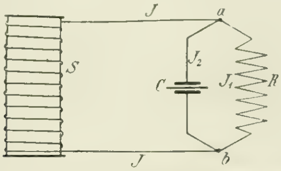


FIG. 2.—DIAGRAM OF TESTING APPARATUS.

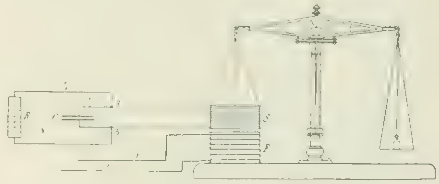


FIG. 3.—SELF-INDUCTION BALANCE.

Contact With Dielectrics in Tests of Dielectric Strength.—Appleyard.—An account of experiments in which he first investigated whether tin-foil electrodes, pressed against a sheet of dielectric with India rubber discs, enable accurate determinations of dielectric strength to be made. The author finds that, except in the case of homogeneous dielectrics, it is misleading to deduce specific values referred to unit cube of the material from the results of tests of sheets. With tin-foil electrodes applied to tests of presspahn, the apparent dielectric resistance diminishes as the load increases and it attains a fairly constant value at a load of about 400 grams per square centimeter. Increase of voltage, especially with small loads, behaves like increase of load, apparently increasing the contact area and diminishing the observed dielectric resistance. When mercury electrodes are used, the dielectric resistance, as measured at different voltages, is sensibly the same even for abrupt and great changes of voltage.—*Phil. Mag.*, October.

Glow-Light Oscillograph.—Gehrcke.—A description of his glow-light oscillograph, in which records of intermittent currents of high-frequency are photographed by means of the glow light between electrodes in nitrogen at 8 mm. or 9 mm. pressure. The new pattern of the instrument consists of two nickel plates mounted in the same plane with their edges only 1 mm. apart, but separated by mica plates. The discharge takes place between the edges, and is viewed end on, so as to get the maximum amount of light for the records. The latter consist of a series of impressions like marks of exclamation, the lower part being the bright positive glow light and the upper part the longer negative glow. The author obtained good records of low-tension alternating currents by superimposing on them a high-tension continuous current from a battery. The new apparatus is specially adapted for acoustic records, such as those of the Dolezalek siren. It is, of course, necessary to syntonize the circuit by introducing a suitable capacity and inductance. The author reproduces some records of the siren, one of them having a frequency of 1,880 periods per second, and the other a frequency as high as 4,660 periods. There is no inertia of moving systems to be reckoned with in the recording apparatus.—Lond. *Elec.*, October 6, from *Zeit. f. Instrumentenkunde*, September.

Cathode Ray Oscillograph.—Rankin.—An article illustrated by diagrams and describing the Braun cathode-ray tube, as modified by Ryan, and its use for plotting various curves in commercial electrical engineering.—*Elec. Jour.*, October.

Fault Finding.—Knight.—Two articles giving notes on mains, work and fault-finding. He describes methods of testing and fault-finding, for the localization of grounds and short-circuits.—Lond. *Elec. Rev.*, August 25 and September 1.

Meters.—Gerhardi.—Continuations of his illustrated serial. The author briefly discusses tram car meters and tells how to choose a type of meter for a certain purpose. He then discusses the arrangement of a meter department.—Lond. *Elec.*, Sept. 22 and 29.

Titration Voltameter.—Kreider.—A description of a new voltameter in which the iodine set free at the anode is estimated by means of sodium thiosulphite in a burette. The precautions which are necessary to prevent the iodine from diffusing towards the cathode are described.—*Phys. Zeit.*, September 15.

Dry Cell.—BROWN.—A description of a simple dry cell constructed on Daniell's principle from sheets of zinc and copper separated by sheets of fabric impregnated with zinc sulphate and copper sulphate, respectively, and with sheets of plain blotting paper as diaphragm. The cell has a fairly constant e.m.f. of "0.9 Daniell."—Lond. *Elec.*, September 15.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—PRASCH.—An illustrated description of several new systems of wireless telegraphy. In the present installations the systems of Rochefort, Nevil Maskelyne, J. F. King are described and illustrated by diagrams.—*Elek. Neu. Anz.*, July 15 and August 15.

An Electrical Piano Player.

By S. CHESTER LYON.

The piano player has come to stay. The piano itself is a device for mechanically and indirectly striking the strings of a harp. Since the introduction of further mechanism render easier the operation of striking the strings in the proper order and combination, such mechanism is artistically as justifiable as the keyboard.

Knowing the marvelous adaptability of electric mechanism, the ease with which it can cause and control motion, its, so to speak, flexibility, many must have wondered why it has not heretofore been applied to piano playing, displacing the cumbersome, unsightly pneumatic contrivances which, for want of something better, had such a vogue. In every other field of mechanical operation, where air is not wanted for some extra mechanical reason, electricity has been victorious. But up to the present in piano playing the pneumatic machines have monopolized the market. No account is to be taken of the pneumatic machines driven by an electric motor. The piano in such a case is still pneumatically operated. The sole useful function of the motor is the lessening of the physical fatigue of the performer. As a part of a musical whole the motor-driven player is inferior to the pedal-operated player, the control of expression given by the varying pedal action being lost.

In truth, the problem was not easily solved. Attempts at a solution had been made for over two generations by skilled mechanics without success. Yet when the solution was found, as seems to be the case with most remarkable inventions, it was very simple.

Let us first look at the simple underlying ideas. Imagine an electro-magnet placed underneath a piano, the armature of the magnet being linked mechanically to the key. It is clear that we can arrange so that the excitation of the magnet will cause depression of the key. It is clear also that a key at a distance may be used to close the circuit and excite the magnet controlling the key on the piano. And it is clear also that what we have imagined done for one key may be done for every key on the board. The realization of this idea would give us a piano operated electrically from a distant and separate keyboard.

We are still a long way, however, from a real electric player. Even the next important step, although dispensing with manual operation of the keyboard, stops far short of the satisfactorily operative electric player. The next step is the introduction of the music roll! Let us imagine the transmitting keyboard reduced in dimensions so that the distance between centers of keys corresponds to the distance between centers of adjacent lines of perforations in the ordinary paper music roll. If now such a roll be fed under such a keyboard it will act like the tape in a Wheatstone automatic telegraph, the circuit for any particular key being closed when a perforation comes under it and opened by the paper band. Such a roll and such a keyboard would, therefore, transmit to the piano every note cut in the roll.

The inventive work on the piano player passed through this stage and was arrested at it some time. But the sins both of omission and commission of such an instrument are numerous. The paper roll is wide and long; it changes in dimensions with the humidity of the atmosphere; it is easily soiled and torn, and in addition, when used as a circuit-breaker in an electric player it is liable to burn at the ends of the notes, thus gradually increasing their length or even running them together. Then, too, in such playing there would be nothing corresponding to the varying touch of the human fingers, no control of the pedals, none of the tempo. All this remained to be done. To get rid of the paper roll, the dimensions of the transmitting keyboard were still further reduced. This permitted, after much work and [illegible] in securing an uniformly made and rolled metal, the substitution of a brass tape about five inches wide and three-thousandths thick, for the paper roll. This width is great enough to take in not only all the perforations for the keys ordinarily played, but also several sets of perforations controlling the expression devices to be described.

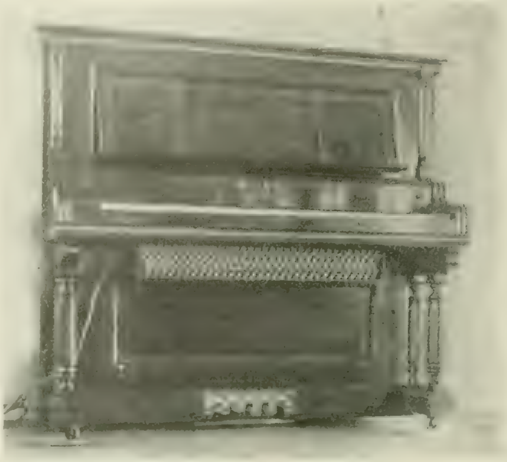


FIG. 1.—ELECTRICAL PIANO PLAYER.

Going back to the primitive form of manually-operated transmitter first described, it will be clear that with a suitable magnet a variation in the pull on the piano key corresponding to the variation in touch of the human finger, could be secured by varying the strength of current and that this variation might be secured most readily by the use of a variable resistance in circuit. For the complete instrument, since the number of keys in action is variable, a separate set of resistances must be provided for each key. The finished instrument, therefore, for ordinary use, carries 65 tiny sets of resistance coils. These resistance coils are used in either of two ways to vary the touch. They may be cut in and out by hand at the will of the performer by the mere turning of a knob, or they may be controlled by the action of the music roll. To this latter end the music roll is provided with perforations similar in character to those used in operating the keyboard of the piano. In practice there are three rows of these perforations and three transmitting keys corresponding. According to the transmitter key in action, one of these magnets is energized and the motion of the armature of this magnet determines the amount of resistance in circuit. The touch in this manner is under perfect control. In a similar way the pedals are operated by the action of the magnets attached to them, the action of these magnets being controlled by means of perforations in the music roll, or by hand at will by means of push buttons.

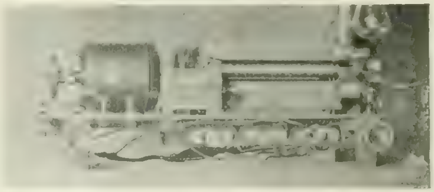


FIG. 2.—TRANSMITTER CLOSED WITH MUSIC ROLL.

As to tempo, that also is either roll-controlled or variable at will by the turning of a knob. The music roll train is driven by a miniature motor. The speed of this motor is variable over a wide range by the turning of a knob which sets the governor. The speed is steady at every setting. Arbitrary control over the tempo is had, therefore, by the movement of the knob. The nature of the material used for the music roll makes roll control possible. In the ordinary paper roll the material is so flimsy that further crowding of the notes is out of the question, while further spacing is negatived by the already excessive length of the roll. With brass, however, although the total length of the roll is only about one-third that of the corresponding paper roll, this difficulty does not exist. In consequence, pre-arranged variation in tempo may be produced by a variation in the spacing of the notes along the roll.

Of course, since brass is a conductor it cannot be used as a circuit breaker directly. The brass roll is, in fact, excluded from the electric circuit entirely. The roll instead of making and breaking a set of electric circuits, acts to raise and lower a set of keys which are mechanically combined with, but electrically separate from, the electric keys. The electric keys are in this manner protected from friction and from all wear not incident to their proper function.

The apparatus naturally divides into two parts, the transmitter and the receiving instrument. The main portion of the latter is shown in Fig. 1 in connection with an upright piano. It consists of a box of magnets placed beneath the keyboard of the piano, there being a magnet for each key to be operated. A small screw eye is secured to each of the piano keys and this screw eye is connected to the armature of the corresponding magnet by a thin steel wire working in a rubber bushing. The armature is centrally pivoted and oscillates about the center. The force of the oscillation is dependent on the strength of the current and the latter on the resistance put in circuit. The forward oscillation of the armature, therefore, depresses the key with a force controlled from the transmitter by the resistance, the touch varying exactly as if the key had been fingered.

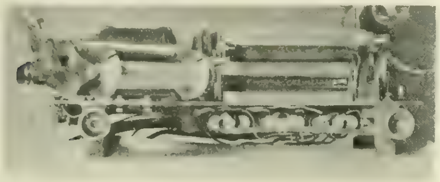


FIG. 3.—TRANSMITTER WITH MUSIC ROLL CARRIAGE SWUNG OUT.

One striking advantage of this system of connections is that the piano is left absolutely free at all times for manual playing in the ordinary way. There is nothing that has to be moved away, nothing that needs to be disconnected. It is impossible to determine by fingering the keys whether or not the magnetic attachment has been made. It is even possible to combine manual with electric playing, for instance one part of a duet may be played by hand and the other electrically. The pedal magnets are separately attached and are entirely out of sight.

Fig. 2 shows the transmitter closed without the music roll. Fig. 3 shows the transmitter with the carriage for the music roll swung out, and Fig. 4 shows the music roll in position in the carriage ready for playing. Fig. 5 is an end view showing the releasing magnet, whose function is explained below. Fig. 6 shows the cradle containing the electric keyboard and the resistance coils. Fig. 7 is a rear view of the transmitter. Fig. 8 shows the receiver attached to a grand piano and the little transmitter placed on a stand at a distance.

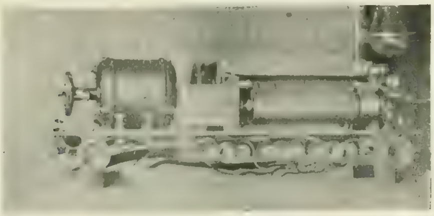


FIG. 4. ROLL READY FOR PLAYING.

The electric keyboard contains besides the keys corresponding to the piano keys, others controlling the action of the pedals and the variation of the resistance. The pedal action being substantially the same as the key action, will be readily understood. The variation of the resistance governing the touch is effected as follows: The resistance coils are mounted in a pivoted cradle which carries also the electric keyboard, Fig. 6. One terminal of each coil is connected to the corresponding electric key. Against the face of each coil rests a spring wire leading to the cable which connects with the piano, Fig. 7. As the cradle is rocked the spring wire sldies over the face of the resistance coil, cutting it in and out of circuit. The rocking of the cradle is effected by the magnets seen at the base of the transmitter in the front view, these magnets being thrown into circuit by special keys on the electric keyboard.

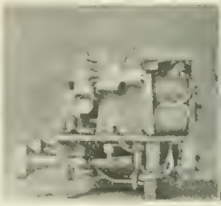
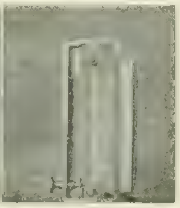



FIG. 5.—END VIEW OF CARRIAGE, SHOWING RELEASING MAGNET.
FIG. 6.—CRADLE WITH ELECTRIC KEYBOARD AND RESISTANCE COILS.

A special key when the roll has been exhausted closes the circuit on the trip-magnet seen in the end view. This causes a change of gear and a rapid rewinding of the music roll.

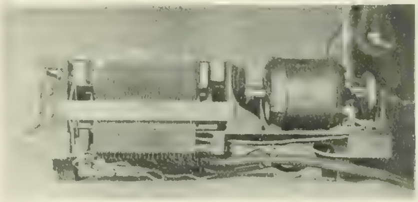


FIG. 7.—REAR VIEW OF TRANSMITTER.

As a purely roll-controlled self-player the Telelectric Piano Player varies the tempo, touch and pedal action to give any desired expression. The interpretation of any master may be expressed in the brass and will be faithfully reproduced in music. For those who desire to use their own interpretation there are provided means which give full, complete and easy control. In the front view of the transmitter will be seen two knurled knobs and in the center of each a push button. The knob at the left controls the governor of the motor and hence the tempo. Any particular tempo may be secured or the tempo may be varied indefinitely with no more trouble than is required to turn the knob. The knob at the right controls the resistance in the circuit and so gives power to delicately shade the touch. The button in this knob, on being pressed, operates the soft pedal while that in the left hand operates the sustaining pedal.

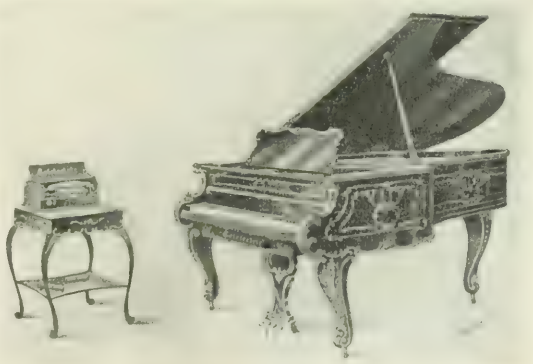


FIG. 8. ELECTRIC PIANO PLAYER.

The control of the piano is as absolute as could be obtained at its own keyboard and no exertion is required. Individualized operation of the electric piano player calls for brains, not feet, as music is an expression of the emotions of the soul, not of the motion of the soles.

Modulating Electric Lamps.

BY W. J. PHELPS.

Hardly had the first pieces of carbonized paper and the first strings of conglomerated lamp black, and the first pieces of carbonized bamboo begun to shed forth their fitful and wattful light, when nimble inventors, long accustomed to the easily regulated oil and gas, began to think of some way to turn down the electric light.

In all candor it must be admitted that the incandescent lamp of early days was far more in need of some device to turn it *up*, than any contrivance by which its sickly red light might be turned down. It was very soon apparent that there were only two or three ways in which to accomplish this result. Resistance could be introduced in series with the filament, thereby cutting down the effective voltage at the filament terminals, and so cutting down the current passing through the filament, reducing its brilliance.

Several lamps of different candle-powers burning in parallel could be switched on and off, in succession, or these filaments of different candle-powers could be mounted in one bulb, and the filament of proper intensity selected at any time, by some complicated system of multiple inleading wires for the lamp, and switching mechanism in the socket.

Another method proposed was to maintain circuits of different voltages all through the house, and either switch a 16-cp filament from a higher to lower voltage or else provide miniature lamps burning on the lower voltage, which could be turned on when desired. One English inventor proposed to run two circuits of 110 volts and 5 volts through the house, using a system of 5-watt miniature lamps, burning on a separate circuit to give the low light when desired.

A variation of system No. 1 was proposed in mounting two 16-cp filaments in the same bulb, with connections by which these filaments could be burned singly, or in parallel or in series. When connected in series they result in the familiar dull red light. However, until recent years, of all the methods employed, doubtless the one in which an adjustable resistance connected in series with an incandescent lamp filament has received the most commercial exploitation, and the most industrious attention from the Patent Office. Patents in great number have been issued for "regulating" sockets. This method, however, fails of any commercial prominence, on account of the unsightly bulk of the apparatus, its average unreliability and the fact that it usually requires an electrician to install the same. The further fact that in the very most economical form, this method only results in cutting down the energy consumed 40 per cent at the lowest notch, has had possibly much to do with its lack of popularity.

The turn-down lamp as a business dates from the invention of the baby filament idea. In the words of the Patent Office, this involves, "in constant-potential lighting, one or more filaments connected within one bulb. The resistance of such filaments being so proportioned that when burned in series one at least of said filaments glows, while one at least of the filaments remains a relatively dead and dark resistance." It is well known that the cold resistance of an incandescent filament is approximately double its hot resistance, owing to the pronounced negative temperature coefficient of carbon.

Inasmuch as one of the objects of a turn-down lamp is to use an extremely small amount of current when the lamp is turned down, and the only way in which a small amount of current can be made to pass at the ordinary voltage is by using a large amount of resistance, it follows that resistance, however secured, is a valuable consideration.

The placing of the big filament in series with the baby filament makes it possible to reduce the dimensions of the latter by considerable, and really bring the same within manufacturing limits.

An incidental advantage of the series arrangement is that in any switching mechanism, the baby filament is shunted around the break, and thereby the sparking is almost entirely removed. In one commercial form in which the baby filament is generally known, the total watts of the nominal 1-cp filament burning in series with the big filament, ranges from 8 to 9. The same filament in combination with 8-cp instead of 16, uses a total power ranging from 5 to 6 watts.

Baby filaments have been made so small as to require only 3 to 4 watts, but it was found impracticable to continue their manufacture, on account of the very numerous breakages in handling such an attenuated carbon thread.

The uses of a turn-down lamp have from year to year enlarged in their importance. Where formerly it was supposed to be of benefit only in the nursery and sick room, it has come to be quite frequently adopted for *every* room in the house. Such use is based on common sense. It seems reasonable that the supply of any commodity should be regulated. If we were obliged to use water faucets in which the water must be turned on full or off entirely, it would be very inconvenient, even if the water cost nothing. If coffee were to be sold only in ten-pound packages, there is little doubt but that it would work great inconvenience, and probably reduce the consumption of coffee. While the average man usually installs a turn-down lamp as the result of some particularly large lighting bill, and for the purpose of cutting down expenses, he is quite likely to discover that he has secured a considerable addition to his personal comfort, and personal comfort, in spite of all our improvements and inventions, is still a most important item to be considered.

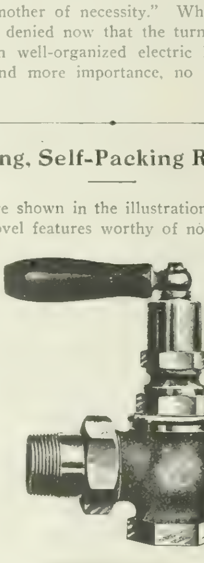
After a hard day's work it is often pleasant to sit in the low twilight of a 1-cp filament and rest the eyes. The artistic uses of a turn-down lamp are as yet practically unexploited. We are spending more and more money in our office buildings, our hotels and our homes for the "looks of things." The writer firmly believes that the time will not be far distant when "looks" will require in the lobby of a hotel, for example, that all the lights shall be turned down dim after 12 o'clock, rather than that a few bright burning 16-cp lamps shall spot the bleak darkness of the upper wall.

In the average office building the halls are maintained quite brightly lighted from 7 to 11 o'clock, for the benefit of about seven or nine men who happen to be working late at their desks. The effect is not beautiful, and the least amount of power which will maintain a decent light all through the halls and passages, is a considerable item in the expense of operating an office building. Turn-down lamps located properly through the halls would give a much better distribution of light for the same amount of power, and in all probability could be used to give light enough, and well distributed enough with considerable less power than is now used.

A joke carpenter recently declared that "Necessity is not the mother of invention: at least not in modern times," but that "Invention is the mother of necessity." It has often seemed during the past seven years to those exploiting a turn-down lamp, that "Invention is the mother of necessity." Whichever of them came first, it will not be denied now that the turn-down lamp is a permanent necessity in well-organized electric lighting, and destined to acquire more and more importance, no matter what form of light is used.

Quick-Opening, Self-Packing Radiator Valve.

The radiator valve shown in the illustration embodies in its construction several novel features worthy of note. It is claimed that there is no possibility of the valve leaking at the stuffing box. By a special device, placed in the stuffing box, the packing is automatically kept tight and will last for years without renewal. The device



RADIATOR VALVE

is very simple, consisting only of a vulcanized washer, located in the top of the stuffing box and kept in position by spring compression, which fully compensates for the wear on washer. These valves open and close by turning the lever handle one-half turn. The quick opening and closing feature will no doubt be appreciated by users who have operated old-style radiator valves. The lever handle can be operated by the foot, as well as by the hand. The construction of these valves is such that when closed the discs bear on the seats very tightly, and the valve is locked in place until released.

These valves are manufactured by the Crane Company, Chicago, Ill.

Doublejoint Desk Fixtures.

The illustrations herewith show two forms of the Ward double-joint desk lamp. As the name implies, there is a double-joint mechanism in the lamp stand. This mechanism is placed near the base, and there is a single-joint mechanism at the socket, which enables the light to be placed at any point desired within the range of the fixture, without loosening or tightening thumb screws or other devices. The joints are so constructed that they may be moved freely without straining or in any way injuring the flexible cord which is concealed in the tubes. The lamps are constructed with a weighted base, as shown in Fig. 1, or with a desk clamp, as shown in Fig. 2. All lamps are fitted with telescoping tubes similar to those used in Kinsman fixtures, making them suitable for small or large desks.

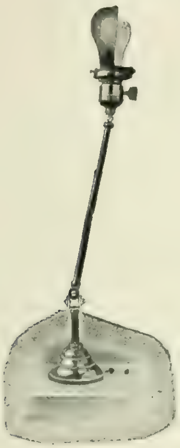


FIG. 1.—BRACKET LAMP.

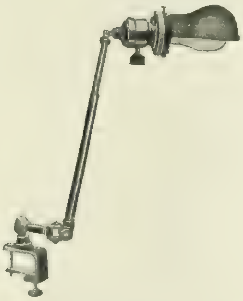


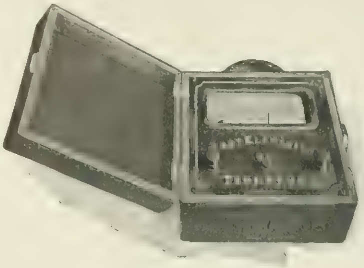
FIG. 2.—BOOKKEEPER'S PORTABLE LAMP.

These desk fixtures are manufactured by the McLeod, Ward & Co., 27 Thames Street, New York.

Portable Direct-Current Voltmeters and Ammeters.

The accompanying illustration shows a type of instrument which has been designed to meet the demand for portable voltmeters and ammeters which would retain their accuracy notwithstanding the rough usage such instruments meet in practice. The instruments are intended for use upon direct-current circuits and are constructed upon the principle evolved by Marcel Deprez, the noted physicist of France, involving the use of a permanent-magnet movement without moving wire. This principle embodies the acme of simplicity and insures the most accurate indications.

The moving element is extremely light and all parts are made rigid and strong, with the idea of obviating damage by jar. Each instrument is enclosed in an iron case which, in turn, is enclosed in a hard maple case of attractive appearance, provided with a leather carrying handle. The materials entering into the construction are claimed to be of the best. The magnet is of a special tungsten steel, put through a rigid process for permanency. All wire is of ample cross-section, and the instrument may be kept in circuit indefinitely. A special feature has been embodied to aid in making a number of instantaneous tests all around some known point. This is a device controlled by a projecting button on the cover, and limits the movement of the pointer between abutments. When not in use it is moved to the zero position.


DIRECT-CURRENT VOLTMETER.

These instruments are being placed on the market by the Troy Electrical Company, Troy, N. Y.

Welded Flanges for Steel Pipes.

The advantages of welded flanges for steel pipes are well known to engineers who employ steam, air, gas and water piping where leakage must be prevented, no matter what variation in pressure may occur. A welded flange is particularly appropriate for steel pipe because, when it is properly made, the flange and the pipe become one piece of metal. We are able to give below an outline of the process of manufacturing welded-flange pipes as carried out by the Ball & Wood Company, at Elizabeth, N. J.

The flanges are made of wrought steel of the same grade as that used in the pipe. The pipe is carefully tested and then specially prepared to receive the rough flange. This is placed on the pipe close to the end, and the flange and pipe are heated. The welding is done by machinery designed especially for the purpose, but the process is practically the same as that employed by the pipe makers in welding the seams or lap. When the process is completed the flanges are faced off and the back and edge turned down. Ordinarily all flanges and bolt holes conform to the standard for extra heavy flanges adopted on June 28, 1901, at a meeting of the valve and fittings makers of the United States. Special flanges of other dimensions are made on special orders, and they can be furnished with plain, tongue-and-groove and male and female faces, or with raised faces and with smooth lathe finish for grinding to a perfect joint. After completion each piece of pipe is tested under hydraulic pressure. There is no injury done to the metal, any more than in welding the seam, and the special equipment and methods of the Elizabeth shops are such that only the ends of the pipe are subject to working in any way, the greater part of the length not being heated or strained in any way. Special attention is given to the most minute details, such, for instance, as using a blacksmith's standard coke fire for heating rather than a gas furnace, which is a little harder on the metal, although it is employed in lap welding the seam of the pipe.

The company's shop, which was started up on July 15, has already furnished welded flange pipe to the Detroit Edison station, the power plant of the Long Island Railroad, the Narragansett Electric Light Company and the Rhode Island Company at Providence—to mention only a few sales for important plants. It might also be added that about the strongest confirmation of the reliability of welded flanges is furnished by their use by the Otis Elevator Company for the cylinders of high pressure elevators. This service is far more severe than that to which any ordinary piping is subjected, for the pressures sometimes run as high as 2,500 pounds per square inch.

In connection with flange welding, the Ball & Wood shop is also equipped for pipe bending. The demand for expansion loops offsets and other special work is constantly increasing, because all changes in direction made with fittings add joints to a pipe line, and joints should be avoided as much as possible, even at somewhat increased cost. In laying out bends there should be a short, straight length of pipe adjoining each flange, before the curve begins. On pipe less than 4 in. in diameter this straight section should be at least 1½ diameters in length, and on larger pipe at least one diameter. Experience has shown that wherever practicable it is well to have the straight portion equal in length to at least two diameters.

Holophane-Pagoda Ball.

In the new million-dollar Syracuse Court House, perhaps the finest of its kind in the country, the question of having the lighting fixtures in keeping with the design of the rooms was taken up very carefully by the engineers and architects in charge of the building. The prime desire was to utilize to the fullest extent the advantages of economy which can be obtained by modern lighting methods without, however, sacrificing in any way the artistic features. As a result the new Holophane-Pagoda Ball, a view of which is given herewith, has been adopted as a standard in 6-in., 7-in. and 8-in. sizes, no less than 900 of these being used on the decorative chandeliers. In cases where a much larger ball was necessary, owing to the fact that Pagoda Balls were not manufactured in such sizes, a ground glass ball has been specified. For what might be called "the useful light" fixture, Pagoda reflectors have been specified in every case, over 2,000 being employed. About one-half of the Pagoda Balls are to be furnished with a handsome cut-glass star on the bottom, which will add greatly to their appearance without detracting at all from their illuminating value.

PAGODA BALL.

Key-Socket and Shadeholder.

The electrolier key socket, shown in Fig. 1, is noteworthy in that it is most compact and has a finished appearance harmonizing well with decorated electroliers. It has a neat metal key which is thoroughly insulated from all live parts. This key is removable and an extension key may be used in its place.

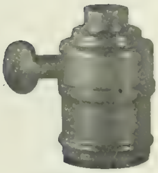


FIG. 1.—ELECTROLIER SOCKET

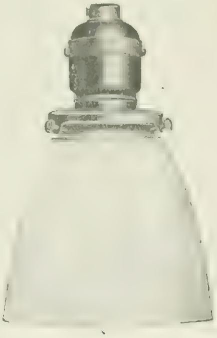
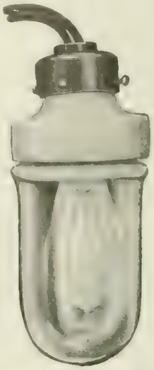


FIG. 2.—COMBINED SOCKET AND SHADEHOLDER.

The combined socket and shadeholder, shown in Fig. 2, is designed to replace the usual socket with the ordinary detachable shadeholder. The shadeholder in the new device is permanently attached to the socket shell in such a way that it cannot slide or turn. This, together with the fact that three points of support for the shade are afforded, instead of two as in the clamp shadeholder, eliminates any sagging of the shade. Both of the above appliances are made by the General Electric Company.

Waterproof Receptacle for Lamps.

An interesting electric lighting specialty is shown in the accompanying illustration. The globe, which encloses the lamp, is screwed tightly into the porcelain top. The joint, which is made, is not only water proof, but is moisture and dust proof, thus affording complete protection to the incandescent lamp. This receptacle is manufactured by the E. H. Freeman Electric Company, Hamilton Ave., Trenton, N. J.

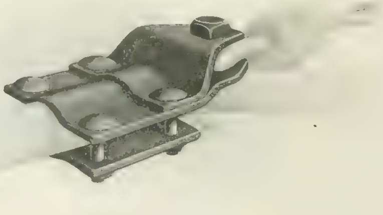


WATERPROOF RECEPTACLE.

Cable Clamp.

The Kearney cable clamp, which is shown in the accompanying illustration, has been designed to supplant the extra joints and fastenings necessary in the ordinary methods of cable suspension at angle poles and dead-ends. Two wrought-steel plates with four clamping bolts constitute the device. The two parts of the clamp are designed to fit the surface of the cable, and, when the nuts on the four bolts joining the two parts are tightened, the clamp grips the cable so that the pull is transmitted through the upper plate to a globe strain or similar insulator fastened to the pole at the curve. By the use of two of these clamps, one holding the cable in either direction from an angle pole, the curved portion of the cable between the two clamps will be relieved of any great amount of strain. This method of construction does away with the necessity for serving the heavy cable about an insulator at an angle pole, and then making a joint to continue the cable after it has turned the angle.

This cable clamp is made in but one size, suitable for cables from No. 0000 B. & S. to 1,000,000 c. m. cross-section. The manufacturers, W. N. Matthews & Bro., 227 North Second Street, St. Louis, state that in comparison with the usual devices a saving of from $10 to $15 per corner, dead-end or curve, can be made by the use of the Kearney clamp and also that a more perfect type of line construction can be had by the use of this device. In order to place this clamp upon the market this company offers to prepay the freight on trial orders of 25 or more clamps on condition that they are to be paid for if satisfactory, otherwise they are to be returned at the expense of the company.



CABLE CLAMP.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade were not quite so uniformly good as they have been in the recent past; they were somewhat irregular, but industry is still at the top notch of activity. Heavy rains in the West and too much warm weather in the South have exercised some influence, but back of it all is the fact that a quieting down of wholesale trade should naturally be expected after three months of activity. Retail trade has received some stimulation from the colder weather, and jobbers are as a consequence doing more re-order business. Trade in the South has been benefited by the lifting of the quarantine restrictions, but the good effects have been partly neutralized by the holding of cotton for higher prices, which also retards collections. Car shortages are becoming more acute, the Pacific Coast now feeling their influence and shipments are being delayed, with effects on retail trade and collections. In the industries there is an unprecedented Fall demand. Shipments of coal are somewhat hampered owing to lack of cars. The activity in building operations, in the large cities and in the country, is beyond precedent. Cotton manufacturing is active and higher wages have been granted. Manufacturing for the holiday season is very active. In regard to the iron and steel industry, the *Iron Age* says the leading interests in the steel industry are more and more emphatically taking a position adverse to any violent upward price movement. They are endeavoring to keep not alone values of raw material within bounds, but are holding down prices on finished iron and steel. The markets for pig iron have stiffened. This week it is the East and the Central West which have marked up quotations. Some of the large Southern interests have practically withdrawn from the market entirely, but there is still some, though little, iron available on the basis of $12.50 for No. 2 at Birmingham. In the Central West the news of greatest interest is that the Steel Corporation has purchased 20,000 tons of iron for October delivery at $15.50 at furnace and 20,000 tons for November delivery at $18, thus establishing an advance. The quantities purchased, however, are smaller than expected. There has been further good buying in the Eastern markets and prices have been advanced to $16.50 to $16.75 at furnace for No. 2 foundry and $17.50 to $17.50 delivered for basic pig. A leading Buffalo interest has put prices up 50 cents per ton. The pressure upon the car builders and locomotive shops is enormous. It is figured out that there are contracts in sight for 80,000 steel cars, which include the 20,000 cars just being figured on for the Pennsylvania system. The locomotive builders are crowded and are covering liberally for their materials. One large interest has contracted for a total of 75,000 tons of bars, plates, etc. Lumber is active, large sales of white pine to be cut this winter being reported. Hardware and all other building material continues strong and active. There has been no change in the copper market, and little business was transacted. There was some inquiry for export. The market closed at 16¼@16½c. for Lake and electrolytic and 15⅝@16⅛c. for casting stock. The number of business failures for the week ending Oct. 19, as reported by *Bradstreet's*, was 178, against 183 the week previous and 227 the corresponding week last year.

DOBLE WATER WHEELS.—The Abner Doble Company, of San Francisco, has recently received several interesting orders for tangential water wheels. Prominent among them is an order from the California Gas & Electric Corporation for a 9,000-hp wheel for its de Sabla power plant. This machine will be similar to the 8,000-hp wheel installed in the de Sabla plant last year, and the three 8,000-hp Doble wheels recently completed and now successfully operating in the new Electra station of the same company. The wheel will operate under a head of 1,530 feet at 400 r.p.m. and will be driven by a single jet of water, thus making it the most powerful water wheel ever constructed for operation under a single jet of water. Another order from the California Gas & Electric Corporation calls for six 570-hp wheels for its Nevada City plant. These will operate under a 190-foot head at 410 r.p.m. A 400-hp wheel for operation under a 400-foot head, equipped with jet deflector operated by a Woodward compensating governor, has been shipped to the Chancellor Gold Mining Company, Wenatchee, Wash. The La Grande Water Storage Company, La Grande, Ore., has purchased an 800-hp, 1,150-foot head, 600 r.p.m. wheel, equipped with a Doble needle regulating nozzle for operation by a Lombard governor. Among other recent orders secured by the company are two double 1,750-hp wheels for the San Joaquin Power Company, Fresno, Cal., for operation under 385-foot head; one Doble needle regulating nozzle for a large water wheel for the Komata Reefs Gold Mining Company, New Zealand, and a double 700-hp water wheel unit for Mitsui & Company, Japan, for operation under 210-foot head, this order including the wheel complete with Lombard governor and gate valve.

TENNESSEE RIVER POWER.—Some details have already been given in these columns as to the plans of the Chattanooga & Tennessee River Power Co. Mr. John Bogart, the consulting engineer, in discussing the general possibilities of the great power plant, said this week: "The navigation of the Tennessee River is now impracticable at low stages of the water. The people of that section of the country have been anxious for years to improve navigation, but it has been impossible to get from Congress the large amount of money required. A contract for a lock and dam to entirely relieve navigation has recently been entered into between the Chattanooga & Tennessee River Company and the Secretary of War. The works to be constructed include a lock and dam, a massive power house, a transformer house and hydraulic and electrical installations sufficient to give an electrical output of 56,000 hp. The company has just agreed upon a contract with the W. J. Oliver Company, one of the largest firms of Southern contractors, for the construction of that part of the work which shall be performed at once, and this is to be followed by contracts for the installation of the hydraulic and electrical power and the transmission line to the City of Chattanooga and other localities in the neighborhood."

PRATT & WHITNEY IN CANADA.—It is announced that the Pratt & Whitney Company has purchased a plant in Dundas, Ont., for the manufacture of its full line of small tools—taps, reamers, milling cutters, punches, dies, etc., etc. This building is a modern structure, and the power plant is already in place. The machinery equipment is being got ready at Hartford, and will be sent on and operations begun immediately. The plant, we are informed, will also include a department for manufacturing a full line of twist drills, an elaborate equipment of special machinery having been gotten ready for the purpose. The location of the factory is near that of the John Bertram & Sons Company, which, as has been announced, was recently purchased by the Niles-Bement-Pond Company.

COPPER CYLINDERS.—In a decision written by I. F. Fischer, the Board of United States General Appraisers has overruled a claim filed by Welles & Locke of New York regarding the rate of duty applicable to copper cylinders produced by electrolysis. The board finds that neither Collector Stranahan's classification nor the claim of the importer is correct. It is held by the board that the merchandise is properly dutiable under the provision in the tariff law for articles not specially provided for. As the appellant failed to make this claim the protest was overruled.

EGAN TELEPHONE APPARATUS.—Mr. Charles Egan, of Illinois, has patented an apparatus for a new design of telephone transmitter and receiver which can be produced, it is claimed, at 50 per cent less than the old style. The Business Men's Association of Springfield is investigating the proposition with a view to tendering the Egan Electric & Telephone Company a free factory site in that city.

WATER-WHEEL GOVERNORS.—The Sturgess Governor Engineering Co., Watervliet, N. Y., report, among recent sales, an order for water-wheel governors and mechanically operated relief valves for the Wares Shoals Mfg. Co.'s plant at Wares Shoals, N. C.; also one 24-in. mechanically operated relief valve for the No. 7 unit of the Hudson River Electric Power Co.'s plant at Spiers Falls, N. Y.

ELECTRIC REFINING OF COPPER.—Negotiations are said to have been concluded for the lease of the Lake Superior Corporation's new copper plant at Sault Ste. Marie, Canada, to the Canadian Nickel Company, a new concern organized for the purpose of refining copper by electricity. Preparations are being made for the installation of the necessary machinery to carry on the proposed enterprise.

THE STROMBERG-CARLSON TEL. MFG. CO., Rochester, N. Y., reports having closed contracts for switchboards for the following places: Roxboro, N. C.; Onaga, Kan.; Rochester, N. Y.; Ellicottville, N. Y.; Eldorado, Ark.; Wabash, Ind.; Newark Valley, N. Y.; Camden, N. J.

ELECTRICAL PLANT WANTED.—The Hawkinsville Cotton Mills, Hawkinsville, Ga., W. N. Parsons, president, are in the market for a 200-kw alternator and a 250-hp Corliss engine. It is not necessary that they should be new.

ORDERS FOR GAS ENGINES.—The Westinghouse Machine Company, of East Pittsburg, Pa., has received within the last few weeks many orders for gas engines, ranging from 10 b.h.p. to 1,000 b.h.p. No less than 36 gas engines are covered by these orders, aggregating 6,647 b.h.p. One of the most recent and significant orders was received from the Rockland Electric Company, of Hillburn, N. Y., for two 500-hp double-acting horizontal tandem gas engines. This company has already in operation three 19 in. x 24 in. Westinghouse double-acting gas engines direct-connected to generators, and this second order serves as a testimonial of its satisfaction with the use of gas engines as prime movers. Another order worthy of special mention is one from the Union Traction Company of Kansas, Independence, Kan., for one 500-hp horizontal-tandem gas engine and one 1,000-hp horizontal twin-tandem gas engine, both for alternating current generator driving in parallel. Other orders were received from the Sherwin-Williams Company, Newark, N. J.; American Sheet & Tin Plate Company, Pittsburg, Pa.; The Sidney Electric Light Company, Sidney, Ohio; J. C. Sterns Electrical Company, Buffalo, N. Y.; American Snuff Company, New York City; Northwestern Lithographing Company, Milwaukee, Wis.; Granite City Hospital, Granite City, Ill.; American Locomotive Works, Allegheny, Pa.; American Acid & Alkali Company, Bradford, Pa.; Amolyo Mining Company, New York City; Home Light, Heat & Power Company, Pittsburg, Kan.; Pittsburg (Pa.) City Hall; Dr. C. F. Bingham, Pittsburg, Pa.; Automatic Electric Company, Chicago, Ill.

PLANT PROPOSALS INVITED.—The Breese (Ill.) Water & Light Company has decided not to attempt to get its new lighting plant in operation before Christmas, as originally intended. All of the bids received on Oct. 9 have therefore been rejected, and new proposals are invited for 10 a. m. Monday Oct. 30. Victor J. Klutho is architect and William H. Bryan is consulting engineer, both of St. Louis. The work is divided up as follows: Section A, building, brick walls, concrete floors, composition gravel roof; Section B, one new boiler, 60x20, with forty-four 4-in. tubes, f.o.b. Breese; Section C, erection of boiler in position, also delivery of two old boilers from old pumping station, 9,000 ft. distant, and erection in new power house, with brick work and boiler and engine foundations; Section D, two 150-hp side-crank, self-oiling engines for direct connection to 100-kw alternators, erected on foundation; Section E, pipe work, heater, pumps, for connecting engines, boilers, etc.; Section F, electrical apparatus, including two 100-kw, single-phase alternators, 2,300 volts, 60 cycle, switchboard and station wiring, 35 arc lamps, and regulators, also converters; Section G, two triplex power pumps, 15,000 gallons per hour each, with 25-hp motors, delivered and erected in position with pipe and wire connections; Section H, distribution section, including poles, primary and secondary lines and erection of converters and arc lamps. Further particulars may be had by addressing either the engineer or architect.

SEPTEMBER FOREIGN TRADE.—The statement of imports and exports for September, issued by the Bureau of Statistics, shows an increase of $18,005,485 in the imports for that month over the figures for the same month last year, an increase of $2,738,707 in exports and a decrease of $16,266,778 in the preponderance of exports over imports. The balance in favor of this country, although much smaller than last year, was about $5,000,000 over the balance for September, 1903. The imports and exports of merchandise for the month and for the nine months ended with September compares as follows with the figures for last year:

	September	
	1905.	1904.
Imports	$102,138,031	$84,132,546
Exports	136,005,822	134,267,115
	Nine months	
Excess exports	$33,867,791	$50,134,569
Imports	$872,548,688	$751,375,016
Exports	1,102,575,531	985,479,872
Excess mdse. export	$230,026,843	$234,104,856

STANLEY-G. I. CONTRACTS.—The Atlanta office of the Stanley-G. I. Electric Manufacturing Company has recently closed the following contracts: Alabama City, Gadsden & Attalla Railway Company, Gadsden, Ala., one 120-kw inductor alternator, with switchboard, exciter and one 50-light alternating-current series arc system; city of North Birmingham, Ala., one 250-kw inductor generator, switchboard and exciter; Capital Light & Power Company, Jackson, Miss., one 250-kw inductor alternator, exciter and switchboard; Guthbert, Ga., one 60-kw inductor alternator; city of Geneva, Ala., one 80-kw. inductor-type alternator, exciter, switchboard and series street lighting system; city of Monroe, Ga., one 120-kw revolving-field alternator, exciter, switchboard and series street lighting system; the Sheffield Company, Sheffield, Ala., one 125-kw rotary converter, transformers, switchboard, etc.; city of Tallahassee, Fla., one 50-light series street lighting system.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular, but showed a rallying tendency toward the end of the week under professional manipulation in a few issues. Traction stocks and industrials were the chief features, special attention being given to the equipment stocks and to a remarkable advance in one of them, American Locomotive common, to 68¼. The Steel stocks were also strong, though featureless. Bonds were steady with limited dealings. All of the electric and traction securities were strong and active and a large business was done. Allis-Chalmers common and preferred made a net gain of 1¾ points each, the former closing at 19⅜ and the latter at 62⅛. The sales of common aggregated 27,700 shares and of preferred 15,900. General Electric made the largest advance of all—9¼ points. The sales of this stock were unusually large, aggregating 19,900 shares, and the range of prices was between 179 and 189¼, the closing quotation being 188¾. The activity in General Electric and Allis-Chalmers was due to recently revived rumors affecting the relations between these two interests. Westinghouse also shared in the active market to the extent of an 8¾-point advance. Its lowest price of the week was 169½ and the highest 176¾, which was also the closing quotation. American Locomotive was active, 258,100 shares of common having changed hands at prices ranging between 59⅜ and 69, the closing quotation being 68⅛, which is a net gain of 7¾ points on the week. Preferred closed at 116, a net gain of 2¼ points. In the traction list, Brooklyn Rapid Transit was by far the most active, the sales aggregating 908,400 shares. The closing price was 78½, a net gain of 6⅜. Metropolitan Street Railway was comparatively quiet, and closed at 127¼, a net advance of 1¼. Interborough Rapid Transit was the exception and closed on the curb market with a net loss of 1½ points at 212½. Western Union was a shade lower, closing at 93¼, while American District Telegraph, which is usually classed as an inactive stock, received unusual attention and made a jump from 35 to 40, on sales of 1,700 shares. Electric Storage Battery made a net gain of ¾-point, closing at 84½. New York & New Jersey Telephone closed at 170. Prices on the curb market recovered in sympathy with values on the Stock Exchange and for the most part are higher than a week ago. Chicago Subway was a notable exception. It broke over a dozen points on further liquidation from many sources, particularly by the pool, but it recovered about half the loss. It is understood that much of the stock thrown over went into strong hands. Rather more attention than usual was given to low-priced stocks, but no new developments occurred in that connection. Following are the closing quotations of October 24:

NEW YORK

	Oct 18	Oct. 24		Oct 18	Oct. 24
Allis-Chalmers Co	17⅝	20⅝	General Electric..........	179	188¾
Allis-Chalmers Co. pfd ..	59¾	63⅝	Hudson River Tel .	..	..
American Dist. Tel	33	39¾	Interborough Rap. Tran...	214¾	212¼
American Locomotive...	..	68¼	Mackay Cos................	46	46
American Locomotive pfd		116	Mackay Cos. pfd.......	72½	73¾
American Tel. & Cable ...	92	92	Marconi Tel	.	..
American Tel. & Tel. . .	137	136	Metropolitan St. Ry..	125⅝	125½
Brooklyn Rapid Transit	72¼	78	N. Y & N. J. Tel...	.	.
Electric Boat	30	30	Western Union Tel.	93	92¾
Electric Boat pfd....... ...	70	70	Westinghouse com.	168	174
Electric Vehicle.	15½	15	Westinghouse pfd..	..	.
Electric Vehicle pfd........	23	23			

BOSTON

	Oct 18	Oct. 24		Oct. 18	Oct. 24
American Tel. & Tel ..	137¼	138	Mass. Elec. Ry. pfd........	56	56
Cumberland Telephone .	122	122	Mexican Telephone.........	1¾	1¾
Edison Elec. Illum...... .		249	New England Telephone...	138	138¼
General Electric.	179	189	Western Tel. & Tel.	14	13
Mass. Elec. Ry	13¾	13	Western Tel. & Tel. pfd...	*95	90

PHILADELPHIA

	Oct 18	Oct 24		Oct 18	Oct 24
American Railways.. .	52	52	Phila. Electric....	8¾	8⅝
Elec. Co. of America.	11	11⅛	Phila. Rapid Trans....	28⅛	27¾
Elec. Storage Battery	82	84	Phila. Traction.	.	..
Elec. Storage Battery pfd.					

CHICAGO

	Oct. 18	Oct. 24		Oct. 18	Oct 24
Chicago City Ry		200	National Carbon.	.	60
Chicago Edison		.	National Carbon pfd	.	116
Chicago Subway	41		Union Traction.	12⅜	
Chicago Tel. Co . .	137		Union Traction pfd..	..	..
Metropolitan Elev. com		28½			

* Asked.

LIGHTING IN CHICAGO.—Chicago dispatches say: LaSalle Street was puzzled over the news of the incorporation of the Metropolitan Gas & Electric Company until it was learned that the new venture had not been started for the object of competing with the present Chicago gas companies. The new corporation, which has a capital stock of $12,000,000, has at its back several Chicago capitalists, and its purpose is to take over gas and electric plants in cities of medium size throughout the country. At present the promoters are said to hold options on plants in several cities, and as soon as the organization is perfected negotiations will be opened with a view to obtaining the securities and systems of flourishing gas companies. The articles of incorporation were taken out in Delaware. The promoters are Joseph C. Markley, of Chicago; George F. Goodnow, of Waukegan, and Harry Davis, of Wilmington, Del.

ELECTRIC LIGHT EARNINGS.—Stone & Webster report the earnings for the month of August of the following companies controlled by them:

	1905.	1904.	Increase.
Edison Electric Illuminating Company, of Brockton:			
Gross	$10,314	$8,165	$2,149
Net	2,376	2,606	*229
Surplus over charges	1,647	1,743	*95
El Paso Electric Company:			
Gross	22,763	20,775	1,987
Net	7,057	6,775	281
Surplus over charges	3,335	3,448	*112
Jacksonville Electric Company:			
Gross	23,995	23,828	166
Net	8,605	10,131	*1,526
Surplus over charges	5,371	7,114	*1,743
Lowell Electric Light Corporation:			
Gross	18,286	17,279	1,006
Net	6,204	6,811	*607
Surplus over charges	5,507	5,654	*147
Savannah Electric Company:			
Gross	51,164	49,931	1,232
Net	21,036	22,555	*1,519
Surplus over charges	10,482	11,911	*1,428
Houghton County Electric Light Company:			
Gross	14,249	11,873	2,375
Net	6,019	4,128	1,890
Surplus over charges	3,832	1,941	1,890
Minneapolis General Electric Company:			
Gross	53,178	43,510	9,653
Net	20,134	18,121	2,012
Surplus over charges	11,063	8,609	2,453
Tampa Electric Company.			
Gross	29,060	30,009	*949
Net	11,290	13,056	*1,765
Surplus over charges	9,405	11,171	*1,765
Terre Haute Traction & Light Company:			
Gross	58,049	54,426	3,628
Net	23,915	22,110	1,804
Surplus over charges	12,917	12,470	446

---

*Decrease.

LIGHTING IN FARGO.—Announcement is made of the sale of the stock owned by the Messrs. William and Sinclair Mainland, respectively, of Oshkosh and Green Bay, Wis., in the Union Light, Heat & Power Company, of Fargo, N. D., after negotiations which have been pending since last July. The buyers of the stock are Paul Doty, St. Paul; J. W. Smith, Fargo, and George H. Prince, St. Paul. The new officers of the company will be: President, Paul Doty; vice-president, J. W. Smith; secretary, O. G. Barnes; treasurer, J. W. Smith. General Manager Markhus will retain that position just as long as he wants it. President Doty, who is very well known to central station men, said that he and those associated with him considered Fargo an important center, growing and very progressive. There would be no change of policy whatever in the conduct of the business of supplying gas and electricity. The Mainlands had been progressive, and this was known far and wide, and it would be continued just as they had established it. Those gentlemen had done exceedingly good work and given Fargo first-class plants in the way of gas works and electric light plant.

THE BELL IN PENNSYLVANIA.—The Central District & Printing Telegraph Company, the Bell concern of Pittsburg, has effected a long-term traffic agreement with the South Penn Telephone Company, of Waynesburg, whereby the 1,700 telephones in Greene County are given access to the trunk lines of the Bell Company. By this deal the Bell concern ties up the company for a long period and blocks any attempt to gather up the independent companies into one large concern. The Tri-State, Consolidated, National and Federal Telephone companies of that end of Pennsylvania and a portion of West Virginia, and which have more or less been identified with the Pittsburg & Allegheny Telephone Company, the largest independent interest in this district, are cut off from service in Greene County. M. C. Rorty, superintendent of the Bell Company, gave out the following statement: "The deal as a whole is the immediate outcome of a disagreement between the South Penn Company and neighboring independent telephone companies, and interrupts communication between a number of these companies. Several other similar deals will shortly be concluded."

DIVIDENDS.—At a directors' meeting of the Crocker-Wheeler Company the regular quarterly dividend of 1½ per cent was declared last week. The directors of the Henry R. Worthington Corporation have declared the regular semi-annual dividend of 3½ per cent on the preferred stock, payable Nov. 1. The Twin City Rapid Transit Company has declared a quarterly dividend of 1¼ per cent, payable Nov. 15. The American Graphophone Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Nov. 15. The directors of the Cambridge Electric Light Company have declared a regular quarterly dividend of 2½ per cent, payable Nov. 1. A quarterly dividend of ¾ per cent is declared on the capital stock of the Northern Texas Traction Company, payable on Nov. 1. The directors of the East St. Louis & Suburban Company have declared a dividend of 1 per cent, payable Nov. 1. The regular quarterly dividend of 2 per cent on Automatic Electric capital stock is payable Nov. 1. The directors of the American Light & Traction Company have declared the usual quarterly dividends of 1 per cent on the common and of 1½ per cent on the preferred shares, both payable Nov. 1. The directors of the International Steam Pump Company have declared the regular dividend of 1½ per cent on the preferred stock, payable Nov. 1.

NIAGARA, LOCKPORT & ONTARIO.—At a meeting of the stockholders of the Niagara, Lockport & Ontario Power Company held at Lockport, control of the company passed from the Lockport men into the hands of the Westinghouse-Albright interests, which are behind the Ontario Power Company of Niagara Falls, Ont. A new board of directors was elected as follows: Herman H. Westinghouse of Pittsburg, George C. Smith of the Westinghouse Company, Robert E. Drake of Syracuse, Paul T. Brady of Syracuse, J. J. Albright of Buffalo, S. M. Clement of Buffalo, C. A. De Guersdorf of New York, William H. Gratwick of Buffalo and Edmund Hayes of Buffalo. The last five represent the Albright interests and the others the Westinghouse interests.

LONG MISSOURI TROLLEY.—A syndicate has been formed consisting of Thomas Nevins & Son, of New York, and Denison, Prior & Co., Cleveland, to construct a high-speed electric railway for the transportation of freight and passengers between Kansas City, Mo., and St. Joseph, Mo., with branches to Leavenworth and Atchison, Kansas, which will have approximately 100 miles of track when completed. The company will construct a bridge across the Missouri River and will enter Kansas City over the tracks of the Metropolitan Street Railway Company, effecting a saving in time to St. Joseph passengers of from forty to fifty minutes. The company will have $5,000,000 stock and $5,000,000 bonds.

N. Y. & N. J. TELEPHONE STOCK.—It is proposed by the New York & New Jersey Telephone Company to make an increase of the capital stock of the company from $15,000,000 to $50,000,000 at the special meeting for that purpose, and offer new stock at par to present stockholders up to 25 per cent of their holdings. The capital stock outstanding is $13,917,600, leaving an unissued portion of the $15,000,000 already authorized amounting to $1,082,400. The amount necessary to make an offering to the stockholders of 25 per cent of their present holdings will be $3,479,400. This will bring the capital stock of the company outstanding up to $17,397,000.

CANADIAN CAPITAL.—The par value of electrical concerns in Mexico, Cuba, Jamaica and South America promoted and owned principally by Canadian capitalists, is said to be over $107,700,000. The various enterprises are the Sao Paulo, the Mexican Light & Power Co., the Mexican Electric, the Rio Janeiro, the Havana Electric, the West India, the Havana Central and the Trinidad. The biggest money-maker of the group has been the Sao Paulo, which has found no difficulty in paying large dividends.

DETROIT HOME TELEPHONE.—St. Louis capitalists associated with the Commonwealth Trust Co. are interested in the new Detroit Home Telephone Co., recently chartered with a capital stock of $2,000,000 and an equal amount of bonds. This company will be one of the links in the chain of transcontinental independents. The promoters of the company are interested in the new United States Independent Telephone Company.

PACIFIC GAS & ELECTRIC.—The stockholders of the Pacific Gas & Electric Company, which has been formed to acquire the business and assets of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation, will have a special meeting in San Francisco December 19, for the purpose of voting on a proposition to create a bonded indebtedness of $10,350,000.

KINGS COUNTY LIGHTING.—The New York State Gas & Electricity Commission has received application from the Kings County Electric Light & Power Company, of Brooklyn, for permission to increase its capital stock from $5,000,000 to $10,000,000, for improvement of plant. A hearing was set for Nov. 17 at New York.

NEW ENGLAND TELEPHONE STOCK.—A special meeting of the Southern New England Telephone Company will be held Nov. 1 at New Haven, Conn., to accept a legislative amendment to the charter which permits the company to issue $10,000,000 capital. The present capital stock is $5,000,000.

HARTFORD LIGHTING STOCK.—The Hartford Electric Light Company will increase its capital stock from $1,600,000 to $1,800,000. Stockholders are given the right to subscribe at par ($100) for one new share for every eight held. The stock is quoted at $250.

CHICAGO EDISON.—The Chicago Edison Company has sold electric power equal to 7,000 hp on long contract to the Chicago City Railway Company. During the next two years the Edison Company will expend $4,000,000 in improvements.

SALE OF MALDEN PROPERTY.—The Malden, Mass., Electric Company has acquired the control of the Malden & Melrose Gas Company by the purchase of 3,300 shares of the 4,050 shares outstanding at about $200 a share.

General News of the Week

The Telephone.

PINE BLUFF, ARK.—The Southwestern Telegraph & Telephone Company has another ordinance before the City Council for a franchise for underground conduits.

LITTLE ROCK, ARK.—An arrangement has been perfected between the Southwestern Telegraph & Telephone Company and the Reich Telephone Company for connections between this city and Center, Ridge, Springfield, Solgohatchia, Overcup and other places.

LEWISTON, IDAHO.—The Pacific States Telephone Company intends to expend $12,000 on its system here.

BOISE, IDAHO.—The Independent Telephone Company will install in its new exchange here a central energy switchboard with a capacity of 12,000 telephones. It will cost $20,000.

LEWISTON, IDAHO.—J. E. McGillivray has closed a contract with the Lewiston-Sweetwater Irrigation Company for the construction of about 16 miles of telephone line along the company's Sweetwater ditch.

DECATUR, ILL.—The Central Union Telephone Company is building a number of new toll lines out of Decatur, one to run to Champaign. The work will cost from $30,000 to $40,000.

QUINCY, ILL.—The Quincy Automatic Telephone Company has increased its capital stock from $15,000 to $1,000,000 and has changed its name to the Quincy Home Telephone Company.

MARION, IND.—O. L. Barger, of Converse, is canvassing this city to see if contracts can be secured for enough telephones to insure the starting of a new company.

LEITER'S FORD, IND.—The Leiter's Ford Telephone Company has incorporated with $2,000 capital stock. B. F. Overmeyer, J. B. Campbell and C. E. Anderson are directors.

VINCENNES, IND.—The Knox County Home Telephone Company has authorized the creation and issuance of $125,000 of preferred stock. The purpose is to improve and extend the system. W. H. Volmer is president. Some facts regarding the telephone situation here were given in last issue.

SOUTH BEND, IND.—The directors of the South Bend Home Telephone Company have declared a semi-annual dividend of 1 per cent on the stock. The South Bend Company is one of the most progressive and prosperous companies in the State.

LEBANON, IND.—The Converse Telephone Company, which for the past five years has been a sublicensee of the Central Union Telephone Company, has severed its connection with the Bell interests and now connects only with the independent systems.

COLUMBUS, IND.—The Citizens Telephone Company of this place has purchased and taken over the Hope Independent Telephone Company of Hope, the price being $28,000. No sooner was the Hope deal consummated than the Citizens Company began negotiating for some of the other independent telephone companies in the surrounding country. Since the Citizens Telephone Company is owned by the Indianapolis Telephone Company, which is closely allied to the New Long Distance Telephone Company, the systematic purchase of these small plants is significant.

GRAND MARAIS, MICH.—The Superior Telephone Company has decided to extend its line to connect with the Grand Marais life-saving station.

DETROIT, MICH.—Articles of incorporation of the Home Telephone Company, capital stock $10,000, have been filed. Among the incorporators are: Max Koehler and Samuel B. Jeffries, of St. Louis, and C. M. Burton and L. A. E. Weadock, of Detroit.

SALINE, MICH.—The Saline Telephone Company, which holds a license from the Michigan State Telephone Company for this village and surrounding territory, has just completed the work of cabling its exchange. An additional section of switchboard will be ordered in a month or two, and at the same time 3,000 feet of 25-pair cable will be added to the system.

SHELBY, MICH.—Shelby Ferry and Elbridge farmers are preparing to run a telephone line to Shelby, which is to be a part of the system of the Oceana Farmers' Mutual Telephone Company. The Farmers' Mutual now has 14 miles of wire strung, 17 telephones in use, and is closing contracts for the purchase of toll lines to Shelby, Pentwater and Mears. The company has a contract with the Bell Company to furnish exchange service at Shelby, Hart and Pentwater.

WATERVILLE, MINN.—The Cannon Valley Telephone Company has increased its capital to $60,000.

NORTH BRANCH, MINN.—The Northwestern Telephone Company has applied for a franchise here.

ALBERT LEA, MINN.—The majority of the Albert Lea Telephone Company's stock is to be sold to the Northwestern Telephone Company.

ST. JAMES, MINN.—The St. James Telephone Company has been formed with a capital of $25,000. Incorporated by C. E. Fuller and J. K. Sonneszn.

ST. PAUL, MINN.—The Northern Pacific Railway Company is constructing a long-distance telephone line from Fargo to St. Paul by the way of Brainerd.

STILLWATER, MINN.—A deed of transfer has been filed by which the Mutual Telegraph Company, a Wisconsin corporation, sells out its entire property to the Tri-State Telephone & Telephone Company.

MANKATO, MINN.—The Northwestern Telephone Exchange Company has begun to construct a farmers' telephone line from this city to Eagle Lake. Twenty or thirty farmers have subscribed for the service.

NEW ULM, MINN.—The capital stock of the New Ulm Rural Telephone Company has been increased from $50,000 to $100,000 and the company is now authorized to incur an indebtedness of $50,000, five times as much as it had at the start.

MOORHEAD, MINN.—The Northwestern Telephone Company has transferred its toll stations in the Red River Valley adjacent to Fargo to the Red River Telephone Company, which will hereafter operate them. The stations are at Sabin, Baker, Glyndon and Horace.

TOWNER, N. D.—The Western Telephone Company has been incorporated. Oliver Dalrymple is president; John Dalrymple, Casselton, secretary and treasurer; Wm. Dalrymple, Duluth, vice-president; Chas. C. Dalrymple, Tower City, and others. The stock is all owned by Oliver Dalrymple & Sons.

JERSEY CITY, N. J.—The New York & New Jersey Telephone Company will on November 1 reduce its message rate in this city from 10 cents to 5 cents.

PALERMO, N. Y.—The Palermo Telephone Company has been organized with a capital of $5,000, by S. E. Bowles, president, and W. W. Turner, clerk.

SARDINIA, N. Y.—The Erie Wyoming Telephone Company of Sardinia, Erie County, has been incorporated. The directors are: R. R. Allen and A. W. Phelps, of Chaffee, and H. R. Freeman, of Sardinia. The capital stock is $10,000.

ATTICA, N. Y.—A new corporation has been organized by the citizens of this town to be known as the Attica Home Telephone Company. George T. Loomis, Clarence H. Beané, W. A. Joiner, Elon P. Spink, Hugh Miller, Carlton D. Wing and Henry B. Flach are the directors. The capital stock of the company is $10,000.

MILAN, OHIO.—The Milan Telephone Company has been formed with a capital stock of $1,000. Incorporators: E. W. Swarthout, J. M. Spencer and G. W. Toole.

CLEVELAND, OHIO.—The earnings of the Cuyahoga Telephone Company for August were $50,528.34, a gain of $13,070.11 over the earnings of August last year. The surplus for the month was $8,051.47, a gain of $2,463.62, or about 45 per cent. The earnings for the first eight months of the year show a gain of $96,256.44 in the gross earnings, and the surplus for the eight months' period was $63,561.71, which was a gain of over 50 per cent.

CANTON, OHIO.—The Stark Telephone Company is to spend $173,000 in making improvements in this city and in Alliance. At present the Stark Company has 3,723 subscribers in Canton and 1,100 in Alliance. It is proposed to construct an extensive addition to the present switchboard, which will then accommodate 1,000 more subscribers in this city. A like improvement is to be made in the company's Alliance office. Sixty-eight thousand feet of cable are to be used in Canton and 2,600 feet in Alliance.

OKEENE, OKLA.—The Mutual Telephone Company has been formed with a capital of $10,000. The incorporators are H. Slemmer and P. D. McClung.

OREGON CITY, ORE.—Frank R. Andrews has applied for the right to build and maintain telephone wires and poles in the streets of Oregon City.

DRAIN, ORE.—The Drain Water Power, Light & Telephone Company has been incorporated by Ira Wimberly, Benton Mires, W. W. Kent, W. C. Edwards and Sam Jones.

DOYLESTOWN, PA.—The Keystone State Telegraph and Telephone Company has petitioned the Borough Council for a franchise for a telephone system in the Borough.

FORT LAWN, S. C.—A new telephone company has been organized at this place. Less Abernathy is president.

HURON, S. D.—Articles of incorporation have been filed for the State Independent Telephone Company at Huron with a capital of $1,000,000. The incorporators are G. G. S. Hutchinson and C. I. Crawford, of Huron; R. F. Pettigrew and George W. Burnside, of Sioux Falls; Andrew E. Lee, of Vermillion, S. D.; E. A. Bruce, of Yankton; E. C. Ward, of Geddes; E. H. Moulton, of Minneapolis, and J. Novotny, of Yankton. The plan is to combine the different independent companies of the State into one organization.

BEAUMONT, TEX.—The principal office of the Lone Star Telephone Company has been moved from San Antonio to Beaumont.

COMMERCE, TEX.—The Commerce Telephone Company has increased its capital stock from $5,000 to $10,000.

AUSTIN, TEX.—The Childress-Wellingston Telephone Company, of Childress, has been incorporated, with a capital stock of $5,000.

DALLAS, TEX.—The Texas Consolidated Long Distace Telephone Company, of Dallas, has increased its capital stock from $30,000 to $60,000.

LONE OAK, TEX.—The Citizens' Telephone Company has filed an amendment to its charter increasing its capital stock from $8,000 to $16,000.

DECATUR, TEX.—The Decatur Telephone Company is in the market for telephone cable, cable terminals, lightning arresters, etc. R. E. Moore is secretary.

SHERMAN, TEX.—The North Texas Telephone Company, of Sherman, is constructing a long-distance line from Sherman to Gainesville via Pottsboro and Woodbine.

DEL RIO, TEX.—The local telephone system and exchange has been purchased by T. H. Sharp and L. Rust, of San Angelo. They will make extensive improvements.

MILANO, TEX.—The H. R. F. Telephone Company will build a line from this place to other points. The company recently completed a line from Milano to Hanover.

OLDENBURG, TEX.—The La Grange & Waldrick Telephone Company has been incorporated with a capital of $1,000. The incorporators are: H. Amberg, Louis Voelkel, Charles France and others.

WEATHERFORD, TEX.—The Riddall Telephone Exchange, which has operated an independent system at Waxahachie for the past few years, has been purchased by J. R. Thomas and Charles Clark. The new owners are preparing to extend the system to outside points.

SAN ANTONIO, TEX.—Another development in the Commercial Telephone Company litigation has taken place here by the filing of a suit in the district court by H. M. Aubrey for $42,000 damages against F. C. Smith, president, and E. A. Glass, secretary of that company. Mr. Aubrey alleges that he owns 422 shares of stock in the company and that through acts of defendants the stock lost all of its value. The petition alleges that in order to wreck the property Smith in 1903 caused to be transferred to him 160 miles of the most profitable part of the lines of the company to satisfy a claim of his wife against the company.

CASTLEDALE, UTAH.—The Eastern Utah Telephone Company has purchased the Carbon and Emery County telephone line. It will build 80 miles of line in Carbon County.

WILLIAMSBURG, VA.—The Chesapeake Telephone & Telegraph Company, organized here in 1900, has passed into the hands of the Southern Bell Telephone Company. The price paid by the Southern Bell is said to be less than $8,000.

RICHMOND, VA.—The United Frederick and Clarke Telephone Company has been formed by J. H. Funkhouser, president, Clarke County; P. M. Funkhouser, secretary and treasurer, Frederick. Capital stock, maximum $1,000; minimum $200.

SEATTLE, WASH.—Articles of incorporation for the Seward Co-Operative Telephone Company have been filed. The capital stock is $25,000. The organizers of the company are H. C. Ewing and William M. Calhoun, of Calhoun; F. E. Brightman, A. J. Tennant, Richard E. Morris and C. D. Haskins.

WAUZEKA, WIS.—The Shanghi Ridge Telephone Company has been organized. A line will be built to Prairie du Chien. Wm. Gossell is president, and C. L. Smethrust secretary.

MILWAUKEE, WIS.—The Cream City Telephone and Telegraph Company has asked for a franchise in this city. The enterprise, it is said, is backed by a syndicate headed by W. D. Shroud, of St. Louis.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has announced a change in the schedule of telephone rentals to Milwaukee patrons. One of the principal reductions concerns the rates upon residence telephones. The nickel-in-the-slot machines now cost from $1.50 to $3 a month, and the company has planned a readjustment, permitting a rebate based upon the number of calls and a much better service at a cost of from $2 to $2.50 a month.

DAUPHIN, MAN. The rate payers have voted in favor of installing a municipal telephone service.

NEEWPAWA, MAN.—The Council is sending out circulars with the idea of starting a movement for municipal telephone plants in all Manitoba towns. George Belton is interested.

WINNIPEG, MAN.—The municipalities of Manitoba have signed for presentation to the legislature various petitions asking that body to take over and operate the telephone systems in the province. It is stated that at Neepawa a public service at low rates has been instituted with financial success. An effort is being made by a number of Chicago business men to secure a franchise in Winnipeg to compete with the existing system. A report made shows that Winnipeg has a telephone for every 13 inhabitants, which it is claimed is the highest average for any city in the Dominon.

CHOLULA, MEX.—An extensive system of telephone lines has been built with this city as the center. These lines connect twenty-three towns with Cholula.

MONTEREY, MEX.—The records of the State Government of Nuevo Leon show that there are in this State 2,105 kilometers of telephone lines, with 985 exchanges, in operation. Twenty-five towns of the State have telephone connection with Monterey.

CHIHUAHUA, MEX.—The Chihuahua Telephone Company has obtained an extension of its franchise in the city and State of Chihuahua for a further period of 25 years. It is stated that the company will make extensive improvements and important extensions of its system.

CITY OF MEXICO, MEX.—The Mexican government has ordered the construction of about 1,953 kilometers of telegraph lines between the City of Mexico and Puebla. The wires will be placed upon iron posts, 3,000 of which will be required for the purpose. The work will be done under the direction of Engineer Camilo Gonzales, director general of Federal telegraphs.

KINGSTON, ONT.—A telephone line is to be constructed between Kingston, Ont., and Watertown, N. Y. At present telephone connection between these two places is obtained by way of Ogdensburg.

NORTH VANCOUVER, B. C.—The British Columbia Telephone Company has agreed to install a system here on condition that the lines of the company be exempt from taxation until 200 telephones are installed. The system will be working by Jan. 1, 1906. Address Supt. Kent, Vancouver

Electric Light and Power.

HOT SPRINGS, ARK.—The Citizens Electric Light Company is about to be incorporated with a capital of $200,000.

VAN BUREN, ARK.—The Van Buren Electric Light & Power Company has been chartered with a capital of $25,000. John E. Powers is president; Henry L. Fitzhugh, vice-president, and Sidney A. Pernot, secretary and treasurer.

BAKERSFIELD, CAL.—The dam at the intake of the Power Development Company's tunnel, just below the Edison company's camp No. 1, in the Kern River canyon, has been completed and the entire flow of Kern River, consisting of nearly 300 feet, is now running through the power company's tunnel. The flow is more than sufficient for the needs of the company, but the excess is turned back to the river through the waste gate near the mouth of the tunnel.

EUREKA, CAL.—The Humboldt Transit Company has ordered an additional 250-kw railway generator from the Westinghouse Electric & Manufacturing Company. Two Union Iron Works engines, each capable of driving a 300-kw generator, have been purchased from the United Railroads of San Francisco, one of which will operate the new generator. The steam reserve station of the Humboldt Transit Company is being operated to a large percentage of its capacity. About $175,000 has been spent on the system during the past year.

HOLTVILLE, CAL.—It is stated that work on the power plant of the Holton Power Company will be rushed to completion. In a few weeks, the work of repairing the poles and placing them along the route to Calexico, Imperial and Brawley will be taken up. The transmission line will follow the Holton Interurban to El Centro, where it will diverge, one line going to Imperial and Brawley, and the other to Calexico. The route, after leaving El Centro, will follow the Southern Pacific right-of-way both north and south. If delay of material does not prevent, power will be turned on shortly after Jan. 1, 1906.

DENVER, COL.—It is probable that a power plant developing 15,000 horsepower, more than enough to supply the city of Denver for lights and the tramway company with power, will be built within 60 miles of this city in the near future. One site for such a plant is on the Platte River, using Lake Cheesman for a storage reservoir, and another site is at the junction of the North and South forks of the Platte River, which is only 29 miles from Denver. The cost of such a plant, complete for transmitting the power to Denver, will be about $1,500,000.

ESSEX, CONN.—The Essex Light & Power Company has broken ground for the new power house on Buck Lane, near the river front.

WASHINGTON, D. C.—Plans and specifications have been prepared for the construction of a central heating, lighting and power plant for all the buildings at the Soldiers' Home. Capt. John S. Sewell is superintendent of construction.

TALLAPOOSA, GA.—The citizens have voted to issue bonds for the construction of an electric light plant. E. A. Latimer is city clerk.

ROME, GA.—R. L. West, of Atlanta, is one of the promoters of a company which proposes to construct an electric power plant on Etowah River, between Rome and Cartersville, to furnish electricity for power and other purposes. The capital is $400,000.

NASHVILLE, ILL.—K. A. Steinhauser has purchased the Nashville electric light plant.

FREEBURG, ILL.—The contract for constructing a municipal electric light plant has been awarded to W. A. Fuller, of St. Louis, Mo., for $8,014.

GRAYVILLE, ILL.—The proposition to issue $10,000 to pay for the Grayville water works and electric light plant carried at the special election Oct. 10.

BREESE, ILL.—All bids opened on Oct. 9 by the Breese Water & Light Co. for a new lighting plant have been rejected, and new bids will be received Oct. 30. Further information can be obtained by addressing V. J. Kluthe, architect, St. Louis.

CHICAGO, ILL.—The Metropolitan Gas and Electric Company of Chicago has been incorporated with a capital stock of $12,000,000. The incorporators are Joseph C. Markley, of Chicago; George F. Goodnow, of Chicago, and Harry W. Davis, of Wilmington.

LOCKPORT, ILL.—The trustees of the Sanitary District of Chicago opened bids Oct. 11 for furnishing electrical apparatus and materials for the power house near Lockport, and for the transmission line along the right of way of the Sanitary District of Chicago. The Western Electric Company, it is stated, submitted the only bid on the entire work, at $300,000.

VALPARAISO, IND. The Valparaiso Lighting Company will spend about $30,000 in improvements, but the company is doing its own work. The improvements include the changing of the system into 3-phase, 60-cycle.

CHARLES CITY, IA.—A deal has been consummated whereby the electric light company passes from the control of H. V. Fussell & Co. to F. O. Martin and A. L. Dodd of this city. The last two mentioned recently purchased the water power at Floyd, and will use the same to furnish power for the light plant at this city, transmitting the electricity some six miles. It is said the new company will also make extended improvements.

PAOLA, KAN.—The citizens have voted to issue $25,000 bonds for the construction of an electric light plant.

CALDWELL, KAN.—A committee has been appointed to consider the subject of electric light in this place. There is a strong sentiment in favor of municipal ownership and also a strong opposition to it.

GREENVILLE, ME.—The Greenville Light and Power Company is constructing a new and larger electric plant about three miles east of Greenville. Mr. Charles D. Shaw, president of the company, and Mr. William M. Shaw, a director in the same company, are the chief promoters of this new enterprise.

PEPPERELL, ME.—The Pepperell Manufacturing Company has just closed a contract with the York Light & Heat Company whereby the latter company is to furnish electric power for lighting the mills and for other purposes. Both the Pepperell and Laconia divisions are to be lighted by electricity. Something like 6,000 incandescent lights will be required to do this.

DEXTER, ME.—The plant of the Dexter Electric Light Company has passed into the hands of N. Curtis Fletcher, of Boston, who owns several electric light plants in Maine, among them being the one in Eastport and several in the western part of the State. It is generally understood that the power will be increased by the installing of a new and more powerful engine and better service in general will be given.

CLINTON, MASS.—A resolution has been adopted by the Mayor and Board of Aldermen, authorizing the issue of $2,000 bonds for the purpose of extending the electric light and water works systems.

WELLESLEY, MASS.—A special town meeting will soon be called in Wellesley to again consider the question of erecting a municipal lighting plant, at an estimated cost of about $80,000.

WORCESTER, MASS.—The present board of directors of the Worcester Electric Light Company has been re-elected without change at the annual meeting of the stockholders. Following the election of the directors, ex-Mayor A. B. R. Sprague was re-elected president, with H. H. Fairbanks secretary and treasurer, and William H. Coughlin superintendent.

WEST BRANCH, MICH.—The Au Sable Power Company is buying all the land it can secure along the Au Sable River, expecting to put in a big dam and supply electric power.

ROYAL OAK, MICH.—The village council has granted a 5-year contract to the Peninsular Lighting Company, of Detroit, to furnish the village with lights at the rate of $67.50 for light per annum. The company will furnish 15 or more lights.

GRAND RAPIDS, MICH.—The Cadillac Water & Light Company has been purchased by Grand Rapids and Cadillac investors and reorganized with a capitalization of $200,000 and an authorized bond issue of $120,000. The bonds provide for the purchase and improvement of the property. The officers of the new company are: President, William H. Anderson; vice-president, Edward Fitzgerald, Grand Rapids; treasurer, William H. Anderson; secretary, N. V. Gerrish; manager, George Westover, Cadillac. The organization of this company was briefly referred to last week.

GRAND RAPIDS, MICH.—Articles of incorporation have been filed with the secretary of state at Augusta, Me., by the Michigan Hydro-Electric Company of Grand Rapids. The capitalization is fixed at $500,000 and the papers are signed by M. B. Wheeler for himself and C. J. Holmes and R. H. Opdyke as trustees. The incorporation is for the purpose of developing water power privileges upon the Manistee and White River and supplying the cities and communities in Western Michigan with power and light.

WYANDOTTE, MICH.—Wyandotte's electric lighting plant has reached its capacity, while the machinery itself has nearly outlived its usefulness. This plant has caused more trouble perhaps than any other municipal plant in a small city in America. It is estimated that the plant has cost Wyandotte $100,000. It will cost $20,000 to modernize the plant. For the first time in its history the electric lighting plant of Wyandotte is almost self-supporting. There is talk of giving up the plant and securing power from either the Edison Company or the Pennsylvania Salt Co. These companies, it is said, can furnish power for street and house lighting at a less cost.

MINNESOTA CITY, MINN.—The Minnesota Light & Power Company is contemplating the enlarging of its plant.

ANNANDALE, MINN.—The Council is considering the construction of a lighting plant.

SHUBUTA, MISS.—The Shubuta Light & Water Company has been incorporated, with a capital of $5,000, by H. Hutchins, A. Bond and others.

HELENA, MONT.—The Wisconsin Bridge & Iron Company, of Milwaukee, Wis., has secured the contract to construct a steel dam near Helena, for the Missouri River Power Company. The dam will be 630 ft. long, 70 ft. high and capable of developing 10,000 horse-power.

KANSAS CITY, MO.—W. K. Palmer has charge of the engineering work connected with the extensive water power development of the Standard Power & Construction Company on the north fork of Canadian River, Indian Territory. Complete surveys, estimates, report, etc., have made. It is proposed to utilize the exceptionally favorable power conditions of this stream and to transmit power electrically to points in the territory within a radius of 100 miles. A system of interurban railways is also projected in connection with the enterprise.

YORK, NEB.—There is a movement here among the citizens looking to the construction of a municipal electric light plant.

NEW BRUNSWICK, N. J.—The subject of a municipal electric light plant is under discussion here by the citizens.

JERSEY CITY, N. J.—The Max Light Company has been incorporated here with a capital of [illegible], by William F. J. Rogers, Charles F. Hickey and Addison C. Ormsbee.

PATERSON, N. J.—The directors of the Paterson Electric Light, Heat & Power Company have decided to return the franchise with the amendments that the Aldermanic Committee on Ordinances has approved. The new company claims that it is absurd for the aldermen to pretend they want competition in lighting, and then, when a company offers to compete and actually guarantees a large reduction, impose onerous conditions which practically forbid the new concern embarking in the business.

SYRACUSE, N. Y.—Bids received Oct. [illegible] for lighting the streets and public building have been rejected.

GOSHEN, N. Y.—The Goshen Illuminating Company has been incorporated with a capital of $25,000 by Jas. Gamble and Wm. H. Dixon, of New York, and John B. Johnston, of Brooklyn.

LYONS, N. Y.—The directors of the Wayne County Electric Company have elected these officers: President, Dwight P. Chamberlain; vice-president, Charles A. A. Lux; secretary, Benton S. Rude; treasurer, William H. Aikenhead.

MOORESVILLE, N. C.—The citizens have voted to construct a municipal electric light plant.

LENOIR, N. C.—The town of Lenoir, N. C., has just granted a 30-year exclusive franchise to L. C. Ivey and associates for an electric lighting and power plant. The company formed will at once begin the installation of a 60-kw single-phase lighting system, 60 cycles, 2,200 volts, for 21 arc lamps for five years.

FAYETTEVILLE, N. C.—The Allis-Chalmers Company, of Milwaukee, Wis., is stated to have secured the contract for overhauling and enlarging the municipal electric light plant for $7,250. The Westinghouse Electric & Manufacturing Company secured the contract for a 235 kw generator and 60 alternating arc lamps for [illegible].

SHAWNEE, OKLA. TER.—The Shawnee Light & Power Company's property has been sold to Charles A. Freuauff, of New York City. The company has been in the hands of a receiver for over a year.

UNION, ORE.—The Grand Ronde Electric Company has prepared plans for a substation in Union, and will expend about $20,000 in bringing power from Cove to Union.

PLAINS, PA.—J. Robertson Williams is interested in the construction of an electric light plant here.

BIRDSBORO, PA.—Plans are being prepared for the construction of a municipal electric light plant.

YORK, PA.—It is reported that the Conewingo Electric Power Company is about to construct a 30,000-horse-power plant to furnish light to York.

DANVILLE, PA.—Bids will be received until Oct. 27 by Dr. Levi I. Shoemaker, State Hospital for the Insane, at Danville, for the erection of a power house, electric generator plant, engines, boilers, motors, etc., and the wiring of administration building, wards and other buildings, grounds, etc. Plans and specifications may be obtained from Philip H. Johnson, architect, 1826 Land Title Building, Philadelphia.

YORK, PA.—The York Manufacturing Company is negotiating with the York Haven Water & Power Company for electric energy amounting to 500 horse-power. Incidentally 12 steam engines are to be sold by the manufacturing company. The engines range from 40 to 200 horse-power. In putting in the new power the company will not dispense with its large steam engine, generator and battery of five boilers, but will retain them for service as an auxiliary or in case of accident.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company is enlarging its boiler house to provide for the addition of two batteries of boilers. It will also install two steam turbines. The company is completing conduit work on the east side of the city which represents an outlay of $200,000.

RICHFIELD, UTAH.—The Richfield Light & Power Company intends extending a line to Glenwood and furnishing that town with light.

MORETOWN, VT.—H. O. Ward, of Moretown, will build an electric plant at the old mill site on the Moretown road.

BURLINGTON, VT.—The Board of Aldermen has appropriated $5,000 for the extension of the municipal electric light plant.

FORT MYER, VA.—Malcolm W. Hill Company, of Washington, D. C., has secured the contract for constructing an addition to the electric light system at the Signal Corps Post, Fort Myer, for $2,694.

TENINO, WASH.—S. W. Fenton has applied to the County Commissioners at Olympia for an electric light and water franchise for Tenino.

WENATCHEE, WASH.—The Council is considering the question of purchasing the electric light plant of the Wenatchee Electric Power Company for $80,000.

PROSSER, WASH.—The fight between the city administration and the Prosser Falls Land & Power Company has been settled by the Council granting the company an electric light franchise. At the same meeting the Council declined to pass a franchise giving the Prosser Electric Company the exclusive right to light the streets for a term of 20 years.

WHEELING, W. VA.—Wheeling Electrical Company and the Consumers' Electric Company have been consolidated under the name of the Light Companies of Wheeling. It is the intention to make improvements to the plants and to carry out the plans, a mortgage of $500,000 has been placed upon the property of the two companies.

FOND DU LAC, WIS.—The Independent Heat, Light & Power Company has petitioned for a franchise in this city.

WESTFIELD, WIS.—Articles of incorporation have been filed by the Westfield Milling & Electric Light Company, with a capital of $30,000. Incorporators: W. H. Moss, Westfield; Clark Older, Portage, and others.

MILWAUKEE, WIS.—The finance committee of the Common Council has decided to recommend for passage a resolution instructing the Board of Public Works to receive bids for a site for a municipal lighting plant. The committee also favorably considered the resolution to employ an engineer to draft plans for the proposed plant.

LARAMIE, WYO.—The new electric light company, represented by W. C. Stern, of Littleton, Col., has purchased the plant of the old company, and intends making improvements, including the installation of an alternating system.

BRANDON, MAN.—A syndicate is being formed to develop the power on the Assiniboine River here. Mayor Fleming can give further information.

CHATHAM, N. B.—Bids will probably be called for about May or June, 1906, for the construction of a municipal lighting plant. The probable cost will be $35,000. P. J. McIntyre is town clerk.

The Electric Railway.

AVALON, CAL.—The Banning Company has applied to the supervisors for a 30-year franchise for a double-track street railway, at Avalon, Santa Catalina Island.

SAN DIEGO, CAL.—The Bartlett Estate Company has been succeeded by the South Park & Eastside Railroad Company, which will develop the local traction plans.

CHICO, CAL.—Sealed bids will be received by the City Council until Nov. 1 for a franchise to construct and operate a street railway for a term of 50 years along certain streets of Chico, as applied for by David S. Edwards. C. E. Steinogul is the city clerk.

HARTFORD, CONN.—Articles of incorporation have been filed at the office of the Secretary of State by the Trolley Express Company, of New Haven, the incorporators being Charles S. Mellen, E. G. Buckland and Calvert Townley. The object of the company is the carrying of merchandise over various electric railway lines. The capitalization is $100,000. All the incorporators are officials of the New York, New Haven & Hartford Railroad Company and the Consolidated Street Railway Company, the holding company of the New York, New Haven & Hartford Company's electric railway.

CHICAGO, ILL.—W. S. Reed, promoter of the Chicago Southern Traction Company is making extensive plans for the improvement of the Chicago Electric Traction lines in Chicago, which he recently purchased.

AVA, ILL.—St. Louis capitalists have organized a company to construct an electric railway from Carbondale to East St. Louis. It is proposed to extend the Southern Illinois Coal Belt and Electric Railway from Herman to Carbondale and make this new road a connecting line to St. Louis.

MONMOUTH, ILL.—The Rock Island & Southern Railway has purchased the franchises of the Western Illinois Traction Company in Monmouth and from Monmouth to Galesburg. The company is now building between Monmouth and Galesburg on the old Western Illinois Traction Company's route. The secretary of the company is Wiley Stewart of Monmouth.

EVANSVILLE, IND.—The Evansville & Mt. Vernon Electric Railway has filed a mortgage of all its property to the American Trust & Savings Company, to secure the payment of a mortgage for $350,000.

GASS CITY, IND.—The Marion, Hartford & Eastern Railway Company has filed articles of incorporation with the Secretary of State. The capital stock is $25,000. J. L. Thompson, R. A. Brashear, W. B. Dodds and F. R. Chandler are the directors.

LOGANSPORT, IND.—The circuit court has granted the petition of the Fort Wayne & Wabash Valley Traction Company to condemn the tow path of the old canal in Cass and Carroll counties for a right-of-way for a trolley line. The consideration is $25,000, to be paid to the owners of the old canal.

KOKOMO, IND.—The Kokomo Railway & Light Company, capitalized at $80,000, and the Kokomo, Marion & Western Traction Company, capitalized at $1,000,000, have consolidated under the name of the latter company. This action unites all lines of street and interurban railways and electric light, heat and power plants constructed and in the course of construction, or authorized to be constructed by the two companies.

MARION, IND.—A contract has been let to the American Engineering Company, of Indianapolis, to finance and construct a traction line from Huntington to this city and thence to Indianapolis. The capital stock of the company has been increased to $50,000. The road will be known as the Indianapolis, Huntington, Columbia City & Northwestern Traction Company, and the main office will be in Indianapolis. N. E. Weist, jr., is general manager.

INDIANAPOLIS, IND.—The final step looking to the ultimate merger of the interurban railways in Indiana was taken Oct. 17, by the election of Hugh J. McGowan, president of the Indianapolis & Northwestern and of the Indianapolis & Western Traction companies. The following companies are included in the consolidation: Indianapolis & Northwestern, Fort Wayne & Wabash Valley, Fort Wayne, Van Vert & Lima, Indianapolis & Martinsville, Indianapolis & Eastern, Richmond Street & Interurban, Indianapolis & Western, Fort Wayne, Bluffton & Marion and Muncie & Portland.

MASON CITY, IA.—The Mason City & Clear Lake Railway has purchased several lots on Main and Drummond Streets upon which will be erected the car barns and the power plant.

DUBUQUE, IA.—The Dubuque & Wisconsin Railway Company has completed its organization in Iowa. The capital stock of the company is placed at $151,501. The directors are J. M. McFadden, A. W. Tredway, F. J. Peikenbrock, H. H. Blish, J. E. Hedley, C. A. Noyes and Maurice Connolly.

PARSONS, KAN.—Parker Wineman, of Chicago, has been granted a franchise by the Council for the construction of an electric railway here.

PADUCAH, KY.—Messrs. Stone & Webster have purchased the street railways, electric light and gas companies of Paducah, Ky., and have combined them under one management under the name of the Paducah Traction & Light Company, incorporated under New Jersey laws. This company has an authorized capital of [illegible].

PATERSON, N. J.—President William Barbour, on behalf of the directors of the New York & North Jersey Rapid Transit Company, has accepted the franchise granted by the Board of Aldermen to the company. The company will now proceed to purchase private rights of way from this city to the Hudson River. Part of the road will be elevated, and it is the intention of the directors of the company to make it possible to reach New York in twenty minutes.

ONEIDA, N. Y.—The directors of the Rome & Oneida Electric Railway Company have elected officers as follows: President, C. C. Goodwin, New York; vice-president, De Witt C. Hancock, Oneida; secretary, Charles Leonori, New York; treasurer, Dr. J. L. Hill, New York.

ENID, O. T.—Enid will grant a fifty-year street railway franchise to responsible parties who will guarantee to build a system of six to eight miles in the city within a reasonable time. A special census of the city, taken last spring, indicated a population of 12,000. Any information desired regarding this matter or the volume of business of Enid will be furnished by the Mayor, Secretary of the Commercial Club or editor of the *Enid Daily News*.

SEATTLE, WASH.—Arrangements have been made for financing the Seattle, Everett & Skagit Railway Company, which plans to build an electric railway from Seattle to Everett at this time and later to extend the road so as to complete it between Seattle and Bellingham Bay. The Silver Lake Syndicate, an English concern with offices at Salisbury House, London, has become interested in the project, and through it a mortgage has been placed with the Colonial Trust Company of New York for $1,500,000. The contract for building the road has been placed with L. M. Rice, of Seattle. The officers are: President, W. H. Gildsen; vice-president, W. Lair Hill; secretary, Edwin S. Gill; treasurer, Otto Stendahl.

FOND DU LAC, WIS.—The Wisconsin Rapid Transit Company is endeavoring to finance a project which it has under way for the construction of an electric railway between Fond du Lac, Eden, Campbellsport, Kewaskum, Barton, West Bend, Jackson, Cederburg, Milwaukee, Port Washington, etc. The company owns about 24 miles of roadway and has surveyed 208 miles of the line.

EAU CLAIRE, WIS.—A local syndicate, composed of O. H. Ingraham, C. Rundy, Roy P. Wilcox, John T. Owen, Byron A. Buffington and George B. Wheeler, has purchased from Arthur E. Appleyard control of the Chippewa Valley Electric Railway. New officers have been elected as follows: President, O. H. Ingraham; vice-president, John T. Owen; treasurer, B. A. Buffington; secretary and manager, George B. Wheeler.

NEW WESTMINSTER, B. C.—W. H. Moore is promoting a company to build an electric railway from Spencer Bridge to Thompson River, a distance of 100 miles.

LAS VEGAS, N. M.—The Las Vegas Railway & Power Company, a new corporation, will succeed the Las Vegas & Hot Springs Electric Railway, Light & Power Company as soon as the affairs of the latter company can be wound up. The company is now erecting a new power house at 12th Street and San Francisco Avenue. In addition to car service equipment, the company is also installing a complete alternating current plant for lighting service.

ST. CATHERINES, ONT.—The sale of the St. Catherines, Pelham & Welland Electric Railway Company's charter to build a line from this city to Dunnville and another to Welland has practically been closed with a syndicate from Toronto capitalists.

New Industrial Companies.

THE ELECTRIC MOTOR VENTILATOR COMPANY has been incorporated at Wilmington, Del., with a capital of $250,000.

THE ELECTRIC CAR COOLING COMPANY has been formed at Ossining, N. Y. Capital, $68,000. Directors: J. P. Foure, P. M. Pierson and A. M. Swiggar, Ossining.

THE UNIVERSAL POWER AND PROMOTION COMPANY, of Wilmington, Del., has been formed to furnish all kinds of power and promote enterprises; capital, $100,000.

THE ACME ELECTRIC COMPANY, of Nashville, Tenn., has been incorporated, with a capital of $7,000. The incorporators are Frank S. Mead, R. K. Gibson and H. J. Henry.

THE CONNECTICUT DEVELOPMENT COMPANY has been incorporated at Jersey City, N. J., with a capital of $100,000. The incorporators are George H. Benjamin, C. Douglas Green and Frank O'Connor.

THE MONTAUK ENGINEERING COMPANY has been formed in New York with a capital of $10,000. The directors are J. A. Anderson and R. E. Jordan of New York, and T. L. Haggerty of Brooklyn.

THE HINKSON ELECTRIC LIQUID PURIFYING COMPANY, of Pittsburg, Pa., has been incorporated in Delaware. The company will manufacture electric and mechanical filters. Its capital stock is $100,000.

THE EGAN ELECTRICAL & TELEPHONE MANUFACTURING COMPANY, of Kenosha, Wis., has been formed with [illegible] capital, by Julius S. Carr, of Chicago, and C. R. Ryan. The former is president, the latter general manager.

THE HALL TELEPHONE MANUFACTURING COMPANY, of New York, has been incorporated, with a capital of $50,000. Directors, R. B. Constantine, South Orange, N. J.; E. J. Hall, Brooklyn, and A. B. Cox, Jr., New York.

THE ROYAL BATTERY COMPANY, of New York, has been formed to manufacture storage and dry batteries, capital, [illegible]. Directors: Emil Grossman, Carl Kaufmann, Alfred Lowenstein, Julius Silverman and Hugo Gernsback, New York.

THE CITY OF WINNIPEG POWER ASSOCIATION has been incorporated at Winnipeg, Manitoba, with a capital of [illegible] to develop electric power on a large scale. Among the promoters are J. H. Ashdown, John Arbuthnot, R. T. Riley, Alex. Macdonald and D. W. Bole.

THE PREPAYMENT ELECTRIC METER COMPANY has been incorporated at Petersborough, Ont., to manufacture electric meters, motors, transformers and other electrical apparatus. Capital, [illegible]. The directors are William Hamilton, J. H. Larmouth, J. H. [illegible], Alfred Parker, all of Peterborough, Ont.

Legal.

VOLUNTARY DISSOLUTION.—The New England National Automatic Fire Alarm Company, of New York, through John P. Faure, Thomas A. Watson, George D. Boschen and others, directors, has applied to the Supreme Court for voluntary dissolution, and Justice Stover has appointed Ashbel P. Fitch referee in the matter. The company was incorporated in 1902, with a capital stock of $300,000. The assets consist of office fixtures, patent rights, and $246 in bank. The liabilities amount to $915.

APPLICATION FOR RECEIVER.—Vice-Chancellor Stevenson, at Trenton, N. J., has made an order requiring the Lambert Schmidt Telephone Manufacturing Company, of Weehawken, to show cause why a receiver should not be appointed for the company on the ground that it is insolvent and has not sufficient funds to continue its business. The complainant is J. Alaric L. Moller, a stockholder. The company was incorporated September 4, 1900, for the manufacture of telephone supplies. Later its capital stock was increased to $100,000.

◆

Obituary.

MR. ALBERT GALLATIN.—The bearer of this distinguished name died suddenly on October 14, at his residence in San Francisco. He was eating dinner, when, without warning, his arms fell to his sides and his head dropped forward. His life was extinct almost immediately. The physician who was summoned said that apoplexy was the cause. Mr. Gallatin went to California in 1850, and entered the hardware store of Huntington, Hopkins & Co., at Sacramento, as a porter. After nine years of service he was taken into the firm and given the management of the business; Hopkins and Huntington having become interested in railroad building in the meantime, Mr. Gallatin sold the first shovel that was used in the construction of the Central Pacific. From this beginning he became one of the best-known capitalists of California. It was through his backing and personal energy that the scheme for the Folsom Power Company for supplying electric power for Sacramento was put through. This was the first utilization of water power for the generation of electricity for long-distance transmission on the Coast. For many years he was vice-president and manager of the Sacramento Electric, Gas and Railway Company. Like the original bearer of his name, one of the great founders of the American Republic, Mr. Gallatin was born in Switzerland.

◆

Personal.

PHILIP P. BARTON

MR. PHILIP P. BARTON has been appointed general manager of the business and operations of the Niagara Falls Power Company, and the Canadian Niagara Power Company. This appointment also includes that of general manager of the Niagara Junction Railway Company, and of the Niagara Development Company. Mr. Barton graduated from Cornell University in 1886 with the degree of Ph.B. After two years of post-graduate work in electrical engineering, he received from the same institution, in 1888, the degree of M.S. His professional career was begun in the electrical department of the Cambria Iron Company at Johnstown, Pa. After several months of practical experience there and with the Allegheny County Light Company, of Pittsburg, Pa., he entered the engineering force of the Westinghouse Electric & Manufacturing Company. For some years he was engaged in installing electric lighting and power plants in various parts of the country, mainly in the South and the West. In 1892, he entered the service of the Brush Electric Sompany, of Cleveland, O., in charge of engineering and sales at its Pittsburg office. After the closing of that office in February, 1898, he was connected for some months with the Pittsburg office of the General Electric Company. In September, 1898, he became assistant superintendent of the Niagara Falls Power Company at Niagara Falls, and two years later was made superintendent of the Niagara Falls Power Company at Niagara Falls, and two years later was made superintendent of the operating department of the same company. In July, 1905, he was appointed superintendent of the operation of the Niagara Falls Power Company and of the Canadian Niagara Power Company, which positions he has held until his present appointment. Mr. Barton is an active member of the American Institute of Electrical Engineers.

MR. W. W. PRATT has assumed the position of manager of the National Power Controller Company of Boston. The company has opened offices on Hartford Street, Boston. It manufactures the electrical apparatus of which Geo. W. Peirce is the patentee.

MR. C. N. KALTWASSER, of New York, has been appointed assistant to A. V. Wainwright, superintendent of the Norwalk district of the Connecticut Railway & Lighting Company's properties. Mr. Kaltwasser is a mechanical engineer, being a graduate of Steven's Institute.

MR. W. H. PATCHELL, engineer in chief to the Charing Cross & City Electric Co. and the Charing Cross & Strand Electricity Supply Corporation, is now visiting this country for the first time, and studying American central station development and practice. He is making a tour of inspection in New York, Boston and other cities. With him is Mr. W. F. Fladgate, chairman of the board of directors.

MR. [illegible] RANKINE has been made treasurer of the Niagara Falls Power Company, and Mr. P. P. Barton, as noted above, general manager in charge of the business interests of the company at Niagara Falls. Mr. Rankine is a brother of the late Mr. W. B. Rankine, and has already been connected with the corporation for some time.

NEW YORK ELECTRICAL SOCIETY.—The following named gentlemen were elected members of the New York Electrical Society at its meeting on October 25: Graham Smith, Paul S. Dieguardi, Walter R. Boyd, Henry Floy, W. [illegible] Hall, M. C. Turner, Arthur Rice and H. M. Watson, all of New York City, J. MacDonald Smith, Ampere, N. J., and H. D. Bauer, Mt. Vernon, N. Y.

MR. HUGH L. COOPER, engineer of the Electrical Development Company, Toronto, has been retained by the McCall's Ferry Power Co. as manager of construction of its hydraulic works at McCall's Ferry. Mr. Cooper has associated with him Mr. Beverly R. Value, resident engineer of the Electrical Development Company's work at Niagara, who will be engineer in charge of the work.

MR. W. S. NEWPORT, who was formerly connected with the Northwestern Electric Equipment Company, of St. Paul, Minn., has entered the electrical and automobile supply trade for himself as a manufacturers' agent, and has an office at 519 Pioneer Press Building, St. Paul, Minn. Manufacturers who are not already represented in that territory are invited to correspond with him in regard to handling their goods.

MR. CHAS. W. LAWRIE, C. E., for several years general superintendent of the Ball Engine Company, of Erie, Pa., and consulting engineer for some of the most important high-speed engine builders in the United States, has accepted the position of general superintendent of the Reeves Engine Company, of Trenton, N. J. With these builders of the Reeves high-speed engine he will assume his new duties on November 1.

MR. F. C. BATES, well known as an officer of the New York Electrical Society, an energetic member of the American Institute of Electrical Engineers, and as a representative of the General Electric Company in New York City, was married on October 19, in Brooklyn, N. Y., to Miss Augusta Engenia Lazelle Hinrichs, daughter of Mr. and Mrs. F. W. Hinrichs of that city. The happy pair are now on their honeymoon.

MR. T. K. WELLS.—The Manila Electric Railway & Lighting Company, of Manila, P. I., which is controlled and operated by J. G. White & Company, of New York, has secured the service of Mr. T. K. Wells as superintendent of transportation. He has had a wide experience in railroad work, having been with the Wabash Railroad and the St. Louis, Iron Mountain & Southern Railroad for 14 years, and with the Syracuse Rapid Transit Company for eight years.

MR. W. JAC MARLAND, recently general agent of the Edison Illuminating Company, of Brooklyn, N. Y., has gone to Chicago to assist Mr. P. B. Yates, sales agents for the Gould Storage Battery Company, in the Western Territory. The sales of this well-known type of storage battery have increased to such an extent as to demand an enlargement of selling forces. Mr. Marland has had much experience throughout this territory and is very well known and liked.

MR. C. J. GLIDDEN.—Mr. Charles J. Glidden, the telephonist and automobilist, who has sailed this week for Europe on the steamer *Kronprinz Wilhelm* to resume his touring around the world in an automobile, related some of his experiences in former trips to the members of the Automobile Club of America, Fifth Avenue and 58th Street, Oct. 23. His talk was illustrated with over 200 views of automobiling and native scenes in Java, the Fiji Islands, Hawaii, New Zealand and Australia, most of which Mr. Glidden took himself.

MR. W. H. BEATTYS, JR., who has been acting as Chicago representative of the Cutler Hammer Manufacturing Company for the past three years, has accepted a position with the National Electric Company, of Milwaukee, and will be located in the Chicago office, where he will assist Mr. Chas. G. Burton, manager of electrical sales, in looking after the interests of the company in this department. Mr. Beattys is a graduate in electrical engineering of Armour Institute of Technology, class of 1899. After graduation, he spent two years with the Chicago Edison Company, and two years with Sargent & Lundy.

MR. HARRY H. HORNSBY, who succeeds Mr. Alexander Henderson as sales manager of the conduit department of the Sprague Electric Company, New York, has had many years experience in the electrical business both in the East and West. While chief inspector of the Department of Electricity in the city of Chicago, he did much to improve the standard of electrical protection. He resigned the position of chief inspector to become sales engineer of the conduit department of the Sprague Electric Company, which position he has held until his present advancement. Mr. Hornsby's extensive experience has qualified him to an unusual extent for his new positon. He has recently passed through a severe illness, and his many friends will be pleased to know that he is rapidly recovering his usual good health.

MR. C. C. COLLINS.—Mr. Curtis C. Collins, at one time connected with the General Electric Company in Lynn and Schenectady, has been appointed assistant general superintendent of the Columbus (O.) Railway and Freight Company. In its account of the appointment a Columbus paper has the following: "The new assistant general superintendent is not by any means a stranger in Columbus. He is a son of former Mayor George G. Collins. He graduated from the Ohio State University in 1895 as an electrical engineer. After six months' practical work he entered the employ of the General Electric Company and took the experts' course. He was in Dr. Steinmetz's office and in other departments. He went to Baltimore as commercial engineer for Maryland, Virginia and North Carolina and then left the General Electric Company to take charge of the S. A. Luz Electrica in San Juan, Porto Rico. This company operated a light and power plant and did an electrical contracting business. Mr. Collins reconstructed the plant and quadrupled its capacity bringing it up to the highest modern efficiency. He was appointed electrical and mechanical engineer for the city of Aucibo and built its three-phase water power transmission plant. The city of Humacao retained him as its consulting engineer and he assisted the towns of Barrio Nuevo, Mayaguiz, Guyama and Caguas in establishing plants. Mr. Collins returned to the United States because he did not wish to lose touch with things here and desired roon to expand."

◆

Trade Publications.

STEAM ENGINES.—The Ball Engine Co., Erie, Pa., has recently issued an illustrated booklet describing some new designs of engines of both the simple and compound types.

STORAGE BATTERIES FOR RAILWAY SIGNAL SERVICE. — The Westinghouse Machine Company, East Pittsburg, Pa., has issued an illustrated booklet devoted to storage batteries for railway signal service.

STEAM SHOVELS.—Bulletin No. 1402 of the Allis-Chalmers Company, Milwaukee, Wis., gives interesting information concerning the construction and operation of steam shovels. These machines are particularly well adapted for making excavations of all characters, and have met with marked favor for work on railways and the foundation of power houses.

ENCLOSED SWITCHES.—Circular No. 1121 of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., is devoted to the type G combination fuse and switch. This switch has been designed to meet the demand for a strong and durable switch capable of withstanding severe service in the hands of unskilled labor, and protected from mechanical injury.

SECTIONAL PIPE COVERING.—A leaflet recently received from the H. W. Johns-Manville Co., 100 William St., New York, is devoted to safety blow-oft sectional covering. This covering has been designed to eliminate the trouble caused by the undue expansion and contraction resulting from sudden change of temperature when the fire door is opened for coaling.

MOTOR SPEED-CONTROLLERS.—The Ward Leonard Electric Company, Bronxville, N. Y., has just issued catalogue No. 19055, covering motor speed-controllers for machine and similar duties. These motor speed-controllers have the same ampere capacity throughout and are equipped with independent, interlocking, overload circuit-breakers and no-voltage release, or with plain no-voltage release, or without any automatic features.

ELECTRIC SIGNS.—The American Electric Sign Company, 41 West Van Buren Street, Chicago, Ill., has recently issued some attractive circulars dealing with flasher electric signs. These signs are built to resemble a picture frame. At the rear of the electric lamp is placed a mirror-effect background, while in front of the lamp is placed a slide which forms the slide proper. A single sign equipment can be supplied with any number of slides, since the slides are interchangeable. The flasher is of the thermo-rheostat type.

CAR HEATING.—The Gold Car Heating and Lighting Company, 17 Battery Place, New York, has just issued an elaborate catalogue dealing with car heating devices. The catalogue contains 123 pages, 9 x 12 in. in size, and is well illustrated throughout. The extent to which these devices have been adopted can be learned from the fact that nearly 40,000 cars and locomotives have been equipped with steam heaters, and that more than 200,000 electric heaters have been sold. The catalogue contains an imposing list of prominent patrons and a liberal number of letters of approbation.

NATURAL VENTILATION.—The National Ventilating Company, 1 Madison Ave., New York, has issued a booklet entitled "The Most Essential Element of Life," dealing with ventilation. The company announces that it has in press a sumptuously illustrated treatise on "Natural Ventilation," which embodies the latest and most authoritative ideas upon the subject. Although the book will be too costly for promiscuous distribution, the company expresses its desire to place it in the hands of all who wish to know the best methods for the ventilation of offices and homes, without draught, dust, smoke, etc.

HYDRAULIC PUMPS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued bulletin No. 1607, describing a high-duty horizontal, double-acting, crank and fly-wheel, plunger pump driven by a cross-compound Reynolds-Corliss engine. Bulletin No. 1608 of the same company deals with motor-driven single-stage centrifugal pumps. The single-stage pumps have a runner of the "enclosed" type mounted on a steel shaft to which it is carefully keyed. The casing is of cast iron of the snail-shell type, and is fitted with machine covers of such size that the runner may readily be removed. The pumps are of the double-suction type, and hence the necessity of thrust bearings are eliminated.

INTER-POLE MOTORS.—Circular No. 16 of the Electro-Dynamic Company, Bayonne, N. J., treats of the constructional features and operating characteristics of the "Inter-pole" variable-speed motors. Circular No. 17 of the same company deals with the driving of machines by individual motors, and outlines the special advantages of the inter-pole motor for this class of work. In order to furnish information which will allow any one to see approximately the power required for operating any particular tool, the company has reprinted as circular No. 16 a table which appeared in the Electrical World and Engineer of May 27, 1905, showing the power ratings of electric motors which have been applied and actually operated on various machine tools.

"INSULATION BOOK."—Supplement No. 1, just issued by the Locke Insulator Mfg. Company, Victor, N. Y., to its insulator book, is a booklet of 34 pages, very attractively prepared and printed, and is designed to be slipped into the envelope provided at the back of the "Insulator Book" for the reception of supplementary publications. This supplement describes and illustrates a number of new insulators, many of which are intended to replace types illustrated in the regular catalogue, and to facilitate making these corrections readily, gummed labels are furnished to be attached to the proper pages of the "Insulator Book." A description of the testing and laboratory department, recently completed. is included in the supplement, as well as a description of the new style of shipping crate which the Locke Company has originated, and by means of which the largest types of insulators can be securely shipped already cemented together, as this can in many cases, be done to better advantage at the factory than in the field.

◆

News of the Trade.

WIRING CONTRACT.—The contract for wiring the new Baltimore & Ohio Building, Baltimore, Md., was secured last week by Harry Alexander. Habirshaw Red Core wire will be used throughout.

H. A. CLARK COMPANY, Inc., is the style under which the American Equipment Company will hereafter conduct its business from Nov. 1, with offices at No. 17 State Street, New York City. Mr. H. A. Clark is president.

THE MENOMINEE ELECTRICAL MANUFACTURING COMPANY, Menominee, Mich., will begin the erection of a plant this fall. The site purchased for the plant is 353x120 feet. A large building with several wings will be erected to provide for the expected expansion of the business of the company.

O. S. WHITLOCK & CO., West Orange, N. J., manufacturers and importers of jewels for electrical and scientific instruments, have recently increased their facilites to care for the growth of their business. One of the causes of this recent growth is attributed to the prompt manner in which all orders are filled and the great care taken by the firm with its product.

BUSINESS ECONOMY.—Mr. Harold A. Wright, "consulting business economist," of 141 Broadway, New York City, makes a specialty of the study of the business problems of his clients, and can aid in the preparation of an accounting system, a factory cost system, a filing system, or any other feature whose adoption will add to economy, efficiency, security and profit for his clients.

NEW YORK ELECTRICAL EXHIBITION. We are advised by the management of the proposed electrical exhibition to be held in Madison Square Garden, next December, that among the new exhibitors enrolled are the Gold Car Heating & Lighting Company, the Gray Telautograph Company, the Natural Food Company, of Niagara Falls, and the National Carbon Company. The apparatus and appliances of these concerns embrace many features of interest.

A VARIETY OF PRODUCT.—The various stations and shops of the Philadelphia Rapid Transit Company furnish an interesting exhibit of the variety in products manufactured by the B. F. Sturtevant Company, of Boston, Mass., for the equipment of plants of this class. In the various sub-stations are no less than ten steel plate fans especially designed for cooling transformers. In one of its shops is a complete heating and ventilating system consisting of fan, heater and distributing pipe. In another is a forge shop equipment, together with an exhauster for removing smoke, while a large cupola furnace is supplied with a Sturtevant pressure blower.

LONG-ARM IN LONDON.—It is announced from London that the "Long-Arm" System Company of Cleveland, O., has been awarded a gold medal for its Earl's Court exhibit of "Long-Arm" electrically operated power doors for ships. This was one of the few displays of American devices in the Naval, Shipping and Fisheries exhibit. The exhibit of this system, by which bulkhead doors are closed from a central station in time of an emergency, has attracted the favorable attention of many European naval experts. Foreign admiralties are investigating it with a view to its adoption, following the example of the American Navy, which has installed the "Long-Arm" system on 32 of our ships. The development of automatic bulkhead doors has been effected wholly within the United States Navy. Mr. Francis T. Bowles, formerly chief constructor, first conceived the idea of an electrical apparatus for operating these doors. Another graduate of the Naval Academy, W. B. Cowles, perfected Admiral Bowles's idea into the practical system now in use.

BAKER & COMPANY, INC., refiners and manufacturers of platinum, gold and silver, Newark, N. J., and New York City, have been awarded a gold medal for the excellence and variety of their exhibit at the Lewis & Clark Centennial Exposition, just closed at Portland, Ore. Being the first exhibit of its character on the Pacific Coast, and located in the Mines & Metallurgy Building under government supervision, it attracted the special attention of a large number of visiting miners and metallurgists, who, in recent years, have been devoting greater care to the recovery of the platinum known to exist in the alluvial deposits along the Pacific Coast. Baker & Company's exhibit was comprehensive in its character, including numerous samples of crude platinum ore, the salts and solutions of the metal, and various forms of platinum ware, such as are used daily in the arts and industries. A more extensive exhibit, which they displayed at the Louisiana Purchase Exposition in 1904 was awarded the grand prize.

THE AUTOMOBILE SHOW.—For the sixth annual automobile exhibition of the Automobile Club of America, to be held in the new 69th Regiment Armory, New York City, in January next, over 45,000 square feet of space has been applied for. Those intending to exhibit at what it is announced will be the most artistic industrial show ever seen in this country, should bear in mind that all application for space, in order to receive consideration in the first allotment, must be made to Secretary S. M. Butler, 753 Fifth Avenue, New York City, not later than Oct. 28. Since one-third of the net profits go to the exhibitors in proportion to the amount of rental paid by each, it is assured that the outlay to those displaying motor-driven vehicles and accessories will be appreciably reduced. The magnificent drill hall, with its high steel arched roof, will permit of an imposing array of vehicles; the roomy galleries will supply exceptional opportunities for the parts and accessories concerns, while down in the basement, which will be well lighted and inviting, the heavy vehicles will find an attractive setting. Being of fireproof construction throughout, the building will offer no danger whatever from fire, and insurance rates will be exceedingly moderate. Smoking will be permitted only in the smoking room. A convenience will exist in the bureau of information that will be in operation three days previous to the opening of the show.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 17, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

801,851. PORTABLE TELEPHONE; Walter N. Clark, Warren, O. App. filed Oct. 1, 1904.

801,864. TELEPHONE SYSTEM; Edward J. Hall, New York, N. Y. App. filed Feb. 8, 1905.

801,888. ALTERNATING-CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed Jan. 9, 1905. (See Current News and Notes.)

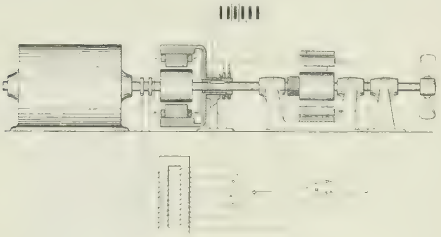
801,895. JUNCTION BOX; Thomas J. Murphy, New York, N. Y. App. filed Sept. 12, 1902. The box is of knock-down construction and is made of sheet metal plates which are secured together by sheet metal corner brackets of special form which interlock with the side members so as to form a rigid structure. The side plates have openings for the entrance of the conduit cables.

801,898. ELECTRIC POWER TRANSMISSION DEVICE; Herbert McNulta, Anaconda, Mont. App. filed Dec. 10, 1904. In order to secure a perfectly elastic and controllable application of power to the screw propeller of a ship or driving wheels of an engine, the patentee positively drives an armature, the torque from which rotates the fields and the connected propeller or parts. The current generated from the relative motion operates an additional motor to give additional torque to the driven parts. The circuits can be manipulated to vary the control in many different ways.

801,904. ELECTRIC TORCH; John C. Perry, Columbia Station, O. App. filed May 28, 1904. An imitation musket or fire arm with a glass bayonet attached, has an electric lamp therein which can be flashed momentarily by a trigger for spectacular purposes.

801,922. AUTOMATIC SPRINKLER SYSTEM; William C. Shaffer, Milwaukee, Wis. App. filed June 5, 1902. A switch blade is maintained midway between two contracts by connections from two opposed diaphragms when the liquid pressure thereagainst is equal. A preponderance of pressure against either diaphragm moves the switch blade and establishes one or the other signal circuit.

801,936. APPARATUS FOR THE SIMULTANEOUS TRANSMISSION OF TELEPHONIC AND TELEGRAPHIC CURRENTS OVER THE SAME LINE; Carlo Turchi, Ferrara, Italy. App. filed July 13, 1904.



801,898.—Electric Power Transmission Device.

801,939. ELECTRIC ARC LAMP; Egidio Viale, Gross-Lichterfelde, near Berlin, Germany. App. filed June 16, 1904. Mechanical details of an arc lamp which shall not be unduly heated in use. For this purpose ventilating openings are made in the casing, and radiating flanges are disposed to dissipate the heat and at the same time prevent moisture from entering the openings.

801,947. MAGNETIC SEPARATOR; John Price Wetherill, South Bethlehem, Pa., and Henry A. J. Wilkens, New York, N. Y. App. filed Dec. 18, 1897.

801,967. MULTIPLEX SYSTEM OF TELEGRAPHY; George A. Cardwell, New York, N. Y. App. filed Feb. 3, 1900. Messages are transmitted in the usual Morse code in superposed sets or groups, to each of which sets or groups of impulses is given a different meaning at different stations, so that two stations may receive the same impulses, but owing to different translations, have different messages conveyed thereby.

801,999. TROLLEY WHEEL; George Loffi, Norwalk, O. App. filed Jan. 7, 1905. In addition to the usual bearing spindle for the trolley wheel, the inside faces of the harp have cupped recesses eccentric therewith which furnish an additional bearing surface for the wheel.

802,015. DEVICE FOR ATTACHING TELEPHONE AND OTHER WIRES TO INSULATORS; Jack McDaniel and Michael Barr, Paris, Ill. App. filed Mar. 23, 1905.

802,020. FOG DISTANCE SIGNALING METHOD; John Patten, New York, N. Y. App. filed May 22, 1903. Upon every ship or vessel is placed an apparatus having means for exploding gun powder under the influence of Herzian or ether waves. Such waves are periodically transmitted from a convenient station on shore so that explosions occur on the different ships simultaneously. Each ship then notes the elapsed time between the sounds and from this data computes the distance between the vessels.

802,052. ELECTRIC COUPLING; Norman Marshall, Newton, Mass. App. filed Oct. 26, 1903. The usual door plate has openings therein in which are inset vulcanite bushings so that the plugs will be positively guided into their correct position without careful manipulation, or danger of making a short circuit.

802,086. CABLE-HANGER; Gustaf Lambert, Charlottenburg, Germany. App. filed June 8, 1904.

802,093. SYSTEM OF OVERHEAD ELECTRIC CONDUCTION FOR VEHICLES Ettore Bauco, Rome, Italy. App. filed Aug. 20, 1902. The trolley wires are stretched in such a way as to constitute track rails for a small carriage structure having contact wheels, which moves thereon. The vehicle to be propelled has flexible connections with the carriage and draws the same along the trolley wires when in operation.

802,096. TREE INSULATOR; Charles W. Dunton, Boston, Mass. App. filed Mar. 24, 1905. In order to overcome damage to the wires and insulators due to the swaying of trees when the latter are used as supporting means, the insulator is mounted on a swinging arm which allows a swaying movement to take place within certain limits.

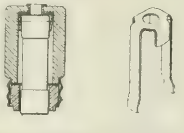
802,111. ANNUNCIATOR; Alfred Laurentius Peterson, Copper Mills, Cal. App. filed Apr. 10, 1905.

802,130. ELECTRIC MEASURING INSTRUMENT; Montraville M. Wood, Schenectady, N. Y. App. filed May 29, 1902. (See Current News and Notes.)

802,153. PROCESS OF REDUCING METALS AND MAKING ALLOYS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed Jan. 6, 1905.

802,160. TROLLEY BASE; Charles E. Gierding, Newark, N. J. App. filed Jan. 30, 1904. A rigid stud projects vertically from the roof of the car and constitutes part of a roller bearing race-way for the fixtures which support the trolley pole.

802,170. MAGNETIC ORE-SEPARATOR; Richard R. Moffatt, Brooklyn, N. Y. App filed July 13, 1904.



802,246.—Electrical Fuse Plug.

802,172. FIRE ALARM OPERATING DEVICE; Osman K. Nestor and Emil Moch, Jersey City, N. J. App. filed May 31, 1905. Thermostat in which springs are prevented from expanding against a metal plate by buttons of fusible substance. When the buttons melt the springs expand and make alarm contact.

802,173. TROLLEY HARP; Edward D. Rockwell, Bristol, Conn. App. filed Mar. 11, 1905. The trolley wheel spindle is removable from the trolley harp in substantially the same way as an ordinary spring shade roller is removed from its fixtures.

802,205. PROCESS OF PRODUCING CHLORATES AND BICHROMATES; Arthur Edward Gibbs, Niagara Falls, N. Y. App. filed Mar. 1, 1904.

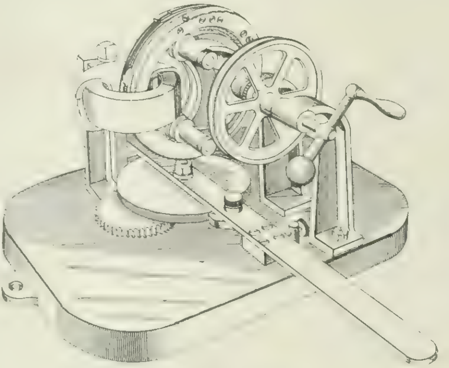
802,246. ELECTRICAL FUSE PLUG; George B. Thomas, Bridgeport, Conn. App. filed Mar. 17, 1905. A fuse plug for Edison sockets in which the fuse cartridge itself makes the contact at the central stud, while a sheet metal frame is connected to the threaded shell and extends into contact with the outer end of the cartridge.

802,266. FIRE ALARM OR SIGNAL; John A. Chase, Denver, Col. App. filed Dec. 16, 1904. A thermostat in which gravity impelled contact is normally restrained by a cord which burns in case of fire.

802,291. MAGNETO-ELECTRIC IGNITION APPARATUS FOR EXPLOSION ENGINES; Gottlob Honold, Stuttgart, Germany. App. filed Apr. 30, 1902. The primary and secondary coils are wound directly on the armature of the generator, and the primary coil is short circuited to oppose the magnetic flux from the fields, and subsequently broken whereby the suddenly increased magnetism causes a jump spark in the secondary armature circuit.

802,305. AUTOMATIC BLOCK SIGNAL SYSTEM; James McIlwain, Okawville, Ill. App. filed Feb. 21, 1905. A railroad signal system in which the locomotive carries a pair of trolley poles and the conductors are so arranged as to give different signals within the cab under different conditions.

802,328. QUANTITY METER; Richard Schmidt, Munich, Germany. App. filed May 13, 1903. A form of coulomb-meter in which the regulator of an ordinary clock is connected to an ammeter so that the clock registers in proportion to the time and the current used.



802,350. Winding Machine.

802,337. MOISTURE PROOF CASE COVERING FOR THE TERMINALS OF LEAD ARMORED INSULATED WIRES, ETC. Charles E. Teush and Luther Hargis, Evansville, Ind. App. filed Mar. 27, 1905. The usual lead sheathes of telephone conduits are bent downard in parallel relation and a cap soldered thereto upon which may be screwed a tubular box which protects the conductors after the connections have been made.

802,350. WINDING MACHINE; Charles P. Nickel, New York, N. Y. App. filed Apr. 27, 1904. An annular coil-carrying winding frame has an internal gear by which it is turned to wind the wire around a ring-shaped armature core in the usual manner of winding machines. Has gearing for angularly moving the armature as the winding progresses.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, NOVEMBER 4, 1905. No. 19.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE	1139 Monadnock Block
PHILADELPHIA OFFICE	929 Chestnut Street
CLEVELAND OFFICE	402 Cuyahoga Building
EUROPEAN OFFICE	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **14,500** *copies are printed. Total circulation for* 1905 *to date,* **607,000.**

NEW YORK, SATURDAY, NOVEMBER 4, 1905.

CONTENTS.

Editorial 759
Accident Swindling in the Electrical Field 762
Electric Lighting Development at Baltimore, Md. 762
A Year's Figures of the Subway 762
Lamp Cluster Litigation 763
The Submarine Cable Situation in Alaska 763
A Gift from Italian Electrical Engineers 764
Underground Wires for Hartford, Conn. 764
Meeting of the Empire State Gas & Electric Association 765
Statistics of American Railroads 765
The Electrical Field in China 766
The Valtellina Three Phase Railway 766
Current News and Notes 767
Electrical Engineers of the Times. XXXIV. A. J. Wurts 770
Niagara Power in Buffalo 771
The Use of the Telephone in Army and Navy Manœuvres. By Col. B. K. Roberts, U. S. A. 773
The Long Island Railroad Electric System 774
Electrical Equipment of a Buffalo Theatre 778
Meeting of the American Institute of Electrical Engineers 779
Lightning Arresters 780
New Telephone Patents 782
LETTERS TO THE EDITORS.
The Place of the Single-Phase Railway. By R. R. Tenney, Jr. 782
The Place of the Illuminating Engineer. By Louis B. Marks 782
Digest of Current Electrical Literature 783
Book Reviews 787
Purifying and Softening Water by Electrolysis 787
Successful Starting of Gas Engine-Driven Single Phase Railway System 788
Gordon Cells 788
Gas Engines in the Rockland Central Station 788
Vigorous Lighting Campaign 789
Electric Drills 790
A Big Electric Lighting Display 790
An Improved Gate Valve 790
"Noscru" Midget Push Button 790
Electrically Controlled Oil Switches 790
Small Power Motors 791
Operating Mechanism of the "American" Arc Lamp 792
Feed-Water Heater 792
Switches for Lamp Circuits 792
A Detachable Pot Head for High-Tension Circuits 793
Overload and No Voltage Circuit-Breaker 793
Steady Demand for Steam Engines 793
Industrial and Commercial News 794
General News of the Week 798

A NEW STATE ASSOCIATION.

We note with pleasure the emergence into the field of united work for a common good, of the Empire State Gas & Electric Association. Its first annual meeting, held this week in New York City, was well attended, and the interest shown, as well as the new enrollments, indicated that the new body will enjoy general support and have plenty of work cut out for it, whether for defence or for progress. The gas and electric interests will now have an organization that can do much for them, and one which co-operating with the new State Commission should be able to do much in securing a better comprehension on the part of the public of the conscientious manner in which the great majority of the companies are seeking to perform their duties in their respective communities, as public utility corporations. Presently, the tide of abuse and contumely with which corporations are now indiscriminately overwhelmed will roll back, and sanity will reassert itself; but it will do so more quickly with such organizations united to stamp out falsehood and to spread the truth. From the economic and industrial standpoints also, quite aside from the aspects of politico-sociology, these associations have much to do, and the opportunity opens for useful work on every hand. The officers who have brought this young body up to its present proportions and prosperity in so short a period are to heartily congratulated. In a general way, it is interesting to observe that the movement toward the organization of these "territorial" bodies has proceeded apace of late years. It is a good thing, especially as the point has been recognized that their strength lies in national organizations and not in building up a rival body. This has been very clearly shown in the gas field, where in fact a merging of national and sub-national bodies into a new solidified organization has recently been witnessed. When the national body does its work the State and territorial bodies will stand by it, and all will be benefitted. When there is central weakness, the minor organizations are often forced to take up work and duties for which they are not adequately equipped.

NIAGARA IN BUFFALO.

The transmission of power from Niagara Falls to Buffalo is an instructive matter in many particulars. It is in the first place an excellent exhibit of what hydraulic power can do in competition even with very cheap coal. It also gives an excellent idea of the extent to which a modern city can rely year in and year out upon a distant source of power. The work in Buffalo has grown up so gradually that no revolutionary changes have been made, and the aggregated plant has those peculiarities of service that are typical of most of the larger American cities. The strange mixture of direct-current with 60 and 25-cycle alternating-current is a curious example of the persistence of habit even in a growing art. Twenty years hence it will seem a wonderful exhibition of futile shortsightedness on the part of very worthy pioneers. By that time, we hope, one kind of current or the other will have acquired a settled supremacy, or at least methods of changing from one to the other without absurd complications will have been discovered. A very interesting feature of the Buffalo situation is the attempt at using 25 cycles for lighting upon a somewhat large scale. If one is going in for 25-cycle lighting it would be better to revert to lamps of larger candle-power or less voltage, or to turn to Nernst lamps, of which the glowers have enough thermal stability to prevent flickering. The 25-cycle experiment is interesting, however, and a considerable relief so long as a genial public can be persuaded to take kindly to it.

◆

City Arc Lighting.

It is interesting and important for central station managers and electrical engineers in general to note that the city of London—the small inner core of the great world metropolis—has reverted to the use of gas for its street lighting. Such a "throwing back" in a period when the arc lamp has universally triumphed as the best medium to employ for this work is susceptible of various explanations, and we observe that the committee in charge offers sundry grounds of justification. It is amusing at this late day to learn that arc lighting had proved a complete failure. The committee reported that incandescent gas lighting was in general and growing use in Paris, Berlin, Vienna and other important Continental towns. The difficulty about arc lighting, apart from its cost, is the unequal distribution and diffusion of the light—patches of bright light and dark shadows alternating in areas so lit. In contrast to gas, also, arc lamps, it is asserted, have little fog-penetrating power. It was considered, too, that the system of lighting a street by large units of light placed on high standards was far from economical. Light is wanted mainly on and about the pavement level, not on the house tops, and as the intensity of light varies inversely with the square of its distance from the object to be lighted, the most scientific way of illuminating a street would seem to be not to "sky" the source of light, but to use medium units on columns of moderate height at short intervals. Thus far the committee. It is asserted that the change has given twice as much light in candle-power, at a saving, apparently, of about $1,500 a year.

We have no reflection or criticism to offer upon our London friends in permitting this to happen, but it seems to us that the general power supply scheme of the past year has its warrant, to say the least, in such an incident, and that in a great city where fifty or sixty individual authorities have lighting powers, gas might well compete with electricity peddled out in a retail way. We have never been impressed with the value or high efficiency of the arc lighting in the city of London, but to our eye it has certainly been better than any gas lighting there. So far as we are aware, the general gain of electric lighting in the city of London and every other part of the metropolis is marked. It could hardly be otherwise in a modern city rising in the scale of comfort and convenience.

Still, there is food for thought in the occurrence, and a stimulus to the improvement of lighting methods hand in hand with cheapening of the current. We know of one city in America—Lowell, Mass.—that has again taken gas altogether for its street lighting, under circumstances of a rather peculiar character. It is a curious fact, we believe, that of late years, owing to the tremendous growth of their indoor load—light, power and heat—many central station managers have become indifferent to street lighting contracts, once the backbone of their business. But while the burden of political fights for the street lighting may have seemed onerous, it is after all a pity to neglect any item of the income, and it is the duty of the central station manager to get all the street lighting he can, if the rates are fair.

◆

Dynamo Heating Time Constants.

An important problem connected with the determination of the performance of dynamo-electric machinery is that of ascertaining the maximum temperature rise for a certain load, and the rate at which the temperature varies. In designing a machine for a specific duty, very little trouble is encountered in obtaining the desired characteristics with reference to the efficiency and the general electrical behavior, since the theory of such characteristics is well known, and the constants involved in the formulas expressing the theory can easily be ascertained from experimental observations on completed machines. Although the determining factor in placing a capacity rating on a certain design of machine is the allowable temperature rise rather than the electrical characteristics, it is to be noted that only recently has the importance of this fact been fully appreciated by the writers on the design of electrical machinery. It is a remarkable fact that the typical treatise on design gave most elaborate discussions on the electrical characteristics of the machine, but the only reference to the effect of temperature on the capacity of the machine was summed up in the statement that a certain superficial area should be allowed for each watt of power lost within the machine. In few cases indeed was any mention made of the fact that the volume of the material in the machine affects the rate of increase of temperature, and that for overloads of short duration both the volume of the material and its superficial area must be considered.

The facts connected with the heating of electrical machinery are treated in an interesting and instructive manner by Mr. A. Press in an article which appeared on page 735 of our last issue. The article deals specifically with the rate of change of temperature when a machine is operating under a certain load. The writer assumes that with a certain superficial area and under constant cooling conditions, the final temperature rise of the machine after infinite time will vary directly with the watts lost within the machine. In order to ascertain the rate at which the temperature of the machine will tend to increase to the maximum value, the assumption is made that the rate of increase in temperature when the machine is first placed in operation at the chosen load is the same as the rate of decrease in temperature when the machine is allowed to cool freely from the maximum temperature due to that load. The well known law of cooling, which states that the instantaneous rate of transfer of energy from the body is proportional to its exposed area and the difference between the temperature of the body and that of the surrounding medium, is applied directly. When a body is heated to a certain temperature above the surrounding medium it is evident that the amount of energy contained within it by reason of its temperature rise is equal to the product of its heat capacity and the range of temperature, and that the rate of cooling at each instant will vary directly as the exposed area and inversely as the heat capacity. The article by Mr. Press indicates the method by which this law may be applied to commercial dynamo-electric machinery, and shows the advantage of specifying as the "heating time constant" of the machine the time which would be required for the machine to reach the final maximum temperature if all the losses were retained within the machine without any dissipation during this time. It is clearly shown that the maximum temperature rise depends directly upon the area exposed to cooling, and that the rate of increase of temperature depends directly on the maximum temperature rise and inversely on the volume of the machine.

◆

Commercial Photometry.

We publish in the Digest this week some account of a so-called watt-photometer designed to tell all about an incandescent lamp at one simple reading. It seems very ingenious and will doubtless strike the fancy of many persons who long for short cuts to exact knowledge. There have been similar instruments toted around in this country by lamp salesmen, and we have been yearly expecting a pocket photometer reading by vernier to hundredths of a candle-power. Now, we do not wish to be understood as depreciating the enthusiasm that produces such instruments, but merely to call attention to the fact that consistent readings are no evidence of precision in a photometer, any more than in an aneroid barometer or any other instrument in which exactness has been sacrificed to portability. The wonder is that such devices at any time come within shrieking distance of precision. In the matter of photometry we wish that every man who talks glibly about horizontal, spherical, hemispherical and other kinds of candle-power were compelled as a preliminary to put in about six months hard work in a first-class photometer room fitted with all the latest devices. The first effect of really conscientious work of this kind is a chronic tendency to unseemly mirth when small fractions of candle-power are defined, and a disposition to slowly lower an eyelid when standards are mentioned. An experienced observer can do wonderfully consistent work, and even a pair of observers working side by side will fall into a sort of automatic agreement, but if they work apart and with different instruments the trouble begins.

The possible errors in photometric absolute determinations are numerous and great, so great that they cannot be eliminated even in a permanent photometer room with any really satisfactory degree of certainty; and it is not too much to say that however ingeniously a portable photometer may be planned, its usefulness is necessarily very limited by reason of errors that cannot certainly be eliminated. A single observer familiar with his instrument can get useful relative results, and that is about the end of the matter. If one could get even this amount of satisfaction in measuring illumination it would be highly convenient, but the closer one comes to the physiological side of light, the larger the personal errors become. Their elimination from ordinary photometry is a problem of the gravest character deserving more attention than has yet been paid it. Even a careful observer not only has his own errors in setting the screen, but these are liable to slow variation over a pretty wide range. He may make a long string of readings with variations of only one or two per cent, and then without apparent reason get the next day an equally consistent set, perhaps five per cent different. Or he will fall into unconscious habits of setting that prove a source of large errors when the conditions are changed, as for instance by the substitution of a different screen. These subconscious personal errors are most troublesome, though least apparent in apparatus of relatively fixed character. Hence these strictures on instruments in themselves extremely well planned from a purely physical standpoint. The amount annually spent in this country alone for artificial lighting is hard to determine with any precision, but it is pretty certainly in excess of $150,000,000. Considering the magnitude of the expenditure, the facilities for measuring the commodity purchased are singularly meagre. They deserve improvement and ought to be persistently studied until improvements are made. But improvements can be made only by thorough investigation of the physiological factors of the problem which determine the limits of the attainable precision.

ALTERNATING-CURRENT GALVANOMETERS.

The wonderful sensitiveness and convenience of the D'Arsonval type of galvanometer is due to the fact that the force exerted upon an element of wire carrying a current in a magnetic field is proportional to the product of the current and the field intensity, so that a feeble current in a powerful field produces a fairly considerable, and not merely a feeble, mechanical force. The magnetic field is permanent and costs nothing to maintain. Unfortunately the D'Arsonval permanent magnet instrument fails to respond to alternating currents, the momentum exerted on the coil by a current in one alternation being annulled by that exerted in the next and reversed alternation. Evidently the magnetic field must alternate isochronously with the alternations of current in the coil in order to maintain a steady torque upon the coil. This naturally leads up to the types of alternating-current dynamometers in which the alternating-current in the stationary coil produces the alternating field, within which the current through the movable coil can set up a rotative effort or torque.

The alternating-current dynamometer is, therefore, a form of instrument bearing resemblance to the D'Arsonval direct-current galvanometer, but substituting an alternating electromagnetic field for the permanent-magnet field. Unfortunately, however, this alternating current field has a magnetic circuit entirely of air, so that the magnetic field is not only proportional to the current, but is also extremely feeble by comparison with that which a permanent magnet can produce. Consequently, an electrodynamometer is not only complicated by an uneven scale of deflections; but the sensitiveness of the apparatus is exceedingly small by comparison with that of a D'Arsonval direct-current instrument. Of recent years attempts have been made to increase the sensibility of the alternating-current galvanometer and to bring it more nearly on a parity with the direct-current D'Arsonval galvanometer, by employing a laminated iron magnetic circuit for the stationary element, so as to produce a powerful alternating magnetic field in the air-space through which the movable coil may swing. It was soon found, however, that the movable coil acted like the secondary winding of a transformer, and that as soon as its circuit was closed externally it endeavored to set itself in such a direction as would satisfy the forces due to the current induced by the alternating field. It would seem that there is a fair prospect of minimizing satisfactorily the difficulty due to locally induced currents in the coil, and thus of enabling the alternating-current D'Arsonval instrument to be used with a satisfactory degree of sensibility, although we are not likely to attain either to the sensibility or to the convenience of the direct-current D'Arsonval type.

A recent number of the *Physical Review* contains an article by Mr. E. M. Terry upon a measurement of the variation of capacity in condensers with temperature by means of an alternating-current galvanometer. It has been well known for many years that condensers have a small negative temperature coefficient, or, that their capacity diminished slightly with increase of temperature; but the measurement has perhaps never been made before by an alternating-current galvanometer to such a degree of precision as the article indicates. The fact that this high degree of precision was attained speaks well for the alternating-current galvanometer method. The details of the control of the instrument are of much interest. The origin of the temperature change of capacity in a condenser has not been cleared up, so far as we are aware. Some have suggested that it was a direct consequence of expansion of the dielectric, whereby it became slightly increased in thickness with rise of temperature, and with a proportional loss of capacity. But if the dielectric film increases in thickness, it will also increase in length and breadth. The increase in capacity due to swelling in two dimensions ought, according to this reasoning, to be double the diminution in capacity due to swelling in the third dimension, so that one might suppose the capacity would slightly increase with expansion of the dielectric due to rise of temperature, instead of diminishing, as is apparently always observed. Perhaps the cause of the phenomenon is more deeply seated. It is earnestly to be hoped that such development may be made in the construction and use of alternating-current galvanometers as may fit them for sensibility under wide ranges of frequency and current strength. This would fill a wide and widespread deficiency.

Accident Swindling in the Electrical Field.

An organization to be called The Alliance Against Accident Frauds has been formed in New York City, at a meeting held last week. There were present at the meeting representatives of corporations from Boston to Chicago, and letters were received from many others saying that they would join the alliance. The objects of the alliance are:

To protect and defend its members again fraudulent claims and prosecute all persons engaged in presenting or promoting such claims; to collect and disseminate information to its members concerning fake claimants, shyster lawyers and unprincipled physicians, ambulance chasers, false witnesses, and others engaged in such practices and methods; to insist upon fair dealing with honest claimants and generally to impress upon the public the principles for which the alliance stands.

The companies represented were the United States Casualty Company, General Accident Corporation, Philadelphia Casualty Company, Great Eastern Casualty Company, New York City Street Railway Company, United Railways and Electric Company of Baltimore, Chicago and Northwestern Railway, New York Central and Hudson River Railway, Boston Elevated Railway, Washington (D. C.) Railways and Electric Company, Delaware, Lackawanna & Western, Hudson River Day Line, Travelers' Insurance Company of Hartford, Philadelphia Rapid Transit Company, Interborough Railway Company, Casualty Company of America, Little & Co., printers, and the Fuller Construction Company.

In the discussion of the plan and scope of the new alliance it was said that its mere existence would frighten off many persons who otherwise might bring fraudulent suits. It will be part of the plan to inform stockholders and policy holders in every corporation in the alliance of every case which is to be fought and the reason for contesting it. By this wide publicity it is thought that fraud will be made additionally difficult and dangerous.

It was said at the meeting that the alliance will do quite as much work to see that honest demands are promptly settled as it will to detect swindlers. With fraudulent demands out of the way, it was said, the railways and accident companies could give more time to genuine cases and settle them more promptly.

An effort is also to be made to have passed in every State laws similar to those passed by the Maryland Legislature against so-called ambulance chasers and dishonest physicians. At the meeting of the American Bar Association at Narraganett last summer the question of barratry was taken up, and that organization said it would co-operate with any association that would labor to put down the practice. A committee was appointed to confer further with the American Bar Association and with the American Medical Association on the subject. The following officers were chosen: President, Robert B. Armstrong, president of the Casualty Company of America; first vice-president, James R. Pratt, of the United Railways and Electric Company of Baltimore; second vice-president, R. C. Richards, of the Chicago and Northwestern; secretary-treasurer, Chauncey S. S. Miller. The first annual meeting will be held January 19.

◆

Electric Lighting Development at Baltimore, Md.

The Eastern Electric Construction Company has lately put a new and competitive central station plant in operation at Baltimore, Md., with regard to which a few facts are appended.

The generating station is of steel and brick construction, situated near the mouth of the Patapsco River, with a siding from both the B. & O. and W. M. R. R. There is also provision for unloading barges, so that coal can be obtained from three sources. There is a coal conveyor installed, motor driven, to convey the coal to the bunkers situated in the top of the boiler room. The boiler equipment consists of two batteries of four Stirling boilers each,equipped with Roney mechanical stokers. In the engine room are installed two 2,000-kw Westinghouse turbo-generator outfits, 6,600 volts, 7,200 alt., three-phase. The condensers are situated directly underneath the turbines, and are arranged for cross connection, so that either condenser can be used with either turbine. Water for the condensers is obtained by duplicate sets of engine driven centrifugal pumps, which circulate the water from the bay. Duplicate steam driven vacuum pumps are also installed.

There are two exciters, one 75-kw, 225-volt Westinghouse motor-generator set, and one 100-kw engine driven unit. In addition to this, there is a storage battery designed to float on the exciter bus-bars, as an insurance against shutdown. The control apparatus, all Westinghouse, is excellently designed and the best of its type. The bus-bars are mounted in concrete structures on the engine floor and are in duplicate. The type "C" oil switches are mounted directly above, on the first gallery, as are also the exciter switchboard, the control pedestals and instrument posts, and the feeder control panels. Either generator can be thrown on either bus, as can be any feeder also. All oil switches are equipped with knife switches, so that each oil switch can be isolated. Motor-driven field rheostats and electrically operated field switches are installed on the second gallery.

The sub-station is supplied with three motor-generator sets consisting of a 1,400 hp induction motor and a 1,000 kw, direct-current, 250-volt, three-wire generator. The switchboard equipment, installed on the main floor, consists of four panels for the control of four incoming 6,600-volt feeders, four panels for the control of four 1,400-hp induction motors and four panels for the control of banks of three 250-kw, 6,600-2,200-volt transformers. The high-tension bus-bar structures are on the first gallery and are in general, similar to those at the main station, but include also the oil switches, which are type "E." The high-tension bus-bars are in duplicate and so arranged that any feeder or any circuit can be thrown on either bus.

The direct-current switchboard consists of four generator panels, a starting panel, three positive and three negative feeder panels and two blank panels. The bus-bars are in triplicate, and the board is so arranged that any machine or any feeder can be thrown on any bus. The starting panel controls the direct-current end of a 125-kw motor-generator set, supplied through three 65-kw oil-insulated, self-cooling lowering transformers. The large motor-generator sets are started by using the generator as a motor, supplied from the 125-kw motor-generator set, and the induction motor is thrown in when up to speed.

The banks of 250-kw, 6,600-2,200-volt transformers are used for supplying the outlying districts, and are controlled on their low-tension side by two transformer panels. The 2,200-volt board is equipped with two buses, to either of which the feeders can be connected. One phase of each feeder which supplies lighting, is equipped with type "F" compensators and regulating transformers, so that voltage can be maintained constant. Power will be supplied also from the same feeder.

◆

A Year's Figures of the Subway.

The subway system of the Interborough Railway Company went into operation October 28, 1904, so that New York City has had just one year of underground electric railroad experience. The resulting data are of great interest. It has carried no fewer than 106,000,000 passengers, or an average of 300,000 a day in spite of many unforeseen obstacles and difficulties, such as flooding by broken water mains, and one very vicious but unsuccessful strike. General Manager Hedley says: "For several months the operation of the Subway was hampered by incomplete terminals and the newness of the system, so that the train service could not be run up to the maximum. Since the completion of the lines to South Ferry conditions have been much improved. Five hundred of the first cars purchased have passed through the shops; the end doors have been made considerably larger, and the bulkheads inside the cars have been removed. This has been the subject of favorable comment on the part of the passengers and has led to a marked difference in the time it takes to embark and disembark."

A plan to lengthen the local platforms so that they can accommodate seven cars instead of five is now under consideration. It is likely that work on the platforms will begin in the next month or two. The line to Brooklyn is in such condition that next year will see direct rail connection between that borough and the financial, commercial, shopping, amusement and residential districts of Manhattan.

Based on the number of fares paid, the stations rank in importance as follows: Brooklyn Bridge, Grand Central, Fourteenth Street, Fulton Street and Times Square. Times Square, the heart of the town, is far ahead of all other local stations. Five million persons, a number exceeding by half a million the estimated population of New York City, boarded Subway trains there during the year. Supposing that just as many got off at Times Square 10,000,000 persons have passed through the station since October 27, 1904.

Eighteen million fares were paid at the Brooklyn Bridge, 10,000,000 at Grand Central, and nearly 7,000,000 at Fulton Street. The average number of passengers carried in the Subway every day was about 300,000. The estimated number of passengers on all the elevated lines for the same period is 261,666,686, an average of 716,895 a day. A fair estimate of the number of passengers carried by both Subway and elevated is 1,000,000 a day.

Only part of the Subway opened a year ago. Since then the Lenox Avenue branch to West Farms, the section from the Brooklyn Bridge down Broadway to South Ferry, and a mile stretch north of 135th Street, under Broadway, have been opened. The Interborough Company expects to run trains under Fort George and over the long viaduct to the Ship Canal by January 1. The Brooklyn branch will be opened next year.

Lamp Cluster Litigation.

On October 31 Judge Holt of the United States Circuit Court, sitting in New York, handed down a decision in a case involving the patents of Rueben B. Benjamin and John H. Dale on that form of lamp cluster arrangement which involves the use of only two wires, these wires making connection with two plates insulated from each other, which form integral lamp sockets. When the lamp is screwed in place it is in electrical contact with one side of the circuit through one of the plates and with the other side of the circuit through the second plate, against which the base of the lamp butts. The attorneys in the suit were Messrs. W. Clyde Jones, Keene H. Addington and Robert Louis Ames for Benjamin, and William M. Stockbridge, of Rosenbaum & Stockbridge, for Dale.

The decision upheld the validity of the Benjamin patents, but declared that these patents were not infringed by the Dale patent in suit. The court criticised the manner in which the Benjamin patents were loaded up with claims, one of the patents in suit containing 46 and the other 17 claims, making 63 in all. Many of these claims were declared to be substantially identical and the excessive number served no useful purpose and simply made burdensome the investigation of the claims. The court also stated that it could see no essential distinction between the two Benjamin patents in the suit. The complainant's counsel had stipulated to rely on only 17 claims of the first patent and 9 claims of the second patent, making 26 claims in all, but the court stated this number might have been further restricted without sacrificing any real rights of the complainant.

The court held that it could not see any substantial and essential electrical distinction between the Dale patent and the two Benjamin patents, but it could also see no substantial electrical distinction between these patents and a prior English patent to Broughan and an American patent to Weeks. Dale when he applied for his patent had the same right that Benjamin had to use the electrical devices shown in the prior patents mentioned. Benjamin produced by mechanical invention a wireless cluster of electric lights commercially superior to anything which had preceded it, and Dale had the same right to do the same thing, provided he did not infringe the Benjamin patents. In conclusion, Judge Holt stated that while he thinks it is a close question, he considers that the Dale patent involves sufficient mechanical invention distinct from the Benjamin patents to make it valid.

The Submarine Cable Situation in Alaska.

It is interesting to note that in his annual report Major W. A. Glassford, chief signal officer of the Department of the Columbia, who has charge of the entire cable and land telegraph system of Alaska, strongly recommends that the earnings of that telegraph service should be applied entirely to extensions and improvements of the system and to the laying of additional cables. This recommendation is heartily endorsed by Gen. Constant Williams, in command of the department, and it is altogether likely that it will likewise receive the endorsement of Gen. Greely, chief of the Signal Service.

Major Glassford was interviewed recently as to the submarine cable situation in Alaska and made some important statements that bear very intimately on wireless telegraph problems. He said: "One of the claims made in behalf of the wireless service was its adaptability to that section, because it would span over the physical difficulties encountered by the present land wires. In support of this claim the name of Capt. Leonard D. Wildman, Signal Corps, who installed the system between St. Michael and Nome, was used in such a way as to reflect upon the Signal Corps for not being in advance of modern progress in transmission of information.

"The Signal Corps is to-day operating the longest successful wireless system in the world between St. Michael and Safety Harbor, a distance of 107 miles. This plant was evolved and installed by the Signal Corps, and would naturally meet with any improvements or extensions, if such were possible. The mere fact that the chief signal officer of the army, after a personal visit to Alaska last summer, did not recommend the installation of the wireless plant demanded by the Alaskan papers shows that he found such extensions or improvements were not possible. On the contrary, an extension of the cable and land lines will doubtless be recommended. It may also be added that a commercial company has already failed to make possible communication through a chain of stations, which it undertook some two years ago in Alaska. The present installation between St. Michael and Safety Harbor is an outgrowth of the experience derived from the company in the failure to establish a chain of stations.

"It has been shown that a single stretch in wireless communication is quite possible, but a chain of them has not so far been accomplished. Even though the wireless installation of the Signal Corps might be extended 107 miles or more overland there would be objections, and possibly insurmountable difficulties in establishing a chain over so long a distance from St. Michael to Valdez, which in a straight line is between 500 and 600 miles, but with a chain of stations would be in the neighborhood of 1,000 miles.

"There has so far not been discovered any means by which a message can be sent and one be received at the same station at the same time. This difficulty or impossibility may be illustrated by supposing that a chain of six stations were established between Nome and Valdez via St. Michael, stations on the Yukon and Tanana and over the mountainous country to the headwaters of the Tanana, covering the present route of the telegraph line. If a number of messages were handed in at Nome at 8 o'clock in the morning to be transmitted over this line, the first relay would be at St. Michael, and the operator there would have to wait until the last of the whole number of messages were received before the first one could be forwarded to the second station in the chain.

"Supposing that an hour's work was over at Nome, it would therefore be 9 o'clock before St. Michael could commence to send. The next station would in turn send to the third station at 10 o'clock, and the third station would send to the fourth station at 11 o'clock, and the fourth station would send to the fifth station at 12 o'clock, and so on, so that it will readily be seen that Valdez would complete the reception of these messages, commenced five hours earlier at Nome, at about 1 o'clock in the afternoon. Valdez would forward them over the cable to Seattle as they were received. This would be the quickest possible time that the messages could be transmitted. In the meantime, by delay of an hour, these twenty or thirty messages might be sent from Valdez to Nome, the extra hour being required for the delay at the crossing. If messages were handed in at an intermediate station in the meantime, the time of transmission would be increased by an hour or so for every few messages.

"It must therefore be clear that, even though great improvements have been made in the wireless telegraph, it could not handle the volume of business that would be given to it as is now transmitted by the telegraph. In addition to this fact, there would be six telegraph stations in all Alaska, as against forty-two at present; and if the stations, were put, say 200 miles apart, which is at present the maximum limit of wireless telegraphy as demonstrated for practicable business transmission, there would be only a few, say five or six, telegraph stations in all Alaska, and it can readily be seen that some of the present important stations must be left out entirely. If they were to divide this disance on a basis of 200 miles, Fairbanks would be left out."

A Gift from Italian Electrical Engineers.

Another gift from the other side of the Atlantic has been received by the American Institute of Electrical Engineers, as a souvenir of the hospitalities of 1904. A pleasant incident at the 200th meeting of the Institute, held in New York City, October 27, was the exhibition to the 300 members in attendance, of the silver tablet presented to the Institute by the Associazone Elettrotecnica Italiana, as a testimonial in recognition of the courtesies extended to the members of the Association on the occasion of their American tour during August and September last year.

ITALIAN TESTIMONIAL TO THE A. I. E. E.

The tablet is an artistic silver casting, mounted on a marble slab, the design embodying medallion portraits of Volta and Franklin, and an inscription in Latin, of which the following is a literal translation:

"By this Testimonial, the Italian colleagues place on record, for all time, their reception in gracious and generous hospitality, by their American colleagues, during the months of August and September, in the year 1904; may it be of good augury. Rome, the 31st day of the month of December, in the year 1904."

This tablet will be placed in a prominent position in the Institute headquarters in the Union Engineering Building, now in process of construction.

Underground Wires for Hartford, Conn,

The subject of underground wires is being considered at Hartford, Conn., and Mr. F. L. Ford, the city engineer, has reported upon the question. He quotes the act amending the charter which gives the authority to the court of common council to provide by ordinance for the placing of all electric wires underground, and also the ordinance passed by the council in 1896 requiring that whenever the council and the street board consider that public interests demand such action, all electric wires within half a mile, north, south and west of City Hall shall be ordered to be laid underground during the ten years after the passage of the act above referred to, approved June 22, 1895, not more than half of the wires within this area to be ordered laid underground within two years from the date of the act.

Mr. Ford deals with the question as to what shall be done with the wires when removed, saying that the companies can be left to duct their own wires, or string them on poles elsewhere as long as the section under consideration is cleared. He believes this the poorest way, and says that another way is for the city to build a duct system of its own and order all wires drawn into it. This plan has been generally recommended and is in use in Baltimore, Rochester, Utica, Wheeling, New Castle, Pa., Erie, New Britain, Bristol and elsewhere. The city engineer's report goes into the arguments for and against municipal ownership of conduits and considers the method of paying for them, and has something to say of private ownership of conduits, and of the middle course of ordering conduits built by the companies under municipal inspection, which has probably been adopted in more American cities than either of the others. The report urges the importance of municipal supervision and discusses the method of conduit construction. Other heads in the report are: Voltage allowed, induction, plan of conduit system, distribution (by overhead terminals and pole lines by single overhead terminals, and underground), cost estimates, how future extensions should be made. Mr. Ford offers the following conclusions:

First—Before any attempt is made to duct the overhead wires of the various corporations outside of the limits prescribed in the legislative enactment of June 22, 1905, and the confirmatory ordinance passed by the court of common council during the following year, the Hartford Street Railway Company should be compelled to follow the course pursued by the other corporation during the past ten years, and duct all of their feed wires within the half-mile limit from City Hall. If there is available capacity, these feeders should be placed within the conduits of the Hartford Electric Light Company, otherwise within their own conduits.

Secondly—The city of Hartford should at once stop the issuance of permits for the duplication of unsightly poles upon our city streets. The photographs accompanying this report furnish conclusive evidence that miles of telephone wires are run within our city limits upon the same poles with 220-volt service wires, 2,400 volt feeders and arc circuits, and 10,000 volt transmission lines, all with alternating current without interfering with the commercial use of any telephone. I should hesitate to say that only one line of poles would be necessary on streets where there are street railway tracks, on account of the difficulty of using the iron trolley poles for the service which might be required by the different companies; but upon streets where there are no street railway tracks, there is no necessity for more than a single line of poles. I believe that the different companies have in the past insisted upon duplicate lines principally for their own convenience and independence.

Thirdly, the city of Hartford should continue its policy of the past ten years by a gradual extension of its conduit system. There is no better evidence of the civic progressiveness of a municipality than the removal of its dangerous and unsightly overhead wires, as fast as possible.

The city should order underground construction when the local condition requires it; should endeavor to have the different corporations build large enough for the requirements twenty-five years hence; should insist that underground distribution be provided, and should see that all work is done in a permanent manner.

Fourthly, the court of common council should provide by ordinance for a continuation of its conduit system, because the present ordinance only contemplated such construction for the ten-year period from 1895 to 1905. Under the legislative enactment of June 22, 1905, the court of common council has ample authority to order any wires placed underground, under such restrictions as it may prescribe whenever after June 22, 1905, it or the board of street commissioners may consider such action necessary. In order to take full advantage of this legislative authority, it will be necessary for the court of common council to pass additional regulations governing underground construction.

Meeting of the Empire State Gas and Electric Association.

The first annual meeting of the Empire State Gas and Electric Association was held at the Hotel Astor, New York City, on Oct. 31, at 10 a.m. This organization was formed eight or nine months ago and since that time has gained numerically as well as taken steps to place itself in a position of greater influence and usefulness; and the work of the meeting this week can but result in establishing the body upon a high plane and in its rightful sphere of importance.

The meeting was called to order by President W. W. Cole, vice-president and manager of the Elmira Water, Light & Railroad Company, at which time some 50 delegates were in attendance, the college room at the hotel being comfortably filled. Mr. T. R. Beal, secretary and treasurer, and secretary and manager of the Poughkeepsie Light, Heat & Power Company, presented the reports of the executive committee and of the treasurer, the former embodying a number of suggestions for the amendment of the constitution. President Cole followed with an admirable address outlining the scope and function of the body and offering valuable ideas and suggestions with regard to future work. This was followed by an unusually good paper by Mr. John Lincoln Wilkie, entitled "Some Aspects of Supervision by the State of Gas and Electric Companies." This paper discussed at some length and very clearly the duties and powers of the new State Commission, pointed out weaknesses and defects in the law under which the Commission operates, and suggested a number of improvements that were worthy of consideration or adoption by the Association as amendments to the law.

After these papers had been read, Mr. Arthur Williams, of the New York Edison Company, and vice-president of the National Electric Light Association, was invited to address the gathering on behalf of the latter body, and did so in a speech of force and clearness, dealing chiefly with the agitation on municipal ownership, and suggesting intimate co-operation between the State organization and the national body for the carrying out of common purposes and for the common defense. He was followed by Mr. T. C. Martin, chairman of the Committee on Progress of the National Electric Light Association, who spoke of the work done by that body, referred to some of the features of the Denver meeting in regard to methods of business getting, and recommended that the Association should lay out its work upon industrial and commercial lines, and while supporting individual members in any fight against injustice, itself avoid getting into politics, as these had often formed an element of danger to such bodies. Discussion followed by a number of members, and the morning session then adjourned.

When the meeting reconvened at two o'clock, discussion was resumed on Mr. Wilkie's paper, and before the session closed resolutions were adopted expressing the sense of the Association as to the relationship of the State Commission to the constituent companies which were so heavily taxed on their franchises, in regard to protecting them from raids and strikes by new organizations desiring to invade fields that were already filled and satisfactorily occupied, and in which large investments had already been made. A most interesting paper was read by Mr. W. S. Barstow, the well-known electrical engineer and president of the New York Electrical Society, entitled "Economic Waste and Competition." This led to a very interesting discussion as to competition, fair and unfair, and the necessity that companies in the field which had been put under the aegis of the State Commission should be able to look to it for relief. One of the members called attention to the fact that although his company was doing good service to the community at low rates, within the past year no fewer than four new franchises had been granted for operation in the same field. It was obvious that if all these companies were allowed to go into business, there must be a period of reckless competition, at the end of which invested capital must again assert itself and the community would suffer, to say nothing of the serious economic waste involved generally.

The election of officers resulted in the re-election of Mr. W. W. Cole, who has proved himself an excellent executive and who at the meeting showed himself to be also a most judicious chairman; Mr. T. R. Meikleham, vice-president, and Mr. T. R. Beal, secretary and treasurer, these being the executive committee, with Messrs. L. L. Witherbee and G. R. Beardslee. The time and meeting place for the next meeting were left in the hands of the executive committee, although a preference was shown by the gathering for New York City.

During the day Mr. Arthur Williams, in behalf of the New York Edison Company, invited any of the members who wished, to visit Waterside Station, and also extended an invitation to attend the lecture to be given on November 2 at the Edison Auditorium on "Scientific Salesmanship of Electric Light and Power," by Mr. A. F. Sheldon. At the adjournment of the meeting a number of new enrollments were made, and the feeling was unanimous that the Association had laid broad and deep the foundations of a most useful and successful existence, bidding fair to equal in its work, if not surpass, any of the territorial organizations already in the field. The utmost harmony prevailed, and it was found possible to discuss all questions of illumination, whether those of gas or electricity on a common platform and with a common point of view.

◆

Statistics of American Railroads.

The advance sheets of the thirty-eighth issue of that valuable compendium *Poor's Manual of Railroads,* contain a mass of data as to the condition and operation of American steam railroads—the new land of Egypt for electrical invasion. The length of steam railroads in the United States on December 31, 1904, was 212,349 miles, a net increase of 5,014 miles in the year. The income account of all the railroads in the United States compares as follows:

Traffic earnings:

	1904.	1903.	1902.
Miles of road operated.	213,828.02	205,237.12	199,684.64
Passenger	$456,342,380	$429,705,287	$396,513,412
Freight	1,374,102,275	1,344,150,719	1,197,212,452
Miscellaneous	147,194,058	135,001,820	127,089,036
Total gross	$1,977,638,713	$1,908,857,826	$1,720,814,900
Operating exp. and taxes	1,338,398,686	1,316,349,313	1,160,788,623
Net earnings	$639,240,027	$592,508,512	$560,026,277
Other receipts	81,357,891	89,485,484	77,663,483
Total available revenue	$720,597,918	$681,993,996	$637,689,760
*Deductions	627,977,878	560,113,908	528,523,326
Surplus	$92,620,040	$121,880,088	$109,166,434

*Includes: Interest on bonds, etc.; rentals, dividends on stock, etc.

Examination of the figures shows that gross earnings increased $67,780,887 in 1904 over the earnings of 1903, or about 3.06 per cent. The increase in 1903 over the earnings of 1902 was $188,042,926, or about 11 per cent, so that the gross earnings of 1904 are $256,823,813, or almost 15 per cent in excess of the record for 1902.

This increase will be valued the more when it is recalled that 1902 was the record year, both in freight movement and in the revenue derived therefrom.

The greatest actual increase in earnings was in the freight department, the receipts of which aggregate $1,374,102,275 in 1904, as against $1,344,150,719 in 1903, but the increase of $29,951,556 equaled only about 2¼ per cent. The increase in passenger earnings, from $429,705,287 in 1903 to $456,342,380 in 1904, equaled $26,637,093, or more than 6 per cent.

The share capital corresponding to the mileage completed at the end of 1904 equaled $6,447,045,374, against $6,355,207,335 in 1903, this increase equaling $91,838,039, the rate of increase being about 1½ per cent. The funded debt of all the lines at the close of the year aggregated $7,475,840,203, against $6,722,216,517 in 1903, the increase equaling $753,623,686, or more than 11 per cent. The other forms of indebtedness of the several companies at the close of the year equaled $172,510,537, against $448,190,448 for 1903, a decrease of $275,679,911. The total share capital and indebtedness, exclusive of current accounts, of all the roads making returns equaled at the close of the year $14,095,405,114, an increase in the year of $569,781,814 over the total of 1903, $13,525,623,300, the rate of increase for the year being over 4 per cent. The return on invested capital averaged 3.31 per cent on stock and 4 per cent on bonds for the year 1904, as against 3.03 per cent on stock and 4.17 per cent on bonds for the year 1903. This shows an increase of 0.28 per cent in the return on stock and a decrease of 0.17 per cent in the return on bonds.

The Electrical Field in China.

From the United States Department of Commerce and Labor, Bureau of Manufactures, a very interesting report is furnished by Special Agent Burrill on opportunities existing in China for the introduction of electrical machinery and supplies of every description. This vast field, he says, seems to have been almost entirely overlooked by those engaged in this great industry. Mr. Burrill describes what has been done for China in introducing electricity, and furnishes detailed information that will enable capitalists seeking good investments, electrical engineers and manufacturers of electrical supplies to realize that an unusual opportunity awaits them in China. Mr. Burrill's report is dated at Shanghai, September 12, and follows:

In discussing the demand for electrical installation and supplies in China it is probably unnecessary to say that at the present time its development and possibilities cannot be covered in detail, but an outline of the opportunities already presented, the work accomplished and the difficulties under which engineers and construction companies labor in obtaining their supplies and fulfilling their contracts may be useful in indicating to American electrical supply companies the desirability of investigating conditions with a view to placing experienced men here in charge of branch offices.

China has enjoyed less development along civil and electrical engineering lines than any other country of its size and importance in the world and presents a field which has evidently appealed to German, British and Japanese firms, for they are on the ground, although inefficiently represented and poorly equipped to handle a business which has offered and will continue to present great possibilities for our home engineers and manufacturers if they will attack the proposition with the same energy and business ability that characterize their operations and assure success in the United States.

In Shanghai, under the title of electrical companies, there are only two firms (both British) in business, each carrying a stock and doing a class of work which in the United States would be called petty contracting. One handles, as its chief source of income, materials entirely foreign to electrical work, while the other has at its head a man who, with the assistance of native employes, installs wiring for lights and bells in the smaller private homes in Shanghai and does work on electric fans and annunciators. I am informed that throughout the Chinese Empire there is not a branch or agency of any of the large electrical supply companies of the United States, which tells the whole story. The customs duty of 5 per cent on machinery certainly cannot be responsible for this condition, and it is only explainable by the assumption that the opportunities for electrical work in the Far East are not sufficiently well known or appreciated by our home companies.

There are three German firms in Shanghai handling electrical supplies as a side line, and only one of these has made any marked success in this particular field. This company orders supplies from its home manufacturers only when needed for actual work, carrying in stock less material for this line of business than would be kept on hand by the small contractor or dealer in the United States. Their business is general in its character, and in their establishment, in addition to the limited stock of electrical supplies, may be found arms and ammunition, agricultural and other machinery, piece goods, tobacco, cigars and cigarettes. They also buy and sell goat and sheep skins and are, in fact, a general trading company, adopting electrical supplies as an incidental source of revenue. This description applies to the other German firms and is mentioned only to show how little attention is actually paid to a line in which exist great possibilities.

Notwithstanding the disadvantages under which contractors labored, some creditable electrical work may be found in a few of the larger cities, of which a brief description may be of interest. The Tientsin Electric Light Company, installed at a comparatively recent date, is already, it is said, a profitable enterprise, and it is reported that a franchise for a trolley system has been granted, on which work is soon to be started. The plant at Tientsin was installed by Arnhold Karberg & Co., of Shanghai, a German firm, and is up-to-date and regarded of sufficient capacity to meet any probable future demand.

Shanghai has under municipal control unquestionably the best-equipped electrical plant in China, and a franchise has recently been granted for a modern electric railway system.

Canton has also an electric light and power company which has just obtained a thirty-year monopoly, and it is maintained by those best informed as to the situation that conditions would justify the installation of an electrical surface road.

Hong-Kong has a paying electric surface road in addition to a fair electric light and power company.

Peking has an electric light plant. About five years ago the German firm of Siemens & Halske began the construction of a surface road, but the work was interrupted in 1900, and it has not yet been completed.

Hankow is about to acquire an electric light and power plant, but would not, for some time at least, support a trolley line.

There are a large number of small isolated plants for both light and power scattered throughout China, and these, acting as an introduction for larger and more elaborate work along the same lines, are gradually being supplanted by the installation of general plants. It may be assumed that these central plants will, in turn, educate and prepare the native population for the great construction work for which China apparently offers opportunities to foreign skill and enterprise.

As there are no firms in this part of the country carrying even a fair supply of electrical material, there is constant complaint because of the delay in the delivery of the goods ordered for construction work. This uncertainty, coupled with the difficulties of insuring their arrival in proper condition and according to plans and specifications, makes it almost impossible, according to electrical engineers, to give satisfactory estimates on any branch of the work.

In sharp contrast to this condition may be cited the success of the Babcock & Wilcox Company. This firm has in the last two years placed over 11,000 hp in the ports along the coast, and is one of the few companies engaged in the manufacture of mechanical accessories having a properly appointed agent with sufficient knowledge of his line to superintend the installation of his own material.

It is obviously impossible to give detailed information regarding the cost of construction in China. It may be said, however, that Chinese wiremen can be secured for 50 cents Mexican (25 cents gold, approximately) a day. These men would, of course, require constant supervision, but when properly instructed and watched do fairly good work. Poles up to 40 ft. in length, and of any reasonable diameter, can be easily obtained at prices ranging from $3 to $4, gold for the larger sizes (40 ft., butt tapering to 10-in. top). These poles have an average life of eight years under ordinary conditions.

It would take a competent and energetic American engineer a comparatively short time to become familiar with the situation and place himself in a position to enter a field that requires and unquestionably will receive careful cultivation in the near future. It would be necessary, of course, under present conditions, to overcome prejudices and inspire confidence. The boycott temporarily paralyzed American enterprises in China, and although it has collapsed officially it is impossible to predict; because of its far-reaching effects, when normal conditions will be restored. It has produced a feeling of business uncertainty and timidity that neither edicts nor proclamations from Peking can immediately dispel, and the unfortunate ending of the Canton & Hankow Railroad project has filled the Chinese mind with added suspicion and distrust of American methods. Notwithstanding this, however, it is certain that Chinese authorities would not hesitate to entertain a proposition for electrical construction that would be advantageous to a municipality, even though it were made by a representative of a company doing business in the United States.

◆

The Valtellina Three-Phase Railway.

Mr. J. M. Graham, fourth vice-president of the Erie Railroad Company, has recently returned from a visit to Northern Italy, where, in company with Mr. de Kando, chief engineer of Ganz & Co., and Mr. Gustave Leve, second vice-president of the Railway Electric Power Company, he made a thorough inspection of the Ganz Valtellina three-phase railway system, which has now been in operation over three years. Mr. Graham rode over the line in the cabs of motor cars hauling express and local passenger trains, and on locomotives hauling freight trains. He also made a thorough inspection of the overhead equipment, stationary transformers, power houses and repair shops.

Mr. Graham, it is stated, was much impressed with the operation of the entire equipment and particularly with the recuperative feature of the system whereby energy is returned to the line, by means of cascade regulation, when a train is descending a down grade or reducing speed. The saving is not only through the return of energy but also reduction of wear and tear to brake equipment, wheel tires, etc. In the Lecco shop he inspected the bearings of motors, which had a mileage record of over 35,000 miles, but which nevertheless showed scarcely any signs of wear.

According to the official time table, the daily train miles on the Valtellina road are about 1,400, and the daily ton miles—on the basis of 150 tons per passenger train and 350 per freight train—about 300,000. The power generated is 10,000 kw-hours per day, this including for lighting, running shop tools, etc. For the operation of the power house, including the hydraulic equipment, 12 men are employed, there being two generating sets of 2,000 kw each in operation with a third in reserve. For the supervision and maintenance of the overhead equipment of the entire system, with its 65 miles of line, 26 men are employed, and 45 men supervise and maintain the electrical car equipment and transformer sub-stations. To this should be added 12 motormen to make up the entire staff.

The total expenditures are as follows: Power house, $4,310; overhead equipment, $6,980; electrical equipment of cars and locomotives, $6,640; motormen, $5,245, making a total of $23,170 per annum. In contrasting this figure with the cost of operating steam locomotives, it is stated that on the basis of 1,400 locomotive miles per day the corresponding cost of steam traction in this country would be $112,750. An allowance should, however, be made owing to the fact that current for the Valtellina line is generated by water power, and labor is much cheaper in Italy than in America. It is claimed, however, that on the basis of coal at $2.50 per ton and American wages, the difference in favor of three-phase traction would be $50,000 per annum.

The objection made to the three-phase system on account of yard switching was made the subject of a demonstration before Mr. Graham, in order to show that yard switching can be performed as rapidly and successfully with cars and locomotives receiving current from two wires as in the case of steam locomotives.

Mr. Leve states this investigation showed, irrespective of the recuperation feature—an exclusive characteristic of three-phase alternating-current traction—that this system, which has now been in operation for over three years, has not only fully demonstrated the great economy in cost and perfect security of service, but also the capability of providing for every phase of railroad work now performed with steam locomotives, no matter how heavy or intricated the traffic would be.

CURRENT NEWS AND NOTES.

LONDON-ROME TELEPHONING.—It is stated that telephonic communication has been maintained fairly well between London and Rome—1,100 miles—with the use of the Majorama microphone transmitter.

A LONDON HEALTH RESORT.—The London *Lancet* last week made the statement that the Underground Railway, with its ozonized atmosphere, created by the electric discharges and arcing of the motive apparatus, has a very healthy atmosphere, so that a trip on it is as good as one to Brighton or Margate.

NEW YORK LIGHTING PLANT.—The New York municipal lighting plant was started this week, with rubbish and refuse as a fuel basis. There are three Burke generators, each of 150-kw, driven by three Ideal engines of 150-hp each. The current is used for lighting the Williamsburg Bridge, in place of the former Edison service. The bridge lighting has already been illustrated and described in these pages.

REACTIONS OF GASES.—Before a very large audience at the auditorium of the New York Edison Company, Mr. Peter Cooper Hewitt on Oct. 23 delivered an admirable lecture on "Electrical Reactions of Gases." It was the first meeting of the season of the New York Electrical Society. President W. S. Barstow presided. The room, which accommodates about 250 persons, was lit with mercury vapor tubes, as well as incandescents. Mr. Hewitt renewed his work on mercury gas lighting and conversion, and the speakers were Dr. Pupin, Prof. Wills, Mr. Percy Thomas and Mr. C. S. Bradley. A most interesting and instructive evening was spent.

MARCONI HERE.—Mr. W. Marconi arrived on the *Lucania* last week, and under his supervision the Cunarder talked all the way over with other steamers. When interviewed, he said: "The most important thing I have to tell you," said Mr. Marconi, "is that we propose soon to install long-distance transmiting machines on the 25-knot Cunarders now being built. That is something that has not been done before—the transmitting of long-distance messages on shipboard. The instruments will cost $25,000 each. We propose to establish in the near future a commercial system between England and Canada." Mr. Marconi will not be here long, but is to lecture this winter before the New York Electrical Society.

AN EXAMPLE.—We quote the following from the New York *Times*: "Considering the prominence of municipal ownership in this campaign, it is a pity—or a delight, according to the point of view—that the experiment New York is making with its municipal ferry does not start more auspiciously. Before the boats began running many old and efficient employees were discharged. Then the operation when begun left nearly everything to be desired. And Sunday there was a strike, or rather would have been a strike, if the demands had not been granted, to avoid tying up the entire service. However, it is promised that all will be well next week, after election in fact. We hope so, but as matters stand, remark that things are not altered by altering their names. The Staten Islanders wanted and want better communications, not another name for their ferry. Municipal ownership is not a conjurer's wand."

NON-SYNCHRONOUS INDUCTION MOTOR.—In a patent issued October 24, Prof. D. C. Jackson proposes a method of arranging the primary coils of an induction motor so that the speed of the rotor is governed by conditions other than the state of synchronism with a rotating magnetic field, and thus of providing a rotor whose theoretical limit of speed may be as high or as low as desired. The inventor disposes the primary and secondary coils unsymmetrically or excentrically with respect to each other. The arrangement consists in increasing or decreasing the normal size of the polar circle of the primary with reference to the secondary, and displacing the respective axes of the stator and the rotor, or of so distributing the primary windings, for instance, that they will by unsymmetrically arranged about the rotor circumference. The inventor states that under these conditions the amount of deviation of the speed from so-called synchronism will depend upon the relative distortions of the primary windings, and an accurate speed control may be effected by altering the distribution of these windings.

ELECTRIC LOCOMOTIVES.—In an address last week before the New England Street Railway Club, Mr. A. H. Armstrong brought out the point that the present maximum schedule speed in use on interurban lines in the West is about 35 or 36 miles per hour, with a maximum speed of 65 miles per hour and a motor equipment of 500-hp per car in two-car or three-car trains. A three-car interurban train of this character can easily develop as much power as the heaviest steam locomotive. Mr. Armstrong emphasized the importance of small wheel diameters in electric locomotives and stated that the dead weight per axle, even with the armature directly mounted thereon, is actually less in the New York Central electric locomotive than in many steam locomotives. An interesting illustration of the New York Central locomotive's enormous accelerating power was given by the speaker, who said that on the testing track near Schenectady the 6,000-type locomotive with seven passenger cars attached was started from standstill, when the steam locomotive of the Empire State Express, traveling at full speed, reached the rear of the electric train's last car and it caught up with the steam train before the last car of the latter could pass the electric locomotive. The New York Central locomotive has now been run about 27,000 miles in a 50,000-mile endurance test, with very satisfactory results. The speaker closed his address with a brief description of the single-phase compensated type motor, touching incidentally upon the field of the gasoline-electric car for thinly populated branch line service.

CAMDEN CONDUIT SYSTEM.—An agitation has been in progress at Camden, N. J., for putting the wires underground, and the City Counsel has been directed to prepare a bill enabling the city government to build its own conduit system in which the operating companies must rent ducts.

A WIRELESS CHALLENGE.—Dr. Lee De Forest has challenged Mr. Marconi to a wireless telegraph competition. The origin of this seems to have been the remark of Mr. Marconi that the recent De Forest feat of receiving messages 1,100 miles from the President's cruiser, "West Virginia," off the Atlantic Coast, was not uncommon, and was not comparable with the feat of signaling across the Atlantic and from mid-Atlantic to both shores. Dr. De Forest now proposes that a test shall be made with apparatus of like power. In other words, he challenges Mr. Marconi to demonstrate that vessels equipped with Marconi apparatus of like power with his own can successfully transmit to stations using Marconi receivers legible messages at any speed whatsoever over distances one-half or one-third those covered by the apparatus used on board the "West Virginia"; the test to be made over land or sea.

CHICAGO MUNICIPAL ROW.—A special dispatch from Chicago of October 28 says: "At a meeting of the Municipal Ownership League of this city last night seven members of the executive committee were expelled upon the ostensible grounds that they had been absent from two or more successive meetings of the committee. Those expelled are Clarence S. Darrow, special traction attorney for the city; Joseph Medill Patterson, Commissioner of Public Works; Henry M. Ashton, special gas attorney for the city; John C. Harding, member of the Board of Education; Joseph A. O'Donnell, West Park Commissioner; Leopold Saltiel, of the Turner Societies, and E. M. Nockels, secretary of the Federation of Labor. Mayor Edward F. Dunne, when informed of the removal of a number of his friends, said: "If there is any fight between the Illinois Public Ownership League and the Municipal Ownership League, I have not been asked to take sides in it. I have not formally affiliated with any of the bodies."

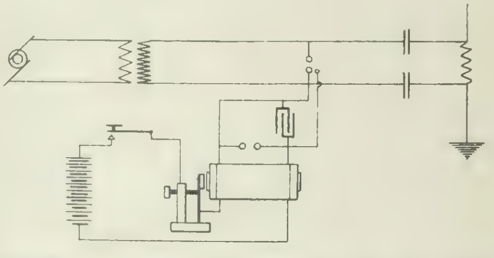
CAPITALIZING A PERSONALITY.—The greatest personality in the American industrial world to-day is Mr. George Westinghouse, whose genius and industry have deeply affected many fields of invention and effort. It is noted that the increase of $5,000,000 in the capital stock of the Westinghouse Machine Company brings the total capitalization of the various Westinghouse companies up to nearly $100,000,000, employed in which are about 30,000 workmen. The Air Brake Company has $11,000,000 capital; Electric Company, $25,000,000; Union Switch & Signal, $3,000,000; British Westinghouse Electric, $5,000,000, and the others, making a total of nineteen in the United States and seven in other countries, furnish the rest. If the total annual output equals the capitalization, as it probably does, the yearly production of apparatus, all bearing the Westinghouse name or stamp, is $100,000,000, in the industrial arts. Such is the beneficent creative power placed by Providence in the hands of one man.

ELECTRIC HEATING.—President Blood, of the National Electric Light Association, has appointed Mr. James I. Ayer to report on the progress of electric heating at the next convention of the association, to be held in May or June next. The report made by Mr. Ayer on this subject at the Denver meeting attracted a great deal of attention and was very fully discussed, both report and discussion showing clearly how much can be done in the way of getting new business by demonstrating the comfort and convenience, as well as the economy in many cases, of the use of various household utensils operated by electric current. This industry is constantly advancing in efficiency and variety of apparatus, and Mr. Ayer's next report will be looked for, with interest. It is worthy of note that one or two of the larger stations in the association have recently established an electric-heating department with the object of pushing this branch of the industry. The Edison Electric Illuminating Company of Brooklyn may be mentioned as an example. Such a department would be proportionately valuable in smaller stations.

PHOTOGRAPHIC TELEGRAPHY.—A cable dispatch from Munich, Bavaria, of October 28 says: "Prof. Korn, a leading electrical inventor, claimed in a lecture before the Electrotechnical Association that the problem of transmitting photographs by telegraph had been solved in principle, and it was now possible to transmit a photograph or sketch six inches square in from ten to twenty minutes. This was done over a telegraph line between Munich and Nuremberg, but was equally practicable over 5,000 miles. The photograph to be transmitted is placed in a transparent glass cylinder which revolves slowly, at the same time moving from right to left. A ray of electric light is thrown upon the cylinder and lens, and when the ray reaches the interior it is brighter or darker, according to the coloring of that particular part of the photograph through which it passes. Inside the cylinder is some selenium, which transmits an electrical current in proportion to the intensity of the light brought to bear on it. The selenium transmits the current more rapidly in bright and less rapidly as the light decreases. This selenium is connected with a wire over which the photograph is transmitted. The receiving station consists of a Nernst lamp placed inside a glass cylinder covered with sensitized paper. The Nernst lamp burns more or less brightly, according to the varying current transmitted by the selenium at the other end, and thus reproduces the exact shade of the original photograph."

WIRELESS COMMUNICATION WITH THE PRESIDENT AT SEA.—The armored cruiser *West Virginia* which conveyed President Roosevelt to Washington, after his trip through the Southern States, was, on Oct. 28, in wireless communication with the Washington Navy Yard. The cruiser was in the Gulf of Mexico at the time, and was 1,100 miles distant from Washington. The signals were received from 2:07 until 5:14 o'clock in the morning. The message picked up at the Washington Navy Yard was passing from the *West Virginia* to the armored cruiser *Colorado*, which, with the *Pennsylvania*, accompanied the first-named vessel up the coast, and stated that the *West Virginia* would probably join the *Colorado* and *Pennsylvania* off Key West about noon on Oct. 28. As soon as the noise of the machinery and engines at the yard began before seven o'clock in the morning, it became impossible for the wireless station to communicate further with the cruiser. A despatch from Kansas City states that the wireless messages transmitted from the *West Virginia* were intercepted Friday night by a field wireless telegraph apparatus used by the signal corps at Fort Leavenworth. Major George O. Squier and Captain William Mitchell were at the time experimenting with an instrument connected to a kite when they caught the messages from the President's boat. They tuned their instrument to various frequencies and intercepted messages from other ships at sea off the Atlantic coast. This, it is stated, is the first time that wireless messages coming from ships on the Atlantic Ocean have been intercepted so far inland. De Forest apparatus is used on the cruisers.

SPARK TIMING APPARATUS FOR WIRELESS SIGNALING.—In order to overcome the disadvantages of the direct make-and-break key employed with wireless telegraph transmitters, Mr. L. De Forest, according to a patent issued October 24, would use a so-called "trigger-spark" adjacent to the main spark, for the purpose of timing the main spark. The apparatus is based upon the principle that ultra-violet radiations, or an ionizing influence, decreases the resistance of a gaseous dielectric. The inventor uses a small power auxiliary spark near the main spark, so that the main spark which is normally inoperative may be made operative for such a time as the ionizing radiations are given forth by the auxiliary spark.



SALEM, MASS., is once more defying the witches, this time by an electrical carnival, associated with parades, special lighting, X-ray exhibits, etc., that in the olden days would certainly have involved the summary execution of all concerned.

TELEPHONE IN TRAIN.—It is stated that when important officials of the Pennsylvania Railroad go to Pittsburg by private car a telephone in the car is connected up immediately on arrival with the railroad exchange and the local exchange. The convenience is enormous.

THE SOFT ANSWER.—Is it true, says the *New York Sun*, that most voices sound snappy and disagreeable over the telephone? Men say no and women say yes, especially when a mere man is speaking over the wire. Is it not true also that many women, indeed very many women, knowing the acoustic perils of telephone wires, have cultivated a telephone voice—insinuatingly gracious, invitingly gentle and and charmingly persuasive?

IN A LIBRARY.—It is noted in the U. S. Consular Reports that the removal of the Heidelberg University library, containing more than 700,000 volumes, into a new and handsome sandstone library building has just been completed. The work of removal employed 15 men 32 days. Each separate book was freed from dust by a cleaner operated by an electric motor, of the form used in house and carpet cleaning, the back and edges of each book being subjected to the powerful suction of the cleaner with highly satisfactory results. The library requires about 21 miles of shelf room.

BLACK SAND.—In our issue for October 14 mention was made of investigations being conducted at Portland, Oregon, by Dr. T. Day, of the U. S. Geological Survey, to determine the mineral value of black sands from placer mines. A San Francisco correspondent writes that one ton of black sand from Guadalupe, Cal., has been treated at Portland, and that over 600 lbs. of steel has been produced therefrom by the use of an electric smelting furnace, after concentrating. A large electric furnace is to be constructed. It is stated that some gold is recovered by the new process.

SUBWAY SIGNALS.—The New York Electrical Society is promised a "demonstration" paper this winter on the block signal system of the Interborough Subway. The system has now been in operation one year, and the number of automatic signal movements for the eleventh month (September) was about five millions. The number of signal failures in that month, all on the side of safety, was 11, which is an average of one failure to 464,004 movements. With this enormous movement there was, it will be seen, not a single relay failure. Three of the 11 failures were caused by water leaking through the roofing near Central Park.

WIRELESS INLAND.—We described recently the Murgas wireless telegraph system at Scranton, Pa. A correspondent writes us: "I saw Father Murgas a few minutes ago, and he told me that he and his operators at Scranton and here have been receiving outside messages from many different points not connected with his system, including several from incoming ships entering both New York and Philadelphia harbors. The signals are quite clear and distinct, scraps of conversation, figures, etc., coming in and being decipherable for long periods of time. He claims that he can place the tuning of his [illegible] of any station or number of stations, and can take complete messages from them."

THE TROLLEY IN JAPAN.—The Kobe (Japan) *Chronicle* of recent date says that it looks as if there will be a boom in electric railways. The Government railway passenger traffic between Kobé and Osaka have been so affected by the Hanshin Electric Railway that the Imperial railway working bureau is considering the advisability of establishing an electric line between the two cities and so meeting the competition. The bureau is also considering the establishment of such a railway between Tokyo and Yokohama. The extent of this competition may be judged when it is considered that the business man living in Kobé, who has to make frequent visits to Osaka, by using the electric railway not only [illegible] merely in the amount of fare, but travels nearly as quickly. He uses the electric route because of its freedom from soot and smoke.

WORTH A HUNDRED MARKS.—It is stated that a few weeks ago a large flag was seen flying from one of the towers of the Cologne Cathedral, 487 ft. above the street level, bearing the inscription "Kabel über Emden-Azoren" (Cable via Emden-Azores). It is entirely against all the traditions and instructions of the ecclesiastical authorities of that celebrated cathedral to countenance anything in the nature of an advertisement, and very shortly after its appearance the flag was hauled down. It appears a bet was made between one of the employees of the German-American Cable Company and a steeple jack that he would not dare for 100 marks to affix to the topmost spire the flag in question. The flag floated to the astonishment of every citizen from the highest church pinnacle of the continent, but the daring steeple jack was arrested and fined 100 marks with a threat of dismissal should he ever dare to repeat such sacrilege.

THE NEW HAVEN RAILROAD.—With regard to the adoption of alternating-current locomotives by the New York, New Haven & Hartford Railroad, instead of direct current, like the New York Central, and the effect on the Grand Central depot, the following dispatch from New Haven of October 27 says: "C. S. Mellen, president of the New York, New Haven & Hartford Railroad, declared to-day that there was nothing whatever in a report that the New Haven road would quit the New York Central. He said: "Our continued use of the Grand Central Station is assured. There has been no thought of going elsewhere. When the Pennsylvania Station is completed there will be a through service established by way of the same to points south and west, and possibly, if there is a public demand, some service locally may be established to and from that station. But that is so far in the future that no action looking to such a result has been taken as yet."

ELECTRIC LIGHT A PROTECTOR.—An interesting confession from the "under world" is contained in an article in the *Ladies' Home Journal* for November, in which a burglar discusses his own "business" and outlines protective measures. The following passage is very significant: "Other things being equal, a burglar will always pass a house lighted by electricity for one lighted by gas. The reason for this is that houses lighted by electricity are now wired in such a manner that the turn of a switch or the pressure of a button on one floor will illuminate another floor. Then, electrically-lighted houses are much more likely to be equipped with modern burglar alarms. Houses so wired are practically traps for the burglar. He may be working on the ground floor, for example, when some member of the household in a chamber above is aroused and fancies that he hears some one moving about below. At once the man of the house reaches for the electric switch and turns on the light for the lower floor, so that the burglar suddenly finds himself in a blaze of light, while the man of the house, a gun in his hand, is screened by the darkness. This puts the householder in a position to shoot without being shot at."

TELEPHONE BONDS.—The United States Census Report showed for the telephone industry at the close of 1902 a total issue of bonds outstanding of $73,81[illegible], or 21 per cent of the total capitalization. The bonded debt has of late made a relatively rapid growth, and the *Wall Street Journal*, a highly competent authority, thinks that the amount now outstanding may have reached $150,000,000. It also says: "It is taken for granted that the bonds con- [illegible] going [illegible] has been neglected here for that reason. There are other points of interest to the telephone bondholder, such for instance as the actual investigation of real estate and buildings in the [illegible] purposes, [illegible] points have been outlined above. As in [illegible] of telephone bonds ranging [illegible] American Telephone & Telegraph 5 per cent notes, down to bonds of the lowest grade. In the middle ground there are bonds with various [illegible] and doubtless as the volume of such bonds grows and as the subject is better understood by the public, telephone securities will become increasingly popular."

PRESERVING NIAGARA.—It is announced that Secretary Root will soon open negotiations with the British Government for the purpose of reaching an agreement for the preservation of Niagara Falls from further utilization, and to protect the scenic beauty of the spot.

AUSTRALIA.—The principal imports of Australia during 1904 included $947,230 for electrical goods, $715,870 for scientific instruments, $8,372,270 for machinery and $354,560 for machine tools. The trade with the United States included $74,070 for electrical goods, $1,931,485 for machinery and $129,995 for machine tools.

TRAFFIC OF LONDON.—The Advisory Board of Engineers to the Royal Commission on London Traffic reporting on urban transportation finds that total tramway mileage completed and under construction is 350 miles, and the population served 6,850,000. The number of local passenger journeys is 1,164,000,000 per annum or 170 per capita. The per capita in New York is 300, in Berlin 270, and in Paris 200.

WELFARE WORK.—An article on "Welfare Work," by Mr. H. H. Vreeland, chairman of the Welfare Department of the National Civic Federation, is a prominent feature of the October issue of the *Monthly Review*, published by that organization. As president of the New York City Railway Company, Mr. Vreeland is a large employer of labor, and as he has come up from the ranks he writes with knowledge acquired through personal experience of the needs and opportunities for improving the physical, mental and moral condition of wage-earners. The article is a compact and comprehensive treatise upon its subject. It is illustrated with some pertinent examples of practical welfare work.

AN ELECTRICITY EATER.—The man sat on the grass in Central Park last week gazing intently at the sky through a two foot gas pipe. His clothes were inside out and around his chest and waist were coiled about 50 ft. of clock spring. "Who are you and what are you doing there?" asked Policeman Cain, happening along. "'S-h-h-h," answered the stranger. "I'm the wonder of the age. I eat electricity. I'm hungry and am out for dinner." "That so?" observed Cain. "What's all this business?" indicating the clock spring and the gas pipe. "This," said the man, pointing to his wire armor, "is that with which I gain breakfast, dinner and supper. It contains the negative and the positive. It keeps me alive. It brings my food from Heaven. And this," indicating the pipe, "is that with which I search for sustenance." He was gathered in and sent to Bellevue Hospital.

RUSSIAN TURMOIL.—The political upheaval in Russia is being accompanied by a stoppage of electric lighting plants and trolley cars, by strikers and revolutionists. The telegraph and telephone services are also seriously interrupted and no one seems to have thought of wireless as a substitute. A strike in the Post Office, including the telegraph operators, began October 29, and communication with the interior practically ceased. Army operators were placed in the telegraph offices, but only a few lines are working. Many lines, including the land lines to the continent and to Libau, where they connect with the cable, have been cut. Cable connections generally appear to be out of order. In St. Petersburg the government authorities have made patrol use of a searchlight mounted on a high building on the Nevsky Prospect.

RESCUE BY WIRELESS.—By means of the De Forest wireless apparatus installed on the steamship *Lucas* and on the steamer *City of Everett*, the latter vessel was discovered in a sinking condition in a storm which raged all day October [illegible], and most of the next day. Operator Heimbecker, of the *Lucas*, was at the receiver when he found another steamer calling. He established immediate connection with the operator on board the *City of Everett* and learned that a hatch on her forward hold had been washed away and that she had shipped so much water that the captain feared she might founder any minute. The *Lucas* stood by for twenty-nine hours, placing herself between the damaged steamer and the wind, thus enabling the *City of Everett* to make temporary repairs, and pump out the water in her hold. She then proceeded to New York, while the *Lucas* continued on her way to Port Arthur.

Electrical Engineers of the Times.—XXXIV.

MR. A. J. WURTS.

Alexander Jay Wurts was born at Carbondale, Pa., March 3, 1862. On the maternal side he is descended from John Jay, first Chief Justice of the United States. His father was a civil engineer by profession. His early education was obtained at the schools of New Haven, Conn., and in 1879 he entered Yale University from which he was graduated with the degree of Ph. B. in 1883. After graduation a post-graduate course was followed at Stevens Institute of Technology, from which institution he received in 1884 the degree of M. E. The same year Mr. Wurts went abroad and took a special course of electrical engineering at the Polytechnicum, Hanover, Germany, under Prof. Kohlrausch.

Returning to the United States in 1886, Mr. Wurts served an apprenticeship with the United States Electric Lighting Company in Newark, N. J., and later was manager of the Julien Storage Battery Company, of Camden, N. J. On November 1, 1887, he joined the Westinghouse Electric & Manufacturing Company in Pittsburg, where he continued laboratory and engineering development work for about ten years. During this period he became interested in protective apparatus, particularly with reference to lightning protection, and discovered the non-arcing metals for which he received the John Scott Medal from the City of Philadelphia upon the recommendation of Franklin Institute. Mr. Wurts' work in this line revolutionized lightning protection apparatus, and the new types he evolved are now adopted in standard practice throughout the world. In 1898 he undertook, for Mr. Westinghouse, the development of the Nernst lamp, in which, with his associates, he was particularly successful, after three years, having carried his work to such a state of advancement that a large factory for the commercial manufacture of the lamp was equipped in Pittsburg, of which Mr. Wurts was made manager.

MR. A. J. WURTS.

In 1904 he tendered his resignation to the Nernst Lamp Company and returned to the Westinghouse Electric & Manufacturing Company under an arrangement whereby half of his time was to be devoted to the company and the other half to the Carnegie Technical Schools, where he was attached to the staff of Director Hamerschlag. In July of the present year Mr. Wurts was appointed Professor of Applied Electricity and head of the Electrical Engineering Department of the Carnegie Technical Schools. In this position he will initially have charge of the organization of the course of electrical instruction and the design and equipment of the laboratories connected therewith—duties for which he is admirably equipped, both intellectually and from his wide experience in research work. As a teacher he is no less qualified, having in his numerous papers and lectures on technical subjects shown the possession to a high degree of the art of exposition.

Mr. Wurts has presented a number of papers before engineering societies and frequently lectured before universities, and has also contributed to the technical press. He is a member of the American Institute of Electrical Engineers, the American Philosophical Society, the American Association for the Advancement of Science and the Pittsburg Academy of Science and Arts.

Niagara Power in Buffalo.

BUFFALO received 24,000 electric horse-power from Niagara Falls last December, for the operation of lamps, stationary motors and street cars. Of this total about 7,000 hp was delivered to the International Railway, and the other 17,000 hp represented the entire load of the electric supply system in that city.

During the 24 hours of December 5, 1904, the total electric load in the terminal house of the Cataract Power and Conduit Company for the Niagara transmission lines at Buffalo varied between a minimum of 7,000 hp at 2:30 a. m., and a maximum of 23,900 hp at 5:15 p. m., as shown in Fig. 1. On this same day the minimum load at the terminal house between 8 and 11:45 a. m. was 17,000 hp. Compared with the like load curve for December 18, 1903, that of December 5, above named, shows nearly the same minimum, and an increase of about 600 hp in the maximum demand.

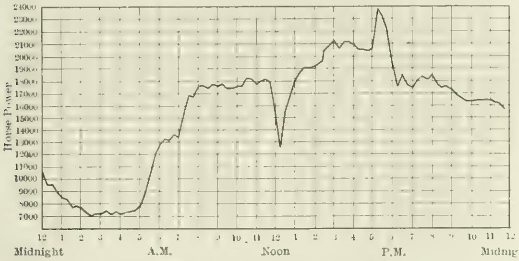


FIG. 1.—LOAD CURVE FOR DEC. 5, 1904.

On June 6, 1905, the total load on the Niagara transmission line at Buffalo had its minimum of 6,000 hp at 4:45 a. m., and its maximum of 18,900 hp at 5 p. m. (See Fig. 2.) About 6,000 hp of this maximum was the street car load. Between 7:30 and 11:45 a. m., and between 1:15 and 5:15 p. m. the electric load was not below 17,000 hp. This June load of 1905 was nearly the same at its minimum as the load on the eighteenth of the corresponding month of 1904, but the maximum load of the latter year was 1,600 hp greater than that of the earlier. So also the lowest point of the day load between 7:30 and 11:45 a. m., and between 1:15 and 5:15 p. m., was some 3,600 hp greater in 1905 than in 1904, on the June days named.

With an increase of load more than twice as great during the regular working hours of the day as at the time of peak load, it seems that the largest additions to the electric service in Buffalo are being made with motors for industrial purposes. An interesting illustration along this line may be noted in the 1,500 hp direct-connected motor and vertical pump that has been installed at the pumping station of the Buffalo water works during the past year. This pump is of the centrifugal type, and has a capacity of 25,000,000 gallons of water per day of 24 hours, or 775,000,000 gallons per month of 31 such days. At the upper end of the pump shaft a vertical induction motor of 1,500 hp capacity is connected, as indicated in Fig. 3. Three-phase, 60-cycle, 2,200-volt power is supplied to this motor by the Cataract Power and Conduit Company at the rate of nine dollars per million gallons of water pumped when 387.5 million gallons are pumped per month. On larger quantities of water per month the discounts from the pumping rate just named are as follows:

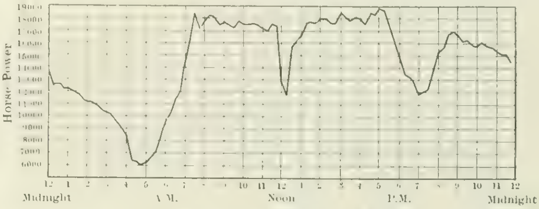
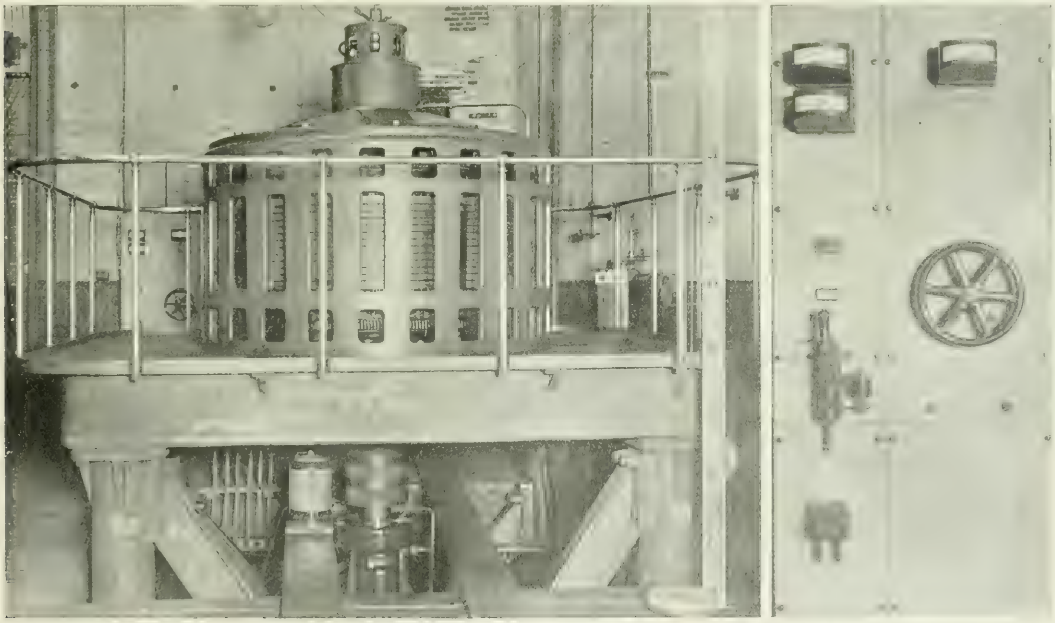


FIG. 2.—LOAD CURVE FOR JUNE 6, 1905.

387.5 to 465 million gallons	11¹/₉	per	cent	discount
465 to 542.5 million gallons	20⁵/₉	"	"	"
542.5 to 620 million gallons	29⁴/₉	"	"	"
620 to 697.5 million gallons	37¹/₂	"	"	"
697.5 to 775 million gallons	44⁴/₉	"	"	"
775 and over million gallons	50	"	"	"

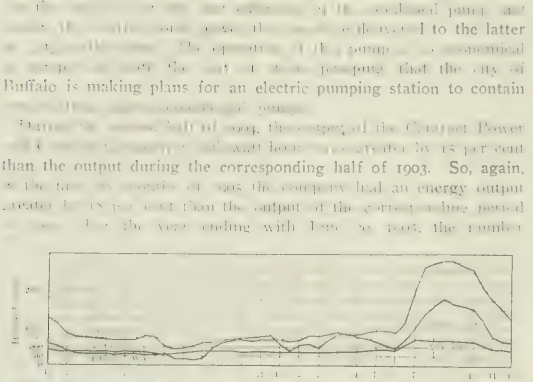
This pumping is done against a water head of substantially 200 ft. For the quantity of water raised by the pumps when working at full capacity during twelve hours per day and 31 days per month, that is 387.5 million gallons, the maximum rate of nine dollars per million gallons is charged. In order to secure the discount of 50 per cent the pump must operate at full capacity 24 hours per day and 31 days per month. If the electric motor has an efficiency of 90 per cent when it is operating the pump at the rate of 25,000,000 gallons of water per day, and if the pump then has an efficiency



FIGS. 3 AND 4.—DIRECT-CONNECTED 1500 HP INDUCTION MOTOR AND ITS SWITCHBOARD.

[illegible] represent, the [illegible] represent [illegible]. So [illegible] the energy entering the motor. When water is pumped [illegible] gallons [illegible] 8.33 lb. of the water [illegible] which the pump [illegible] water [illegible] and efficiency of the [illegible] pump and [illegible] to the latter [illegible]. The operation of the pumps [illegible] economical [illegible] the cost of steam pumping that the city of Buffalo is making plans for an electric pumping station to contain [illegible] pumps.

During the [illegible] half of 1904, the output of the Cataract Power [illegible] kilowatt hours was greater by 15 per cent than the output during the corresponding half of 1903. So, again, [illegible] the first six months of 1905 the company had an energy output greater by 18 per cent than the output of the corresponding period [illegible]. For the year ending with [illegible] 30, 1905, the number



[illegible] FOR SEPT. 2, 1905.

[illegible] by the company showed an increase of 17 per cent over the corresponding year ending in 1904, and 20 per cent over the year ending in 1903.

Transformers with an aggregate capacity of 18,000 16-cp lamps are operated with 25-cycle current from Niagara Falls for incandescent lighting by the Buffalo General Electric Company.

Such an extended application of alternating current at this low frequency to incandescent lighting is notable because of the opinion held by many engineers that 25-cycle current cannot give satisfactory results for this service. In spite of this opinion elsewhere, the load of incandescent lamps on 25-cycle circuits is rapidly moving upward at Buffalo, and lamps are being operated with such current in buildings where it is fair to assume that first class service is demanded. Among the more important institutions using incandescent lamps on 25-cycle circuits are the following, the number of lamps in each being indicated:

Buffalo Club	[illegible]
Grosvenor Library	246
Lafayette High School	1,047
Genesee Hotel	1,500
Athletic Park	4,000
Buffalo Country Club	150
Park Club	200
74th Regiment Armory	1,500
Albright Art Gallery	[illegible]
Total [illegible]	[illegible]

All of these incandescent lamps are of 16 nominal candle power, [illegible] that there are [illegible] lamps of 32 cp, and 167 lamps of 8 cp at the Buffalo Club. Besides the above, the Albright Art Gallery has 265 Nernst lamps operated with 25-cycle current.

The [illegible] of service transformer operating incandescent lamps [illegible] and the total lamp capacity in [illegible]

[illegible]

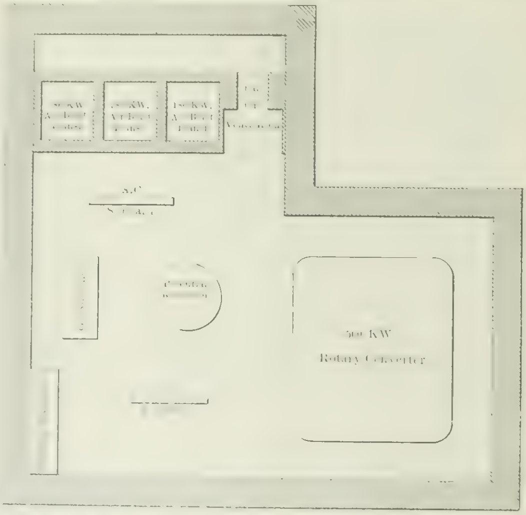
[illegible] these [illegible] transformers the [illegible]

Quite [illegible] portion of the incandescent lighting with 25-cycle current is done in residences, as well as in public places. Current for incandescent lamps is distributed in three forms by the Buffalo General Electric Company, [illegible] and [illegible] the Edison three-wire system is [illegible] of the city. Sixty-cycle current is [illegible] in the suburbs, and [illegible] extensions [illegible] have been employed.

[illegible] may be gathered from the [illegible] operated by the Buffalo company [illegible] September 2, 1905, shown in Fig. [illegible] On the [illegible] power ranged between a [illegible] to a maximum of 2,775 hp at 8:30 [illegible] on the three-wire direct-current system [illegible] at 7:30 a. m., and its [illegible] 1,701 hp at 8:30 p. m. Power at 25 cycles for incandescent lighting [illegible] 24 hours [illegible] to a load of [illegible] hp [illegible] and reached a maximum of 608 hp at 7 p. m. At 8:30 p. m., when the combined lighting load on the three systems reached [illegible] maximum of [illegible] hp, the load of incandescent lamps operated with 25-cycle current was 13 per cent of the total lighting load.

Because of the increasing load on the 250-volt, three-wire lighting system [illegible] difficulty as to its operation from the Wilkeson street sub-station of the Buffalo company, where all of the motor generators for this purpose were located, unless a large increase was made in underground feeders. At the Wilkeson street sub-station the combined capacity of the 150-volt direct-current generators, driven by synchronous motors and operating the three-wire system, is 1,200 kw. This sub-station is about 0.5 mile distant from the junction of Main and Court Streets in Buffalo, and as much as 0.75 mile from many other points in the business section.

In order to provide for the increasing three-wire load it was decided [illegible] beneath the sidewalks of the city at suitable points along the three-wire system, and to install transforming and converting apparatus in these spaces. The first subterranean station of this sort was located beneath the sidewalk at the corner of Main and Court Streets, where



[illegible] SUB-STATION AT MAIN AND COURT STREETS.

thousands of people pass over it daily. (See Fig. 6.) Within its [illegible] walls, which have a uniform thickness of 18 in., this minute [illegible] measures about 453 sq. ft. in ground area, and contains [illegible] apparatus for transforming and converting 11,000-[illegible] three-phase current to direct current at 250 volts. [illegible] this sub-station the underground cables carrying the 11,000-[illegible] electrically-operated oil switches, and thence to [illegible] transformers rated at 186 kw each. The secondary [illegible] transformers connect with an automatic potential regular and with a rotary converter rated at 500 kw and 220 to 280 [illegible] the direct-curent side. From this converter, cables pass to a switchboard and then out to connect with the positive and negative conductors of the three-wire system only a few feet distant in a street manhole. Floor, walls and ceiling of this sub-station are of concrete and steel, and it is left much of the time without an attendant.

Another sub-station similar to the one just described is being completed, and these two will increase the capacity of the system by 1,000 kw.

Regulation of voltage on the two sides of the three-wire system is done exclusively at the Wilkeson sub-station, as the four generators there are connected in pairs, while the rotary converters in the two subterranean sub-stations connect only with the outside wires. The construction and equipment of these two sub-stations are thought to offer a good example of a cheap method of increasing the capacity of a three-wire system.

The above facts as to the extending use of Niagara power in Buffalo have been obtained through Mr. Elwood Grissinger of the Cataract Power and Conduit Company, and Mr. Paulding F. Sellers, engineer of the Buffalo General Electric Company.

◆

The Use of the Telephone in Army and Navy Manoeuvres.

By Col. B. K. Roberts, U.S.A.

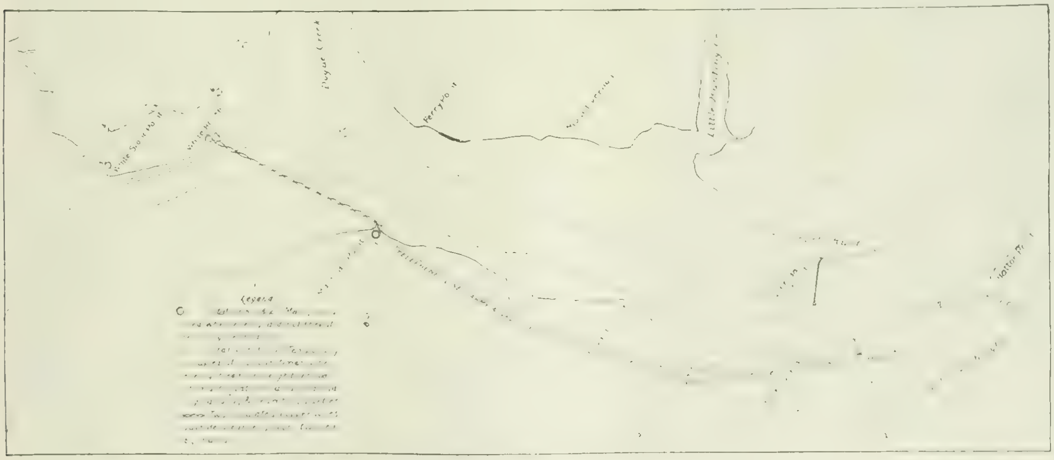
During the recent Army and Navy exercises of 1905, which were held in the Artillery District of the Potomac near Washington, effective use was made of the telephone as a means of communications outside of the regular fire control installations, in order to keep the officers informed as to the movements and approach of the Navy in its attack on the forts which defended the City of Washington. The accompanying illustration shows the lay of the land, and will serve to indicate the various places referred to in the short account of the communications given below. It should be borne in mind that Marshall Point is a forest and that White House Farm and White Stone Point are replete with foliage during the summer.

As Forts Washington and Hunt were connected completely by wire by the regular fire control installations, there remained to devise some scheme for obtaining communication by wire, if possible, with outlying signal parties so as to give timely notice of the approach of the vessels of the enemy, and to save in some part the strain on the observers and the strain upon the personnel of the batteries. It was at first decided that the placing of an outlying telephone and telegraph station at Marshall Point would give a view of the stretch of the river next beyond the field of fire and afford a place at which and to which the scout boats could report. The stretch of river referred to is in greater part out of view of the forts. An old piece of armored cable was laid from Fort Washington to Mockley Point and, from the south end, a flying telephone and telegraph line was built to Marshall Point. This consisted of wooden lances about 12 ft. long, each having a hard rubber insulator at the top and a metallic holder for the wire. A single No. 14 galvanized iron wire was used, the ground being depended upon for return.

It had been planned to build an open pole line to Marshall Point, but the time [illegible] for the purpose was not [illegible] parties as [illegible] during temporary [illegible]. On [illegible] at the end there was to be used the Signal Corps [illegible] telephone and buzzer kit, a type of instrument now highly developed by the Signal Corps. It was known that this instrument would work through a very poor line, and in fact that it had been made to work (the buzzer system) through actual breaks of considerable size in a single insulated wire laid on the ground, notwithstanding the fact that the ground was used as return. As signal parties were to occupy the country at White House and at White Stone Point, where the scout boats would be able more conveniently to report information, it was deemed advisable to connect White House through Marshall Point with Fort Washington. For this purpose two lengths of ordinary No. 14 insulated outside weather-proofed wire were used, twisted by hand, and laid double as a precaution. Most of the wire was old, having been recovered from aerial lines. The double wire was weighted with anything at hand (old pipe and scrap iron) and laid from a small launch. The wire lasted through the exercises and was then recovered. As a matter of fact, the line was so good that the telephone part of the buzzer was used effectively a greater part of the time.

The principles upon which this instrument operates depend upon the comparatively high voltage developed at the terminals of an electromagnet when the current through it is suddenly interrupted and upon the sensitiveness of the telephone as a receiving instrument for feeble momentary currents, especially when they are of the sharply accentuated character produced in the manner just described. An automatic make-and-break vibrator gives a buzzing sound in the telephone receiver, which by short or long contacts of the key produce the dot or dash of the Morse alphabet.

The instrument can now be used on a telegraph line using either the buzzer or telephone over the line while ordinary Morse is being transmitted. This is accomplished by using condensers interposed between the line and the buzzer. No current flows through the condenser as long as the current is steady or nearly so and the comparatively slow pulsations of the Morse sending have no appreciable effect on the buzzers. On the other hand, the very rapid pulsations or undulations produced by the buzzer will produce correspondingly rapid charges and discharges of the condensers and will transmit from one buzzer to the other with little diminution of sound. At the same time ordinary telegraph business will not be interfered with.



Map Showing Location of Telephone Circuits

The rules of the Army and Navy exercise forbade the landing of parties because there were not enough land troops available to carry out fully the guarding of communications. As a matter of fact the Marshall Hall-Mockley Point lance line was several times cut by a landing party, but it was almost immediately repaired, and a Signal Corps man always retained a connection with the wire between the break and Fort Washington, and with his buzzer continued to communicate with Fort Washington, and to report the movements. At one time the landing party succeeded in disconnecting the line at the Mockley Point end of the armored cable, but the fault was immediately traced out and remedied. Dummy wires were arranged at both of the main stations, and, after the landing had once been attempted, the original landing places of the wires under water were abandoned, but the entrance wires to the water were left in sight; the real end of the wire or wires at Marshall Hall was then brought in a boat under the wharf and in a roundabout way to the station. At White House the line was carried along shore under the water to an old abandoned wharf at White Stone Point and thence into the woods. Enough equipage and instruments were left in the tent at each main station to lead the enemy to think that the party had been scared off and that the true station had been captured; meantime an operator was in the woods not far off sending in full reports with a buzzer. A single operator could trail out the wire and keep up communication; when pushed he dropped the wire and went off with the buzzer, and a short time later he made connection at some other point with another length carried by his comrades (each buzzer is equipped with a separate dry battery). Continuous reports of every movement and minute descriptions of every motion and action of every vessel of the enemy were sent in.

Visual signal apparatus was of course on hand at all stations, as were the men for night and day visual signaling in case the line should fail. Except on one occasion when a visual signal informed Fort Washington that the line was broken at Mockley Point, at the cable end, no visual signals had to be relied upon. At the same time Marshall Hall, White House, Fort Washington and Fort Hunt each had its visual signal party on watch through telescopes and glasses, ready to open up communication at a moment's notice. As landing and guards against landing were not matters of interest or contemplated, the incidental cuting of the lines served merely to incite ingenuity on either side, and of course did not affect the main principles involved in the communications.

It is said that very quick work was sometimes done with the buzzer at Santiago and in the Philippines—on the other hand the real value of the buzzer is the power to get actual communication over lines and breaks and faults which absolutely preclude the telegraph and telephone, and where no possible communication could ordinarily be had. Although communication over such imperfect lines is slow, it is of immense importance that some means of communication be at hand. It is worthy of note that in the case above described the line was too good to do justice to the buzzer, for the telephone part of the instrument was always operative, and the buzzer was not called upon for severe service.

Ratio of Electric Charge to Mass of Corpuscles.

An account is given in *Annalen der Physik*, No. 10, of an investigation in which R. Reiger resumed Thomson's work on the ratio of the charge to the mass in cathode rays of the most widely varying origin. Mr. Reiger examined cathode rays proceeding from cathodes of different metals, from hot wires, from hot metallic oxides, from a negatively charged surface under the influence of ultra-violet light and from radioactive substances, as well as secondary cathode rays, and cathode rays transmitted by thin metallic plates. In addition, he produced cathode rays from glass illuminated by ultra-violet light and cathode rays generated within a gas, as in the capillary portions of a vacuum tube, so as to determine whether the rays preserve their characteristics when emitted by an insulator or a gas. The results confirm previous ones in showing that whatever the origin of the rays, the ratio of e to m is sensibly the same, only varying within narrow limits with the velocity of the electrons. For a glass plate illuminated by ultra-violet light, and negatively charged by means of a sheet of tinfoil attached to the back of it, the author obtained values for this ratio varying from 1.03×10^7 to 1.0×10^7 electromagnetic units, the voltage being varied from 8,000 to 10,000. For "strictional" cathode rays the ratio was found to be 1.32×10^7, and for anode canal rays—i. e., cathode rays transmitted through perforations in the anode—Simon's value of 1.68×10^7 was rediscovered.

The Long Island R. R. Electric System.

THE western division of the Long Island Railroad is the most complete example thus far presented of the electrification of a steam railroad system. Work was begun in the fall of 1903, and on July 26 of the present year all lines leading out of the Flatbush Avenue terminus of the company commenced electrical operation, there being 42 miles of line or 90 miles of single track, not including 7½ miles of siding. The power capacity of the system is sufficient to move fifteen six-car trains per hour in each direction between Flatbush Avenue and Belmont Park; three six-car trains per hour in each direction between Flatbush Avenue and Rockaway Park; and two four-car trains in each direction between Valley Stream and Hammels. While this comprises only part of the Long Island system, when the tunnel lines to the borough of Manhattan, now being constructed by the Pennsylvania Railroad Company, are completed, a new set of conditions will be introduced, which will require very considerable extension of the electric service, and will no doubt comprehend at that time all the lines of the company for, say, 25 miles out of both terminals.

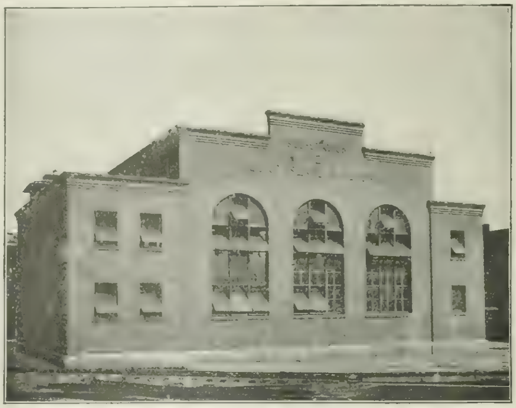


FIG. 1.—VIEW OF EXTERIOR OF EAST NEW YORK SUB-STATION.

A decision upon the character of the equipment and the characteristics of the electrical apparatus involved, a reference to the possibilities of connecting with the lines of neighboring companies, including the Brooklyn Rapid Transit Company, the Interborough Rapid Transit Company and the Pennsylvania Railroad tunnels, as well as the physical character of the lines of the Long Island Railroad itself. In coming to a decision upon the work, therefore, operation over elevated lines, in subways, on the surface, and also in the Pennsylvania Railroad terminal and tunnels, had to be harmonized. It was decided therefore to adopt for the car equipment

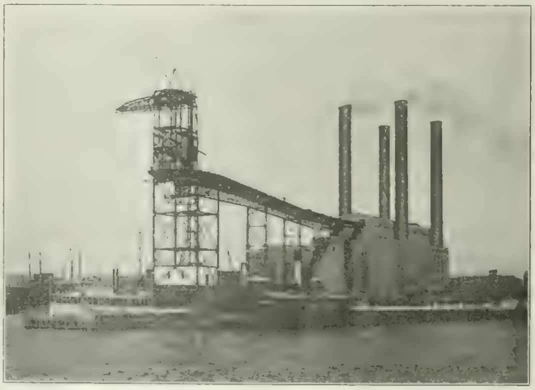


FIG. 2.—VIEW OF LONG ISLAND CITY POWER HOUSE.

a type and dimension of car which would permit, if necessary, of through operation over connecting lines. It was also decided to adopt a system of electric distribution which was standard on connecting lines, namely, third-rail contact and direct current at 600 volts for the propulsion current, and alternating-current transmission at 11,000 volts for conversion at sub-stations.

Current for the entire system will be generated at the large power house, now nearly completed at Long Island City. This power house will eventually be one of the largest in the world, and has the distinction of being entirely equipped with steam turbines. There are at present installed three Westinghouse-Parsons turbine units, of 5,500 kw capacity each, and the engine room provides facilities for three more such units. It is to be noticed that this power house does not stand at the center of gravity of the electrified system at present, but it must be remembered that the Long Island electrification forms a part of the general scheme for the operation of the Pennsylvania Railroad terminal and the moving of trains in the North and East River tunnels. When all these improvements are in complete operation, and when the western division of the Long Island Railroad is entirely electrified, the Long Island City location will be in about the center of distribution.

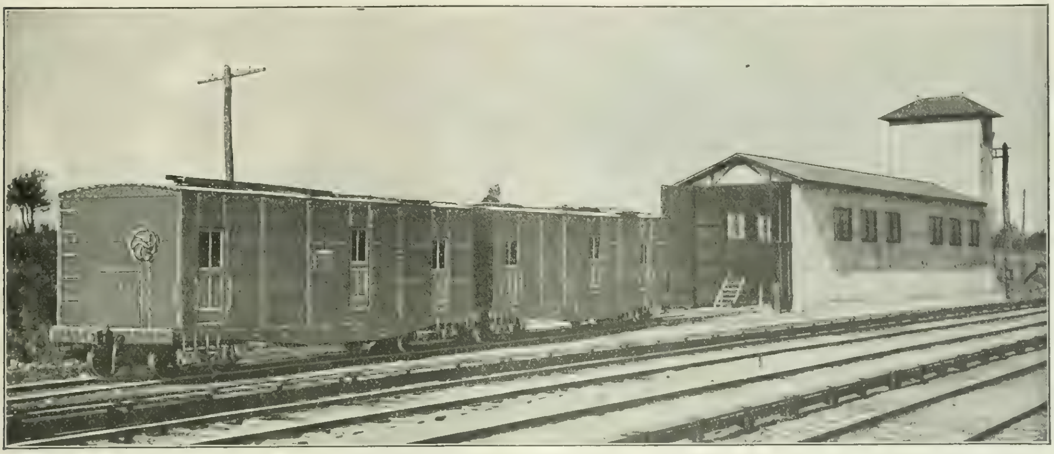


FIG. 3.—VIEW OF TWO PORTABLE SUB-STATIONS AND STEEL AND CONCRETE HOUSE AT BELMONT PARK.

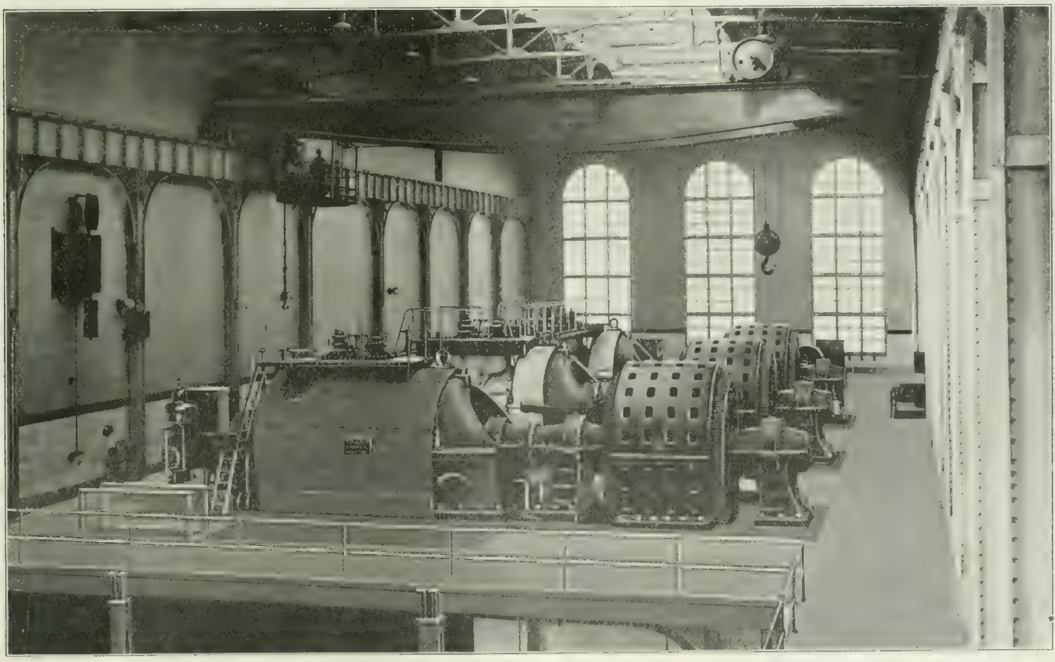


FIG. 4.—VIEW OF ENGINE ROOM FLOOR, SHOWING STEAM TURBO-GENERATORS.

The three-phase alternating currents generated at the power house, are carried in conduits through the built-up portion of Long Island City as far as the railroad yards. From here the cables are brought overhead and carried on a specially designed lattice steel-pole line. The construction of this pole line represents an advance over anything hitherto attempted in this direction. The poles are of very strong construction and are mounted on concrete foundations. Wherever the transmission lines cross telegraph or telephone wires, the latter are led underneath the high-tension wires, the very substantial character of the heavy electric cables precluding their breaking and falling across the telegraph wires. A further precaution is taken by having the poles placed closer together [illegible].

[illegible] Grand and Atlantic [illegible] East New York [illegible] junction [illegible] R[illegible].

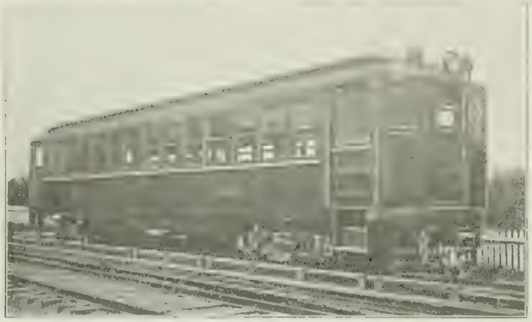


FIG. 5.—VIEW OF STEEL MOTOR-CAR SHOWING CONTACT SHOE PROTECTION

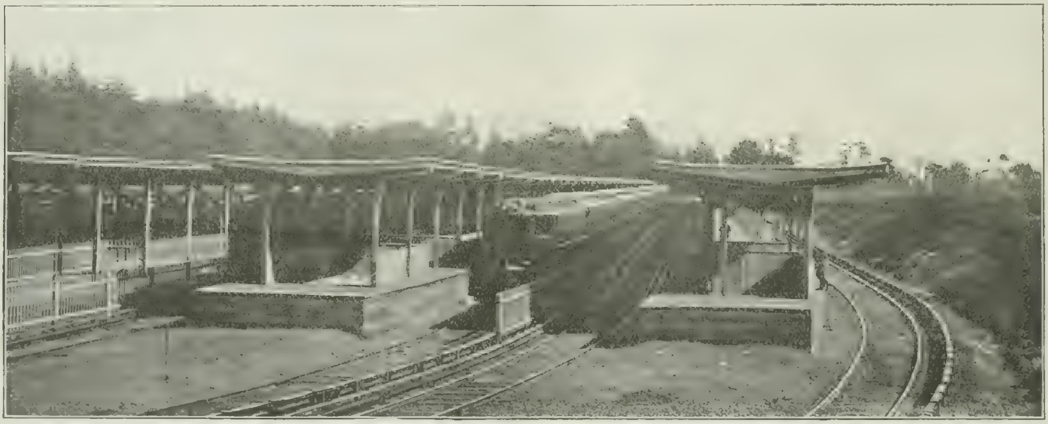


FIG. 6.—TERMINAL FOR ELECTRIC TRAINS AT BELMONT PARK

[illegible] the sub-stations have been located at junctions [illegible] points at which the heavy loads occur. Such locations also make it possible and convenient for the arrangement of transfer switches for the high-tension circuit.

The equipment at Woodhaven Junction is the largest of all, being provided with an initial equipment of three 1,500-kw rotary converters and nine static transformers of 550-kw capacity. Ultimately this station will be equipped with six 1,500-kw rotary converters, with [illegible] number of static transformers.

The Grand Avenue sub-station is provided with an initial equipment of three 1,000-kw rotary converters and nine static transformers of 275-kw capacity. The ultimate capacity, however, will include four 1,500-kw rotary converters, with a corresponding increase in transformer capacity.

The Rockaway Junction sub-station is provided at present with an initial equipment of two 1,000-kw rotary converters and six static transformers of 375-kw capacity. The ultimate equipment will include four 1,500-kw rotary converters and the proper number of static transformers.

The East New York [illegible] equipment of three [illegible] kw rotary converters, with nine 375-kw transformers, while the ultimate equipment will consist of four 1,500-kw rotary converters and the corresponding number of transformers.

The sub-station at Hammel is equipped with two 1,000-kw rotary converters and six 375-kw transformers. Ultimately, however, it will contain six 1,500-kw rotary converters, with a corresponding increase in transformer capacity. In addition to the above, this sub-[illegible] 2,000-kw [illegible] the world in use for electric railway work. Its installation was deemed expedient owing to the [illegible] the farthest from the power station and the transmission line is exposed to an unusual [illegible] Jamaica Bay [illegible] miles. [illegible] light during the winter and the very large battery capacity makes it practicable to shut down the rotary equipment for much of the time during the winter months.

[illegible] arrangement [illegible] transformers being set up on the first floor, while the [illegible] building [illegible] all the machinery under their control. The high-tension cables are led to [illegible] building [illegible].

An interesting feature of the sub-station system is an emergency provision for augmenting their capacity to the extent of 1,000 kw through the use of portable sub-stations. These consist of steel cars, each carrying a 1,000-kw rotary converter and three static transformers. Two such portable sub-stations have been built. They were designed primarily not only to reinforce the permanent sub-stations, but to maintain the potential at any points where traction might temporarily be very heavy. Such conditions would be met at the different race tracks, and therefore buildings have been provided at Belmont Park race track and at Springfield Junction, near the Metropolitan race track, where these portable sub-stations may be [illegible]. The reason for their extensive

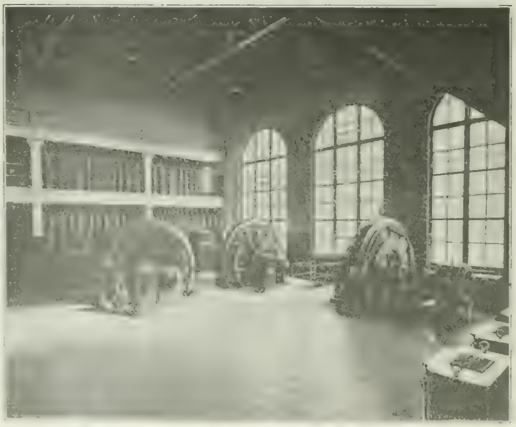


FIG. 7.—VIEW OF INTERIOR OF EAST NEW YORK SUB-STATION, SHOWING HIGH-TENSION SWITCH GALLERY.

use is found in the fact that no feeders are used for supplying the third rail, the high conductivity of these rails permitting of the dispensing of feeders for all ordinary conditions of traffic.

Direct current at a potential of 600 volts is led directly to the third rail from the different sub-stations, and is carried in this way to considerable distances, great care being taken with this third rail installation to guarantee the safety of pedestrians, and no expense has been spared to attain this result.

The rail is laid at the standard distance from the track rail adopted by this road, the Pennsylvania Railroad and the Interborough Rapid Transit Company, namely, 27 in. from the gauge line of the track to the center line of the third rail, and with top of rail 3 in. above the top of the track rail. Placing the third rail in this position will allow of interchange between the above named railroads and will permit of proper clearances for steam equipment, especially the steel hopper cars now in general use. The rail is laid on sleepers, which extend at intervals beyond the line of track, and is supported by insulators made of vitrified clay, and is covered throughout its entire length by a wooden sheathing. Wherever the rail is led in front of stations, a special side sheathing is attached to both sides, making it practically impossible for pedestrians to come in contact with it. Another feature in connection with the protection of passengers at stations is the fact that a running board, similar to the one covering the third rail, is led along the outside edge of the platform, and effectually prevents passengers from coming in contact with the collector shoes of the motor cars.

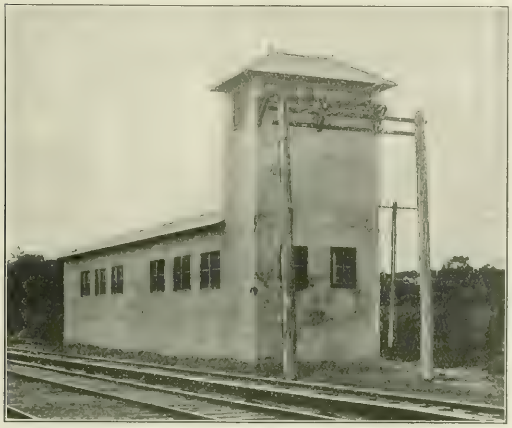


FIG. 8.—STEEL-CONCRETE HOUSE AT BELMONT PARK FOR TWO PORTABLE SUB-STATIONS.

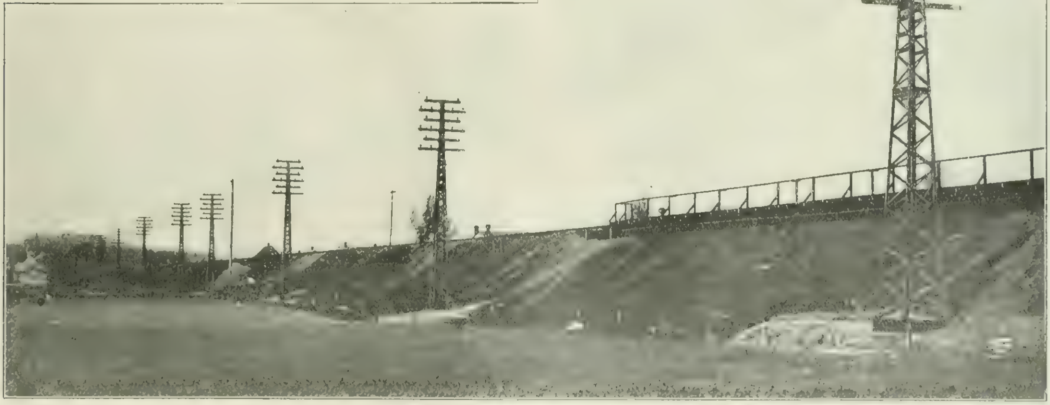


FIG. 9. VIEW OF TRUNK TRANSMISSION LINE BETWEEN LONG ISLAND CITY AND WOODHAVEN JUNCTION.

The trains are made up of steel motor cars, of which 130 have already been equipped, and trailers in the ratio of three to two; that is, a five-car train will consist of three motor cars and two [illegible] motor cars being cars 1, 3 and 5. An eight car train, however, will consist of five motor cars and three trail cars, the [illegible] Nos. 1, 3, 4, 6 and 8.

All the cars are equipped with the Westinghouse pneumatic multiple-unit system of control, and each motor car has two propelling motors of [illegible], both of which are carried on the same truck. [illegible] cars were designed by George Gibbs, chief engineer of electric traction for the Pennsylvania, New York & Long Island Railroad and for the Long Island Railroad, and were built by the American Car & Foundry Company and the Baldwin Locomotive Works, the car bodies being entrusted to the former company and the trucks by the latter. These cars are quite similar in appearance to the steel cars in use in the New York Subway which were also designed by Mr. Gibbs, being constructed throughout of steel and finished in aluminum.

These cars are now receiving their equipment at the shops of the Long Island Railroad, which have a capacity for the equipment of about ten cars per week, which are received from the builders in an entirely completed condition as regards exterior and interior finish, but are bare of any electrical apparatus. After receiving their electrical equipment they are given many trial runs before being placed in active service. Each motor car weighs 83,000 lbs. and is capable of maintaining a maximum speed of 55 m.p.h. and a schedule speed, including stops 1.6 miles apart, of 24 m.p.h.

A noticeable feature of their operation is the fact that, although attaining their maximum speed under very short headway, there is no jerk experienced in the process, acceleration being accomplished very smoothly and evenly. The trains are brought to a stop in the same even manner, being equipped with specially designed air brakes controlled by the new Westinghouse graduated release triple valve. In this respect the equipment is a great improvement over any electric trains hitherto tried.

When it was decided three years ago to electrify the system, Westinghouse, Church, Kerr & Company were engaged to act as engineers and constructors for the road, the entire work being under the direction of George Gibbs, who acted first as electrical engineer of the road and first vice-president of Westinghouse, Church, Kerr & Company, and afterward as chief engineer of electric traction for the road, the general features of the work being under the supervision of the electrical committee of the road, composed of various officials. The construction work has been under the supervision of George B. Caldwell, who acted as superintendent of that department.

Electrical Equipment of a Buffalo Theatre.

An installation involving some new and rather radical features in the electrical equipment of theatres has recently been made in the new theatre which has been erected on the site of the old Court Street Theatre in Buffalo, N. Y. The new theatre is now known as Shea's Theatre, but was originally intended to be known as the Park Theatre.

Owing to the great amount of illumination desired, and the fact that the space at the command of the owners would not allow of the installation of a private power plant, the question of the system to be used became of paramount importance, the necessity of preserving a balance under all the diverse conditions of this kind of an equipment being thoroughly comprehended. The illuminating company impresses on its commercial lines a potential of 110-220 volts and usually requires a three-wire system. It was finally decided to place the whole installation on a two-wire system, using the 220-volt lines of the company, thus eliminating any question of balance under all conditions. For the accommodation of traveling companies, which invariably carry 110-volt appliances, a subsidiary 110-volt line was run to a duplicate set of bunch pockets located on the stage.

There are over 1,500 32-cp lamps used on the stage alone; six borders of two hundred each, two hundred in the "foots," and a row around the sides and top of the proscenium arch. Those around the proscenium arch are sunk in the arch itself, behind the stucco, and are not visible to the audience. They are installed in such a manner that the light from each side is reflected clear to the front of the stage, on a line with the "foots." It seems to be a desire with some theatre people, monologists especially, to get as close to their audience as possible, and these proscenium lights were installed especially to maintain a volume of light on the artist, under these circumstances, a spot or flood light not being acceptable.

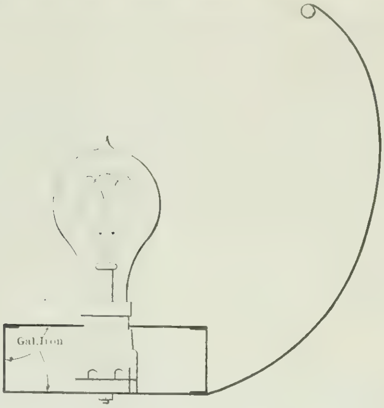


FIG. 1.—SECTION THROUGH BORDER LIGHTS.

Considering the large number of lights in the borders, the question of weight was of moment. The borders are shown in the accompanying drawing, Fig. 1. They are made wholly of medium gauge galvanized iron, black painted outside, and of heavy white enamel inside. The receptacles are bolted to the bottom of the metal trough, the heads of bolts being sealed in, and the nuts soldered on.. All the circuit wiring is laid in the metal trough, and ready accessibility, in case of trouble, is obtained by the removable sectional cover. A new feature is the hanging of the borders as shown in Fig. 2. Six-foot iron rods are riveted to the iron ribs of borders, four to each border. The borders are hung with double lines, fastened securely at gridiron, passing through small pulleys at top of iron rods, thence through sheaves and trimming blocks to a pin rail.

By a glance at the drawing, as shown in Fig. 3, the best effect possible will be seen to have been attained in the footlights. *A* is the drip slot *B* is the hinged cover to wiring trough, and *C* is the hinged reflector that can be thrown back to permit of changing the lamps. The incandescent part of the lamp filament is on an exact line with the floor of the stage, and by the use of the hinged parabolic reflector, an even light is diffused from the floor of the stage to a considerable height.

The stage switchboard is built in a solid box of concrete, access to which is gained by a small iron door at the rear. The front is protected by a heavy grille. Space was a factor, the board being allowed only 7 by 4 ft. Every light in the building, except those in the lobby, is controlled from this board. The lobby is on a separate service, and there is not a panel board in the house. Owing to the limited amount of space and the heavy equipment, the engineer was confronted with a serious problem. All the switches are fused (the enclosed type being used) on the face of the board, there being absolutely nothing behind the board except bare copper bars. Instead of the alternate blades of switches being of the same polarity, as is usually the case, the blades most closely adjacent in separate switches are of one polarity. The fuses are installed on each side of switches instead of at the bottom.

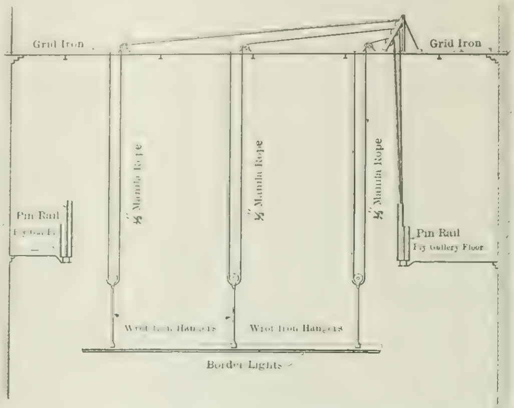


FIG. 2.—ELEVATION SHOWING ADJUSTMENT OF BORDER LIGHTS.

Fuses with specially constructed terminals have to be used, so small is the available space. The 1,500-amp. fuses on the main switch are mounted one on top of another. All the switches are provided with knob handles of special design, which are placed at right angles to the cross-bars of switches. This is another space-saving arrangement and is specially adapted to quick work by the operator. At the bottom of the various rows is placed an insulated bar which prevents the switch from coming in contact with the one directly underneath, and holds the switch at right angles to the board.

The bus-bars on the back of the board are welded at all bends and angles, no screws or bolts being used, and are so arranged as to be adjustable, i. e., one of several special switches can be easily arranged to control any given set or combination of lights.

The dimmers, which are of the "simplicity" interlocking type, are directly under the switchboard, and, in point of capacity, are the largest bank ever made by the Cutler-Hammer Company. Each exit and fire escape light is on a separate circuit, which is carried directly to the service side of the main cut-out underneath the street. These circuits, which are not fused, are controlled by a special switch located in a cabinet in the box office, which is locked when performance begins and only opened in order to throw the switches when the house is cleared.

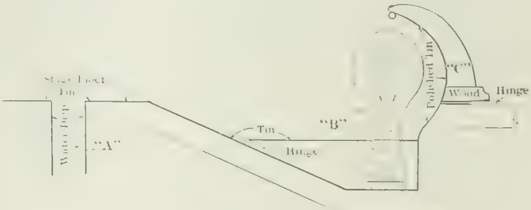


FIG. 3.—SECTION THROUGH FOOT LIGHTS.

The exterior illumination is confined principally to a highly ornate porte cochére that covers the entire sidewalk. This porte cochére is constructed almost entirely of heavy copper and stained glass, and a myriad of small lamps are ensconced in the tracery of the copper work. Over the copper-tiled roof of the porte cochére is an ornamental double electric sign, bearing the legend "Park Theatre" in 36-in. letters.

The sign is built wholly of heavy galvanized and wrought iron. Edison-base lamps are used, and the screw receptacle shells are soldered directly to the interior iron frame of the sign. Copper bars are run to the center contact points of the receptacle shells, and the iron frame work of the sign carries the return current.

The total installation represents over 5,000 lights, and probably is the largest in this country, outside of New York City.

The theatre is owned by the Shea Amusement Company, which own and operate several theatres in this country and Canada. The electrical equipment is under the direction of Mr. Robert Evers. Mr. John Gray, of New York City, laid out the work and superintended it for the contractors, the McDonnell & Dumond Company, of Rochester, N. Y. Messrs. Leon H. Lempert & Son, the theatrical architects, of Rochester, made the plans and superintended the construction for the owners.

◆

Meeting of the American Institute of Electrical Engineers.

The October meeting of the American Institute of Electrical Engineers was held in the assembly room of the New York Edison Company, on October 27. The general subject of the meeting was "Lightning and Lightning Protective Apparatus," the three papers referred to below being presented on this subject. On the platform with President Wheeler and Secretary Pope were ex-presidents Scotf, Steinmetz and Lieb. President Wheeler welcomed to the meeting Mr. W. H. Patchell, of the British Institution of Electrical Engineers, and invited him to take part in the discussion of the papers. Mr. J. W. Lieb directed the attention of the members to a silver tablet which the Italian Society of Electrical Engineers had presented to the American Institute of Electrical Engineers as a token of the appreciation of the hospitality accorded its delegates while guests of the Institute on the occasion of the recent International Electrical Congress.

A paper was presented by Mr. N. J. Neall describing a method of obtaining, by means of test papers inserted between the gaps, records of the operation of lighting arresters in service, and reporting on some results obtained by the use of this method on several transmission lines. The test papers were furnished by the Westinghouse Electric & Manufacturing Company to a number of operating companies about one and one-half years ago, who agreed to investigate this matter under its auspices. The general idea in the distribution of test papers was so to cover the country that the same apparatus at different localities would come under comparison; there was no endeavor to make a thorough comparison of all types of arresters used, chiefly because the selection rested with plants in operation, and the main investigation was to be of the effectiveness of the arrangement of gaps and resistances in the low-equivalent lightning arrester. Incidentally, however, some interesting results were obtained on other types at what happened to be comparable voltages of transmission. The range in voltage of the high-tension plants extends from 6,600 to 55,000, particular interest attaching to returns at 25,000 and 30,000 volts. The tests covered territory extending from Maine to California.

By comparing the holes made by the discharges through the older forms of arrester which have no series resistance, with those made by discharges through the low-equivalent arrester for the same voltage, it was found that no greater difficulty in discharge is encountered, as evidenced by the ragged edges or torn appearance of the holes in the low-equivalent arrester papers. These blister-like holes seem characteristic of free severe static discharges. If a paper is placed in the path of discharge of a high-tension condenser used in the equivalent spark-gap method a blistered hole invariably results. If an element having a high static resistance is inserted in the circuit, this hole is reduced to a fine one with smooth edges. If current continues to pass the hole will be enlarged and badly smoked, but will still have smooth edges. By comparison it is found that the typical static discharge through a carbon pencil type of resistance is of this smooth-bore character, while gaps used without resistance give the blister effects.

A curious effect observed in the plain gap papers shows that the original puncture may be very fine and yet the current once having held over will completely burn it away. On the other hand, the low-equivalent lightning arrester gives evidence of a quicker suppression of the short-circuit arc after the discharge has passed.

The most important information given by these papers is that the lightning disturbances on a line are not of the magnitude generally supposed. The small holes made in paper are substantially the same as those made in insulation, and it is worthy of note that these small holes pave the way for very serious breakdowns of apparatus, due to the current from the generator forming a continuous arc.

A comparison of lightning arrester papers punctured in practice with the papers taken from the idle lines, leads to the belief that the low-equivalent arrester discharges these disturbances almost as freely as if the resistances were omitted.

A comparison of results shows clearly that for freedom of discharge the arresters which are built like the low-equivalent with low resistance have freer discharge than the straight gaps and high resistance.

The action takes place through the series gaps and both of the resistances, and nothing occurs in the shunted gaps unless discharges are of high frequency and are greater than a certain severity. When discharges are found in the shunted gaps, the papers usually show a clean puncture, indicating that the discharge is chiefly static. It seems that the time-element of the disturbances, together with the throttling action of the non-arcing metal multi-gaps, enables the static disturbance to pass before the line current can follow.

Arresters with gaps and resistance capable of carrying considerable current for a short space of time act like high-potential regulators, relieving the line of surges promoted by many causes other than lightning. The papers show the ability of arresters to discharge automatically and repeatedly without attention. They indicate that the discharges at 55,000 volts pass as freely as those at lower voltages.

The paper by Mr. Julian C. Smith on "Some Experiences with Lightning Protective Apparatus" was read by Mr. G. S. Dunn. Mr. Philip Torchio presented his own paper on "Notes on Lightning Arresters on Italian High-Tension Transmission Lines." Abstracts of these two papers are given on page 780 of this issue.

The discussion of the papers was opened by Mr. P. H. Thomas, who stated that much progress had recently been made in lightning arresters and that the requirements for a successful arrester were much better understood than formerly. Commercial arresters at the present time embody two essential details: some form of air-gap and some means for interrupting the arc which the generator tends to sustain when a discharge takes place across the air-gap. In order to assist in rupturing the arc a resistance in the ground wire has been found quite good, but such resistance is not essential to successful operation, and it is, perhaps, not the best protection. For the purpose of ascertaining the behavior of various types of arresters and learning the nature of the disturbances to be taken care of, the method of using test papers as proposed and carried out by Mr. Neall, seems especially advantageous, and it is desirable that record be kept continuously under various operating conditions for several years. Experience has shown that the resistance used with the low-equivalent type of arrester performs satisfactorily the task of carrying off the discharge without injury. The most difficult condition under which an arrester must operate is that due to a direct lightning stroke. Such a stroke ordinarily damages several poles on the line. In order to protect the station from the effects of a direct stroke on the line it is well to place arresters at perhaps one mile from the station so as to remove the charge with sufficient rapidity to prevent an excess of voltage from reaching the station over the line. Mr. Thomas expressed the opinion that a most satisfactory arrester for direct strokes could be found in spark-gaps connected to the ground through long fuses. The one disadvantage of the fused arrester resides in the fact that a single discharge destroys each fuse, and the arrester can again be put into operating conditions only by inserting a new fuse. This disadvantage could be overcome by using several air gaps, each with a fuse, and adjusting the gaps for different discharge voltages.

Mr. C. F. Scott remarked that a most useful feature of the method used by Mr. Neall resides in the fact that it encouraged engineers to take an active interest in the performance of the arresters and to [illegible] lightning [illegible] [illegible] rawn. Evidence is conclu- [illegible] ne char- [illegible] the current [illegible]

Prof. W. S. Franklin stated that it is more important to [illegible] the [illegible] lightning arresters, and that the collection of information as to the number of discharges passing through [illegible] relatively small value. In regard to [illegible] for the extremely high frequency existing in a lightning discharge the iron added as a core to a choke coil does not increase its inductance. The introduction of an abrupt and great change in the section and shape of the line conductors is advantageous only to the extent to which such change produces localized inductance or capacity, which alone can act to reflect the charge. The use of a high-resistance connection to earth is obviously advantageous. What is needed, however, is a surface resistance which will allow the high-frequency discharges to pass freely, but will not appreciably conduct the low frequency line current. The requirements could best be fulfilled by the use of terra cotta pipe covered with a thin film of current-conducting paint, such as platinum chloride.

Mr. W. H. Patchell, chief engineer of the Charing Cross & City Electric Company, London, related his experience with arresters on 70 miles of 10,000-volt underground cables. The surges which were produced in these [illegible] due to abruptly changing line conditions were not properly taken care of by the plain horn arresters which were installed initially. It was found that when an arrester, set for a discharge voltage of say 16,000, operated, there would be formed a metallic bead which would decrease the distance between the horns to less than that corresponding to normal voltage. A satisfactory arrester was constructed by using a surface of carbon on one of the horns, and adjusting the horns so that the sides were almost parallel for several inches in a vertical direction, a glass box being placed around the horns for the purpose of serving as a chimney to assist in blowing out the arc. The resistance used in series with the arrester consists of glycerine and water, to which has been added a trace of sodium.

Mr. J. H. Hallberg said that not all of the difficulty experienced in the use of lightning arresters could be attributed to the arresters themselves, because frequently they are improperly installed. A recent investigation of the failure of multi-gap arresters on a certain 4,000-volt system revealed the fact that the arrester gaps had been so placed that the lightning discharge found an easier path directly across the terminals than across the gaps. When the terminals were separated and more gaps placed in series, the trouble was entirely eliminated.

Mr. H. C. Wirt, in reply to an inquiry by Mr. Hallberg, stated that the former difficulty which was attributable to the variation in the resistance in series with the arresters when graphite pencils were used, had been overcome by the use of carborundum as a resistance material.

Mr. H. G. Stott remarked that disturbances on the line could be divided into two [illegible] and [illegible]. The former of these can be taken care of by the use of adequate insulation. In dealing with the latter class the arrester must conform to two conflicting requirements, namely, it must allow the lightning discharge to pass without hindrance, and it must prevent the passage of the main line current. It seems impossible for [illegible] to perform both functions perfectly, and a compromise must be effected.

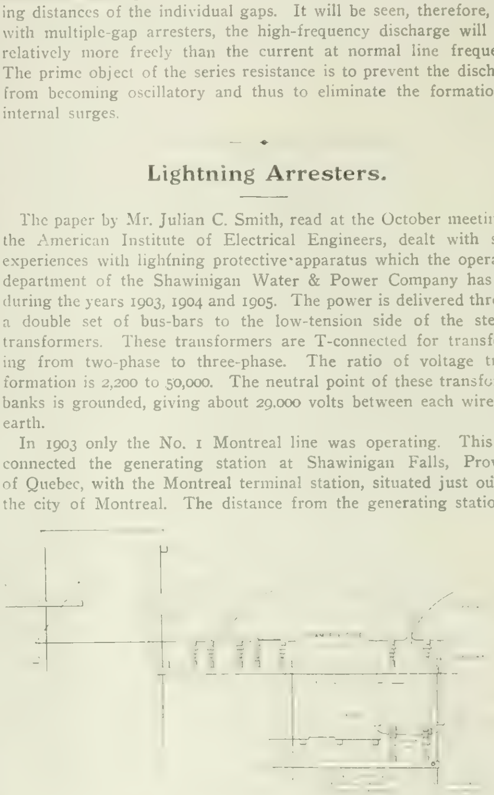
Dr. C. P. Steinmetz discussed in detail the nature of the disturbances on transmission lines and outlined the requirements for successful arresters. He said that the knowledge concerning the complex phenomena involved in lightning is far from complete. A few general facts may be stated [illegible] originate from within the system, due to switching, etc., or they may come from the atmosphere by static or magnetic induction or by direct stroke. So far as the line is concerned the effects of these various disturbances are quite similar; they differ in quantity only. Some [illegible] high power, others [illegible] frequency [illegible] in a [illegible] ter. A single lightning disturbance [illegible] normal frequency power [illegible] same circuits. These effects have not yet been thoroughly investigated [illegible] the third, ninth [illegible] in a three-phase system may combine to produce low-frequency surges. The effects which are produced at the points where [illegible] yet to be studied completely. Experience has shown that while underground [illegible] surges, they are free from trouble from lightning [illegible] rendered immune from external disturbances by placing the wires within a conducting shield. An approximation to the shield is found in an overhead wire connected to ground at frequent intervals. The essential requirements of a [illegible] lightning arrester is the ability to allow the high-frequency charges to pass to ground readily at a voltage somewhat in excess of the normal working value and to prevent the low-frequency current from following the arc at the normal voltage. It has been found that for high-frequency discharges several gaps in series require a disruptive voltage corresponding to the total distance of the gaps. With low-frequency current, however, the striking distance of several gaps in series is more nearly the sum of the striking distances of the individual gaps. It will be seen, therefore, that with multiple-gap arresters, the high-frequency discharge will pass relatively more freely than the current at normal line frequency. The prime object of the series resistance is to prevent the discharge from becoming oscillatory and thus to eliminate the formation of internal surges.

◆

Lightning Arresters.

The paper by Mr. Julian C. Smith, read at the October meeting of the American Institute of Electrical Engineers, dealt with some experiences with lightning protective apparatus which the operating department of the Shawinigan Water & Power Company has had during the years 1903, 1904 and 1905. The power is delivered through a double set of bus-bars to the low-tension side of the step-up transformers. These transformers are T-connected for transforming from two-phase to three-phase. The ratio of voltage transformation is 2,200 to 50,000. The neutral point of these transformer banks is grounded, giving about 29,000 volts between each wire and earth.

In 1903 only the No. 1 Montreal line was operating. This line connected the generating station at Shawinigan Falls, Province of Quebec, with the Montreal terminal station, situated just outside the city of Montreal. The distance from the generating station to the terminal station is 85 miles. The transmission cables are supported on 35-ft. poles, with cross arms 6 ft. long fastened with through bolts. The top of every pole is bored to receive a pin. All pins are 18 in. long and were boiled in stearine. It is to be noted that the whole load of the long-distance line consists of synchronous apparatus, and that by properly regulating the fields of this apparatus the power factor can be kept at unity.



[illegible] LIGHTNING ARRESTER AND RESISTANCE

In the fall of 1904 the No. 2 Montreal line was completed. The No. 2 line is parallel to the No. 1 line for nearly the entire distance, and in most places is not more than 100 ft. distant. The second line is similar to the first except for the fact that a ground wire is strung along the line at the neutral point of the triangle. This ground wire is connected to the earth at each pole by a wire running down the pole.

When the No. 1 line was put into service the lightning apparatus installed was as follows: At each end of the line was a bank of Westinghouse lightning arresters of the low-equivalent type and a bank of static interrupters. The number of gaps in these arresters was decided upon only after a series of tests had been made to determine the lowest practicable breakdown voltage. These arresters were set to discharge at about 65,000 volts. In 1904 a bank of General Electric arresters was placed on the 50,000-volt line at the Joliette sub-station. This bank was also adjusted to discharge at about 65,000 volts. In 1904 three banks of horn arresters were put on the No. 1 Montreal line. These arresters consist of bent copper rods. The horns were spaced 6.25 in. apart at the gap, this distance corresponding to a breakdown voltage of 90,000. In 1905, when the No. 2 line was equipped with lightning arresters, three banks of low-equivalent arresters were put in, one at each end and one at Joliette. In addition to these arresters three banks of the 1905 type of horn arresters were put in.

As stated above, the only line in operation in 1903 was the No. 1 Montreal line. That line was protected by low-equivalent arresters at each end. During the summer of 1903 several disturbances occurred, which may be summarized as follows:

1. Poles splintered by heavy discharges. 2. In a few instances insulators broken. 3. Flashes across the static interrupter terminals. 4. Arcs on the transformer terminals. 5. Arcs inside the transformer cases at the top between adjacent leads. 6. Damage to apparatus caused by 3, 4 and 5. 7. Interruption to service, due usually to excessive voltage drop, causing synchronous apparatus to fall out of step.

In view of these disturbances and damage it was decided to put in a type of horn lightning arrester affording a low resistance path to ground, to depend on a fuse for the interruption of the short circuit which would occur if the horns did not break the arc, and to set these horns so that only the heavier discharges would break them down. The horns were consequently adjusted to discharge at about 90,000 volts.

At the end of 1903 it was determined that the arresters installed were sufficient to meet the conditions caused by ordinary storms. They protected the line from abnormal rises of potential due to switching or short-circuits; but in those cases when the lightning stroke damaged poles on the line the rise of potential was so high and took place so rapidly that the arresters could not carry enough current to keep the potential of the line within safe limits. The horns installed were especially designed to take care only of the disturbances which the standard arresters could not handle.

In 1904 there were more than the usual number of storms. On the following dates the horns discharged:

Date.	Shawinigan.	Joliette.	Montreal.
July [illegible]	3 horns	1 horn	None
August [illegible]	[illegible] horns	3 horns	None
September [illegible]	[illegible] horns	2 horns	None

During 1905 the number of storms was less than usual, but there were two very violent storms, both near Shawinigan. Poles on the No. 1 line were damaged. At various times during the summer the horns of both lines discharged, but it is noteworthy that the horns of the two lines did not discharge at the same time; that is, the two lines only about 100 ft. apart would not be equally affected by lightning discharge.

The horn arresters on the No. 2 line were designed to take less current than those on the No. 1, a resistance consisting of a mixture of glycerine and water being put in the ground connection, in parallel with this resistance was a horn gap. During the first storms it was noticed that the resistance had an equivalent spark gap greater than the horn, although the resistance was about 10,000 ohms and the gap about three inches. The resistance was greatly decreased early in the summer by pushing the terminals closer together and the gap was slightly increased. After this was done the lightning discharge went through the resistance.

Another factor came into play in 1905. The two long-distance lines are operated in parallel on the low-tension sides at both ends. As stated previously, the neutral point of the transformer banks is grounded at Shawinigan. A series transformer was placed in the ground wire leading from each bank of transformers, and an overload relay connected to the series transformer, so that if any considerable amount of current flowed into the neutral the relay would open the oil switch on the low-tension side of all of the transformers connected to that line. The operators in the Montreal terminal station were depended upon to separate the two lines in cases of trouble. By this means a ground or heavy disturbance on one line would cut that [illegible] the experience [illegible] past [illegible] shown that this scheme works satisfactorily. To some extent, however, it masks the action of the lightning arresters, as in case of heavy discharges over the horns the relay would cut off the line.

Summing up the experience with reference to the horns, the author stated that they were considered a valuable addition to the standard equipment. Since the installation of the horn arresters there have been no arcs in the station. No damage has been caused to the apparatus. No interruptions to the service have been caused directly by lightning. On the other hand, each time the horns discharged a more or less severe short-circuit occurred, in no case, however, being severe enough to cause trouble or to cause the synchronous apparatus to fall out of step.

The paper by Mr. Philip Torchio described lightning arresters in use on Italian high-tension transmission lines. Details are given of the so-called "series lightning arrester" of Gola and the "water-resistance static discharger" of Friese.

It is claimed by Gola that the shortcomings of the ordinary commercial lightning arresters are due to some deficiency in the choke coils employed and not to any deficiency in the lightning arresters themselves, their function being only to discharge the line. To overcome the shortcomings of such choke coils, Gola devised an apparatus in the shape of a large shell, consisting of a choke coil and a number of large cast-iron diaphragms and shells connected in series by means of small copper conductors, the whole being placed in series on the line to perform the functions of a choke coil, and also to introduce an abrupt and great change in the section, material and shape of the line conductors leading to the station apparatus. The device is illustrated in Fig. 2. In proximity to the sharp-edged ends of the shell are located corresponding air-gap, horn-shaped lightning dischargers which are connected, through a resistance to ground, either directly or in series with ordinary lighting arresters, according to the requirements demanded by the line voltage. The functions of the supplementary lightning arresters is to assist the main air gap in rupturing the arc after the lightning discharge has taken place. It is claimed that while this device will allow the main line current to pass undisturbed, it will so obstruct the passage of lightning or static discharge currents as to cause them to be reflected at this point and pass to ground via the dischargers above mentioned. This obstruction is claimed to be due to several [illegible] of discontinuity of the circuit.

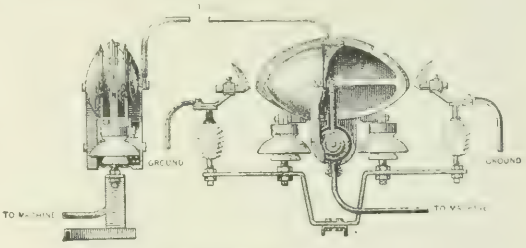


FIG. 2.—GOLA ARRESTER.

The "water resistance static discharger" is connected at each end of the line, one discharger between each conductor and ground, thereby forming a permanent continuous path to ground for a small portion of the main line current. A general feeling prevails that this grounding will eliminate a great many troubles from lightning and surges on the line. Several ways of grounding the line are in use in Italy, but the one at the Morbegno station of the Valtellina three-phase railway may be considered as representative of the water-resistance type of grounding device. The device is mounted on an iron frame outside the station. It consists of grounded feed and discharge water pipes supplying the necessary water to three pairs of glass tubes, each pair being joined at the middle by a metallic union to which are brought the grounding connections from the line conductor; the grounding is made through the two water tubes in parallel. The current to ground in this system, operating at 20,000 volts (11,000 volts to ground) is [illegible] 2 amp. from each line wire to ground. The superintendent of the station was hopeful of the success of the device.

At the Paderno station of the Milan Edison Company a different arrangement of water-resistance static discharger was being installed at the time of the writer's visit. It consisted of only three large glass water tubes, but of greater diameter and length than those used in the Morbegno station. In this case it was also expected that the device would give satisfactory results.

The best practice of to-day for the protection of Italian transmission lines indicates that the plan illustrated in Fig. 3 should be adopted. The plan shows that:

1. The terminals of the transmission lines should be extended in a direct line some distance away from their entrance into the station, and the ends should be equipped with Siemens' horn arresters grounded through water resistances.

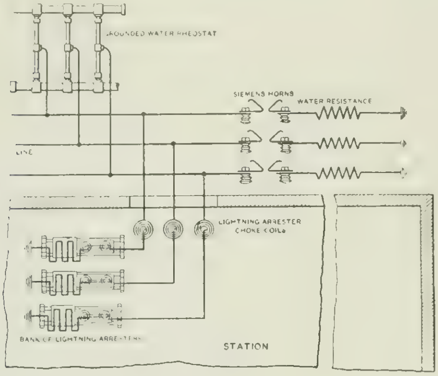


FIG. 3.—WATER-RESISTANCE STATIC DISCHARGERS AND HORN ARRESTERS.

2. On the line side of the branch entering the station a water-resistance static discharger should be installed.

3. Choke coils and ordinary lightning arresters should be installed inside the station. Possibly choke coils of the series lightning arrester type should also be added.

4. Siemens horn arresters should be used on the poles along the line only after careful study of the installation. Series lightning arresters, with Siemens horn arresters, or ordinary lightning arresters may, however, be installed at particular points; as, for instance, where a line divides into branches or at special points of a line installed in a mountainous country.

New Telephone Patents.

SUBSCRIBER STATION APPLIANCES.

For a long time subscribers' sets such as are now used were perfectly satisfactory, but now for many purposes a set reduced to a minimum size will alone meet the requirements. The size of the various parts has been reduced, and they have been mounted together most compactly. Now Mr. C. E. Egan proposes to go a step further by combining several functions in one device, and to this end he dispenses with one of the usual ringer coils and mounts in its stead about the leg of the case a rolled type condenser. The remaining coil he provides with a tap intermediate of its ends, and by this means uses a short length of this coil as the indicating coil of his talking circuits. He has obtained two patents covering his system and has assigned them to the Egan Electric & Telephone Manufacturing Company.

What may be termed a "tell-tale" has been patented by A. L. Peterson, of Clipper Mills, Cal. This takes the form of a gravity drop to be mounted upon the front of a bell box with its trigger in position to be released by the bell hammer whenever this is vibrated. Such a drop will show that a call has come in even when a number of bells are in proximity and thus cause confusion of their sounds.

W. N. Clark, of Warren, Ohio, has invented a receiver-supporting arm for desk sets. The arm support is secured to a base, to which the desk stand may be clamped, the supporting arm, built upon the principle of the jointed gas bracket, carries the receiver.

TRANSMISSION SYSTEMS.

Mr. John C. Barclay, of New York City, has endeavored to overcome the attenuating effects of the normal cable by the distributed shunt method. His shunts are tapped to earth at intervals, and consist of high-resistance, non-inductive graphite filled capsules. To absorb the inductive effects of adjacent wires upon each other, Mr. Barclay distributes throughout his cable neutralizing conductors, which are dead-grounded at short intervals.

Another and entirely different method of bettering transmission is that of I. Kitsee, of Philadelphia. Mr. Kitsee strives to reduce the impedance of the talking circuit by shunting the induction coil secondary across the line. This is the gist of one of his patents. Another describes the use of an extremely high potential introduced upon the line to carry to a great distance with very small current, and the receivers at the two stations bridged off the line, each in series with an artificial line proportioned to the transmission line.

LETTERS TO THE EDITORS.

The Place of the Single-Phase Railway.

To the Editors of Electrical World and Engineer:

SIRS:—I wish to show my appreciation of an article written by Mr. Frank J. Sprague in your issue of October 21, entitled the "New York Central-New Haven Electric Traction Situation." Certainly our best engineers will concede that the single-phase railway in its present state of development has but one place, namely, on interurban lines of moderate length and with infrequent stops.

Although there are several single-phase roads which have been in "successful" operation in this country for the past few months, I doubt if all parties concerned would class them as entirely satisfactory. It seems to me that if the same attention were paid the direct-current series motor as has been given the series alternating, we would achieve far greater results. With slight changes in our present car equipment we could easily use an e.m.f. of 1,150-volt direct-current, or by connecting four motors in series (the motor, of course, requiring special insulation), an e.m.f. of 3,000 volts could be used. There would be no change in commutation, and only one form of car equipment would be required, all of known high efficiency and perfectly reliable. By special field winding it would be a simple matter to run at half speed in the cities on low trolley voltages and still retain a high efficiency.

With the advent of the steam turbine we may look forward to even greater developments in the direct-current line, and it is safe to predict a direct-current series motor of 1,100 volts or more with commutation even better than the present low voltage single-phase series motor.

It does seem to me a shame to discard a motor which is so ably suited for just this class of service for one which at the present is only a makeshift until something better turns up.

European countries have successfully used high-voltage direct-current for some time, and the results they have attained we can not only duplicate but develop still higher. Now that the gasoline motor car in interurban work has come upon the field we must be up and doing or be taken off the turf. What the public wants is something better, not something just as good, and I do not see this in the series alternating system.

BIRMINGHAM, ALA. R. B. TENNEY, JR.

The Place of the Illuminating Engineer.

To the Editors of Electrical World and Engineer:

SIRS:—Your editorial entitled "Illuminating Engineering," in your issue of October 21, will, I am sure, go far toward awakening an interest in a branch of engineering, the importance of which has just begun to be realized.

Generally speaking, the one great difficulty that has stood, and still stands in the way of placing interior illumination upon a scientific basis, is that the architect takes it upon himself to handle the question of illumination. The architect decides upon the character and amount of illumination required for any given purpose, and prescribes the location of outlets for the light sources; he often designs the lighting fixtures and selects the glassware for them and determines how far the fixtures shall be dropped from the ceiling or how far they shall project out from the walls. In short, so far as the question of distribution of illumination is concerned he specifies practically everything.

Going one step further, he often lays out his own lighting plant and draws specifications for wiring, etc. Even when he employs a consulting electrical engineer to do this latter work, the engineer's duties cease at the wiring outlets that are prescribed by the architect.

This condition of affairs is largely responsible for the wasteful or improper illumination that is now the rule rather than the exception. It is therefore apparent that before the art of illumination can be placed upon a sound basis, the problems which heretofore have been handled exclusively by the architect must be placed in the hands of the illumination engineer. The task of bringing about this change will be a difficult one for the reason that the architect as a rule feels that he is fully capable of solving these questions for himself. The question of illumination has been left to him in the past and he sees no reason why it should not be left to him at present and in the future. An awakening is, however, taking place.

During the past six months I have personally interviewed a great many architects on this subject, and although in many cases I have found myself "bucking up against a stone wall," on the whole the results of my campaign in the cause of illumination engineering have been decidedly encouraging.

Only a few weeks ago one of the most prominent architects in the country, by whom I have been retained, stated before a body of engineers, that the time had come when the question of illumination must be turned over by the architect to the illumination engineer. Up to a few months ago this architect had in all cases handled the question of illumination himself.

I do not for one moment wish to be understood to advocate the wresting of the entire question of illumination from the hands of the architect. On the contrary, I am of the opinion that the best results can be secured only by co-operation between the illumination engineer and the architect. By such co-operation the most desirable combination of scientific and æsthetic illumination may be attained.

NEW YORK CITY. LOUIS B. MARKS.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

1,500-Volt Direct-Current Traction Motor.—RIKLI-KEHLSTADT.—An illustrated description of 1,500 to 1,700-volt motors for traction on narrow-gauge roads, built by J. J. Rieter & Co., in Winterthur. The difficulties with respect to sparkless commutation and to perfect insulation are stated to have been completely overcome. The following data are given: Gauge, 1 meter; wheel base of truck, 1.80 meter; wheel diameter, 840 mm.; normal voltage, 1,500; power for continuous operation during one hour, 75 hp (at axle); number of revolutions, 430 per minute; weight, including gear case, 1,750 kg. The construction is in general the same as in an older motor of the same firm for lower voltages. The necessity of providing an absolutely sufficient insulation reduces, of course, greatly the available space on the armature circumference. With three segments per armature slot the motor capacity would have been reduced too much; it was, therefore, decided to use five segments per slot. With increasing number of segments per slot the commutation becomes more difficult, not so much on account of the mutual induction of the armature conductors placed in one slot, as on account of the different position of the coils in a slot to be commutated at a moment with respect to the external field. The author says that the use of special commutation poles did not seem advisable. He therefore provided a large neutral zone, the ratio of pole arc to pole pitch being 0.67. By employing a high flux density, especially in the armature teeth and by specially constructing the field coils, the external field is rendered very stable. As shown in Fig. 1, the field magnet coil is turned up on either side so as to fit closely to the armature circumference in the neutral zone, whereby some sort of compensation of the armature field is produced. The insulation was made very carefully, so that a testing voltage of 6,000 to 7,000 between winding and frame could be applied. The main dimensions of the motor are: Armature diameter, 440 mm.; armature breadth, 220 mm. (including a ventilation slot of 10 mm.); number of slots, 53; number of segments, 265; diameter of commutator, 360 mm.; useful breadth of commutator, 90 mm.; motor resistance at 70° C., 2.65 ohms. It is stated that the motor runs absolutely sparkless below 90 hp and at 90 hp small sparks occur at times. Even when at full power 28 per cent of the armature current was shunted away from the field coils, there were no sparks; and this shunt circuit could be switched in or out any number of times, without producing sparks. Fig. 2 gives the characteristic curves of the motor at 1,500 volts. Even at 1,700 volts and 90 hp the behavior of the motor was perfectly satisfactory. Although it was not tested at higher voltages, the author says there is no reason why the motor should not be considered safe at 1,800 to 2,000 volts. With the shunt connection mentioned above, shunting 28 per cent of the current, the speed increased 12 per cent with constant torque. At times of heavy traffic this would be sufficient to make up for delays. When operated for a full hour at 75 hp, the increase of temperature (over that of the atmosphere) was 72.5° C. in the armature iron, 62.5° C. in the field coils and 44.5° C. in the commutator.—*Elek. Bahnen*, September 23.

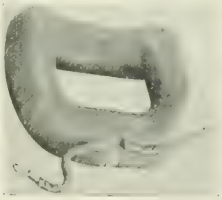


FIG. 1.—FIELD COIL.

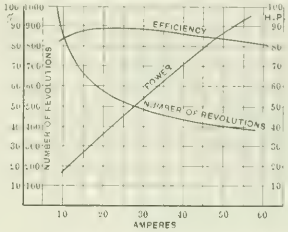


FIG. 2.—CHARACTERISTIC CURVES OF MOTOR.

LIGHTS AND LIGHTING.

Tantalum Lamp.—WEDDING.—An account of an experimental investigation. The distribution of light was determined for a 25-cp tantalum lamp, consuming 0.3625 amp. at 110 volts. Since the arrangement of the filament with respect to the vertical axle is symmetrical, it is sufficient to determine the distribution of light in one vertical plane. The results are given in Fig. 3. The mean spherical candle-power is 19.3. Since the lamp consumed 39.82 watts, its specific power consumption is 2.065 watts per spherical candle

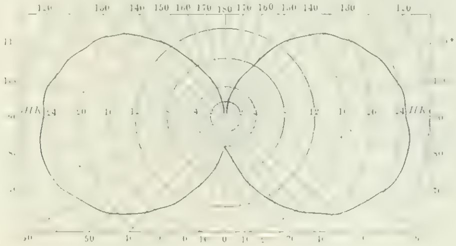


FIG. 3.—DISTRIBUTION CURVES.

power, and [illegible] watt per [illegible]. The author determined by a bolometric method the ratio of energy of radiation within the visible spectrum to the total energy of radiation in horizontal direction; the [illegible] was [illegible] × 10 watts. The total radiation, 12.2 [illegible] watts. He then carried out a life test with four [illegible] tantalum lamps, in comparison with four 16-cp and [illegible] incandescent lamps. In this test the candle-power went down [illegible] candles, [illegible] cp [illegible] 0.88 [illegible]. The results are given in Fig. 4. In the curve of the

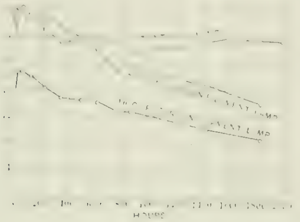


FIG. 4.—LIFE CURVES.

tantalum lamp the filament of the [illegible] lamps broke after 880, 1,030, 1,126 and 1,283 hours, respectively (the points are indicated in the curve by small crosses), the mean being above 1,000 hours. However, this breaking of filament did not terminate the usefulness of the lamps, since the ends of the broken filament easily weld together again. The filament then gets shorter and the candle-power increases. The author remarks that the tantalum lamp has not a "useful" life in the same sense as the carbon filament lamp; the usefulness of the carbon filament lamp is determined by the real life. If the real life is considered not to end with the first breaking of the filament, but to continue as long as the lamp gives light, the mean life of the four lamps is 1,866 hours. The author finally makes a comparison of the economy of the tantalum lamp and the carbon-filament lamp. The former costs $1, the latter $0.125; but the former consumes less power than the latter. The exact comparison for four lamps in each case is given in the curves of Fig. 5 on

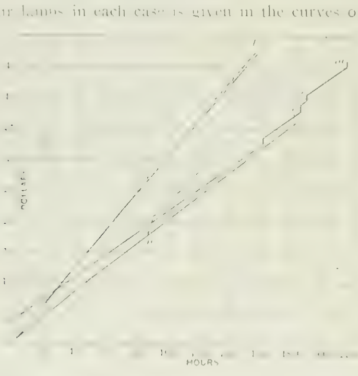


FIG. 5.—CURVES OF COST ELECTRICAL ENERGY.

[illegible] 10 cents per 1 kw-hour. The abscissæ [illegible] total cost; i. e., sum of first cost and cost of electrical energy. The curve *d e f g h* refers to the [illegible] tantalum lamp. At *e* the filament breaks the first time and the lamp is [illegible]. If, however, the ends of the filament weld again together, the curve becomes ***d e i k***. The curve [illegible] refers to the [illegible] filament lamp. It will be seen that after 750 hours the tantalum lamp is the more economical. The curve [illegible] refers to the [illegible] carbon-filament lamp. In comparing the curves [illegible] account is taken of the fact that the former (tantalum) refers to 25 candles, practically throughout the whole life, and the latter (carbon filament) to 16 candles, and that only at the start.—[illegible], October 12.

Tantalum Lamps.—ZINGLER ("For Siemens Brothers & Co., Ltd.").—A communication stating that the present tantalum lamp when used on alternating-current circuits is not as good as on direct-current circuits, the life of the lamp frequently being considerably shortened and the globe showing a tendency to blacken. [illegible] tantalum lamps for the present should be restricted as far as possible to direct current circuits. The candle-power of the commercial lamps of various voltages are proportional to the standard candle-power (23 candle-power) of the 110-volt lamp. "We have had many inquiries as to why we do not put the 110-volt lamp on the market with a candle-power somewhere about 16, the general opinion being that 23 candles was too high for most requirements, although the current consumed is actually less than for the 16-cp carbon-filament lamp. According to present manufacturing arrangements, in order to reduce the candle power, it is necessary to have a lower voltage lamp, so as to secure the same high efficiency. We are now prepared to accept orders for 22-watt lamps for pressures of 50, 55, 60, 65, 73 75, 100 and 110 volts. These lamps have a useful life of about double that of the lamp described above, and give 30 to 40 per cent less light, with a consumption at starting of 2.2 to 2.4 watts per candle-power. For instance, the 110-volt lamp of this type gives a light of about 14.5 candle-power with a consumption of 2.2 watts per candle-power. Its useful life is about 800 to 1,000 hours, and the total life often reaches 1,500 to 2,000 hours. With the consumption mentioned, a lamp having such a long useful life is a great improvement on anything that has been produced in connection with carbon filament lamps."—Lond. *Elec.*, October 13.

Domestic Electric Lighting.—SWINBURNE.—An abstract of a lecture delivered at the Olympia Electrical Exposition in London. Concerning the relative cost of electric light and gas he stated that without taking into account the cost of lamps, electricity at 6 cents per kw-hour is equal to gas at 50 cents per 1,000 cubic feet. "The gas people were very 'cocky' because they had invented things they called mantles which, instead of giving 12 candles for 5 cubic feet per hour, or something of that sort, gave about 18 candles per cubic ft. per hour when new, and the result was that on this comparison every cent per unit paid for electrical energy corresponded to about 75 cents for gas, and thus electricity at 6 cents could correspond to gas at $4.50. Of course, this comparison was a misleading one; it applied only whilst the mantles were new, and the mantles deteriorated quickly. The question of dirt was also an important factor in a comparison of electricity and gas. In London a house required redecorating once in four years under ordinary conditions of gas, and coal fires. With electricity this could be increased to once every five or six years, so that the amount saved in this way would pay for the redecoration of the house in 20 years. He had worked this out, and he arrived at the result, that, even with free gas, it would be cheaper to take the electric light in the long run."—Lond. *Elec.*, October 13.

POWER.

Power Transmission.—ESSON.—The first part of his presidential address to the Civil and Mechanical Engineers' Society on the influence of electricity on power engineering. He gives an historical review of the subject. Concerning the high-tension series and direct-current transmission system of Thury he speaks as follows: "A system showing such strong vitality, though working on what nine-tenths of our engineers would call antiquated lines, cannot be dismissed in a sentence. The facts are that the system is going ahead in the face of the three-phase alternating system, and is successful on a scale commensurate with many of the larger three-phase installations. The Americans say that the success of such a system would be impossible in their country because the motors would not there get the careful and skilled attention given to them on the continent. This may be so, but with a large plant and sub-stations the objection need not hold."—Lond *Elec.*, October 13.

Power Distribution in Lancashire.—A fully illustrated description of the Lancashire Electric Power Company's system of generation and distribution. The power house as it stands to-day is only the nucleus of what is to follow, and it is intended that it will be increased to many times its present size in a very short time. The system is the first one in England to work with 10,000-volt overhead bare conductors. As far as generation is concerned, there is practically no difference between the plant of the Lancashire and the one recently erected by the Yorkshire Company. The load of both plants will consist of a mixture of mills, collieries and bulk supplies to local authorities. However, in Lancashire, tappings are taken direct from the duplicate 10,000-volt mains to the consumer's premises, and the e.m.f. is there transformed down directly to the voltage required. In Lancashire the 10,000-volt feeders are taken to sub-stations where the pressure is reduced to 2,000 volts to supply consumers at this voltage.—Lond. *Elec.*, October 13.

Pumps.—HERZOG.—A very long and profusely illustrated description of Sulzer high-pressure centrifugal pumps.—*Elek. Bahnen*, September 14.

TRACTION.

1,500-*Volt Direct-Current Traction.*—RIKLI-KEHLSTADT.—The road from Bellinzone to Mesocco in Southern Switzerland is to be operated by direct-current at 1,500 to 1,600 volts. Each motor-car will carry four 1,500-volt motors (see the description above in the abstract under Dynamos, Motors and Transformers). The motors are able to haul a maximum load of 60 tons up a grade of 6 per cent with a speed of 20 kilometers per hour.—*Elek. Bahnen*, September 23.

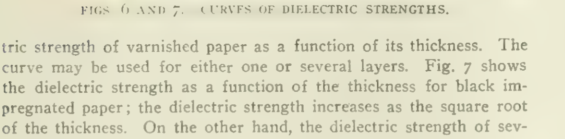
Hastings.—An illustrated article on the Hastings electric tramways, the greater part of which was recently opened. There are some extremely steep grades (1 in 9½) and sharp curves. The main portion is of the usual trolley construction, but it has not yet been decided what system shall be adopted along the sea front. The city objects to the trolley system at that place, and the conduit system appears unsuitable on account of the close proximity of the sea. It therefore would seem that a surface contact system is to be selected. The power house contains four 540-hp generating units.—Lond. *Elec.*, October 13.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Sub-Station.—An illustrated description of the Moscow-road sub-station of the Metropolitan Electric Supply Company in which 1,000-volt, two-phase currents are transformed for supplying the three-wire, single-phase supply network at 2x100 volts. Each transformer has a three-wire secondary winding. There are separate transformers on each phase.—Lond. *Elec.*, October 13.

WIRES, WIRING AND CONDUITS.

Dielectric Strength of High-Tension Insulating Materials.—KINZBRUNNER.—The conclusion of his paper on the ratio between thickness and dielectric strength of high-tension insulating materials. In the present installment he discusses varnished and impregnated papers. The term "impregnated paper" applies to a paper which, though soaked either while hot or cold in a thin insulating liquid, yet retains its paper-like surface, in opposition to "varnished paper," the surface of which is covered with a film of the actual insulating liquid. Tests with three kinds of varnished papers obtained from different manufacturers showed that their quality varied but little from each other. Fig. 6 shows the relative dielectric strength of varnished paper as a function of its thickness. The curve may be used for either one or several layers. Fig. 7 shows the dielectric strength as a function of the thickness for black impregnated paper; the dielectric strength increases as the square root of the thickness. On the other hand, the dielectric strength of several layers of this black impregnated paper is nearly proportional to the number of layers, exactly as was the case with untreated paper. The conclusion is that with varnished papers and linens —i. e., materials the surface of which is covered with a film of insulating varnish—the sub-division or the number of layers per given total thickness of insulation is immaterial from the electrical point of view, while with impregnated papers the dielectric strength per given thickness can be materially increased by using a large number of very thin layers. Some data are also given on rubber, gutta-percha and pure Para; the latter material seems to be the only exception from the general rules. These general rules are summed up as follows: "The dielectric strength of most of the insulating materials (Para excepted) is proportional to the square root of the thickness. This law may thus be expressed by the formula $E = C \sqrt{t}$; and for the sake of convenience C should be taken as the disruptive voltage of 1 mm. of the respective material, and should be termed its dielectric strength. The dielectric strength of a material (paper excepted), consisting of several layers of the same material, is directly proportional to the square root of the number of layers; this law may, therefore, be expressed by the formula $E = E_1 \sqrt{l}$, where E_1 stands for the disruptive voltage of one layer, and l for the number of layers. Fig. 8 sums up the results as to this dielectric strength as a function of the thickness for various insulating materials on the basis of the author's determination.—Lond. *Elec.*, October 6.



FIGS. 6 AND 7. CURVES OF DIELECTRIC STRENGTHS.

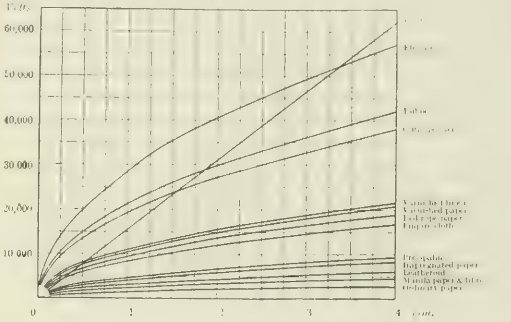
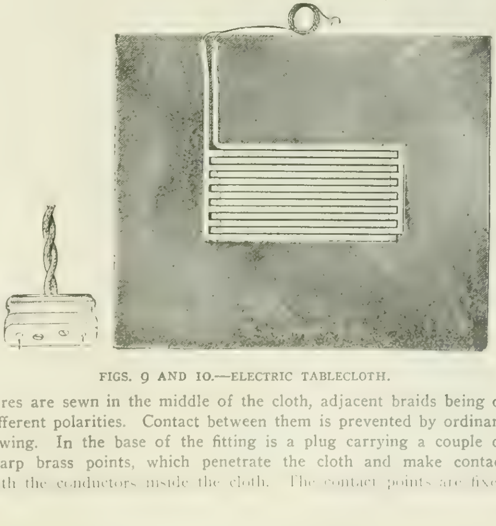


FIG. 8.—CURVES OF DIELECTRIC STRENGTHS.

Calculating the Cross-Section of a Line.—SARRATT.—A long mathematical paper in which the author first discusses the law of Lord Kelvin and then treats of the following mathematical problems: To find a conductor of minimum volume, first for a given total ohmic drop and second for a given energy loss. The results obtained are applied to three cases, in all of which the current increases along the line according to a linear rule; the first case is that of a cylindrical conductor; the second that of a conductor with a section proportional to the current (giving the best utilization of copper with respect to the energy loss); third, conductor of a section proportional to the square root of the current (corresponding to the best utilization of copper with respect to the total ohmic drop). He finally discusses the problem of finding the most economic conductor as a function of the distance, if the drop of voltage at the terminal of the line is given.—*L'Eclairage Elec.*, September 30 and October 7.

Electric Table Cloth.—An illustrated description of a table cloth by means of which it is possible to light standard lamps without putting wires on the table. This is effected by a cloth and plug constructed as shown in Figs. 9 and 10. A series of braided brass wires are sewn in the middle of the cloth, adjacent braids being of different polarities. Contact between them is prevented by ordinary sewing. In the base of the fitting is a plug carrying a couple of sharp brass points, which penetrate the cloth and make contact with the conductors inside the cloth. The contact points are fixed



FIGS. 9 AND 10.—ELECTRIC TABLECLOTH.

at such a distance apart that it is almost impossible for them not to enter conductors of different polarities. If, however, this should happen it is necessary merely to lift the fitting and put it down in a slightly different spot.—Lond. *Elec.*, October 13.

ELECTROCHEMISTRY AND BATTERIES.

Electrochemical Industries in Europe.—LEMEAU.—A long illustrated account of the electrochemical exhibits at the International exhibition in Liege with a review of the present condition of the industry in Europe, especially in France and Belgium. The electric furnaces for the production of ferro-alloys and high-grade steels by Keller, Heroult, Girod, Gin and Kjellin are described and illustrated. Other chapters deal with the electrolysis of water; the Solvay process for electrolysis of sodium chloride with a mercury cathode; the electrolytic production of chlorates and sodium peroxide, etc.—*Electrochem. and Met. Ind.*, November; from *Bull. Mensuel, Societe Belde d'Electriciens,* October.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometer.—An illustrated description of the portable "watt-photometer" exhibited the Olympia Exposition in London. In this instrument a carefully calibrated incandescent lamp forms the standard, and the candle-power of the lamp under test is read off on a direct reading scale, the accuracy being independent of fluctuations in the voltage. The lamps are completely enclosed, so that the apparatus can be used in broad daylight without any inaccuracy being introduced. A direct reading wattmeter is fitted into the same case, and is provided with an additional key, on depressing which the pointer indicates the specific consumption of the lamp directly in watts per candle-power. The internal connections are shown in Fig. 11 where *V C* is the volt coil, *C C* the current coil. It will be seen that as the right hand lamp holder travels towards the photometer, it passes over a number of contacts, whereby the resistance of the pressure circuit of the watt-meter is decreased and vice versa. The value of these resistances is such that the scale can be graduated directly in watts per candle-power. When it is desired to read watts only, this variable resistance is replaced by a fixed resistance. The candle-power, total consumption and the specific consumption of the lamp are thus read off directly, and without any calculation. Connection can immediately be made to any electric light fitting by means of an adaptor which is attached to the instrument.—Lond. *Elec.*, October 6.

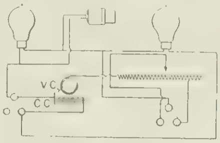


FIG. 11.—PHOTOMETER CIRCUITS.

Speed Indicator.—An illustrated description of the "Vulcan" speed indicator exhibited at the Olympia exposition in London. It consists of a dead-beat hot-wire voltmeter, supplied with current from a small magneto dynamo, which is driven by a rubber band. The voltage of the dynamo and, therefore, the readings of the indicator are directly proportional to the speed, while the dial is calibrated to show the speed in miles per hour. A flexible cord connects the dynamo to the indicator. The dynamo has only one moving part which is merely an armature of soft iron, and there are no moving wires, brushes or commutators.—Lond. *Elec.*, October 6.

Meter for Storage Batteries.—REYVAL.—An illustrated description of various types of meters exhibited at the Liege exposition. Among them are several types of the O'Keenan meter which consists principally of a small magneto-electric motor, the armature of which is shunted with a resistance through which the total current of the installation flows. One special kind of this meter is adapted to give the total of the ampere-hours of charge and discharge of storage batteries and to indicate at any moment the condition of charge of the battery. The shunt consists of a resistance divided into two adjustable parts by means of a sliding contact, the ratio of these two parts being equal to the efficiency of the battery (ratio of the ampere-hours of charge to those of discharge. The discharge current passes through the whole shunt, while the charging current passes through only one part. During charging the dial needle revolves in a sense reverse to that of the revolution of the hand of a watch and gives the quantity of electricity introduced into the battery directly in ampere hours, but reduced in the proportion of the efficiency of the battery. During discharge, the needle goes in the opposite direction and indicates at any moment the condition of charge. Small auxiliary dials give the total discharges in ampere-hours.—*L'Eclairage Elec.*, September 30.

Recording Galvanometer Readings Photographically.—A note stating that Diesselhorst uses an incandescent lamp which is caused to flash-up at regular intervals by a pendulum device, the lamp filament being reflected by the mirror of the galvanometer on a fixed sensitized plate. Good records are obtained when the lamp is over-run, the author having obtained successful records with a 2.5-cp., 100-volt Siemens & Halske lamp, having a filament 6 cm. long and fed from a 110-volt supply circuit.—Lond. *Elec.*, October 6.

Electricity Meters.—GERHARDI.—The continuation of his illustrated serial in which he describes the arrangement of meter testing tables, meter stands and testing racks.—Lond. *Elec.*, October 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Distinctness of Telephone Sounds.—WIERSCH.—An account of an investigation of the conditions which determine distinctness in the reproduction of speech by the telephone, microphone or phonograph. The sources of indistinctness are the sibilant sounds represented by *s*, *z*, *sh* and *f*. These are, as a rule, very imperfectly rendered or actually inaudible. The author found by manometric flame observations that the frequencies of these hissing consonants lie two or three octaves above the proper tones of the usual diaphragms. Now a diaphragm is most easily set in motion by a vibration of its own period. Notes of low pitch usually have some overtone which affects the diaphragm, but the hissing sounds are themselves too high for that. Their pitch is at least as high as that of a closed pipe 14 mm. in length. To reproduce them faithfully, therefore, it is necessary to have membranes of high pitch, and these can be obtained by special tension devices and magnet construction. The various sibilants thus become clearly distinguishable. That the human ear can distinguish them the author explains by the fact that the external ear consists of a set of resonators responding to notes of very high pitch. Such notes are also produced by some insects, and by the bursting of froth bubbles.—Lond. *Elec.*, October 13; from *Ann. d. Physik.*, No. 10.

MISCELLANEOUS.

Electric Cooking.—An editorial with reference to the demonstrations of electric cooking apparatus at the present Olympia Exposition in London. Advantages of electric cooking are the absence of flame, smoke, fumes, and the immunity from fire risk; further with suitable arrangements the heat can be supplied at any spot needed so that one part of a dish can be kept cool, while the other is subjected to a high temperature, and the heat of every part of the cooking vessel can be regulated to a nicety. The cook can devote herself entirely to the cooking, there being no fire to claim her attention. The main disadvantage is the large waste of energy in burning the coal as a steam producer, generating electrical energy and transforming it back into heat. Concerning the energy required, figures are given for an electric grill for use in hotels or restaurants. "This measures 40 in. by 32 in.; it takes 82 amperes at 110 volts (i. e., about 9 kilowatt hours per hour), and only 10 min. are occupied in the preliminary heating up; it is said that 130 mutton chops may be cooked on it simultaneously in 15 min." Electric cooking appliances have two distinct forms. In one type a coil of wire or films of metal are imbedded in an insulating and refractory substance, in the second type long lamps are used. The latter have the advantage that the heating body is more readily replaced, and is less costly than in the embedded-conductor pattern, but naturally there is more heat lost from radiation and convection. "For some forms of cooking, luminous heat rays are preferred by cooks; in fact, for toasting and for the inefficient process of roasting on a turning spit they are essential. By employing a roasting oven with lamps all around it, moreover, similar results can be obtained as with a revolving spit, and continual basting is possible, while there is far less waste of heat than in roasting a joint before the open fire. Probably a perfectly electrically-equipped kitchen will contain both forms of heaters, and some of them will be combined in the same apparatus." All these appliances are at present very expensive. Several of these appliances are described and illustrated in the report of the Olympia exhibition in the same number.—Lond. *Elec.*, October 6.

BOOK REVIEWS.

Electric Railways Theoretically and Practically Treated. By Sydney W. Ashe and J. D. Keiley. New York: D. Van Nostrand Company. 285 pages, 172 illustrations. Price, $2.50 net.

This book deals exclusively with the rolling stock and its electric equipment, and as no mention is made of track constructions, power house installations or of the transmission or distributing circuits, the title is somewhat misleading. It treats of the trucks, the car bodies, the motors and the control apparatus, and describes briefly a few types of direct-current locomotives for industrial, mining, freight-haulage and passenger-haulage purposes. A useful feature of the book is to be found in Chapter II, which deals with the analysis of train performance. While it cannot be claimed that the information contained in the 34 pages of this chapter is in any respect new to electrical railway engineers, it is presented in a way which should find favor with such engineers on account of its combined completeness and availability for ready reference. Under the head of "Train Recording and Indicating Instruments" the Keiley recorder, the Sheldon accelerometer, the Armstrong recording ammeter and the Arnold dynamometer car are given deserved prominence. Both the theoretical and the operating features of direct-current motors are discussed, but no attempt is made to deal with the problem of designing such machines, although the requirements of motors for specified services are outlined in the section of the book dealing with train performance.

Under alternating-current railway motors only those of the single-phase commutator type are discussed. It is, perhaps, too much to expect that an adequate and accurate description of both single-phase series and repulsion motors could be given in the 16 pages allotted to these machines. While the descriptive matter is in the main accurate, there are several misleading errors, which a little well-directed care could have eliminated. There is evidently a confusion of apparent power with real power when the authors state on page 91 that "the output of an alternating-current motor is the product of the efficiency, the power factor and the input." There is likewise a confusion of the "transformer-series" motor, as designated by Lamme, with the "repulsion-series" motor, as developed by Winter-Eichberg. The illustration on page 93 shows the former machine, while the descriptive matter relates to the latter.

A considerable portion of the book is devoted to types of controllers and their operation. The types described include plain rheostatic, series-parallel, multiple-unit, and unit-switch systems for direct-current operation, and the potential-regulator system for alternating-current operation. The treatment throughout the book is largely descriptive in nature, very few mathematical equations being employed, and the use of calculus has been avoided except in one or two instances. The book should serve well as a reference for those interested in problems connected with the rolling stock of electric railways.

Die Fernleitung von Wechselstromen. By Dr. G. Roessler. Berlin: Julius Springer. 243 pages, 60 ills. Price, 9 marks.

The author of this volume has virtually prepared in it a textbook on the theory of alternating-current transmission lines according to the fundamental physical conditions. Hyperbolic functions are not employed explicitly, although a large number of formulæ are of hyperbolic trignometry in disguise.

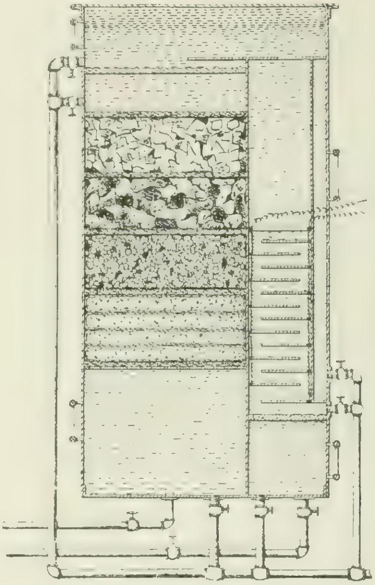
Although the treatment is mathematical throughout, yet a number of practical engineering data, concerning cables and transmission wires, are given in the tables. The illustrations are clear and give good graphical representations of the quantities discussed. The book contains more exact information concerning the theory of long-distance alternating-current circuits than any that has yet appeared to our knowledge in the German language.

From the engineer's standpoint the treatment is somewhat refined and laborious, because for nearly all practical purposes alternating-current transmission lines may be treated as having their total capacity located in the center of their length. It is only for relatively high frequencies, or unusually great lengths of line that a more rigid mathematical analysis is required. The book will be a useful text-book to students of the advanced theory of alternating-current circuits.

Purifying and Softening Water by Electrolysis.

The Electric Water Purifying & Filter Company, New York, is placing on the market apparatus for the purification and softening of water which is claimed to embody all the advantages of efficient filtration and cheap electrolysis. This system, it is claimed, will purify and soften water at a cost not exceeding 1½ cent per thousand gallons, computed for the most obstinate of waters and on the prevailing charges of the New York Edison Company for electricity.

The electrolytic action causes the precipitation of the principle scale-making compounds, found almost everywhere in water, consisting chiefly of sulphate of lime (gypsum), carbonate of lime, carbonate of magnesia, phosphate of lime, oxide of iron, and silica. The passing of the hard water through the apparatus causes the precipitation of most of the mineral substances above described, the acidity is destroyed and the iron deposited at the cathode. The principle advantage of the system, however, lies in the fact that it not only prepares good water for industrial purposes, but it prepares pure water for drinking purposes and can be adopted for use in apartment houses, hotels and even in connection with city water supply.



ELECTROLYTIC WATER PURIFIER.

The new process, instead of driving free oxygen from the water, liberates an excess of this element, which, owing to the shape of the positive electrode, is kept in contact with the water and eventually is re-dissolved. This has the effect of strongly vitalizing the water and at the same time sterilizing it, owing to the bubbling through it of nascent oxygen generated at the anodes, it being a well-known fact that nascent oxygen is one of the most active of germicides. Another important factor which tends to rid the water of bacteria is the precipitation of solid matter; this tends to carry down with it other substances held in solution and effectually clears the water of organic matter.

The following is an analysis made on crude polluted river water after electrical treatment and before filtration:

	Polluted Water.	After Treatment.	Amount Eliminated.
Dry residue and salts	0.3048	0.1826	0.1220
Organic matter	0.1068	0.0312	0.0756
Mineral matter, sand, etc.	0.1980	0.1516	0.0464
Chlorine	0.02485	0.01775	0.0071

Bacteria Per Cubic Centimetre.

Before Treatment.	After Treatment.	Eliminated.	Per Cent. Eliminated.
340,000	75	339,925	99.975

It will be seen that the amount of bacteria remaining was only twenty-five one-millionths of the quantity present before treatment and results have shown that most of these are removed by subsequent filtration. The only germ which is not affected by the treatment is the *bacillus subtilis*, which, as is well known, withstands even heat and antiseptics, but is perfectly harmless. One of the important features brought out by the analysis is that this process entirely eliminates nitrates and nitrites, which are always contained in water which has been contaminated by sewage.

The accompanying illustration shows the apparatus as adapted to hotels and apartment houses. It consists of a cylindrical iron tank divided into two parts by a vertical partition. The anodes are baffle-shaped plates of iron arranged as shown, the cathode being the wall of the tank itself. By this arrangement the hydrogen, liberated at the cathode, has free access for escape, while the oxygen, liberated at the anodes, is held in confinement until enough has accumulated to overflow into the surrounding water. The solid matter is precipitated to the bottom of the tank while the treated water overflows to the filter contained in the other half of the tank. The outfit is very simple and easily transported.

Successful Starting of Gas Engine-Driven Single-Phase Railway System.

Announcement is made of the successful starting of the Warren & Jamestown alternating-current railway system operating between Warren, Pa., and Jamestown, N. Y. The electrical equipment has had several weeks' preliminary run from a small gas engine driven unit temporarily installed in the power house at Stoneham. On October 19 the large gas engines were placed in service for the first time and a permanent operating schedule was inaugurated. Probably the most interesting feature of this rather unique railway system is the exclusive employment of horizontal double-acting gas engines of the heavy duty type for the generation of power to operate the road. Two of these engines are now installed, the first of which is already operating. The second will be placed in service in a short time. These two engines will be called upon to operate in parallel on the electrical end. Parallel operation is particularly difficult in service of this kind on account of the violent fluctuations in load which occur, due to the size of the cars employed and the small number in operation at any particular time. As it is not possible to utilize storage batteries to absorb these fluctuations, the engines are called upon to sustain them and are thus put to the severest possible test.

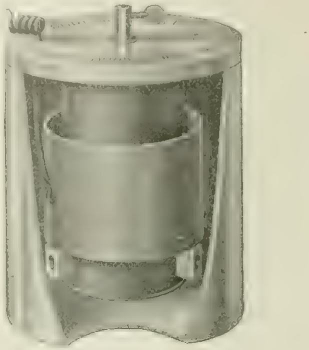
The two units installed are each of approximately 500 hp capacity, direct-connected to 260-kw revolving-field engine-type, single-phase generators. Each has two cylinders arranged in tandem fashion with a single crank. They will operate entirely upon natural gas distributed by a local company. In this district the gas has a calorific value of 1,000 B.T.U. per cubic foot. A 55-hp vertical Westinghouse engine of the single-acting type is also in operation driving an air compressor and exciting unit for the main equipment.

Current is generated directly at a voltage suitable for transmission without the use of transformers. Transformer sub-stations are located along the right of way which reduce the line voltage to 3,300 volts for the trolley at which pressure it is collected by the cars. The Warren & Jamestown Street Railway, although recently organized upon its present basis, has been running part of its present line for eleven years. Three years ago it began experimenting with gas power with sufficient success to induce the use of gas engines for the entire power generation.

Gordon Cells.

In the construction of the Gordon cell, which is shown in the accompanying illustration, attempt has been made to eliminate, as far as possible, the objectionable feature of the usual primary cells which resides in the time and labor necessary to set up and recharge them.

The copper oxide (negative element) is used in flake form, and is shipped in perforated metal cylinders, the perforations of which are closed in such a way as to prevent leakage in shipment. Attached to the cylinder are three porcelain insulating supports, upon which the zinc (positive element) rests. The zinc is made in circular form, and is held in place by the lugs; it does not hang from the cover of the cell. For the solution, high-grade caustic soda is used in powdered form. The jars are made of glass, porcelain and enameled steel, and are provided with tin, porcelain and fibre covers. The perforated cylinder, containing the copper element, and to which the zinc is attached, is fastened securely to the cover by a substantial binding-post.



PRIMARY CELL.

This cell is manufactured by the Gordon Battery Company, 439 East 144th Street, New York.

Gas Engines in the Rockland Central Station.

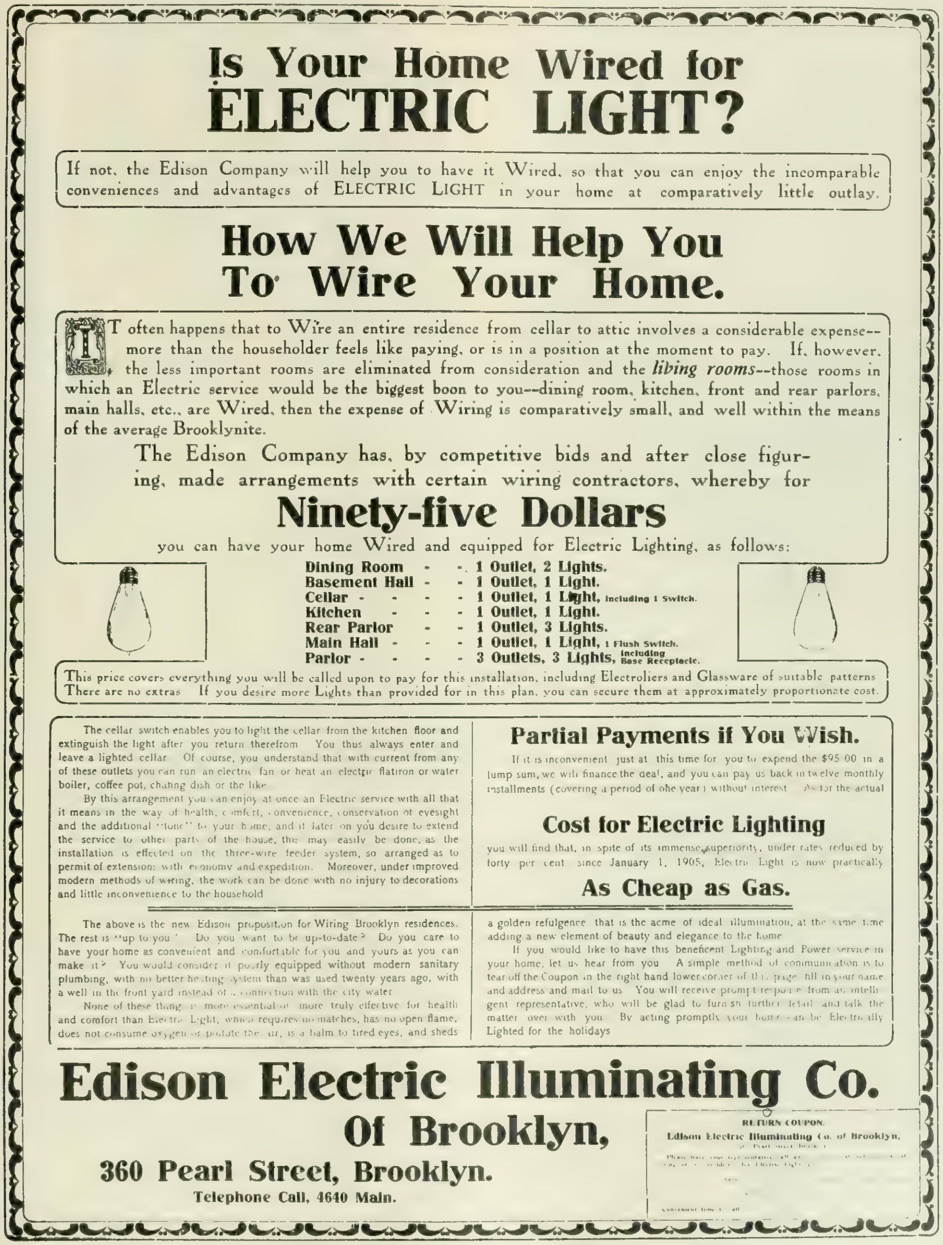
To the Rockland Electric Company of Hillburn, N. Y., belongs the credit of inaugurating an interurban electric supply system from by-product producer gas fuel in connection with power and fuel gas supply to adjacent industrial works. The use of gas power arose from the extremely low fuel cost of gas power and from the advantages of fuel gas in furnace work. The present power equipment, totaling about about 1,075 hp generating capacity, not including an exciter unit, consists of three 19x24-in. Westinghouse double-acting gas engines, direct-connected to 225-kw Westinghouse two-phase generators and a 75-kw Westinghouse vertical three-cylinder unit for operation during light loads upon the plant.

Having found its present equipment inadequate to meet the increasing demands for electricity, the Rockland Electric Company has placed an order with the Westinghouse Machine Company of East Pittsburg, Pa., for two additional 23x30-in. two-cylinder double-acting horizontal tandem gas engines. These engines will be of the four-cycle type, imparting two impulses to the crank shaft at each revolution irrespective of the load. Each will drive a 60-cycle alternating-current generator and will operate on producer gas of approximately 125 effective B. T. U. per cubic feet. The normal rating of each engine will be 470 hp, and each will be capable of developing 10 per cent overload for a period of two hours. After the installation of the two engines now on order, the total capacity of the equipment will approximate 2,100 hp.

The gas power plant of the Rockland Electric Company has been in continuous operation during regular working days for nearly a year, supplying power for lighting the surrounding towns, power for adjacent Ramapo Iron Works and fuel gas for a number of heating furnaces. The principal product of the gas plant—water gas—is exclusively used for this purpose on account of its high flame temperature, while power gas is a by-product. Both gases are generated by one system—the Loomis-Pettibone—three complete generating sets being in use. It is frequently the case that the cost of electric power in small suburban communities is prohibitive to a large number of residents, resulting from the high cost of generating steam power; but in this case, owing to the ability of the gas engine to thus turn to useful account a practically waste product, the cost of power is greatly reduced and the cost of an otherwise expensive gas is decreased sufficiently for general manufacturing purposes.

Vigorous Lighting Campaign.

The Edison Electric Company of Brooklyn has inaugurated a vigorous campaign for business by full-page advertising in all the local papers, offering to wire any house for $95, on easy payment terms, with 9 outlets, 12 lights, switches, etc. It will be interesting to see the result of these laudable efforts. Believing the matter to be one of interest and importance to many of our readers, whom it may help by way of suggestion, we reproduce in smaller fac simile the advertisement herewith. The same advertisement has been reprinted, full size, as a handsome circular, by the Edison Company, and in that form will reach a large number of the well-to-do householders of Brooklyn. Thus the appeal will be reinforced and the subject will be taken up and discussed in hundreds of homes where never before had the use of electric light and power come up as feasible, however desirable it might be. We understand that the Edison Company, pursuant to usual policy, will leave to contractors the wiring, etc., to be done, they having agreed to execute all such work satisfactorily at the price named. Thus a stimulus to local business is given all along the line, the contractors with their men benefiting also by this progressive action on the part of the company. Although the "ad" is hardly cold, a number of returns have begun to come in, and the winter's campaign for new business shows encouraging results even from the very start.



Is Your Home Wired for ELECTRIC LIGHT?

If not, the Edison Company will help you to have it Wired, so that you can enjoy the incomparable conveniences and advantages of ELECTRIC LIGHT in your home at comparatively little outlay.

How We Will Help You To Wire Your Home.

IT often happens that to Wire an entire residence from cellar to attic involves a considerable expense--more than the householder feels like paying, or is in a position at the moment to pay. If, however, the less important rooms are eliminated from consideration and the *living rooms*--those rooms in which an Electric service would be the biggest boon to you--dining room, kitchen, front and rear parlors, main halls, etc., are Wired, then the expense of Wiring is comparatively small, and well within the means of the average Brooklynite.

The Edison Company has, by competitive bids and after close figuring, made arrangements with certain wiring contractors, whereby for

Ninety-five Dollars

you can have your home Wired and equipped for Electric Lighting, as follows:

Dining Room - - 1 Outlet, 2 Lights.
Basement Hall - - 1 Outlet, 1 Light.
Cellar - - - - 1 Outlet, 1 Light, including 1 Switch.
Kitchen - - - 1 Outlet, 1 Light.
Rear Parlor - - 1 Outlet, 3 Lights.
Main Hall - - - 1 Outlet, 1 Light, 1 Flush Switch.
Parlor - - - - 3 Outlets, 3 Lights, including Base Receptacle.

This price covers everything you will be called upon to pay for this installation, including Electroliers and Glassware of suitable patterns There are no extras If you desire more Lights than provided for in this plan, you can secure them at approximately proportionate cost.

The cellar switch enables you to light the cellar from the kitchen floor and extinguish the light after you return therefrom You thus always enter and leave a lighted cellar Of course, you understand that with current from any of these outlets you can run an electric fan or heat an electric flatiron or water boiler, coffee pot, chafing dish or the like

By this arrangement you can enjoy at once an Electric service with all that it means in the way of health, comfort, convenience, conservation of eyesight and the additional "tone" to your home, and if later on you desire to extend the service to other parts of the house, this may easily be done, as the installation is effected on the three-wire feeder system, so arranged as to permit of extension with economy and expedition. Moreover, under improved modern methods of wiring, the work can be done with no injury to decorations and little inconvenience to the household

Partial Payments if You Wish.

If it is inconvenient just at this time for you to expend the $95.00 in a lump sum, we will finance the deal, and you can pay us back in twelve monthly installments (covering a period of one year) without interest As for the actual

Cost for Electric Lighting

you will find that, in spite of its immense superiority, under rates reduced by forty per cent since January 1, 1905, Electric Light is now practically

As Cheap as Gas.

The above is the new Edison proposition for Wiring Brooklyn residences. The rest is "up to you" Do you want to be up-to-date? Do you care to have your home as convenient and comfortable for you and yours as you can make it? You would consider it poorly equipped without modern sanitary plumbing, with no better heating system than was used twenty years ago, with a well in the front yard instead of a connection with the city water

None of these things is more essential or more truly effective for health and comfort than Electric Light, which requires no matches, has no open flame, does not consume oxygen or pollute the air, is a balm to tired eyes, and sheds a golden refulgence that is the acme of ideal illumination, at the same time adding a new element of beauty and elegance to the home

If you would like to have this beneficent Lighting and Power service in your home, let us hear from you A simple method of communication is to tear off the Coupon in the right hand lower corner of this page fill in your name and address and mail to us You will receive prompt response from an intelligent representative, who will be glad to furnish further detail and talk the matter over with you By acting promptly your home can be Electrically Lighted for the holidays

Edison Electric Illuminating Co.
Of Brooklyn,
360 Pearl Street, Brooklyn.
Telephone Call, 4640 Main.

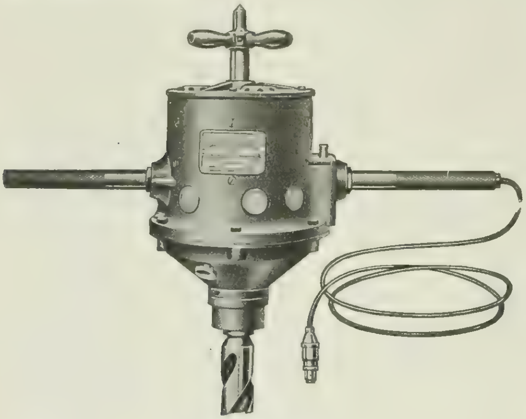
RETURN COUPON.
Edison Electric Illuminating Co. of Brooklyn,

ADVERTISEMENT FOR ELECTRIC LIGHT BUSINESS.

Electric Drills.

The accompanying illustration shows a type of the Duntley air-cooled electric drills, which have been designed for use in machine shops, plumbing establishments, hotels, office buildings, apartments, and all manufacturing establishments where drilling or boring is required. It is stated that these drills were tested under all working conditions, to which pneumatic drills are subjected, before being offered to the public, with the result that hundreds are now doing service with excellent results.

The larger capacity single motor drills are provided with a friction clutch (or collar). When the machines are shipped from the factories, the collars set to slip at any time they may be cutting at a speed requiring amperage in excess of their rating. The slipping of the collar permits the motors to run at full speed while the drill spindle stops, thus preventing the blowing out of the fuse plug (which has been provided as an additional safeguard against damage by overloading the motors or by allowing the drill to stick), or the heating of the motors. When the drill sticks, allowing the friction collar to slip, a slight turn of the pilot wheel (or feed screw), to release the pressure on the drill, will cause the friction collar again to take hold and start the drill spindle rotating.



ELECTRIC DRILL.

The switch is at the base of the handle where it is operated easily and quickly by a thumb pressure. The drill shown in the cut is of the two-motor style, having two small motors in one casing, with a special method of field winding which insures uniformity of speed of all motors. The weight of the equipment has been kept down to a value which is not objectionable by the use of gearings which allow the motors to operate at high speed.

The success of these small electric portable drills is attributed to the use of fans attached to the lower end of the armature shafts. The armatures revolve at 5,000 r.p.m., and a liberal volume of air is drawn in and circulated between the field and armature windings, thereby insuring the proper cooling. These electric drills are being placed on the market by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, Ill.

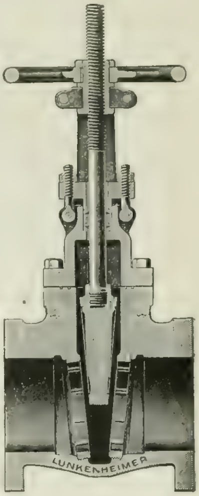
A Big Electric Lighting Display.

For a "one night stand" electrical display, the one recently made at Dayton, O., is worthy of note. It is no small job to put in the wiring and necessary apparatus to carry out an illumination which comprehends 400 acres in its scheme. This is what was done at Dayton. The result was a fairyland of electricity that attracted 35,000 people to the "world's greatest garden party." This party was given by the Men's Welfare League, an organization of factory employees. Five days before the day set for the party the electrical department of the National Cash Register Company set ten men to work to install the wiring in the trees and shrubbery on the country estate selected as the scene of the party. In putting in the apparatus there were used 59,347 feet of wire of various sizes, 33,898 candle-power in incandescent lamps, 3,300 weather-proof sockets, 1,850 receptacles, six gallons of lamp coloring and fifty pounds of tape.

A dancing platform, 70 by 80 ft., was lighted by 280 eight-candle-power and 140 four-candle-power incandescent lamps. The main entrance to the grounds was lighted with 350 four-candle-power lamps. Eight large electric signs advertised refreshment booths within the grounds.

An Improved Gate Valve.

In the "Victor" gate valve, a detailed view of which is shown herewith, the by-pass is not separate from the valve proper, but it is cast integral with the body, and it is claimed that this method has many points of excellence. The additional metal required for the by-pass tends to strengthen the valve body; being self-contained, it is not affected by extremes of expansion and contraction, which tend to distort the valves used on exterior by-passes. It will be seen that, instead of being screwed into the body, they are bolted thereto by several large steel studs and nuts, the latter seating on the spot-faced surfaces. The stuffing box is made of bronze, and has a flange on the bottom thereof, which prevents the iron flange above it from touching the iron body, and hence, prevents corrosion between these surfaces. These valves are manufactured by the Lunkenheimer Company, of Cincinnati, O. They are made of iron with bronze trimmings, in three different weights for working pressure up to 125, 150 and 250 pounds per square inch. They are also made entirely of bronze in two weights, suitable for pressures of 150 and 250 pounds per square inch.



SECTIONAL VIEW OF GATE VALVE.

"Noscru" Midget Push Button.

The miniature push button shown herewith is noteworthy on account of the easy method of connection, and of its substantial nature. It is practically indestructible, as it is made of porcelain and metal. It has all of the features and strength of an electric light appliance, although it is intended exclusively for bell work. This device is manufactured by the Sarco Company, 906 Sixth Avenue, New York, for the American Electrical Novelty and Manufacturing Company.

Electrically Controlled Oil Switches.

The tendency to design all central station apparatus so that it can be controlled from a central controlling board has led to a demand for a simple and inexpensive system of electrical control for high-tension oil switches.

In Figs. 1 and 2 are shown a front and rear view of a 15,000-volt electrically-controlled oil circuit-breaker made by the Hartman Circuit-Breaker Company, of Mansfield, Ohio. The panel containing the oil switch, operating solenoids and overload relays, can be installed at any convenient point in the station, and operated from the main switchboard by means of a small double-throw switch. The rotary movement used in opening and closing the Hartman switch readily lends itself to solenoid control. The usual operating handle is replaced by a steel sprocket wheel. The link belt which engages the sprocket wheel is attached at one end to the movable core of the closing solenoid and at the other end to the core of the opening solenoid. The downward movement of the core of the larger solenoid effects the closing of the switch, and the same movement of the core of the smaller solenoid effects the opening of the switch.

The operating current is derived from the exciters, a storage battery or any convenient source of direct-current supply. The solenoids can be wound for any standard voltage. When an automatic switch is required, the overload relays are placed on the same panel and the operation of the plunger of either relay will close the direct-current circuit and effect the opening of the circuit-breaker.

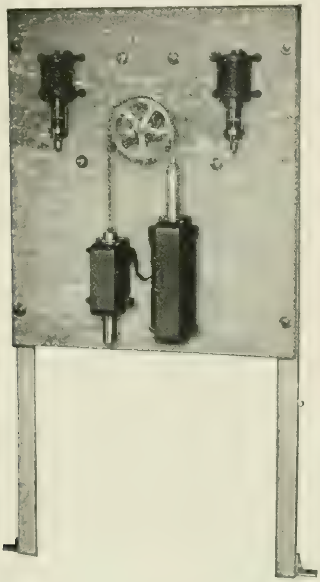


FIG. 1.—FRONT VIEW OF CIRCUIT-BREAKER, SHOWING CONTROLLING SOLENOIDS AND TIME-LIMIT OVERLOAD RELAY.

A combined overload and inverse time-limit relay is shown in Fig. 1. The time-limit relay operates on the vacuum principle, the admission of a smaller or greater quantity of air into the brass tube containing the plunger having the effect of retarding or accelerating the movement of the latter. On an ordinary overload, the automatic opening of the circuit-breaker may be delayed for any desired period up to 10 seconds. The heavier the overload, however, the quicker will be the action of the plunger, and an excessive overload or short-circuit will cause the plunger to act almost instantly.

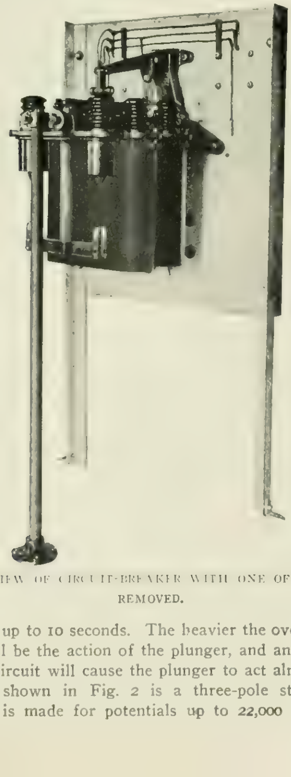


FIG. 2.—REAR VIEW OF CIRCUIT-BREAKER WITH ONE OF THE OIL TANKS REMOVED.

The switch shown in Fig. 2 is a three-pole standard, type C switch, which is made for potentials up to 22,000 volts. The live parts of each pole are enclosed in a cell made of specially-treated indurated fibre. The contacts are of the laminated double-break type, and the oil tanks are moulded in such a way as to isolate each breaking point.

Small Power Motors.

In addition to the various mechanical tools which are now commonly driven by small power motors, either direct-connected, belted or geared, there remain such mechanisms as the sewing machine, the letter-sealing machine, the coffee mill, the massaging outfit and the various forms of copying machines, printing presses, etc., to which the electric motor may be applied to great advantage. The accompanying illustrations show a type of motor designed by the Fort Wayne Electric Works, Fort Wayne, Ind., to meet the demand for motors for these purposes. These machines are of both the direct-current and the alternating-current types. Motors of the former type are built for loads not exceeding one and one-half horse power, while those of the latter type are constructed for capacities not exceeding one-thirtieth horse-power. Fig. 1 indicates the constructional features of the direct-current motor, while Fig. 2 shows a machine of this type operating a vibrator outfit.

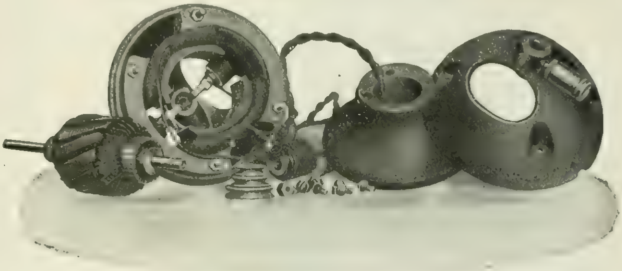


FIG. 1.—PARTS OF DIRECT-CURRENT MOTOR.

The frame of the motor is cast in two sections, hemispherical in form, which are supplied with two openings near either end of the shaft by means of which the commutator and brushes may be examined. Both the field and the armature cores are well laminated, the field laminations being stamped in such form as to provide a magnetic circuit entirely separate from the cast-iron frame.

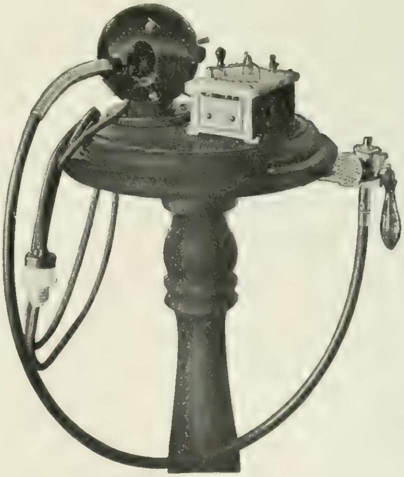


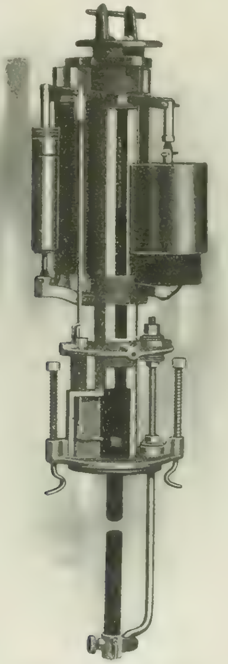
FIG. 2.—DIRECT-CURRENT MOTOR OPERATING VIBRATOR OUTFIT.

Nearly all applications of small power motors can be accommodated by the construction shown in the illustrations, but the Fort Wayne Electric Works announces that it is prepared to furnish special designs to meet any particular need which may exist for the use of friction discs or a system of gears.

Operating Mechanism of the "American" Arc Lamp.

In our issue for October 7 a brief description was given of the lamps manufactured by the American Arc Lamp Company, Kalamazoo, Mich. Below is given a description of the operating mechanism of the direct-current lamp. The accompanying illustration shows the frame complete, without covers, the upper part of the frame being cut away to give a view of the working of the clutch on the upper carbon. The frame is cast in one piece, with a hollow tube in the center for enclosing the upper carbon and the clutch.

The clutch is constructed on the toggle principle in order to insure reliability in feeding and to guard against the possibility of the carbon slipping. The resistance coil is wound on two solid ventilated porcelain cores. Particular care has been taken to insure that the magnet coil is indestructible. It is stated that the lamp may remain on dead short circuit for many hours without doing damage to the coil. The upper carbon holder is provided with a copper contact, and is entirely enclosed in the metal guide tube. The lower carbon holder is a single rod with a detachable holder, which when burned out may be replaced without disturbing the insulation of the rod. Realizing that the life of the lamp is largely dependent upon the dash-pots, the company has constructed the dash-pots of the "American" lamp of self-lubricating graphite, which gives the best of action.

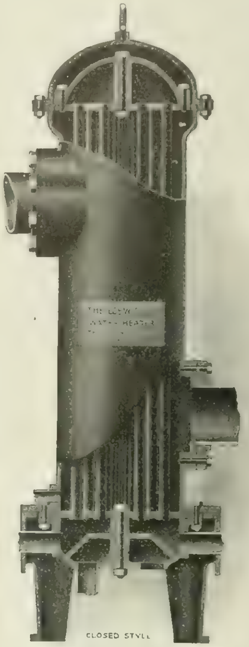


MECHANISM OF ARC LAMP.

Feed-Water Heater.

When water is being heated in a tube, the center will not heat so rapidly as the outer surface of the water. The feed-water heater shown in the accompanying illustration has been so constructed that when the water traveling through the tubes reaches the several ports at the top and bottom of the various sections of the tubes, the course of the water is entirely changed, thereby altering its relative position, thoroughly mixing it, and the temperature is thus equalized throughout the mass of the water. The heater is also so arranged that the water passes six times through the exhaust steam, thus obtaining the highest possible amount of heat units. The several parts which mix and thoroughly equalize the temperature of the feed water also accomplish another purpose—fittings are rendered entirely unnecessary and they have been dispensed with, so that friction caused by circulation is reduced to a minimum.

This heater, which is manufactured by the Loew Supply & Mfg. Company, Cleveland, Ohio, is built of heavy cast-iron and brass. The outer shell, legs and caps are of cast-iron, and the tubes are of straight seamless brass.

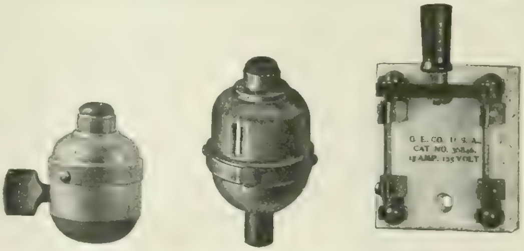


FEED-WATER HEATER.

Switches for Lamp Circuits.

In addition to its well-known pendant push-button type of switch the General Electric Company is now manufacturing the pendant key type (shown in Fig. 1). This form of switch is particularly designed for use where an inexpensive switch is desired to control one or two incandescent lamps, which are inaccessible and which do not require a 5-amp. or 10-amp. switch. It is neat in design and matches the company's standard sockets and receptacles.

The pendant push-button switch, illustrated in Fig. 2, is most useful in connection with temporary or permanent installations of incandescent or multiple arc lamps. It is also excellently adapted for use with fan motors, as it locates the control of motors at the most advantageous points regardless of their accessibility.



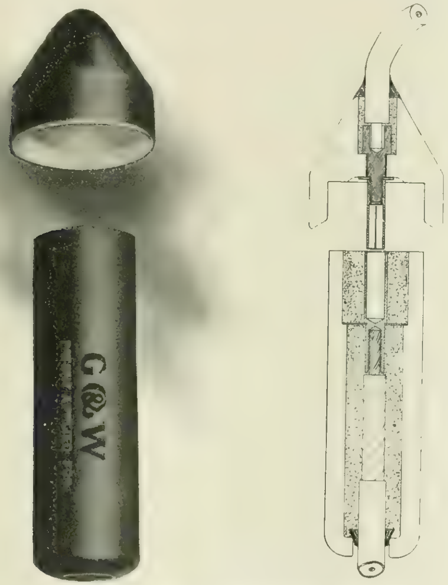
FIGS. 1, 2 AND 3.—PENDANT AND KNIFE SWITCHES.

In both types of pendant switch the contact surfaces are of ample size and the mechanism is dependable. The circuit of the push button switch is closed by pressing a button at the bottom of the switch, and opened by pressing the release button at the side. The key switch operates on the same principle as a standard key socket.

The double pole, 15-ampere, 125-volt, baby knife switch, indicated by Fig. 3, is a production of the General Electric Company. It follows the design of the large punched clip switches, and is neat, durable and compact.

A Detachable Pot Head for High-Tension Circuits.

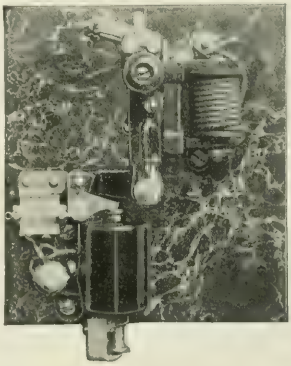
Where high-tension overhead circuits pass to underground cables there has been felt the need of a pot head which will not only protect the end of the cable insulation, but which will also make it possible to disconnect the overhead from the underground lines. It is also sometimes desirable in ordinary overhead distribution to have disconnecting devices for branch lines on poles. The detachable porcelain pot head shown in Figs. 1 and 2 has been developed on the circuits of the Commonwealth Electric Company, Chicago, and is being offered on the market by the G. & W. Electric Specialty Company of that city. Fig. 1 shows the exterior appearance of the porcelain shell of this pot head, while Fig. 2 is a longitudinal section through the whole device. As seen in Fig. 2, the lead covered cable enters a long porcelain sleeve. This sleeve is clamped to the cross arm. The conductor of the cable is soldered into a brass sleeve, one end of which forms a receptacle for a split plug by which a connection is made with the overhead line. The brass sleeve is held in a central position in the porcelain sleeve by a washer. When a cable has been slipped into the sleeve the space between the cable and sleeve is filled with "Mineralac," or other insulating compound. The overhead line wire terminates in a plug in a porcelain cap, the space between the wire and cap being filled in with compound in a similar manner. The split plug in the cap slides into the receptacle which forms the cable terminal. Fig. 2 shows the plug withdrawn from the receptacle. It is evident that with such a pot head disconnection of overhead and underground lines can be accomplished instantly and without danger to the linemen. At the same time, the fact that porcelain instead of metal forms the outer covering gives a much higher degree of insulation than is possible with a lead sleeve. It is used on voltages of from 2,000 to 8,000. The device is one which appeals to every overhead construction man on account of its simple and substantial character and high insulation. It takes less skill to apply than a wiped lead pot head joint, and gives better and more impervious insulation than a taped joint, to say nothing of the easy disconnection feature other joints do not have.



FIGS. 1 AND 2.—POT HEAD FOR HIGH TENSION CIRCUITS.

Overload and No-Voltage Circuit-Breaker.

The following illustration shows an improved type of overload and no-voltage circuit-breaker being placed upon the market by the Ward Leonard Electric Company. The overload hood, latch and clip parts being on one casting, only five holes are required to be drilled for remounting. It is composed of two automatic circuit-breakers, one for no-voltage release and the other for overload release. The two are so related that the overload mechanism cannot be closed when the circuit is opened by the no-voltage circuit-breaker, and the latter cannot be closed or held closed when an excessive current flows, thus insuring safety of the motor and of the entire circuit in case of short-circuit and excessive current. The no-voltage switch is responsive solely to the line voltage and will open instantly when for any reason the counter e.m.f. of the motor falls below a protective amount.



CIRCUIT-BREAKER.

Steady Demand for Steam Engines.

Although the steam engine of to-day must compete with the simplicity, compactness and effectiveness of the steam turbine and the high commercial economy of the gas engine, there are still many cases where it is found advantageous to install this class of prime movers. The advent of the steam turbine and gas engine only seems to stimulate the demand for prime movers of all types, and the steam engine business keeps pace with this demand.

The Westinghouse Machine Company, of East Pittsburg, Pa., which has built some of the largest steam engines in this country, has within the last few weeks booked orders for more than 75 steam engines, aggregating 10,764 horse-power. Of the different types of steam engines manufactured by this company 5,040 horse-power of marine type were sold, 2,740 horse-power of compound steam engines, 1,823 of "Standard," 801 of "Junior," and the remainder of Corliss. The largest single order during this time was received from the Tahuantepec Railway, of Mexico, for four 16-in. x 34-in. x 16-in. marine type engines and two 8½-in. x 8-in. Standard engines for equipping the Salina Cruz and Coatzacoalcos power houses.

Other orders were received from the Rio de Janeiro Tramway, Light & Power Company, of Brazil; the Chicago, Milwaukee & St. Paul Railway Company, Chicago, Ill., for compound steam engines, and still others from the Lawrence Machine Company, Lawrence, Mass.; Pennsylvania Railroad Company, Wilmore, Pa.; Hokkaido Tanko Railway Company, Japan; Muncie & Portland Traction Company, Portland, Ind.; International Steam Pump Company, New York; Kure Arsenal, Japan; Graham Brothers, Stockholm, Sweden; Vesta Coal Company, Pittsburg, Pa.; Gray Manufacturing Company, Gastonia, N. C.; Furukswa Western Bureau, Japan; Home Light, Heat & Power Company, Springfield, O.; Erie Railroad Company; Great Falls & Old Dominion Railway, Baltimore, Md.; the Sidney Electric Company, Sidney, O.; Kiuskiu Railway, Japan; Imperial Printing Office, Japan; Waltham Gas Light Company, Waltham, Mass.; Lumberton Cotton Mills, Lumberton, N. C.; American Car Heating Company; Santa Cecelia Sugar Company, Cuba.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable progress in trade is the burden of reports from all sections. The lower temperature has stimulated business in seasonable merchandise, such as wearing apparel, etc., and removed the anxiety regarding the possible necessity of having to carry over heavy stocks at the end of the season. Inquiries for spring shipments from jobbers are undiminished, and little idle machinery is found in the leading manufacturing industries. Production and consumption are at a new high level, without the unsettling influence of a return to the inflated prices of a few years ago. Very liberal orders have been placed for cars and other rolling stock, which have been covered by sales of bars, billets and crude pig iron, the latter being most active at the East. Coal is active, but the Illinois and Indiana output is limited by the car supply. The same causes tend to stiffen the price of bituminous coal at the East. Lumber is active notwithstanding the lateness in the season. Textile mills are well employed, although the labor situation is not quite so favorable as it has been recently. New business is rather slow in coming in, however. Taken as a whole, the business situation is one which finds no precedents for this season of the year. The European demand for our breadstuffs is now materializing and business in this line, it is stated, is now limited only by cargo-carrying capacity. Higher prices for nearly all farm products have helped demand in agricultural districts, and, to a certain extent, improved collections. In the metal trade the market had a steady to firm tone. Lake and electrolytic copper closed at 16½c. and casting rock at 16¼c. The business failures for the week ending Oct. 26, as reported by *Bradstreet's* numbered 178, which is the same as those of the preceding week. In the corresponding week last year the number was 180.

EXPORT OF ENGINES.—At no time, perhaps, in the history of the United States has its export trade been so great as it is at present, this being especially true in regard to high-grade power machinery. The recent impetus given to the development of the Far East is responsible for a considerable part of this increase. During the past two months the Westinghouse Machine Company, of East Pittsburg, Pa., has booked many orders from foreign countries. Some of the important steam engine orders follow: One 16-in. and 34-in. x 16-in. marine type vertical cross compound engine for the Kure Arsenal, Japan; four 16-in. and 34-in. x 16-in. marine type and two 8½-in. x 8-in. standard steam engines for the Tehuantepec Railway of Mexico; one 11-in. and 19-in. x 11-in. compound steam engine for the Furukawa Western Bureau, Japan; one 13½-in. x 12-in. standard steam engine for the Hokkaido Tanko Railway Company of Japan; two 10-in. and 18-in. x 10-in. compound steam engines for the Kuiskiu Railway of Japan; one 14-in. and 24-in. x 14-in. compound steam engine for the Imperial Printing Office of Japan; one 9-in. and 15-in. x 9-in. compound steam engine for Graham Brothers, Stockholm, Sweden; one 18-in. x 16-in. compound steam engine for the Rio de Janeiro Tramway Light & Power Company of Brazil, and one 18-in. x 16-in. standard steam engine for the Santa Cecelia Sugar Company of Cuba.

WESTINGHOUSE-PARSONS TURBINES IN DETROIT.—The Public Lighting Commission of Detroit, Mich., has just placed an order with the Westinghouse Machine Company, of East Pittsburg, Pa., for a 2,000-kw turbine type generating unit, following this order shortly afterward with a second order for a machine of the same size. In the equipment of its power house on the river front in the center of the business district of Detroit, the commission has heretofore used vertical engines of the compound marine type. The early generator equipment was of the direct-current series type, the generators being rope driven from the vertical engines. Later the system was gradually replaced by the more modern alternating-current series arc system, with alternating-current generators of the direct-connected type. The two new units will be installed in the original building, replacing some of the rope-driven machinery. The turbines will be of the standard Westinghouse-Parsons type, operating at a boiler pressure of 160 pounds without superheat and at a normal vacuum of 28 inches. The generators will also be of standard Westinghouse design, of the revolving field type, and with the enclosed generator frame construction.

BIG STATEN ISLAND PLANT.—The Procter & Gamble Company, for the financing of its new soap plant on Staten Island, will increase its common stock 50 per cent, or from $6,000,000 to $9,000,000. The additional stock will be offered at par to holders of common stock. At present the stock is quoted at $450 a share in Cincinnati. The Procter & Gamble Company manufactures soap, candles and glycerine. With its original plant in Cincinnati, it built another in Kansas City a year or so ago. When the Staten Island plant is complete thousands of dollars now paid out in freight charges will be saved to the company. Actual work on the new plant will be completed in little over a year. William A. Procter is president of the company and James N. Gamble is vice-president. The new plant will need an extensive light and power equipment, and motors will be used throughout.

BELL TELEPHONES.—According to the report of the American Telephone & Telegraph Company, it had outstanding on Sept. 30, 5,324,217 instruments, a gain of 1,043,016 instruments over the number outstanding at the same date last year. This would give about 2,500,000 subscribers. The detailed figures are:

	1905.	1904.	Increase.
Gross output	160,613	106,305	54,308
Returned	51,494	38,353	13,141
Net	109,119	67,952	41,167
From January 1st to September 30th			
Gross output	1,301,058	876,609	424,449
Returned	457,405	374,925	82,480
Net	943,653	501,684	441,969
Total outstanding	5,324,217	4,281,201	1,043,016

GRAPHOPHONE FACTORY.—The American Graphophone Company, Bridgeport, Conn., is erecting three additional buildings. The extension to the power house will be equipped with a new Allis-Chalmers compound condensing engine of 600 horsepower, direct connected to Bullock generators. The producer gas plant, 30 x 70 feet, which is being installed by the Wiley Power Gas Company, Rochester, N. Y., is of 600 hp capacity and will make producer gas direct from anthracite coal. The company will use the gas for heating purposes only. The new roll building is 65 x 110 feet, two stories high, and will be used for rolling the stock from which the flat graphophone disk records are made. In this building six new 24 horsepower rolls, motor-driven, will be installed.

MECHANICAL STOKERS IN RAILROAD SHOPS.—The Pennsylvania Railroad Company has very recently placed an order with the Westinghouse Machine Company for six 132 in. x 26 in. grate and four 100 in. x 20 in. grate Roney mechanical stokers to extend already its large equipment at Altoona. Two new boiler plants were erected at Altoona only a few years ago for supplying steam power at the Altoona shops. These plants were both equipped throughout with Roney stokers, and are representative of the high development of modern boiler plant construction.

WASHINGTON STATE POWER.—Stone & Webster, of Boston, have bought the Nooksack power plant from the Bellingham Bay Improvement Company, of Bellingham, Wash., and the lighting franchises of the company. Plans for the plant provide for an ultimate development of a total from 12,000 to 15,000 hp at a cost of approximately $1,000,000. This power will be used by the Whatcom County Railway & Light Company in connection with its railway and lighting interests in the city of Bellingham, and will also be sold for general power purposes.

AMERICAN TROLLEYS IN CANADA.—U. S. Consul Ifft, of Chatham, Ontario, reports that the Windsor & Essex Electric Railway Company proposes to construct an electric railroad from Chatham to Windsor, just across the St. Clair River from Detroit, connecting there with the American electric lines and at Chatham with the Chatham, Wallaceburg & Lake Erie road. It is expected that next spring will see the construction work on this line under way. Both these lines are backed by American capital.

TAXING TURBINE MODELS.—The action of the customs officials in exacting a heavy duty on miniature patterns of turbines for steamships has resulted in the Allis-Chalmers Company filing an appeal with the Board of United States General Appraisers. It is understood that the company imported the turbine patterns to use as models. Collector Stranahan held that the articles came within the meaning of the tariff provision for "manufactures of metal," and demanded duty at the rate of 45 per cent.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, it is reported, is equipping the 4,500-line central energy multiple lamp signal switchboard now being installed by it at Meridian, Miss., with its new and improved combination listening and four-party indicating ringing keys. This key, it is said, has a number of new features in its construction that are of vital importance to the serviceability and durability of equipment of this kind.

FIGURES OF FOREIGN TRADE.—The foreign commerce transacted by and for the manufacturers of the United States will amount to more than a billion dollars in the calendar year 1905. In the nine months ending with September, for which the Department of Commerce and Labor, through its Bureau of Statistics, has just announced its figures of our foreign commerce, the imports of materials for use in manufacturing amounted to $442,000,000 and the exports of manufactures amounted to $424,000,000, a total of $846,000,000 in nine months, or an average of $94,000,000 per month, or more than $3,000,000 per day for the manufacturing interests alone. Manufacturers' materials now form practically one-half of the total imports of the United States, or, to be more exact, 48.4 per cent; and manufactured articles form practically 40 per cent of the total domestic exports, or, to be more accurate, 39.26 per cent. In 1890 manufacturers' materials formed 33 per cent of the total imports and manufactures formed but 20 per cent of the total domestic exports. Manufacturers' materials imported in the nine months ending September, 1905, were practically twice as great in value as in the corresponding months of 1890; while manufactures exported in the nine months ending with September, 1905, were practically four times as great as in the corresponding months of 1890, the figures for the nine months' periods of the years named being, for manufacturers' materials imported in 1890, $208,000,000, and in 1905, $422,000,000; and of manufactures exported in 1890, $113,000,000, and in 1905, $424,000,000. Thus the exportation of manufactured articles has grown much more rapidly than the importation of manufacturers' materials, suggesting that the exporters of the country are drawing, year by year, a relatively larger proportion of their raw materials from our own country. The fact, however, that manufacturers' materials now form a larger proportion of the total imports than in earlier years suggests that the growing requirements of the people of the United States in other lines are now being more fully met through home industries than ever before, while an analysis of the imports now brought into the country shows that a growing share of these increasing imports is of articles requiring for their production climatic conditions not existing in the United States.

A WEEK'S BUSINESS IN STEAM TURBINES.—During the week ending September 29, the Westinghouse companies of East Pittsburg, Pa., received orders from the Toledo Gas Electric & Heating Co., Toledo, O., for two 1,000-kw, turbo-generator sets, the Pennsylvania Railroad Co. for four 500-kw, turbo-generator sets, the Water, Light & Gas Company of Hutchinson, Kan., for two 500-kw, turbo-generator sets, and the Solvay Process Co., of Syracuse, N. Y., for one 500-kw, turbo-generator set. Each turbine will be of the type known as the multiple expansion parallel flow with an overload capacity when running condensing of at least 50 per cent, and the alternating-current generators will be of the turbo type with rotating fields. The turbines for the Toledo Gas, Electric & Heating Co. will be adapted for driving a direct-connected 60-cycle generator at 1,800 r.p.m., each being capable of developing 1,500 B.H.P. when operating at 1,800 r.p.m. with dry saturated steam at the throttle of 150 lb. pressure and 28-in. vacuum in the exhaust pipe. They will be provided with secondary governor valves by means of which 50 per cent overload may be developed, or full load developed when operating with condenser. The generators will have four poles and will deliver three-phase current at 4,400—4,800 volts. The generator frames will be of the enclosed type with the latest and most improved system of ventilation. The two 500-kw turbines for the Water, Light & Gas Co. will operate with dry saturated steam at the throttle of 150 lb. pressure and 28-in. vacuum. The 60-cycle generators will deliver two-phase current at 2,200 volts. The 500-kw steam turbine for the Solvay Process Co. will operate with dry saturated steam at the throttle of 125 lb. gauge pressure and 28-in. vacuum. The 60-cycle direct-connected turbo-generator will deliver two-phase current at 440 volts. This company already has in operation a number of Westinghouse steam and gas engines, in addition to 3,500 horse-power in Roney mechanical stokers. Westinghouse apparatus is also installed in the Detroit plant of this company.

AMERICAN DE FOREST WIRELESS TELEGRAPH COMPANY.—The following list of stations with the kilowatt capacity of each covers the De Forest installation at present in operation in the United States, Canada, Central America, Cuba and Brazil, the figure in the brackets denoting the capacity: Portland (2), Mobile (2), Boston (20), Providence (2), New Orleans (35), Springfield (5), Southwest Pass (2), Hartford (2), Galveston (2), New Haven (2), Port Bolivar (½), Bridgeport (2), San Francisco (2), New York (2), Cheyenne (2), Manhattan Beach (40), Boulder (2), Paterson (1), Denver (2), Galilee (2), Colorado Springs (2), Philadelphia (2), Cripple Creek (5), Atlantic City (2), Pueblo (5), Washington (8), Trinidad (5), Cape Hatteras (5), Kansas City (15), Charleston (2), Kansas City (20), Savannah (2), St. Louis (20), Jacksonville (2), Chicago (2), Key West (2), Chicago (20), Key West (Navy) (35), Indiana Harbor (2), Pensacola (10), Port Huron (1), Cleveland (5), Buffalo (5), Havana (2), Bocas del Tora (2), Ottawa (15), Port Limon (2), Quebec (15), Rio de Janeiro (2), Montreal (15), Santos (2), Porto Rico (35), Nome (2), Guantanamo (35), St. Michaels (2), Colon (35), and Ships 1 ea. (25). The combined capacity amounts to a total of 497.5 kilowatts of power which is being used by the De Forest installation in this hemisphere. The list of stations to be erected in 1906 shows a total capacity of 322 kilowatts, as follows: Toronto (25), St. John's, Nfd. (50), Dom. Govt. (32), Ships (25), Atlanta (40), Denver (40), San Francisco (80), Sault Ste. Marie (15) and Port Arthur (15). There will doubtless be many other installations, and it is stated that by the end of 1906 there will be more than 1,000 kilowatts available at the various De Forest stations.

THE PELTON WATER WHEEL COMPANY, of San Francisco and New York, has closed an important contract with the Oro Water, Light & Power Company, or Oroville, Cal. This covers two complete Pelton units of 2,000-hp capacity each, direct connected to electric generators, the wheels operating under 465 ft. head. The water wheel arrangement embraces the "double overhung" type of construction, which is typical of Pelton apparatus, especially in connection with engine type generators, forming a compact and self-contained unit. Sturgess governors will be employed, the requirements in this regard being exceedingly severe, as the current is to be used for both light and power. The latter involves the operation of gold dredges, in which the fluctuations of power and load are very sudden and heavy. Other recent orders are: A wheel equipment for the Crown Columbia, Paper & Pulp Company, of Washington, consisting of a triple Pelton unit for direct connection to heavy pulp grinders in the paper mills. The wheels are mounted upon a steel shaft 18 ft. in length, provided with an oil thrust bearing of special design. Takata & Company have ordered a 300-hp unit for Tokio, and a large wheel has just been furnished the Ingersoll-Sergeant Drill Company for direct connection to one of its compressers. Owing to the steady growth of its business, the Pelton Water Wheel Company is obliged to enlarge its works, and to that end has purchased a block of land in South San Francisco, where a modern machine shop is now under course of construction. This new shop will be equipped with the latest high-grade tools and handling devices, and it is expected to be a model of its kind, affording exceptional facilities for the construction of high-grade apparatus.

GOOD BUSINESS IN SIGNS.—The Haller Machine Company, electric sign works, Chicago, reports the following recent sales of large electric signs: Jas. S. Kirk & Co., Chicago, roof sign, 5 and 6-ft. letters; Val Blatz Brewing Co., Milwaukee, 6 and 24-ft. letters and stars; Anheuser-Busch Brewing Co. (for Baltimore, through McCay Engineering Company), 10-ft. trade mark and 4-ft. letter display sign; Klingman Furniture Company, Grand Rapids, Mich., through M. B. Wheeler Electric Co., large roof display sign; Topeka Edison Company, Topeka, Kan., one hundred and ten letter exchangeable roof sign; The Fair, Chicago, 37 5-ft. letters, changeable advertising sign; National Tube Company, Pittsburg, through Pittsburg Display Advertising Company, 30 5-ft. letters for mounting on tube frame, and others. Additional factory space has been secured, so that orders can be filled more promptly.

LEXINGTON APARTMENT HOTEL.—Percival Robert Moses, electrical engineer, 320 Fifth Avenue, New York, will act as consulting expert on the installation of a complete electric and refrigerating equipment for three ten-story buildings, 145-155 West Forty-seventh Street, Longacre Realty Company, owner, consisting of, in addition to present steam equipment, one 125-hp sectional boiler, one 12 x 12, one 11 x 12, and one 11 x 10 simple automatic high-speed engines direct connected to 50-kw, 40-kw and 30-kw direct-current compound wound multipolar 240-volt generators with motor-dynamos to balance the three-wire system. There will also be a complete 5-ton refrigerating machine installed for the ice supply of the dining room and café and refrigerating system for the kitchen and pantry boxes.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has announced its intention of going more extensively into the manufacture of metal gears of all kinds as well as its well-known New Process noiseless pinions. In furtherance of this plan the company has just completed a two-story brick addition containing about 10,000 feet floor space and is installing a number of additional turret lathes, drills, grinders, spur gear cutters, bevel gear planers and other machines necessary for the manufacture of accurate gearing. This additional equipment will increase the company's capacity about 75 per cent. Business with this concern is very brisk, and it reports shipments as considerably in excess of last year with prospects very bright for a continuance of same.

BUYING WIRES ON BRIDGE.—The Bridge Commissioner of Greater New York has been authorized to buy the wiring of the New York Edison Company on Williamsburg Bridge, so that it can be utilized by the city plant now started; instead of putting up new wires at greater expense.

INDEPENDENT TELEPHONE FACTORY.—Advices from St. Louis state that preparations of a definite character were made Oct. 27 at a banquet in St. Louis for inaugurating the operative plans of the United States Independent Telephone Company, the national corporation with a capital stock of $50,000,000 which was recently organized to conduct a general telephone business throughout the United States. The arrangements as now decided upon, contemplate the immediate building of a $6,000,000 telephone equipment plant in St. Louis and the enlargement of the present apparatus manufacturing establishment in Rochester, N. Y. The Rochester and St. Louis manufacturing plants will make the equipment. The Rochester factory will supply New York and the East and the St. Louis factory will supply the cities and states of the West. The Rochester company is capitalized at $6,000,000 and employes 2,500 men. Its investment will be increased, its buildings enlarged, its capacity doubled and its force of workmen raised to at least 5,000. The St. Louis concern will be of the same size as the present Rochester plant, having a capital of at least $6,000,000 and a force of at least 2,500 workmen. Breckenridge Jones, vice-president of the Mississippi Valley Trust Company, who is one of the most active promoters of the national independent enterprises, tendered the banquet Oct. 27, to the visiting capitalists and telephone officials at the St. Louis Club. More than fifty guests were assembled, including presidents and vice-presidents of the leading St. Louis banks and trust companies. General Counsel Page explained the franchise of the Mercantile Electric Company, which enables the company to operate in New York. He said that capital has been obtained for installing the metropolitan system, but declined to state what financiers of New York are interested.

ORDERS FROM JAPAN.—The Japanese engineering and contracting firm of Takata & Co., Tokio, Japan, 10 Wall Street, New York City, reports a large quantity of orders for Westinghouse apparatus. Among these may be noted the following: Furukawa Western Bureau: One 62½-kw, 570 volt, compound wound, direct current, engine type generator, direct connected to a Westinghouse 11 x 19 x 11 automatic compound engine. Senju Seijusho: Two type 7-B, D. C. generator panels; one type 7-B, D. C. feeder panel; one type 7-B, blank panel, all arranged to make a complete switchboard to control two 33-kw, 110 volt, shunt wound, D. C. generators connected for 3-wire distribution. Kosaka Mine: One 15-hp, 7,200 alts., 3-phase, 220 volt, type "C" induction motor; one 3-hp 7,200 alts., 3-phase, 220 volt, type "C" induction motor, which are to be direct connected to Denver Engineering Works electric mine hoists. Naval Briquette Works: One 10-hp, 110 volt, shunt wound, open type "S" motor, with back gear, ratio of 5 to 1; one 5-hp, 110 volt, shunt wound, open type "S" motor, with back gear, ratio of 5 to 1. Kimura Gold Mine: One type 13, 3-phase generator panel for one 3-phase generator, and one 3-phase feeder, 3,500 volts, 40 amperes; two 30-hp, 200 volt, 3-phase, 7,200 alts., type "C" induction motors; three 37½ kw, 7,200 alts., O. D. transformers; three 7½ kw, 7,200 alts., O. D. transformers.

BIDS FOR NAVY EQUIPMENT.—Bids will be received until Nov. 14 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., a quantity of insulated iron wire, generating sets, electric cable, sockets, insulators, copper wire, etc. Address H. T. B. Harris, Paymaster-General, U. S. N. Bids will be received until November 18 by Mordecai T. Endicott, chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing underground, lead-encased, braid-covered, arc and incandescent lighting cables, as per specification No. 1450 at the United States Navy Yard, League Island, Pa. The estimated cost is $12,500.

THE SCHMIDT-WILCKES ELECTRIC COMPANY has completed its organization as an independent telephone and switchboard manufacturing concern, with a plant located at Weehawken, N. J., and offices at 135 William Street, New York City. President Lambert Schmidt states that it has secured some very valuable telephone patents and under them will make its new product. The officers are, besides Mr. Schmidt, who is well-known as a telephone inventor and manufacturer, Mr. Felix Wilckes, vice-president; Mr Ferdinand Wilckes, secretary and treasurer; Prof. R. A. Fessenden and Mr. E. Van Berlo.

TELLURIDE POWER ENTERPRISE.—Manager L. L. Nunn, of the Telluride Power Company, has recently filed an application with the state engineer for 60 second-feet of water from the Duchesne River, in Wasatch County, for power purposes. He proposes to erect a power plant to furnish light and power for Park City, Salt Lake, Bingham, Mercur, Eureka, Price, and other localities. The water will be diverted through a 60,700-ft. canal.

Financial Intelligence.

THE WEEK IN WALL STREET.—The easier condition of the money market at the beginning of the week brought about bullish manipulation in leading stocks, but a reaction appeared toward the end. The declines were partly the result of the preceding overbuying, but were helped by the reports of the troubles in Russia, with the resulting apprehensions abroad. Local franchise stocks were subject to adverse influences, due to the uncertainties of the New York City election. The advocacy of municipal ownership of public utilities, or of repressive regulation of corporations operating under city franchises, caused marked weakness in the Metropolitan Street Railway group and other stocks of the same class. Brooklyn Rapid Transit also felt the influence of this sentiment. The industrials were the principal features of the week, the anthracite coal stocks being the chief objects of attention. American Locomotive made a new high record, and other high-priced shares were vigorously advanced. United States Steel shares were quite strong early in the week in anticipation of a favorable statement for the September quarter. The results of the week's trading in the electric industrial, traction and telegraphs are shown in the following figures: Allis-Chalmers common declined ⅜-point net, the closing quotation being 18¾ and preferred 2⅞, closing at 59¼. General Electric and Westinghouse common each closed with a net loss of 8¾ points, the last prices being 185 and 168, respectively. Westinghouse preferred, on the other hand, closed with an advance of 2½ points, the last quotation being 197. Brooklyn Rapid Transit lost 3½ points and Metropolitan Street Railway 8¼, the closing quotations being 74½ and 119. Interborough Rapid Transit declined ¾-point net, the final figure being 211¾. American Locomotive common advanced to 71⅜ and closed at 65¾, which is a net loss of 2¾, and preferred reached 117¼, but fell to and closed at 114½, a decline of 1¼ points. Western Union is down ½, closing at 92¾, and American Telegraph & Cable made a gain of ¾ point, the last quotation being 93. Lower prices are the rule on the "curb" market. Standard Oil advanced sharply, making a total gain of 70 points within a month. The closing stock quotations of Oct. 31 are as follows:

NEW YORK

	Oct 24	Oct. 31		Oct. 24	Oct. 31
Allis-Chalmers Co	20⅝	19½	General Electric	188¾	187¾
Allis-Chalmers Co. pfd	63⅝	60	Hudson River Tel	..	..
American Dist. Tel	39¾	39	Interborough Rap. Tran	212¼	211
American Locomotive	68¾	64⅞	Mackay Cos	46	46⅜
American Locomotive pfd	116	114¾	Mackay Cos. pfd	73¾	72¾
American Tel. & Cable	92	92	Marconi Tel	..	..
American Tel. & Tel.	136	136	Metropolitan St. Ry	125½	119
Brooklyn Rapid Transit	78	75¾	N. Y. & N. J. Tel	..	..
Electric Boat	30	30	Western Union Tel.	92¾	93
Electric Boat pfd	70	70	Westinghouse com.	174	170¼
Electric Vehicle	15	15	Westinghouse pfd.	..	..
Electric Vehicle pfd.	23	23			

BOSTON

	Oct. 24	Oct. 31		Oct. 24	Oct. 31
American Tel. & Tel	138	136½	Mass. Elec. Ry. pfd	56	56¾
Cumberland Telephone	122	122¾	Mexican Telephone	1¾	1⅛
Edison Elec. Illum	*249	*248	New England Telephone	138¼	*136
General Electric	189	186½	Western Tel. & Tel	13	13
Mass. Elec. Ry	13	13	Western Tel. & Tel. pfd.	90	90

PHILADELPHIA

	Oct 24	Oct. 31		Oct 24	Oct. 31
American Railways.	52	54	Phila. Electric	8⅝	8⅛
Elec. Co. of America.	11⅛	11	Phila. Rapid Trans	27¾	27⅛
Elec. Storage Battery	84	82	Phila. Traction	.	..
Elec. Storage Battery pfd.		.			

CHICAGO

	Oct. 24	Oct. 31		Oct. 24	Oct. 31
Chicago City Ry	200	*206	National Carbon	60	63
Chicago Edison			National Carbon pfd	116	116
Chicago Subway			Union Traction		..
Chicago Tel. Co			Union Traction pfd.	..	..
Metropolitan Elev. com	28½	28			

* Asked.

GENERAL ELECTRIC STOCK INCREASE.—The General Electric stockholders will meet December 5 to vote on the proposition to increase the capital stock by the amount of $11,674,500, making the total amount $60,000,000. The increase will be used to augment working capital, which is demanded by the company's expanding business and the increasing tendency to lock up funds in the construction of large and expensive machines, such as turbo generators. The gross business for the year ending January 31, 1905, was $42,800,000, a figure which will be materially exceeded, it is said, this year.

DIVIDENDS.—The directors of the New England Telephone & Telegraph Company today declared a dividend of $1.50 per share, payable November 15. Directors have declared the regular quarterly dividend of 1¾ per cent on the National Carbon preferred stock, payable November 15. Directors of the American District Telegraph Company of New York have declared a dividend of 1 per cent, payable November 15.

WESTINGHOUSE MACHINE.—The stockholders of Westinghouse Machine Company will hold a special meeting on Dec. 23 to vote on an increase of capital stock from $5,000,000 to $10,000,000.

PORTLAND RAILWAY COMPANY.—J. & W. Seligman & Co., of this city, and E. W. Clark & Co., of Philadelphia, recently bought control of the Portland Consolidated Railway Company, of Oregon. The Portland Railway Company was incorporated on October 13 under the laws of Oregon as the successor company, with $4,000,000 common stock and $3,000,000 of 5 per cent preferred stock, cumulative from July 1, 1906. The new company has authorized an issue of first and refunding 5 per cent bonds for an amount limited to $10,000,000. Of the new bonds $5,982,000 are outstanding, $1,603,000 are reserved to retire prior liens, and $2,415,000 are reserved for additions and extensions at not more than 80 per cent of cost. The company owns 112 miles of trolley line. Of the preferred stock only $2,500,000 will now be issued, leaving $500,000 in the treasury for future requirements and improvements. Underlying bonds will be redeemed on January 1, 1906, to the amount of $982,000, reducing the amount of prior liens to $1,603,000, as above stated. The sum of $500,000 is to be expended for betterments, including double tracking at various points, heavier rails and new equipment. The new officers and directors are: F. I. Fuller, president; H. L. Clark, vice-president; C. N. Huggins, secretary and treasurer; O. F. Paxton, general counsel. Executive committee: H. L. Clark, E. W. Clark, Frederick Strauss and Ogden Mills. Other directors are A. L. Mills and J. C. Ainsworth. Redmond & Co. have purchased the $5,982,000 bonds and have resold a large portion of them. They are quoted at par and interest.

COLORADO TELEPHONE.—A circular of Moffat & White reports on the condition of the Colorado Telephone Company (Bell system): For twelve years or since 1893 it has paid 6 per cent on its stock. Last year it had a surplus of $379,153 available for the payment of the $261,249 of dividends. This was after paying 26.2 per cent. of gross for operation, 18.5 per cent for general expenses and 21 per cent for maintenance, or 65.7 per cent on these three items. The circular in part says: "While some small opposition companies exist in the territory, they have not been successful, and they are insignificant, both financially and in respect to the number of subscribers. There are no 'independent' companies in Denver or other important cities in the Colorado Telephone Company's territory. The following table shows the growth of the business for the past four years:

Dec. 31,	1901.	1902.	1903.	1904.
Real estate	$204,657	$344,401	$409,584	$421,585
Invested in plant.....	2,472,570	3,278,822	4,226,040	4,666,151
Total investment	2,677,227	3,623,223	4,635,624	5,087,736
Outstanding stock ...	2,400,000	3,400,000	4,153,550	4,354,150
Gross earnings	858,819	1,083,037	1,294,838	1,497,350
Expenses and taxes ..	625,936	771,231	977,734	1,118,196
Net	232,883	311,806	317,104	379,154
Number of subscribers	16,443	23,473	30,226	37,102

"The growth and prosperity of the company has continued during the current year, as shown by the fact that on September 30 the subscribers numbered 43,906, as against 37,102 on December 31."

CHICAGO PNEUMATIC TOOL.—We have received a copy of the report of the Chicago Pneumatic Tool Company for the quarter ended Sept. 30. It shows that earnings applicable to dividends are at the rate of about 11 per cent a year. For the nine months ended Sept. 30 earnings applicable to dividends were $441,789. This was equal to 7¼ per cent for the first three quarters, and at the rate of 10 per cent a year on the capitalization of $6,113,800. A dividend of 1 per cent quarterly is now being paid on the stock. The current earnings are equivalent to nearly 23 per cent on the market valuation of the stock, which is quoted in the Chicago market below 50. The net earnings of the company, from present indications, will exceed the earnings of either 1902, 1903 or 1904. As a matter of fact the net earnings in the first half of the present year were almost as large as reported for the entire preceding year. In 1902 they were $897,059, and in 1903, $701,464. No dividends were declared in 1904. Since the first of the year the income of the Chicago Pneumatic Tool Company has shown an increase each quarter, and the net earnings for the year may come very near $1,000,000.

MAIL TUBES IN NEW YORK.—The pneumatic tubes conveying the letter mail between New York, Brooklyn, the General Post Office and Produce Exchange and the Grand Central Station went out of service last week, when they were seized by receivers for the Tubular Dispatch Company for non-payment of $645,000 interest due on bonds. The seizure did not materially affect the mail service of the city, for the Post Office was prepared and had an extra force of wagons out to do the work as soon as the use of the tubes was denied. The Tubular Company owns the tubes, while the New York Mail & Transportation Company owns the pumping apparatus supplying the motive power. When the receivers desired to seize both the tubes and power plants the Mail & Transportation Company refused to turn the power plants over to them. The Mail & Transportation Company received an annual rental of $115,000 from the Government. The Tubular Company wanted it to pay the interest on the bonds, but the Mail and Transportation Company refused. It is a great pity a "telpherage" tube system is not put in force for this service.

MILWAUKEE ELECTRIC EARNINGS.—The Milwaukee Electric Railway & Light Company's gross earnings in September showed an increase, although amounting to only .18 per cent, but as operating expenses were cut down during the month to the extent of $6,204 the increase in net was proportionately greater than that of gross and amounted to 4.4 per cent. Other income and charges increased slightly and the net result was that the September surplus showed an increase of $5,593 as against September, 1904. For the nine months of the current fiscal year only a slight increase was shown in gross earnings, but as expenses were reduced by $36,466 with other modifications, the income account shows an increase available for dividends amounting to $37,972 and a total surplus for the nine months of $543,011. Last year the company paid the full dividend on the preferred stock of 6 per cent, making a disbursement of $270,000 and 5 per cent was paid on the common stock which required $400,675. This left a surplus of $105,829 on the operations of the year.

MEXICAN ELECTRICAL MINING.—The Colonial Securities Company of New York invites subscriptions to the $3,000,000 capital stock of the Guanajuato Amalgamated Gold Mines Company. The company, which is incorporated under the laws of New Jersey, operates the Negociacion de la Paz group of gold and silver mines at Guanajuato, Mexico. The stock is issued in shares of the par value of $5 each, and the subscription price is $2.50 a share. Subscriptions will be received at the office of the Colonial Securities Company until noon on November 10. It is stated in the prospectus that the mines are now producing large quantities of high-grade ores under the most primitive methods. The proceeds of the subscription will be used to install machinery required to operate the mines on a large and profitable scale. The change of conditions in the famous Guanajuato region has been brought about entirely by electric power, as described in these pages some time ago.

NORTH AMERICAN TELEGRAPH.—It is stated from Minneapolis that the officers of the North American Telegraph Company make the announcement that the relationship between that company and the Postal will be greatly strengthened by the transfer of stock now held by Minneapolis men. There will be no change in management and the North American will remain an independent company, but the new deal will insure a renewal of the lease, which will expire in 1911. At the recent meeting 9,000 shares of the 10,000 shares of North American were represented, and it was voted to make such an exchange pro rata of North American six per cent stock for Postal 4 per cent guaranteed preferred, as would make up the additional amount of North American desired by the Postal Company.

N. Y. & N. J. TELEPHONE.—The stockholders of the New York & New Jersey Telephone Company have authorized the increase of the capital stock from $15,000,000 to $50,000,000. It is understood that the stockholders will be allowed to subscribe to stock up to 25 per cent of their present holdings. The capital stock now issued is $13,770,100, and if the additional issue amounts to 25 per cent of that, the total capitalization will be $17,212,625. The company operates in Brooklyn and in several counties of New Jersey.

MISSOURI VALLEY ELECTRIC RAILWAY.—Denison, Prior & Co., of Cleveland and Boston, and Thomas Nevins & Sons, of this city, are offering for subscription $2,500,000, the unsold portion of the $5,000,000 underwriting of the Missouri Valley Electric Railway, which has been organized under the laws of Missouri for the purpose of constructing a high-speed electric railway on private right of way from Kansas City, Mo., to St. Joseph, Mo., as already noted in these pages.

INCREASE OF CAPITAL.—The shareholders of the Mexican Light & Power Company, at a special meeting held in Montreal, ratified the plan of the board of directors to increase the capital stock of the company. The capital has been $12,000,000, which has now been increased to $16,000,000. The increase was subsequently allowed by the federal authority.

KEYSTONE TELEPHONE BONDS.—The directors of the Keystone Telephone Company, of Philadelphia, are about to make application to list $4,000,000 of their first mortgage 5 per cent bonds on the Stock Exchange.

BONDS FOR EXTENSIONS.—Shareholders of the San Francisco, Oakland & San Jose Electric Railway will meet on December 21 to vote on creating an issue of $1,500,000 second mortgage bonds, to provide for extensions and new rolling stock.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company reports $385,102 gross for August and $143,243 net. The eight months gross is $3,005,691 and the net $1,146,116. After charges, the eight months surplus is $667,801.

MONTICELLO, GA., LIGHT BONDS.—Bids will be received until November 7 by W. J. Phillips, secretary and treasurer of the town of Monticello, Ga., for $30,000 water and light bonds.

General News of the Week

The Telephone.

FORT PAYNE, ALA.—J. W. Walker, manager of the telephone exchange, is trying to establish an electric light plant. He has secured a number of customers, and dynamos and electrical machinery will soon be purchased.

KINGMAN, ARIZ.—The Consolidated Telephone Company has secured a franchise to maintain a telephone line between Ash Fork and Kingman, to connect with the present system at Jerome and with the Kingman and Needles line, with a branch to Gold Roads.

EUREKA, CAL.—Mr. Stephen Fleming has applied for a telephone franchise from Blocksburg to Carlotta. Bids will be received for the franchise until Nov. 13.

OAKLAND, CAL.—The City Council has decided to advertise for bids on a telephone franchise, despite the opposition of the Pacific States Telephone Company. The Home Telephone Company, of Alameda County, applied for the franchise.

OAKLAND, CAL.—Within the next 30 days the Pacific States Telephone & Telegraph Company will begin the installation of an underground conduit system in this city, which, when completed, will represent an expenditure of $120,000. In addition to the underground work, the company will commence the construction of a large number of overhead lines, for the purpose of extending its system into parts of the city where the present lines are inadequate to meet the demands of subscribers. The total cost of the new work will be more than $200,000.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company is opening Bell exchanges in Maryland at Kensington, Woodlawn, Mt. Airy, New Windsor, Taneytown and Union Bridge.

GRIFFIN, GA.—The Council of Griffin has named a committee to investigate the alleged deficient service of the Southern Bell Telephone Company.

SAVANNAH, GA.—At the lighting plant on Indian street extensive improvements are now under way. Considerable new machinery is being put in, which will double the capacity of the plant.

NAMPA, IDAHO.—The Bell Telephone Company will install a new switchboard here and inaugurate numerous other improvements to its system.

HUTSONVILLE, ILL.—The Hutsonville Telephone Company has been organized with a capital stock of $5,700, by C. D. Ryerson and C. H. Voorheis.

ANGOLA, IND.—The Steuben County Electric Telephone Company has increased its capital from $5,000 to $100,000.

BROWNSTOWN, IND.—The Brownstown Telephone Company has closed a deal with the Union Telephone Company by which it has placed in service sixty or more telephones.

LAFAYETTE, IND.—The Lafayette Telephone Company (independent) has purchased a large building here and will expend several thousand dollars remodeling it for a new exchange. The company will install new equipment and otherwise improve its plant in the new home.

WARSAW, IND.—During the past two years the Commercial Telephone Company has made rapid progress, having increased from 200 to 750 subscribers. The company has installed a new switchboard, completely renovated its outside construction, and in addition to paying all obligations, has accumulated a surplus.

MARION, IND.—A new telephone company has been formed with headquarters in this city. The directors include members of the Winchester, the Fort Wayne, the Delaware & Madison County and other independent telephone companies. The company formed and soon to be incorporated is said to be backed by large capital and its purpose is to install in Marion one of the best automatic plants that can be purchased. Long distance lines will be built to connect with nearby cities and towns. A franchise has been prepared and made public, which will be submitted to the Council at its next meeting. The company agrees to place all wires under ground in the business part of the city, and all wires in the resident part in cables. Business men and the people generally are urging the Council to grant the franchise because present conditions are unsatisfactory. This move means another telephone war or a fight for at least a large share of the business in Marion as against the present consolidation of the Central Union and United Telephone Company. The merchants claim the latter have cut them off from all connection with the independent long-distance lines, much to their detriment.

INDIANAPOLIS, IND.—A meeting was held in this city on Oct. 26 by the Breckenridge Jones' interests of St. Louis, and by the Stifel-Brailey interests of St. Louis and Toledo, whereby the property and control of the Indianapolis Telephone Company and the New Long Distance Telephone Company were turned over to them. This action was foreshadowed in ELECTRICAL WORLD AND ENGINEER of Oct. 28. The reorganization consisted simply of the election of new officers, as follows: For the Indianapolis Telephone Company, H. C. Stifel, of St. Louis, president: Jas. S. Brailey, of Peru, vice-president; John H. Holiday, of Indianapolis; A. H. Bauer and B. A. Althemier, of St. Louis, directors. Messrs. Jones and Volker, of St. Louis, and Messrs. Stifel, Brailey and Foster, of Toledo, voting trustees. The officers of the New Long Distance Telephone Company, H. C. Stifel, president; C. M. Foster, vice-president; Breckenridge Jones, of St. Louis; J. S. Brailey, of Toledo; A. F. Ramsey, of Crawfordsville; M. B. Wilson and Louis Hollweg, of Indianapolis, directors. There will be no change in the local management of the two companies. H. B. Sales will remain as secretary and general manager. President Stifel announces that the companies will continue separate operation, and that a large sum will be expended each year in making improvements and extensions. The St. Louis and Toledo people have also secured the property of the Terre Haute Telephone Company. These movements are the foundation for the belief that there is to be a gigantic merger of the independent companies of the Middle West with the independents of the East and the West.

JAMES, IA.—The James Telephone Company has been organized. Henry Junck is president; Frank Woolworth, secretary and treasurer.

DAVENPORT, IA.—The annual meeting of the stockholders and directors of the American Telephone & Telegraph Company of Iowa has been held and officers were elected as follows: President, E. P. Meany, of New York; secretary, Melville Egleston, of New York; treasurer, J. C. Vail, of New York.

DES MOINES, IA.—During the past year the telephone mileage of Polk County, Ia., has increased very rapidly and figures supplied to Auditor Burnett show that the present year's mileage amounts to 978.78, whereas last year it was but 306. The Mutual Telephone Company, of Des Moines, is the heaviest taxpayer with 104 miles at $384.00 per mile, a total of 30,998, and the Jasper County Telephone System comes next with 187 miles, paying a tax of $12,108.25.

SIOUX CITY, IA.—Construction work on the new independent toll telephone line, which is to connect Sioux City, Yankton and Sioux Falls, has been started. The cost of the lines will be $250,000. They will be built by the three independent companies, the Yankton Telephone Company, owning the lines from Yankton to Sioux Falls and west from Yankton to Tyndall; the Missouri River Telephone Company, owning the lines through the counties west from Tyndall to Bonesteel, and the Chamberlain, Mitchell & Citizens' Telephone Company, of Sioux Falls, having lines to Canton, Salem, Dell Rapids and Worthington, and connections with the Twin City Telephone system.

WELLINGTON, KAN.—The Bell and Independent Telephone Companies at Wellington have come to an agreement. The Bell has retained the toll line business.

PARSONS, KAN.—A charter has been granted the Citizens Home Telephone Company, a corporation with a capital of $500,000, organized for the purpose of taking over and consolidating all the independent telephone companies in Southeastern Kansas. James Plottner, George Yeager and others are the incorporators.

DENMARK, ME.—The Denmark Telephone Company has been formed with a capital of $10,000, by E. L. Head, president; O. L. Wentworth, clerk.

LEOMINSTER, MASS.—It has been voted by the executive committee of the directors of the Worcester Consolidated Street Railway Company to enlarge the power house at Leominster at a cost of $6,000. An addition is to be made to allow room for the new machinery for power for the Worcester & Leominster line, now in process of construction.

DETROIT, MICH.—Michigan is to be invaded by another big telephone company, according to Detroit reports. It is claimed that the men interested have $5,000,000 to invest in the enterprise.

BENTON HARBOR, MICH.—The Twin City Telephone Company, in this city, and the Bell Company, in St. Joseph, have decided to put their wires in the business portions of these two cities underground.

DETROIT, MICH.—The Michigan Telephone Company has under consideration the placing of the Michigan Avenue lines in conduits early next year, and will lay about ten miles of underground work in that thoroughfare.

WEXFORD, MICH.—Farmers of this township have organized a rural telephone company. The central office will be located in the village of Sherman. It is expected eventually to extend the lines a distance of 25 miles in various directions.

MANISTIQUE, MICH.—Through the efforts of business men in the two cities it is possible that the construction of a telephone line between Manistique and Escanaba will be undertaken by the Michigan State Telephone Company, this fall.

SHELBY, MICH.—Shelby, Ferry and Elbridge farmers are preparing to string a telephone line to Shelby, which is to be a part of the system of the Oceana Farmers' Mutual Telephone Company. This company has a contract with the Bell Company to furnish exchange service at Shelby, Hart and Pentwater.

NEW PRAGUE, MINN.—The Tri-County Telephone Company has been formed with a capital of $1,000,000, by S. A. Votapek and Albert Eybak.

BILLINGS, MONT.—Bids will be received at the office of the Engineer, U. S. Reclamation Service, Billings, until Dec. 15, for installing a telephone system, with eight or more telephone stations, and 22 miles or more of pole line.

FORSYTH, MONT.—The Forsyth Telephone Company, capitalized at $20,000, has filed articles of incorporation with the county clerk. A line will at once be constructed as far as Miles City. The incorporators are: J. E. Edwards, C. M. Blair and Frederic Collins.

JOPLIN, MO.—The Home Telephone Company has made plans to absorb the Southwestern Missouri Telephone Company's system..

CARL JUNCTION, MO.—The Spring River Mutual Telephone Company, of Carl Junction, has been given permission to build a telephone line on the public highway from Carl Junction through Waco to Asbury.

ST. LOUIS, MO.—St. Louis officers of the United States Independent Telephone Company, which was recently organized in Rochester, N. Y., were, on Oct. 25, chosen officers in the Indianapolis Home Telephone Company. They are James P. Bradley, jr., vice-president, and John Holliday, Benj. Altheimer and A. Bauer, directors. The Long-Distance Telephone Company elected the following-named officers: Herman Stifel, president; Marquard Forster, vice-president, and Breckenridge Jones, A. F. Ramsey, M. B. Wilson and Louis Hollweg, directors.

CENTRAL CITY, NEB.—The Nebraska Telephone Company is preparing to rebuild its lines at this place. Between $10,000 and $15,000 will be expended.

ODESSA, N. Y.—The Odessa Telephone Company has been organized with a capital of $5,000, by Elmer Sherwood and Dwight Sherwood.

ALBANY, N. Y.—An ordinance has been passed requiring the Hudson River and the Home Telephone Companies to place their wires in this city in underground conduits.

CORNWALL, N. Y.—The Cornwall Telephone Company has been incorporated by W. B. Goodwin, Learned Hand and G. Morrell, of New York, directors. The capital is $5,000.

TICONDEROGA, N. Y.—The Ticonderoga Home Telephone Company has been formed. Capital, $25,000. Incorporated by Robert N. Clemons, Dresden Station, N. Y., and others.

BUFFALO, N. Y.—In all probability the Home Telephone Company and the Interoceanic Telephone Company, of Buffalo, will join hands in the laying of the conduits throughout the center of the city to care for all wires. The question of conduits seems to be practically settled. All the wires in the business section are to be accommodated. A twenty-duct conduit is proposed for Main Street. Two and one-quarter miles in all will probably be built at an expense of $40,000.

TOLEDO, OHIO.—The Wood County Telephone Company has increased its capital from $200,000 to $300,000.

AUSTINBURG, OHIO.—The Austinburg Telephone Company has been formed. Capital, $5,000. Incorporated by F. M. Houghtaling and Tracy Herrick.

MOUNT BLANCHARD, OHIO.—The People's Telephone Company has increased its capital stock from $50,000 to $100,000. F. E. Palmer is president.

WOOSTER, OHIO.—The Wooster, Millersburg & Orrville Telephone Company will enlarge its quarters to accommodate its rapidly increasing business.

WINDSOR, OHIO.—The Windsor people are planning a local telephone company and want to get connection with Jefferson. The cost for annual rental of the telephones in Windsor will be about $3.

BRYAN, OHIO.—The Bryan Telephone Company, of this place, has purchased the plant of the Pioneer Telephone Company, of Pioneer, operating something over 100 telephones.

LIMA, OHIO.—The seventh district of the Ohio Independent Telephone Association, composed of Allen, Auglaize, Marion, Wyandot, Hancock, Putnam, Paulding, Van Wert, Mercer and Hardin counties, met in semi-annual session here, October 5, with representation from each of the forty-one companies in the district.

ZANESVILLE, OHIO.—At a special meeting of the stockholders of the Zanesville Telephone & Telegraph Company, $50,000 was voted for extensive improvements to the company's property in the city during the next year. This $50,000 will be expended to lay more of the vitrified conduits in the city streets, extending the already extensive underground system of wires; also in the extension of cables. The single wire lines will also be greatly extended at the same time. All this improvement contemplated will accommodate 1,000 to 1,500 new subscribers.

ALLENTOWN, PA.—The Consolidated Telephone Company, of Allentown, Pa., has decided to spend $200,000 in installing automatic telephone plants in this city, and in Hazelton.

PIERRE, S. D.—The local telephone exchange has been sold and Manager Zietlow and Secretary Bilkenhaupt are now the owners. Connections are to be made with the Twin Cities.

DALLAS, TEX.—The Texas Independent Telephone Clearing House Association has been organized and application has been made for a charter. The promoters will proceed to organize the various independent long-distance companies under one head for mutual benefit. The incorporators are: E. W. Dunaway, A. J. Brown, C. L. Simpson, J. E. Boynton, G. R. Butler and C. A. Shock.

PRICE, UTAH.—An arrangement has been entered into between the Utah Telephone Company and the Bell Company, whereby the lines of tne two companies are to connect in this city.

WILLIAMSBURG, VA.—The Chesapeake Telephone & Telegraph Company, of Williamsburg, has passed into the control of the Bell Telephone Company. The purchase is said to give the Bell control of the system from Norfolk to Richmond.

PARKERSBURG, W. VA.—The Citizens Telephone Company, which has lines all through the lower end of the county, and is seeking connection with this city, has been granted permission to set its poles along the public highway.

DE PERE, WIS.—The Telephone Company has inaugurated its service in De Pere. The company is extending the line to Kaukauna, by way of Greenleaf and Wrightstown.

MILWAUKEE, WIS.—Mr. Harold D. Stroud, of St. Louis, has applied to the City Council for a telephone franchise. This is the fifth independent company to aply for a franchise. The company proposes to charge 2 cents per call and allow reductions on a certain number of calls.

LA CROSSE, WIS.—All the electricians and linemen of the four telephone companies centering here struck on Oct. 23 for recognition of the union. The companies are paying the union scale and working union hours, but the question of open or closed shop is the point in controversy. The Wisconsin Telephone Company and the La Crosse Telephone Company are concerned. The La Crosse County Telephone Company, the Tri-State Telephone Company, and several interurban lines are less seriously affected.

Electric Light and Power.

GRAVETTE, ARK.—G. W. Dunbar, of Gravette, is interested in the construction of an electric light plant, street railway and water works.

PASADENA, CAL.—The Valley Electric Company has been incorporated with a capital of $500,000, by R. F. Davis, E. A. Miller, of Pasadena, and others.

VISALIA, CAL.—A. G. Wishon has applied for a franchise to erect poles and wires for transmitting electric power and for telephone wires along streets and highways in Tulare County. Bids for the franchise will be received by E. L. Scott, coun'y clerk, Nov. 10.

SAN FRANCISCO, CAL.—Arrangements have been completed for the financing of the Stanislaus Electric Company, which was recently incorporated to establish an electric power station on Stanislaus River, and furnish electric light and power to Stockton, San Jose, San Francisco and intermediate points. Leopold Michaels, president San Francisco Gas & Coke Company is reported interested.

SPARTA, GA.—The citizens have voted in favor of issuing $12,000 bonds to establish an electric light plant.

ATLANTA, GA.—R. L. West, of Atlanta, is among the promoters of the Etowah River electric power development, between Rome and Cartersville, Ga.

ATLANTA, GA.—The Southern Light & Power Company has decided to issue $500,000 bonds, to be used for the construction of an electric plant in or near Atlanta, for the purpose of furnishing power in Fulton and DeKalb counties.

PARIS, ILL.—The Paris Gas & Electric Company has been reorganized with Wm. Hunter, of Paris, as president, and J. C. Shumway, of Taylorville, secretary, and will issue $20,000 bonds to make improvements.

CHICAGO, ILL.—The City Council on Oct. 23 passed a resolution authorizing the commissioner of public works and the city electrician to prepare estimates of cost of securing electric power from the water power of the drainage canal; also authorizing the finance committee to make the necessary appropriation for use of this power.

ZIONSVILLE, IND.—The Zionsville Lumber Company is preparing to install an electric light and power plant in connection with its large planing mill

GENEVA, IND.—Wm. R. Thurston, of Berne, Ind., has been granted a franchise to build an electric light plant in Geneva. A stock company is being organized by Mr. Thurston.

VINCENNES, IND.—John Fries, Wm. Bolk and H. H. Osterhage are heading a company to build a large ice plant and cold-storage house. The company will also, it is understood, install an electric plant.

EVANSVILLE, IND.—The Evansville Gas & Electric Light Company has entered into a contract to furnish electric power for three of the interurban roads running into Evansville, with a possibility of securing a similar contract for the fourth line. Extensive additions are being made to the company's plant in order to supply the needed power. The company estimates that it will expend upwards of $130,000 on these improvements.

SHELBYVILLE, IND.—By direction of the United States Court, the property and business of the Citizens' Water & Light Company, of Shelbyville, has been transferred back to the company. A mortgage for $50,000 on the plant has been given to the United States Mortgage & Trust Company. The directors are now planning to make extensive improvements.

INDEPENDENCE, IA.—The city officials are considering plans for the improvement of the electric light plant.

PAOLA, KAN.—The citizens have voted to issue $25,000 to construct an electric light plant.

GEARY, KAN.—The Geary Electric Light & Power Company has been incorporated with a capital of $5,000. Directors: Chas. F. Dyer, I. J. Robb and J. M. Robb, all of Bridgeport.

DEXTER, ME.—The Dexter Electric Light Company has passed into the control of N. Curtis Fletcher, of Boston. It is understood that the service will be extended and improved.

NORTH ANSON, ME.—The Carrabassett Stock Farms Company has completed the dam at East New Portland, preparatory to installing an electric light plant to furnish light for this village.

BIDDEFORD, ME.—The estimated cost of wiring the buildings of the Pepperell Manufacturing Company is estimated at $16,000. The York Light & Heat Company will expend $42,000 at the power station in increasing the lighting capacity. It is estimated that the cost to the electric light company of running wires, etc., from the station to the mill entrance will be $10,000.

BALTIMORE, MD.—The Board of Awards has approved the plans of Subway Engineer Phelps, for special duct pipe and underground cable.

AMHERST, MASS.—The Amherst Gas & Electric Light Company will extend its service to West Pelham.

QUINCY, MASS.—The City Council has been petitioned for the right to establish a municipal gas and electric lighting plant.

HAVERHILL, MASS.—The Haverhill Electric Company has petitioned the city to share the expense of placing its wires underground.

PITTSFIELD, MASS.—The Great Barrington Power Company has awarded to the Stanley Company, of this city, the contract for generators and electrical equipment. The contract amounts to about $13,000.

LEOMINSTER, MASS.—Extensive repairs and improvements are to be made at the Leominster Electric Light & Power Company's plant on Mechanic Street, which is now owned by the Massachusetts Lighting Company.

FITCHBURG, MASS.—The committee on fuel and lighting streets reported an agreement with Fitchburg Gas and Electric Light Company to furnish incandescent lights in all city buildings at 12 cents per kilowatt hour, a cheaper rate than is now paid.

WORCESTER, MASS.—The Worcester Electric Light Company has sent a petition to the Gas and Electric Light Commission requesting permission to increase the capital stock of the company $200,000, the purpose of the increase being to provide funds for additions to the plant.

LYNN, MASS.—The Street Lighting Committee has signed the contract with the Lynn Gas and Electric Company for lighting the town for the next five years. An important provision in the contract is one relating to a municipal plant, as it provides that the contract shall cease at any time during the term of five years for which it is made, if, by the vote of the town, a municipal plant should be established.

MALDEN, MASS.—At a meeting of the Malden and Melrose Gas Light Company, the entire stock of the company was sold to a syndicate representing the Malden Electric Company, which will consolidate the companies. The directors of the new company are also directors in the Springfield Gas Company and in the Malden Electic Company. They are A. B. Tenney, Brookline; E. A. Hildreth, Cambridge; F. P. Royce, Dedham; C. H. Tenney, Hartford; H. P. Wood, Boston; Oakes Ames, Milton; S. A. York, E. M. Bradley and H. E. Warren, all of New Haven. The treasurer will be A. B. Tenney and Horace P. Wood will be clerk. The new company will take immediate action to improve the service and will make extensive repairs.

SALEM, MASS.—The street lighting contract expired the first of October, but as it contained a provision that it might be continued for six months without a new contract, there is no danger of the city being obliged to pay an extra price or going without lights before April 1, at least. The committee on street lighting is collecting data of what other places are paying for lights and the quality of the light, and proposes to place the whole matter before the City Council with the figures offered by the local company. There is a strong element in the Council in favor of returning to the open arc system, as it is claimed that the city was better lighted under that system and the apparent saving made by the change has been offset by the increased number of lights required.

MUSKEGON, MICH.—The Grand Rapids & Muskegon Electric Water Power Company has petitioned for a franchise to furnish the city with electric light and power.

MANISTEE, MICH.—The Manistee River Power Company has petitioned for permission to dam the river near Sherman and erect a power house about 1 mile east of that village. Traverse City, Manistee and Cadillac, it is stated, are to be furnished with light and power and the plant is to be capable of developing 3,000 horse-power. A meeting of the Board of Supervisors is to be held Nov. 15 at Cadillac to consider the petition.

LUDINGTON, MICH.—The County Board of Supervisors has granted to the Pere Marquette Light & Power Company a permit to erect a dam on the south branch of the Pere Marquette River in Mason County. J. H. Cotton is president of the company and George S. Root, vice-president. It is understood that the company intends to furnish power and light to Hart, Scottville, Custer, Pentwater and other towns.

FOLEY, MINN.—O. F. Doyle has submitted an estimate to the citizens of Foley, estimating the cost of a water works and an electric light plant at a total of $13,144.

STARKVILLE, MISS.—Bonds to the amount of $8,000 have been sold for extending the water and light plant.

DILLON, MONT.—The electric power plant of the Dillon Electric Light & Power Company is being improved at an expense estimated at $10,000.

WARSAW, MO.—W. S. Davis, City Clerk, writes that bids are wanted Nov. 10 for the construction of an electric light plant.

RENO, NEV.—A movement is being made by the City Council toward the municipal ownership of the holdings of the Reno Power, Light & Water Company, and it is believed that some such deal will be consummated in the near future.

MEREDITH, N. H.—It is reported that the plant of the Meredith Electric Company has been purchased by the Laconia Electric Light Company, and the power station here is to be discontinued. It is said to be the intention of the new management to extend the wires from Lakeport to Meredith, a distance of about 6 miles.

NEWARK, N. J.—A special committee of the Board of Public Works has recommended that a municipal electric light plant be established to light that part of the city north of the Lackawanna Railroad. The Belleville pumping station is the suggested location of the plant, which will have a capacity of 500 lights.

ASHTABULA, OHIO.—The superintendent of the electric light plant has petitioned the finance committee for an appropriation of $7,250 for improvements to the electric light plant.

MANSFIELD, OHIO.—The stockholders of the Mansfield Electric Light & Power Company have chosen directors. The following officers were elected by the board of directors: President, C. W. Upson; vice-president and treasurer, J. J. McIntyre; secretary and superintendent, W. C. Hedges.

LEBANON, PA.—Geo. R. Hersey and Eli Nisley have secured an electric light franchise.

HUNTINGDON, PA.—The Juniata Water & Water Power Company has increased its capital for $5,000 to $75,000. It is stated to be the purpose of the company to construct a plant on Juniata River, near Huntingdon, for the generation of electric power.

DANVILLE, PA.—The date of opening of bids for the erection of a power house, electric generator plant, engines, boilers, motors, etc., and wiring the Administration Building, Wards, etc., at the State Hospital for the Insane, has been extended from Oct. [illegible] to Nov. [illegible]. Address all bids to Dr. Levi I. Shoemaker, Chairman Building Committee, Board of Trustees, State Hospital for the Insane, care of Dr. H. B. Meredith, Superintendent.

EDGEFIELD, S. C.—It is proposed to install an electric light plant here.

BISHOPVILLE, S. C.—The corporators of the Bishopville Light & Power Company have secured a charter from the State of South Carolina.

GREENVILLE, S. C.—Jos. E. Sirrine, of Greenville, is the engineer for the $750,000 electrical power development for the Hatton's Ford Power Company, near Anderson, S. C.

LAWRENCEBURG, TENN.—The citizens have voted to issue $25,000 bonds for the construction of water works and an electric light plant.

KNOXVILLE, TENN.—The City Council has authorized the Board of Public Works to award to the Knoxville Railway & Light Company a contract for 303 or more arc lights at a cost of $72.50 per light per year for a period of 10 years.

COALVILLE, UTAH.—The City Council has awarded a contract to Thomas L. Allen for an electric power plant in this city.

SHENANDOAH, VA.—Mayor S. D. Louderback will receive bids until Nov. 14 for an electric light and power franchise.

FORT D. A. RUSSELL, WYO.—Bids will be received by Capt. W. S. Scott, Q. M., U. S. A., Cheyenne, until Dec. 2 for furnishing and installing electric fixtures in certain buildings and for extending the lighting system at Ft. D. A. Russell.

LETHBRIDGE, ALBERTA, CAN.—A by-law will be introduced in the City Council favoring the purchase by the city of the electric light plant and the telephone system, and operate both under municipal ownership.

WINNIPEG, MAN.—The Great Falls Power Company proposes to develop the power at Big Bonnet Falls. Duncan Sinclair, Winnipeg, is secretary of the company

The Electric Railway.

TUSCALOOSA, ALA.—A. J. M. Dewberry and others have secured a franchise from the town of Tuscaloosa, to operate an electric railway in the town and in Jefferson county. It is proposed to build the line from Birmingham to tidewater, furnishing a cheaper rate on iron and other products.

DOWNIEVILLE, CAL.—Rights of way have been secured for the new electric railway from Sierraville to Beckwith. The entire valley will also be supplied with electric power as soon as the power plant can be erected.

SAN FRANCISCO, CAL.—W. R. Hawley, assistant general manager of the Crown Paper Company and bankers Rhodes, St. Clair and Butcher, of Philadelphia, are interested in water rights on the Santiam River in middle western Oregon, and propose to build an electric railway from Portland to Salem. This will probably be extended in time to Eugene and Roseburg. The Philadelphians acquired interests in the lighting at Salem and Eugene.

SAN FRANCISCO, CAL.—The Ocean Shore Railway Company has filed amended articles of incorporation, increasing its capital stock from $3,000,000 to $5,000,000, the greater sum being required for the construction and equipment of the road now being built from the Richmond district in this city to Halfmoon Bay and Santa Cruz. Contracts for the electrical equipment of the power house and substations of the company were recently awarded to the General Electric Company, while Chas. C. Moore & Company secured contracts for the steam equipment.

SAN FRANCISCO, CAL.—At the annual meeting on Oct. 16 of the Vallejo, Benicia & Napa Valley Railroad, it was decided to extend the line to St. Helena and Calistoga. The company expects to spend several million dollars in extensions and improvements within the next three years. All the present officers were re-elected except the general manager. To that position L. F. Perry was chosen. It is probable that the general offices of the road will be removed from Los Angeles to San Francisco and later to one of the terminal points.

WATERBURY, CONN.—The Thomaston Tramway Company and the Connecticut Railway & Lighting Company have entered into an agreement to have the street railway line between Waterbury and Thomaston constructed not later than July 1, 1906. The two sections of road will effect a junction at the boundary line between the city of Waterbury and the town of Thomaston.

OTTAWA, ILL.—The Illinois Light & Traction Company, of Streator, has been incorporated with a capital stock of $400,000. The shareholders are I. H. Sherwood, W. V. Coons and Fred Edwards.

CROWN POINT, IND.—The Northwestern Indiana Interurban & Street Railway Company, of this city, has filed articles of incorporation, capitalized at $10,000. The directors are Geo. M. Bliss, Frank C. Knight and W. B. Wray.

MASON CITY, IA.—The Mason City & Clear Lake Traction Company has let contracts for machinery for a new power station. The Westinghouse Company will furnish the electrical equipment.

SPRINGFIELD, MASS.—At the annual meeting of the Connecticut Valley Street Railway the following officers were elected: President, Col. F. E. Pierce, of Greenfield; secretary and treasurer, D. P. Abercrombie, jr., of Turners Falls; superintendent, J. A. Taggart, of Millers Falls.

SPRINGFIELD, OHIO.—Judge Kunkle has authorized Stacey B. Rankin, receiver of the Springfield, South Charleston, Washington C. H. & Chillicothe Traction Company, to sell the property.

STEUBENVILLE, OHIO.—The Steubenville & Wellsburg Railway Company has been granted a franchise over certain streets in Steubenville. The company will operate a line from Steubenville to Wellsburg and Follansbee, W. Va.

NELSONVILLE, OHIO.—The Nelsonville, Athens & Glouster Traction Company is securing right of way for a line between Athens, Nelsonville, Buchtel and Glouster, all mining towns. The promoters of the company are L. F. Carpenter, T. E. Wells, Charles Lutt, B. C. Wise and others, of Nelsonville.

COLUMBUS, OHIO.—The following directors have been elected for both the Columbus, Buckeye, Lake & Newark Traction Company and the Columbus, Newark & Zanesville Electric Railway Company; W. K. Schoepf, Hugh Mc Gowan, George H. Warrington, J. B. Foraker, jr., Dana Stephens, Randall Morgan and T. H. Dickson. The officers selected were: President, W. K. Schoepf; vice-president, Hugh McGowan; secretary-treasurer, F. A. Deverall. The executive and transfer offices of the companies have been removed from Boston to Cincinnati.

OREGON CITY, ORE. W. P. Hawley, a local capitalist, states that Eastern capital is preparing to build an electric rialway from Portland to Roseburg; the first section, from Portland to Salem. The proposed road will go to Eugene and south by a route yet to be determined, to Roseburg.
the solicitors.

POTTSTOWN, PA.—The Ringing Rocks Electric Railway Company has passed into the hands of the Security Company, of Pottstown, trustee for the bondholders. The mortgage on the road has been foreclosed and execution issued, and after three months have elapsed it will be sold. It was the intention of the owners of the road, who are principally Pottstown business men, to extend the line to Boyertown, but the objections of a few obstinate property holders held up the line and prevented the company from carrying out its plans.

MORGANTOWN, W. VA.—W. W. Smith, of Morgantown, attorney for the Morgantown & Dunkard Valley Railroad Company, writes that it is proposed to construct an electric railway 42 miles in length from Morgantown to Mannington. The probable cost of the work is $300,000 to $500,000. Prof. C. R. Jones will have charge of the electrical part of the work. Bids will be called for in 60 to 90 days.

ST. CATHERINES, ONT.—Application will be made to the Parliament of Canada for an act to incorporate a company to be called the Buffalo, Niagara & Toronto Electric Railway Company. Collier & Barson, of St. Catherines, are

New Industrial Companies.

THE TUDOR FARM MOTOR CAR COMPANY, of Sharon, Mass., has been formed with $15,000 capital, by Dorsey L. Greene, Emil Camus and James H. Whipple.

THE AUTOMATIC PROTECTION COMPANY has been incorporated at Jersey City with a capital of $100,000. Incorporators: Louis B. Dailey, Thomas F. Barrett, and L. H. Gunther.

THE HUTCHISON ELECTRIC HORN COMPANY, of Ossining, N. Y., has been incorporated with a capital of $20,000. The directors are M. R. Hutchison and W. M. Williams, of New York, and P. J. Pierson, of Ossining.

THE BRUCE ELECTRIC COMPANY, of Columbus, Ohio, has been incorporated with $25,000 capital stock, by Robert L. Bruce, J. B. Addison, George C. McKeever, Lewis G. Addison and Charles Munson. The company will deal in all kinds of electrical and glass supplies and fixtures.

THE MOUTERDE ELECTRIC ACCUMULATOR COMPANY has been incorporated at Montreal, Que., with a capital of $250,000 for the purpose of manufacturing accumulators, meters, motors, etc. The directors are: Francois Mouterde, Montreal; J. G. Ryan, New York; J. S. Visger, Denver, Col.

THE JONES & MOORE ELECTRIC COMPANY has been incorporated at Winnipeg, Man., with a capital of $75,000, to deal in electrical machinery and supplies. The directors are: J. W. Jones, Toronto, Ont.; G. J. Hicks, L. M. Delbridge, J. C. Kavanagh and C. W. Bradshaw, all of Winnipeg, Man.

THE RAIL JOINT COMPANY was organized last week by filing a certificate of incorporation. It has a capital stock of $1,500,000, of which $1,000,000 is common and $500,000 preferred. The officers of the company are: President, Frederick T. Fearney; vice-presidents, Lawrence F. Braine and Percy Holbrook; treasurer, Fernando C. Runyon; secretary, Benjamin Wolhaupter. This company will take over the business and properties of the Continuous Rail Joint Company of America, the Weber Railway Joint Manufacturing Company and the Independent Railroad Supply Company

Legal.

WIRELESS LITIGATION.—Judge Townsend, in the United States Circuit Court, sitting in New York City, last week, refused to vacate an order issued on May 20 at the instance of the De Forest Wireless Telegraph Company, suspending the injunction granted against the Marconi Company in its suit against the De Forest Company for alleged infringement of patents. Last May Judge Townsend handed down an exhaustive opinion in the case rejecting the Marconi Company's broad claim covering the entire wireless telegraph field, but at the same time sustained that part of the Marconi Company's contention relating to the construction of the elevated structure used in sending and receiving messages. Upon this latter finding an injunction was issued, but the defendants got an order suspending the operation of the injunction pending an appeal. Recently the Marconi Company attempted to have this last order vacated, which Judge Townsend by his latest order denies. The final outcome of the case rests with the decision of the United States Court of Appeals.

Obituary.

MR. GEORGE C. BAILEY, secretary and treasurer and Chicago manager for twenty years for the John A. Roebling's Sons Company, died at his residence, 5224 Jefferson Avenue, Chicago, on Oct. 28. Mr. Bailey was born in 1843 and was with the John A. Roebling's Sons Company for eight years before he went to Chicago to establish a branch there in 1885. His wife and two children survive him. He was a member of the Union League Club of Chicago. Funeral services were held in Chicago October 30.

Personal.

MR. H. H. WESTINGHOUSE, at the annual fall meeting of the board of trustees of Cornell University, was elected one of the trustees.

MR. C. F. CHISHOLM has been appointed superintendent of the Suburban Gas & Electric Company, of Revere, Mass., which has a large electric light plant.

MR. C. H. HINES has been appointed master mechanic and chief engineer of the Tezuitlan Copper Co., Tezuitlan, Puebla, Mexico, and has assumed his new duties

MR. ARTHUR WARREN has resigned his position as manager of publicity for the Allis-Chalmers Company, and will sail for Europe on a journalistic mission about the end of November.

MR. A. H. BURTON has started the electrical construction and contracting firm of A. H. Burton & Co. at South Norwalk, Conn., and has already on hand a large number of wiring contracts for new buildings and residences.

MR. ANDREW PINKERTON has resigned as electrical engineer of the Vandergrift-Apollo Works of the American Sheet-Steel Company, in order to enter into partnership with George P. Dravo, of Milwaukee, the firm to engage in consulting engineering and contracting.

MR. WARREN F. HUBLEY, until recently representative of the Sunbeam Incandescent Lamp Company, at Philadelphia, Pa., has resigned in order to accept the position of Western representative of the American Transformer Company, of Newark, N. J. His headquarters will be with the Western Electric Company, Chicago, Ill.

MR. LEWIS B. STILLWELL has been appointed consulting electrical engineer of the New York, Westchester and Boston Railway Company, effective Nov. 1, 1905. He will advise the chief engineer in all matters pertaining to the electrical and mechanical equipment, and will generally direct the work of the electrical department.

FIRST LIEUT. A. C. VORTS, U. S. Signal Corps, has been relieved from further operations in special orders of August 21st, and will make during the fiscal year ending June 30, 1906, three visits from St. Michael to Nome, six visits to Safety Harbor, and one visit to Kaltag, Alaska, on business pertaining to wireless telegraphy system of Alaska.

MR. S. E. WOLFF has been appointed assistant general manager of the Saginaw-Bay City Railway & Light Company. Mr. Wolff has for a number of years been manager of the Jackson Gas Company. The place of assistant general manager is newly created. Mr. Wolff had been with Hodenpyl, Walbridge & Co. for a period of about twelve years and he is everywhere recognized as one of the best experts in his line.

MR. MAX LOEWENTHAL, who of late years has devoted his attentions and energies as an electrical engineer to the development of electric heating, has undertaken as a specialist the creation and development of a heating department for the Edison Electric Illuminating Company, of Brooklyn. Such an experiment is well worth the making by every local lighting company, and Mr Loewenthal's work will be followed with deep interest.

MR. H. S. PUTNAM has been appointed electrical engineer of the New York, Westchester and Boston Railway Company, effective Nov. 1, 1905. He will have entire charge of the electrical department as organized in the office of the chief engineer; will report directly to the chief engineer, will supervise the work of the electrical department, and see that it is carried out along the lines as suggested by the consulting engineer.

MR. H. H. VREELAND has been visiting Minneapolis, and while there said: "In my belief, the day will soon come when every street running north and south in New York City, will be provided with its surface, subway and elevated lines. Even then it is doubtful if the increased facilities will care for the enormous travel that the growth of the city brings with it every year. As fast as possible the problem is being worked out with new subways and elevated lines."

MR. C. T. YERKES.—A cable dispatch from London of October 28 says: "Mr. Charles T. Yerkes is back in London, entirely recovered from the mysterious illness which caused such a sensation last July. He laughed merrily when told of the supposed contents of the will he was reported to have made. Whether or not he has bequeathed his priceless art treasures to the Metropolitan Museum in New York he altogether refused to say. "If the people want to know what is in my will," he said, "they will have to wait till I am under the turf, and I can only hope their charity is as strong as their curiosity."

MR. CHARLES W. WETMORE, president of the North American Company; Edwin M. Bulkley, of Spencer Trask & Co., a Director, and C. D. Smithers, of F. S. Smithers & Co., have just returned to New York City from a trip of inspection of the properties of the important subsidiary companies of the North American Company, the United Railways, Union Electric Light and Power, and Laclede Gas Companies of St. Louis; the Milwaukee Railway & Lighting Company and Milwaukee Light, Heat & Traction Company, and the Detroit Edison Company. All were found to be in greatly improved condition

MR. JOHN F. TINSLEY, assistant electrical engineer, Signal Corps, U. S. Army, has resigned from the service to become associated with the American

Steel & Wire Company. Mr. Tinsley graduated from the electrical engineering department of Rutgers College, with the degree of Bachelor of Science in the class of 1900, taking first honors. Previous to his appointment to the engineering staff of the Signal Corps, early in [illegible], he was connected with the Western Electric Company, in New York, and later with the United Electric Company, of New Jersey, in engineering work. In the Signal Corps, Mr. Tinsley has been connected with some of the most important work of that branch of the service, notably the Alaskan submarine cable work. For some time past he has been the Signal Corps engineer for the Department of California, where he was associated with Major Squier, in the latter's important experiments in wireless telegraphy. In 1904, Mr. Tinsley obtained the degree of Master of Science from Rutgers for professional work done since graduation and for a thesis on cables. He is a member of the Chi Phi and Phi Beta Kappa fraternities, an associate member of the American Institute of American Engineers, and an active member of the San Francisco branch of the Institute, which he helped to organize.

◆

Trade Publications.

ARC LAMPS.—Supply catalogue No. 7501 of the General Electric Company, Schenectady, N. Y., describes parts of edgewise parallel-rod, 110-volt, direct current multiple enclosed arc lamps, forms 12 and 14.

MINING MACHINERY.—The Allis-Chalmers Company, Milwaukee, Wis., has just issued bulletin No. 1403, describing the Hancock jig for use in concentrating plants. Bulletin No. 1404 deals with the McDougall roasting furnace of the enclosed firebox type.

THE SIMPLEX ELECTRICAL COMPANY, 110 State Street, Boston, Mass., has issued a limited edition of a little device in celluoid, serving as a wire computer. It is easy to carry in the pocket, and easy to apply in everyday work. On the back are sizes in B. & S. gauge and in circular mils.

TELEPHONES.—The Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y., has issued an attractive booklet describing its numerous types of telephones. Illustrations are given of intercommunicating desk telephones, combination hand telephones, portable desk telephones, central energy wall telephones, intercommunicating wall telephones and private branch exchange switchboards.

CRANES.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has issued an extremely well illustrated catalogue dealing with overhead-traveling, Gantry locomotive and ladle cranes for iron and steel works. These cranes are operated by electric motors. In addition to giving numerous views of installations now in service, the catalogue contains a list of the users of Wellman-Seaver-Morgan cranes, showing the number, the type and the capacity of the equipments.

PACKING AND GASKETS.—The Peerless Rubber Manufacturing Company, 16 Warren Street, New York, has issued an illustrated booklet describing "Rainbow" sheet packing, "Peerless" piston and valve-rod packing and "Eclipse" gaskets. A entertaining feature of the booklet resides in the use of numerous illustrations to emphasize the humorous remarks employed in calling attention to the several imitations of these standard goods which have appeared from time to time.

ELECTRIC RADIATOR.—Publication 3367, of the General Electric Company, Schenectady, N. Y., describes the luminous electric radiator. The source of the heat is a small filament which becomes incandescent immediately, emitting a powerful heat from the moment the current is turned on. The device radiates the heat and does not depend for its operation on setting up a current of warm air, which takes considerable time. The radiator is especially advantageous for giving temporary heat on chilly days, when it would not pay to start a fire in the house for the sake of warming one or two rooms.

MAKING TELEPHONE CABLES.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has just issued an instructive booklet giving an insight into the processes of manufacture of telephone cables. The booklet contains numerous illustrations showing the interior of the factory where the cables are produced. Views are also given of the laboratories for making mechanical, electrical and chemical tests. In issuing the pamphlet the company takes occasion to state that ten years' experience in the manufacture of cable has necessitated the quadrupling of its plant to meet the increased demands.

REFLECTORS.—The new reflector manufactured by the National X-Ray Reflector Company, Chicago, is stated to be constructed on scientific principles, its power being due to the peculiar corrugations and flutings. The reflected rays, it is said, combine to produce a pure white light, with a resulting large economy. A 10-in. reflector utilizing a 16-cp lamp gives a useful illumination several times that from the lamp alone. It is claimed that these reflectors increase the illumination in a useful direction from a given number of lamps 100 per cent, and, conversely a given amount of illumination can be obtained from half the number of lamps usually employed.

MOTORS IN SMALL SIZES.—Booklet 4120 of the Emerson Electric Manufacturing Company, St. Louis, Mo., describes a line of self-starting, single-phase motors in sizes from .05 hp to 2.50 hp, and a line of fully enclosed, bipolar and multipolar motors in sizes from .05 hp to 2.50 hp. These motors are treated more in detail in the following bulletins. Bulletin No. 3201 treats of bipolar motors for direct current in sizes from ⅛ to ⅓ hp, while Bulletin No. 3202 deals with [illegible] type in sizes from 1-20 to ⅙ hp. Bulletins No. 3301 and 3302 describe single-phase and direct-current motors, direct-connected to forge blowers and volume blowers respectively. The application of single-phase induction motors to the direct driving of laboratory lathes is discussed in Bulletin No. 3701.

ELECTRIC LIGHT SUPPLIES.—The H. T. Paiste Company, Arch and Thirty-Second Streets, Philadelphia, has recently issued Catalogue No. 12, covering electric light supplies. It contains a complete list, together with illustrations of Edison screw-base sockets and receptacles. There is shown also a new line of molding branch blocks, designed on the Fielding principle, so that they may be used anywhere along the line of molding without cutting it. Opposite each listed article is given a photograph illustration of the article itself, together with a statement concerning the average weight of standard packages of that article. It is believed that this table will prove of especial convenience in estimating costs. The book should prove of real and lasting value to the buyers and users of electric light supplies.

◆

News of the Trade.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has opened a Boston office at Winthrop Square, 7 Otis Street. This office will be in charge of Mr. Frank Booth, who will represent both the Paiste Company and the New York Insulated Wire Company.

THE RUSSIAN OIL REGION.—The Earl of Ronaldshay's account of "A Visit to Baku," in *The Living Age* for November 4th, will give to many readers their first direct information regarding a region which has been the scene of some of the most tragic and sanguinary outbreaks of race and religious animosity during the last few months. These troubles have had a distinct effect on the conditions of American oil fields and oil markets.

FORT WAYNE ELECTRIC WORKS.—The Boston office of the Fort Wayne Electric Works, under the management of Mr. J. Allan Smith, has moved from its old home in 518 Exchange Building, into more commodious quarters at 110 State Street, Rooms 601-604 Plymouth Building. The old telephone number, Main 2044, is still retained. This change was necessitated by the large increase in business transacted by this office and the desire to handle it advantageously.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39 Cortlandt Street, New York, will be among the exhibitors at the electrical show to be held in Madison Square Garden from Dec. 12 to 23. This company furnished all of the third rail insulators for the Interborough Rapid Transit Company for use both on the elevated and on the subway, and also supplied material for the Brooklyn Rapid Transit Company and the Scioto Valley Traction Company in Ohio.

THE AMERICAN ELECTRICAL NOVELTY & MANUFACTURING COMPANY has made arrangements with the Sarco Company, of New York, whereby it has taken the entire output of "Noscru" midget push buttons, and will hereafter be the sole selling agent of this device. On account of its numerous connections throughout the country, the American Electrical Novelty & Manufacturing Company will be able to make deliveries of push buttons in San Francisco as quickly as in New York.

KEYSTONE INSTRUMENTS.—The Keystone Electrical Instrument Company has arranged for representation in several different places in addition to the present agents and representatives. In Boston it is represented by F. B. Smith, 170 Summer Street, and in New York by Arthur Organ, at 114 Liberty Street. In Chicago it will be represented by William P. Crockett, 165 S. Canal Street; in St. Louis by S. M. Keeble, Seventh and Hickory Streets; in Philadelphia and territory adjacent thereto by Louis J. Costa, 1229 Real Estate Trust Building.

SOCIOLOGICAL REFORM.—After Nov. 1 *Charities* of New York, and *The Commons* of Chicago, will be merged. The combined weekly journal is a distinctly American idea—more or less of a co-operative undertaking among those who know conditions first hand and are shouldering such movements as housing and child labor reform, the prevention of tuberculosis, and the social utilization of public schools. The editorship will be in the hands of Edward T. Devine, of New York, and Graham Taylor, of Chicago. While neither periodical has hitherto gained a general circulation they have been read to a remarkable degree by editors, teachers, public officials, the executive officers of organizations, and others who get at public opinion of the community. To develop this educational work along national lines, a publication committee has been organized with Robert W. De Forest, former tenement house commissioner of New York, as chairman, and including Jane Addams and Margaret Dreier Robins, of Chicago; Jacob A. Riis, Frank Tucker and Robert S. Brewster, of New York; Daniel C. Gilman, Baltimore; Robert Treat Paine, Arthur F. Estabrook, Joseph Lee and John F. Moors, of Boston; Simon N. Patten, Philadelphia, and S. W. Woodward, Washington.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrical Salesmen Association. Secretary, Geo. H. Erich, 218 North Court Street, Rockford, Ill.

American Electrochemical Society. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelphia. Next meeting Ithaca, N. Y., May, 1906.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Civil Engineers. Secretary, Chas. W. Hunt, 220 West 57th St., New York

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street Railway Association. Secretary, B. V. Swenson, 114 Liberty St., New York.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, 56 Pine St., New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

Association of Electric Lighting Engineers of New England. Secretary, C. R. Brown, 516 Atlantic Ave., Boston, Mass. Annual meetings held in Boston on third Wednesday in March.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 16, 1906.

Electrical Trades Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa.

Electrical Trades Association of Canada. Secretary, J. A. Mann, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electric Association. Secretary, T. R. Beal, Poughkeepsie, N. Y. Annual meeting, October.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Ottawa, Ill.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Electrical Association. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress St., Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association.. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Oct. 10, 1905.

Missouri Independent Telephone Association. Secretary, Frank S. Leach, Sedalia, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Cleveland, O., July 18, 1906.

National-Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 1142 Wells Building, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in January, 1906.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio. Next meeting, Canton, O., Nov. 17 and 18, 1905.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

Southwestern Electrical and Gas Association. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, C. B. Fairchild, Jr., 114 Liberty St., New York.

Underwriters' National Electric Association. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass. Annual meeting of Electrical Committee, 32 Nassau Street, New York, Dec. 6, 1905.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Western Society of Engineers, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 24, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys, 140 Nassau St., N. Y.]

802,369. CIRCUIT CONTROLLER OR ELECTRIC SWITCH; John P. Coleman, Edgewood, Pa. App. filed Apr. 1, 1904. The longitudinal controller shaft is square and has a sleeve slidable thereon carrying the contact arms. The sleeve is held against longitudinal movement by its bearings, so that oscillatory movements of the shaft control one set of contacts, while longitudinal movements of the shaft are transmitted to another set. The device is so arranged as to prevent oscillatory movements of the shaft after a longitudinal movement.

802,370. ILLUMINATING APPARATUS; Paul E. Collins, Boston, Mass. App. filed Aug. 29, 1904. Various groups of incandescent lamps forming the letters are switched into and out of circuit by controllers which are operated by thermostats. In this way an intermittent illumination of the several groups is secured without clock work or other continuously running mechanism.

802,373. MAGNETO DYNAMO ELECTRIC MACHINE; Elisha B. Cutten, Butte, Mont. App. filed May 29, 1903. A magneto machine for producing jump sparks having an armature wound with primary and secondary coils. The primary circuit is broken by a specially arranged commutator so as to divide the spark among a plurality of points.

802,387. TELEPHONE CUT-OUT AND SWITCH; Owen M. Galloway, Edward B. White and Adam D. Neptune, Mountayr, Ia. App. filed Sept. 1, 1904.

802,397. INSULATOR FOR ELECTRIC WIRES; Clarence A. Humphrey, Elyria, O. App. filed Feb. 15, 1904. A screw-threaded vertical stud has a notch or recess therein into which a wire is clamped by means of insulating blocks, and a nut which screws on to said threaded stud.

802,413. ELECTRICAL APPARATUS; James E. Seeley, Los Angeles, Cal. App. filed July 20, 1904. A large electro-magnet is provided for generatin impulses by self-inductive action which are received by a condenser. An auxiliary discharging circuit for the condenser contains a spark gap and the primary of an air transformer. When the condenser discharges across the spark gap the air transformer is effective to produce a jump spark for ignition purposes.

802,417. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Feb. 23, 1904.

802,418. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Nov. 25, 1903.

802,419. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Jan. 15, 1904.

802,420. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Aug. 17, 1905.

802,421. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Mar. 31, 1905.

802,422. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Apr. 29, 1905.

802,423. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Apr. 29, 1905.

802,424. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed May 4, 1905.

802,425. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed May 4, 1905.

802,426. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed May 10, 1905.

802,427. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed June 20, 1905.

802,428. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed June 24, 1905.

802,429. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed June 24, 1905.

802,430. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed June 24, 1905.

802,431. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed June 29, 1905.

802,432. SPACE TELEGRAPHY; John Stone Stone, Cambridge, Mass. App. filed Dec. 16, 1904. Patents 802,417 to 802,432, inclusive, will be reviewed in a subsequent issue.

802,437. BELL RINGING APPARATUS; Friedrich Weuls, Bockenem, Germany. App. filed Apr. 2, 1903. A continuously operating motor is geared to an intermittently moving part which has spring connections to the bell hammer so as to impart a regular and gradual movement thereto for ringing the bell.

802,451. ELECTRIC MOTOR; Dugald C. Jackson, Chicago, Ill. App. filed Mar. 8, 1900. (See Current News and Notes.)

802,452. INDUCTION-MOTOR DEVICE; Dugald C. Jackson, Chicago, Ill. App. filed Mar. 8, 1900. (See Current News and Notes.)

802,463. RAIL BOND; George A Mead and Charles R. Sturdevant, Mansfield, O. App. filed Dec. 22, 1904. A rail bond adapted to be soldered to the upper side faces of the rail. The parts to be soldered are of wedge-shaped or tapered form so as to merge into the surface of the rail.

802,480. ELECTRIC INTERRUPTER OR VIBRATOR; James E. Seeley, Los Angeles, Cal. App. filed Feb. 1, 1905. A mounting for an induction coil vibrator comprising a tensile strip from which the vibrator projects in the form of a lateral arm. The periodicity is adjusted by varying the tension of said strip.

802,485. RAILWAY SIGNAL SYSTEM; Charles W. Stiff and Claude L. McKesson, Colorado Springs, Colo. App. filed Dec. 1, 1904. A mechanical tappet for railroad signal systems comprising a ratchet wheel in a box upon the railroad ties, and a projection which steps it around for making different circuits by contact with the engine wheels.

802,497. GROUND STRIP FOR PROTECTIVE APPARATUS; Frank B. Cook, Chicago, Ill. App. filed Aug. 5, 1904. Comprises a metallic frame having studs thereon between which the lightning arresters are held in place. The lightning arresters comprise spaced carbon blocks which are held against the frame by spring clips which also form the connections from the circuit to be protected.

802,498. RETAINING CLIP FOR THIRD RAIL INSULATORS; William Courtenay, New York, N. Y. App. filed Dec. 6, 1904. An insulating base or support has transverse holes therethrough, each of which contains a pair of opposed hooks which are secured to one another and serve to clamp the rail.

802,539. TROLLEY FOR ELECTRIC CARS; George F. Warburton, Denver, Colo. App. filed Aug. 6, 1904. An auxiliary trolley pole is connected to the usual pole by spring means, and is designed to prevent breaking the motor circuits even in case the main trolley leaves the wire.

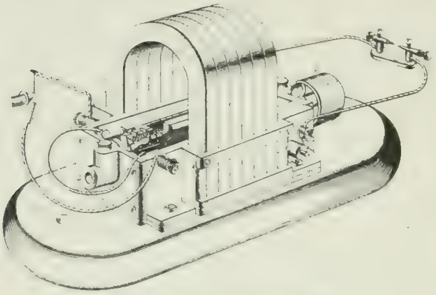
802,553. PLUG FUSE BOARD; William F. Bossert, Utica, N. Y. App. filed Feb. 14, 1905. In order to obtain a cheaper construction of panel board, and to secure better conductors thereon, the fuse plug sockets are made of stamped and drawn copper plate rather than brass castings of the form usually employed. The threaded shell receiving portion is made by flanging the edges of a hole through the copper plate and then threading such flanges.

802,554. AUTOMATIC FIRE ALARM SYSTEM; George B. Bowell, London, Eng. App. filed Dec. 31, 1903. A fire alarm signal transmitter in which the opening of the alarm circuit causes clock work to transmit the alarm impulses in the usual way. A shunt relay within the apparatus is effective to transmit a different signal in case the wires within the apparatus become disconnected from the signal transmitted in case of a fire.

802,573. ALARM SYSTEM; John M. Latimer, Philadelphia, Pa. App. filed Sept. 11, 1902. Two parallel leads run from the signal transmitter throughout the building, and are connectable at various points by thermostats for closing the alarm circuit. Each one of the leads has connections at both ends for forming a separate test circuit which is constantly closed, and insures the continuity of the leads.

802,577. CONDUIT FOR ELECTRIC WIRES; Robert W. Lyle, New York, N. Y. App. filed Feb. 10, 1903. In conduits of the form where dovetailed grooves are provided in the side walls for the reception of metallic dowel pins, the grooves have terminal walls which are integral with the conduit.

802,583. ELECTRIC RAILWAY SIGNAL; Elwood W. McGuire, Richmond, Va. App. filed Mar. 6, 1905. At the different turn-outs conductors are placed between the track rails so that a car standing on the turn-out completes certain signal circuits which cause signals within the car.



802,373. Magneto Dynamo Electric Machine

802,584. ELECTRIC RAILWAY SIGNAL; Elwood W. McGuire, Richmond, Va. App. filed Mar. 30, 1905. Oppositely toothed ratchet wheels are respectively stepped around by the entrance or exit of a car from the single track section, so that a contactor arm makes a signal circuit as long as cars are present thereon. Conductors are arranged at the turnouts to complete circuits with the cars standing thereon to which the signals are thus transmitted.

802,597. SELECTIVE SIGNALING APPARATUS; Egbert A. Reynolds, New York, N. Y. App. filed Aug. 19, 1904.

802,619. SYSTEM OF ELECTRICAL DISTRIBUTION; John H. Anderton, Boston, Mass. App. filed Feb. 28, 1905. In order to show when an induction motor driving a continuous current dynamo may be safely connected with an alternating circuit, the patentee provides means for transforming the direct current which is used for starting, into an alternating current synchronous with the phase of the motor, and employs the usual incandescent lamp phase indicator so as to know when the motor is in condition to be thrown on to the alternating current mains.

802,620. METHOD OF TREATING SOLID MATERIALS; Kristian Birkeland and Samuel Eyde, Christiania, Norway. App. filed Sept. 1, 1904.

802,632. SELF-PROPELLED VEHICLE; Edwin R. Gill, New York, N. Y. App. filed Jan. 2, 1901. The wheel of an electric automobile is in itself constructed with a complete very flat electric motor built therein. The purpose is to do away with power transmitting devices, and particularly to permit the power-driven wheels as well as the idle wheels to be deflected in the act of steering.

802,644. TELEPHONE DESK SET; William Kaisling, Chicago, Ill. App. filed Nov. 23, 1903.

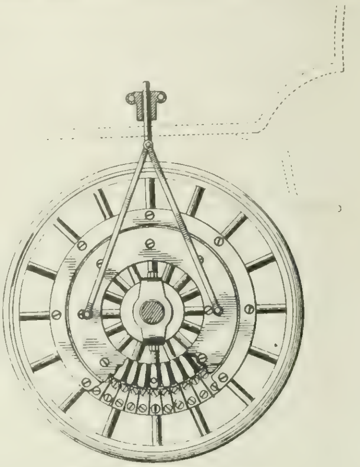
802,671. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Feb. 14, 1903.

802,675. ELECTRIC BELL; Charles E. Avery, Jersey City, N. J. App. filed Mar. 16, 1904. An ordinary bell has an electro-magnet axially arranged therein which operates a pivoted bell clapper. The supporting hook for the bell is so arranged as to make both electrical connections whenever the bell is hung thereon.

802,676. CONTROL OF APPARATUS GOVERNING THE PASSAGE OF CARS ALONG RAILWAYS; William A. Bartley, New York, N. Y. App. filed Feb. 24, 1905. Means for enforcing a caution signal in case the speed of a train is too high, employing train stops which are made effective in case the time of passage of the train through a block section is too small.

802,684. HEAT COIL; Frank B. Cook, Chicago, Ill. App. filed Apr. 8, 1905. The heat coil is wound on a metallic core which has a cap soldered to one end thereof. When the core is heated, the cap melts off and permits two spring blades to separate and break the circuit to be protected.

802,697. CIRCUIT CONTROLLING DEVICE; Harry T. Johnson, Jersey City, N. J. App. filed Apr. 2, 1904. A form of burglar alarm having a spring pressed plug projecting through the floor which is normally held against circuit closing movement by the chairs and other furniture of the room. When the chairs are moved the plug springs up and makes the alarm circuit.



802,632. Self-Propelled Vehicle

802,702. POLARITY INDICATOR; Frederick W. Manger and Charles E. Avery, Jersey City, N. J. App. filed Mar. 24, 1904. A glass tube contains a pair of electrodes immersed in liquid which changes color when the current passes therethrough. The polarity is indicated by the change of color at the negative pole.

802,707. APPARATUS FOR PIERCING METAL; Frank M. Peters, Chicago, Ill. App. filed Mar. 15, 1902. An apparatus for piercing armor plates or steel billets, employing a conducting tube having a carbon rim which is pressed against the metal. A circuit is formed between the tube and the metal to be pierced so that the heat generated at the point of contact melts the metal and allows the tube to pass therethrough.

802,716. PROTECTED RAIL; Louis Steinberger, New York, N. Y. App. filed Nov. 2, 1904. A third rail formed of a metal strip bent into an inverted U-shaped form. The rail is grasped by insulators at one of its edges and has an insulating coating on its exterior surface for protection.

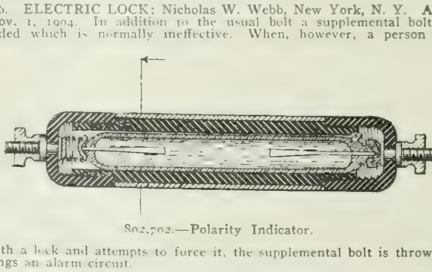
802,736. ELECTRIC FUSE; Frank B. Cook, Chicago, Ill. App. filed July 9, 1904. Means for supporting an ordinary fuse tube upon a panel board without screws or clamp nuts, comprises spring clips having transverse openings into which the ends of the fuse are inserted. When the fuse tubes are bent down into position the spring resistance causes an efficient clamping contact.

802,749. ELECTRIC SIGNAL FOR RAILWAYS; Frederick H. Gray, Leavenworth, Kan. App. filed Mar. 7, 1905. The trolley wire is made with insulated sections at intervals and connections therefrom operate relay magnets for the signal circuits under the influence of the motor current as the car passes the successive sections.

802,753. ELECTRIC BELL RINGER; Ira W. Hall, Brownwood, Tex. App. filed Mar. 21, 1904. An electro-magnetic trip serves to release a weight which falls slowly, and simultaneously starts a bell-ringing mechanism into operation. After the weight falls a predetermined distance it contacts with a lever which serves as a stop motion to prevent further ringing of the bell.

802,875. FIRE PROTECTION SIGNAL SYSTEM; James G. Nolen and John E. Shepherd, Chicago, Ill. App. filed Mar. 20, 1905. A device for indicating changes of pressure in sprinkler mains, etc., comprising an ordinary steam gauge tube with a lever attached thereto which makes and breaks a circuit at a mercury cup under the expanding and contracting movements of the tube.

802,896. ELECTRIC LOCK; Nicholas W. Webb, New York, N. Y. App. filed Nov. 1, 1904. In addition to the usual bolt a supplemental bolt is provided which is normally ineffective. When, however, a person tampers with a lock and attempts to force it, the supplemental bolt is thrown which rings an alarm circuit.



802,702.—Polarity Indicator.

802,939. GROUND PLATE FOR ELECTRIC PROTECTIVE APPARATUS; Frederick R. Parker, Chicago, Ill. App. filed Nov. 26, 1904. A combined thermal protector and lightning arrester employing a ground plate having studs which position the lightning arresters, and spring contacts which hold the lightning arresters in place and also constitute supports for the thermal protectors.

802,941. PROCESS FOR THE REDUCTION OF METALLIC OXIDES AND THE SEPARATION OF THE RESULTING METALS; Auguste J. Rossi, New York, N. Y. App. filed Nov. 3, 1902.

802,960. ELECTROLYTIC APPARATUS; Frank J. Briggs, Everett, Mass. App. filed Jan. 19, 1905.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, NOVEMBER 11, 1905. No. 20.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE .... 1139 Monadnock Block
PHILADELPHIA OFFICE .... 929 Chestnut Street
CLEVELAND OFFICE .... 402 Cuyahoga Building
EUROPEAN OFFICE .... Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **620,000.**

NEW YORK, SATURDAY, NOVEMBER 11, 1905.

CONTENTS.

Editorial 805
Differential Gas Rates 808
New York Lighting Commission 808
Incandescent Lamp Litigation 808
American Inventors in the German Patent Office 809
Indiana District Independent Telephone Meeting 810
The New Power Plant for U. S. Capitol, Congressional Library and Congressional Office Buildings 810
The New York Central-New Haven Situation as to Traction Systems 810
Electrical Engineers of the Times. XXXV. Paul M. Lincoln 811
Current News and Notes 811
Congress of Swedish Engineers. III. By Arvid Westerberg 815
Roller Bearings for Electric Cars 818
Voice Overtones, or Harmonics, as Affecting Long Distance Telephone Transmission. By D. MacL. Therrell 818
New York Central Generating Plant 822
Stone Wireless Telegraph Patents 825
Recent Electrochemical Developments 826
New Telephone Patents 827
LETTER TO THE EDITORS
"How Can the Ball Roll?" By Paul MacGahan 827
Digest of Current Electrical Literature 827
The Problem of Secret Telephony. By Edward P. Thompson 831
Allis-Chalmers Steam Turbine for the Brooklyn Rapid Transit Power House 832
Electrical Equipment of a Paper Box and Bag Factory. By F. F. Coleman. 833
Telephone Transposition Insulator for High Potential Power Lines 835
Monarch Aluminum Reflectors 835
Printing Press Controller 835
Self-Contained Electrical Fountain 836
"Wonder" Electric Lighting Outfits 836
Industrial and Commercial News 837
General News of the Week 840

AMERICAN PATENTS IN GERMANY.

A most important article appears in our pages this week dealing with the treatment of American inventors as patentees in Germany. It is needless to tell most of our readers that for several years past there has been a good deal of hard feeling in the United States as to the manner in which the Imperial Patent Office is alleged to have made the path of the American inventor a difficult one. We have ourselves heard bitter complaints on the subject of alleged unfairness, and we have understood that the feeling of bitterness was general. But no one seemed to have an explanation or a remedy.

We are very glad to be able now to lay before our readers the official statement on the subject of no less a personage than President Hauss, of the Imperial Patent Office. This authority has taken considerable pains and trouble to present the attitude and actions of the German officials in what he considers to be the fair and proper light, and even if his letter were nothing else, it would have great value as an exposition of the methods and modus operandi of his department. It is more than that, however; it is a plea for better, helpful understanding on both sides. We commend this statement of President Hauss to the thoughtful study of our readers, in the hope that it may tend to closer co-operation, and to friendship where distrust existed. If, as President Hauss asserts, American inventors are themselves largely to blame, it is time they knew it and acted accordingly.

THE SWEDISH ELECTRIC RAILWAY EXPERIMENTS.

We have, from time to time, made reference to the slowly developing plan for the "electrification" of the Swedish Government Railroads, and this week we are able to present the preliminary report of Mr. Dahlander, chief engineer of the Railroad Administration, upon the preparations made for experimental work with single-phase locomotives and motor cars. It is an elaborate programme and one which if followed out will lead to the collection of important data on this type of apparatus. The controlling reason for limiting the present experiments to the single-phase system seems to have been the supposed greater facility of speed control than in the case of induction motors, a[illegible] to [illegible] of larger importance in the case of general railroading [illegible] y to [illegible] e ci[illegible] and local service than in interurban or similar [illegible] It was also believed that higher voltage could be used on a single-phase trolley line than would be permissible with a polyphase construction. In view of the Zossen work one may be permitted to discount this hypothesis somewhat. However it is just now very timely to try out single-phase locomotives, since their working properties are as yet very imperfectly known, and if satisfactory imply great developments in electric railroading. Some five or six miles of track are being equipped, and two locomotives, one from the British Westinghouse Co. and the other from Siemens-Schuckert Co., will be put through thorough tests. The experimental power station allows variation of frequency from 15 to 25 cycles and of voltage from 3,000 to 20,000, so that it should be possible to cover the working range of conditions very thoroughly.

There appears to be nothing out of the ordinary in the plans for the locomotives, save that in the Siemens-Shuckert locomotives the motors are provided with separate artificial cooling which ought to produce a good effect as it has in the few cases in which it has been tried. It will certainly prove interesting, however, if the output of these single-phase motors turns out to be limited by the heating rather than by the commutation. The programme for experiments is a very elaborate one and should give a vast amount of valuable data when completed. It is exactly what is needed in case of a strikingly new system, and it is what we have very little chance of getting in this country. Here, whenever a revolutionary novelty appears, of whatever kind, it is likely to be put into service through the courtesy of various financial interests, and it is only after the outsiders have been permitted to break in and acquire some experience that one gets a fair perspective view of the situation. It is doubtless wise policy thus to be cautious in putting out new devices, great or small, but for the engineer desirous of getting to the bottom of the matter it is sometimes a bit wearisome. When Mr. Dahlander brings in his report we shall be anxious to see it and shall lose no time in presenting it to our readers. The Swedish railway proposition is a most striking one since it involves a very wide variety of service in a country where the density of traffic is relatively small. Experience gained upon it will be far more illuminating than any to be acquired in more densely populated regions, and for that reason will be of more significance as applied to American railroading. Our problem in this country is not how to equip suburban service or fast interurban lines, for this experience we have already acquired, but how to deal economically with mixed service on long lines, how to plan a system generally useful in the same way that steam locomotives are generally applicable. The single-phase scheme gives promise along these broad lines and the sooner it is thoroughly tried out the better.

◆

RESIDUAL E. M. F. IN THE CARBON ARC.

A vast amount of literature and discussion have been devoted to the question as to whether there is or is not a counter electromotive force in the ordinary carbon arc lamp. There is certainly a difference of potential presented between the carbons during the operation of the lamp on a direct-current circuit. This difference of potential may be from thirty to two hundred volts, according to the conditions of the case. Whereas some have maintained that this difference of potential was to be attributed to a c.e.m.f. in the arc, others have asserted that the arc is devoid of c.e.m.f. and that it possesses only ohmic resistance. Of late years the latter theory has prevailed, and it is now generally believed that the column of incandescent carbon vapor forming the arc possesses a definite amount of resistance. The flow of current through this resistance accomplishes the observed difference of potential. A paper read before the American Physical Society this year by Mr. G. G. Becknell tends to show that there is a definite small c.e.m.f. in the carbon arc of less than two-thirds of one volt. This c.e.m.f. is found to persist after the removal of the exciting current through the arc. This is certainly definite evidence as to the existence of a real c.e.m.f. The persistence is not for a mere shadow of time, but in dwindling magnitude is found to endure for five or ten seconds. The theory of the phenomenon is not clear; but it appears to be associated with the high temperature of the carbon tips, and perhaps also with the difference in temperature between them. It is found from oscillographs taken of the pressure and current at the carbon terminals of arc lamps supplied by alternating currents, that the current and voltage reverse synchronously; or that there is no appreciable residual c.e.m.f. to displace the phases of e.m.f. and current. A c.e.m.f. of half a volt might, however, readily escape detection. The general conclusions are, therefore, that the potential difference at arc-light carbons are attributable to a drop of pressure in a real resistance offered by the glowing carbon vapor. At the same time there may be a thermo-electric c.e.m.f. of less than one volt, the exact nature of which is somewhat obscure. It is to be hoped that experimenters will follow this matter up in the future.

◆

THE NATURE OF LIGHTNING.

The three Institute papers on lightning protection, on which we comment below, serve to point the moral which we have drawn at divers times regarding the need of knowing more about lightning prior to trying to avert it upon scientific principles. It is clear enough from the papers that the lightning under consideration was a very variable thing, and that ways and means of circumventing it must likewise be variable. For example, the excellent results from horn arresters on the Shawinigan Falls line show clearly that under the circumstances found there the minor disturbances often grouped as static, cut little figure from the operative standpoint, and that the important thing was real lightning actually striking the system. On the other hand, Mr. Torchio's description of the precautions on station lines showed plainly a system of protection directed mainly against static and induced discharges. In order to attack the problem of lightning protection with some chance of success the nature of the phenomena needs to be studied exhaustively. We know in an approximate way that lightning is of the general nature of a condenser discharge between cloud and earth or between cloud and cloud. For a long time this by a false analogy led to the conclusion that lightning is, therefore, essentially a high frequency oscillatory discharge. But it is clear that the nature of the actual discharge depends on the amount of capacity concerned and on the resistance and reactance of the path. It is easy to see that these factors may assume values leading to so great damping that the discharge would be nearly or quite non-oscillatory, and even if it were oscillatory the capacity involved would probably correspond to very low frequency.

Some recent experiments by Herr Schmidt reported in the *Elektrotechnische Zeitschrift* throw considerable light upon the subject. Herr Schmidt prepared a little rotating disc bearing a white cross spun by clockwork at 50 or 60 revolutions per second and watched it when illuminated by lightning flashes. He found that a "flash" might mean anything from a single discharge lasting no more than 25 or 30 microseconds to a diffuse form lasting perhaps one or even two hundred times as long, while sometimes there would be a volley of several flashes each, very brief and separated by intervals of perhaps 1,000 microseconds. Whether these were unidirectional or oscillatory could not be determined, but the indications point to the former condition. Nevertheless, in the shorter discharges there well may be many a pitch of wave front corresponding to an enormously high frequency, even in a discharge itself a single unidirectional impulse. To account for the observed energy effects there must sometimes be an enormous impulsive current capable of tremendous inductive effects. On the other hand, it is probably true that the diffuse discharges observed by Herr Schmidt may have had wave fronts of very moderate abruptness, although perhaps none the less dangerous. A cloud is not comparable to a metallic sheet as a condenser. Relatively speaking, it is a poor conductor, perhaps even an aggregation of conductors discharging very irregularly. For this reason discharges of lightning may vary enormously in character. In any event in line protection one is dealing not with the flash as a whole, but with say the last one per cent of the path. It is then, a wonder, that purely protective measures have any value at all, let alone a value worth considering, and it would seem wiser policy to direct attention toward keeping the lightning from reaching vital points of the system, which is the real function of the so-called lightning arresters. Compared with a genuine lightning stroke all ordinary disturbances on the lines seem, and are, trivial and little to be feared.

Lightning and Lightning Protection.

The three papers on lightning arresters read before the last meeting of the American Institute of Electrical Engineers proved as interesting in regard to the discussion which they evoked, as in regard to the matter contained in the papers themselves. Ever since electrical engineers first erected wires on pole lines, some seventy years ago, troubles have been experienced from lighting. It was soon recognized that these troubles were not all attributable to direct lightning discharges, but that very many were secondary consequences of lightning discharges; the latter setting up sudden induced disturbances was always of high potential and of sudden impulse. The lightning discharges are probably non-oscillatory, but the induced disturbances are liable to be oscillatory. The range of electric energy, potential and current in lightning disturbances is enormously great, and this has constituted one of the great difficulties in supplying adequate protection. There is all the range between the lightining flash which enters an electric station along a line wire, perhaps blowing out a sidewall, or wrecking a chimney, with the violence of the explosion of a ten-inch ordnance shell, and the relatively feeble secondary oscillation which produces a little jump-spark in a coil of wire and burns the insulating coating of the same at some small spot. It is almost impossible to find a practicable and simple lightning arrester which will fully protect the apparatus and station in both of these extreme cases. Thus it happens that an arrester which will do its duty effectively under mild conditions, fails completely when a thunderbolt is aimed at the station. Similarly, it is easy to understand that there may be wide differences of experience and opinion as to the value of an arrester, since lightning disturbances are fortunately not of everyday occurrence, and the particular doses of the trouble which fall to one observer's lot can never be identical with those witnessed by another.

In the days prior to electric lightning, when telegraph lines were the only overhead electric conductors, the damage by lightning was limited to the smashing of poles or insulators out of doors, and to the injury to telegraph instruments within the stations. Lightning arresters came to be part of the regular telegraph equipment, and for the great majority of the disturbances encountered, these lightning arresters were found to give sufficient indoor protection. The arresters were fuse-wires, choking-coils, spark-gaps in air or vacuum tube, and opposed corrugated plates of metal. For out-of-door work, the poles were protected by ground wires, which practically limited the lightning damage to the insulators. As, however, electric light and power wires came into use overhead, the same troubles presented themselves as in the telegraph circuits, but complicated by the fact that the dynamo currents were prone to follow in the path opened by the static discharge. Moreover, the damage done to apparatus in the stations was apt to be far more costly to repair than in the case of telegraphic instruments, owing to the size and cost of the dynamo electric machinery. The result was that lightning arresters on lighting and power circuits necessarily developed along the methods for blocking the dynamo current. The higher the electromotive forces employed in the circuits, the more difficult becomes the task of opening a path to extra high potentials due to lightning, and yet closing that path to the sequence of the dynamo currents. Moreover, in the modern high-tension transmission system, the rise of potential due to the sudden rupture of a short-circuit may be similar in character to that produced inductively by lightning, and these surge potentials must be allowed to splash over the lightning arresters, although the dynamo current must not follow, lest the destructive energy expended in the arrester by the dynamo current exceed that to be anticipated from lightning, not to speak of the interruption of service in the system due to the short-circuit. For these reasons, the ordinary lightning-arrester is rather more properly to be regarded as a dynamo-current arrester.

The factor of safety in the insulation of a tansmission system necessarily becomes less and less, the higher the pressure employed, because our knowledge of the science and art of making insulators and providing insulation has not kept pace with the advance in working voltages. Hence the arresters on high-tension lines have to be installed for continually reducing margins. At a working pressure of thirty kilovolts, the arresters need not open under less than sixty kilovolts, or one hundred per cent rise. But at a working pressure of sixty kilovolts it becomes desirable that the arresters should splash over at ninety kilovolts or fifty per cent excess. In fact, one of the papers read described the installation of arresters for a 50-kilovolt line, arranged to splash over at about 65 kilovolts, or 30 per cent excess, on the basis of virtual voltages. As an extra precaution, however, horn arresters of simple bent copper rod were later installed to work at 90 kilovolts, or to come to the assistance of the earlier installation in case the virtual potential should rise 80 per cent above normal. The results set forth in the two papers on American systems show that several hundred miles of high-tension lines have been operated for more than one year without any breakdown of machinery due to lightning troubles. This, at least, is a satisfactory record. When we remember that, according to the most recent statistics of the Weather Bureau, lightning in the United States is annually responsible for the loss of five hundred lives of persons and of four thousand head of live-stock, three thousand fires in buildings and six thousand injuries to buildings, it is hardly to be expected that electrical transmission lines can be operated without any lightning troubles, no matter how good the arresters employed may be.

Much discussion was elicited as to the value of suspended grounded wires over the working wires. Here again is an expedient which has been tried many times and with the most contradictory reports. It is universally agreed that if all transmission wires were buried in the earth—that is, placed underground, so that there were no parts of the circuit overhead—there would be complete protection from lightning either from direct stroke, or from induced discharge. Nevertheless, we should still be open to trouble from surges, and lightning arresters might still be necessary to protect the circuits from the overflow of potential due to accidental oscillations. The only full protection from lightning disturbance possible for overhead wires, in the sense of similarly preventing the lightning disturbance, would be by carrying the earth over the wires in the form of a grounded metallic cylinder, or of a grounded metallic cylindrical cage of wire. This, of course, is not a practicable plan. Nevertheless, one or more grounded wires carried parallel to a working transmission line, in so far as they form imaginary elements of a completely enveloping wire cage, contribute in some degree to screening the working wires from atmospheric electric disturbances. The only question is as to the degree of protection thus afforded, and to the cost or other disadvantages of erecting such grounded wires. The higher the working potential of the line, the further away the grounded wires must be supported and the lesser the screening influence that any single such wire can afford. It seems, therefore, very doubtful whether it is practicable to give adequate screening to a high-tension transmission line in this manner.

Differential Gas Rates.

Almost invariably when the subject of differential electrical rates come up for discussion, the objection is advanced that much difficulty is involved in the introduction of such rates in the face of gas competition, owing to the existing uniform rate system of charging for gas. At the recent St. Louis meeting of the American Gas Light Association the fact was brought out prominently that the present uniform system of gas rates is far from satisfactory, and that the differential principle developed in the central station field is attracting the attention and interest of gas companies.

In his presidential address, Mr. E. G. Cowdery said that in serving some classes of customers there was no profit, and care should, therefore, be exercised to keep these upon a basis of paying their own way and not be dependent upon the large consumer to make good the deficiency caused by the small one.

One of the papers read at the meeting related to this subject, the author being Mr. F. E. Forstall. Mr. Forstall said that his paper is the fourth which has been read before the association on the subject, and he gave a résumé of the three others. The first paper referred to was by Mr. Walton Clark and was read as far back as 1891. In this paper it was held inequitable to collect upon the investment necessary to the service of one customer, an interest greater or less than is paid by any other customer upon the investment made in his behalf, as was necessarily done when the charge for gas was simply uniform price per thousand cubic feet. A system of charging was advocated whereby the rate per thousand cubic feet should be an amount covering the proportion of the items of expense and interest common to the performance of the total service, and the addition to each bill of the items peculiar to the individual service. The second paper referred to was presented by Mr. Forstall in 1898 and maintained the broad principle advocated by Mr. Clark. The third paper was read by Mr. F. W. Frueauff at last year's meeting of the association, and advocated that the H. L. Doherty differential rate system of charging for electric current should also be applied to charging for gas.

The present paper by Mr. Forstall goes into the subject in considerable detail, giving figures to show the inequity of charging large gas consumers on the same basis as small consumers. In concluding the paper the author says he believes firmly in justice, and therefore in the policy, of a method of charging for gas that will make each consumer pay his share and no more or less than his share of the expenses and the profits of the gas company serving him, and expresses the hope of seeing the end of the present method of charging, under which from 20 to 25 per cent of consumers are served with actual loss to the company, an additional 35 to 40 per cent do not return their fair share of the profit, while from 35 to 45 per cent return an excessive profit.

New York Lighting Commission.

The New York State Commission of Gas and Electricity has given out data as to the work it has done since it began business August 22. Complaints have been made to the commission as to the price of gas in New York City and the preliminary steps looking to a full investigation of the whole subject are now being taken. Syracuse is contemplating a similar step. Approval of the Auburn company's application has been given as below, in accordance with the evidence before the commission.

Since August the commission has transacted business as follows: Approval of bond issues, Light & Power Company, Newark, $40.000; Phoenix Fuel, Light & Water Company, Phoenix, $100,000; Brooklyn Borough Gas Company, Brooklyn, $615,000. Approved of incorporation: Hermon (St. Lawrence County) Electric Light Company, $15.000; approved of stock issue, Auburn Gaslight Company, increase from $500.000 to $600.000; approved of transfer of franchise, Citizens' Light & Power Company, Auburn, to Auburn Gaslight Company.

Rules of practice have been adopted by the commission. Each lighting corporation of the State is required to submit to the State Commission an annual report for the year ending June 30.

The rule in relation to complaints provides that all complaints shall be in writing and the causes of the complaint shall be stated clearly and correctly. Four copies should accompany the original. Within 10 days an answer is expected from the company against which the complaint is directed, and if the answer is not satisfactory a hearing may be ordered.

The general superintendent or manager of every gas and electric light or power company or the person in charge of the business of the individual must inform the commission of any accident resulting in the loss of life or injury to persons, immediately after its occurrence.

Incandescent Lamp Litigation.

The United States Circuit Court sitting at Trenton, N. J., rendered last week a decision denying an application of the General Electric Company for an order of contempt of court against James McLaren, of Newark, N. J., for violation of an injunction prohibiting the defendant from employing in the manufacture of incandescent lamps the process of patent No. 726,293, granted April 28, 1903, to John W. Howell on an application filed November 9, 1897.

The patent in suit is on a method of pumping the air from a lamp bulb, closing the connection between the pump and bulb without the aid of heat, volatilizing a chemical in connection with the bulb to absorb the remaining gases, and then sealing the bulb. An injunction had been served on the defendant on January 13, 1905, following a decree *pro confesso* entered December 10, 1904, declaring infringement by the defendant of the patent in suit. The defendant in his answer in the present case explicitly denied that he had disobeyed in any respect the mandate of the court, or had exhausted or is now exhausting lamps under the complainant's patented process. The court denied the order adjudging contempt and criticized the character of testimony offered against the defendant.

The complainant based its applications for an order of contempt of court upon the testimony of four persons, Albert R. Page, Mary Kenny, Arthur E. Little and Bertha Sincock. Reviewing the testimony, the court said that the witness, Sincock, was only in the employment of the defendant some time in the summer of 1904. Page, after working for the defendant for nearly six months, left his employ, he swears, on the day after the injunction was served, but four witnesses for the defendant say that it was on the same day. Page testified in one affidavit that changes were made in the apparatus by the defendant on the very day the injunction was served simply as an attempt on his part to obtain benefits of exhausting lamps through the use of the complainant's process and avoiding, if possible, the injunction served upon him, but in another affidavit said: "Possibly this change (in the apparatus) was not made for the purpose of avoiding, or in the attempt to evade, the effect of the injunction, but that was the understanding obtained at the time the change was made." The court held that Page left the defendant's employ on the day when the injunction was served and not on the day after, as Page testified.

In regard to the principal witness, Mary Kenny, the court stated that she was an employee just prior to her entering the defendant's service, that she entered it at the instance of the complainant and in his interest, and that her testimony is contradicted by several witnesses on material points. The other witness for the complainant, Arthur D. Little, an expert, assumed that the affidavits of Page, Kenny and Sincock set forth the process of exhausting lamps used by the defendant, and according to which the process described is that of the complainant and was infringed. The court held that the opinion of this witness so far as it is based upon affidavits of the witnesses, Page and Sincock, is without foundation, as they both describe the process in use by the defendant prior to the service of the writ; the only real basis for the expert's opinion rests upon the disclosures made by affidavits of the witness, Kenny, and the court held that it was unsafe to rest the case upon her sole affidavit.

Who Turned Out the Lights?

It is stated that the town council of Levis, Quebec, had a long sitting one night recently to decide whether the town should have an electric or a steam plant for the water works. During the discussion of the subject the electric lights suddenly went out, leaving the council for some time in darkness. That settled the question. The council decided upon a steam plant and gave the contract for it.

American Inventors in the German Patent Office.

One of the vexed and burning questions with American inventors, as many of those in the electrical field are aware, is the alleged difficulty of securing fair and even proper treatment at the hands of the Imperial Patent Office, when taking out patents in Germany. So far as we know, up to this time no explanation of apparent injustices has been forthcoming and so the situation has slowly drifted into one of bitterness and estrangement, and American inventors have said that it was useless to try to get decent consideration in the German Empire. This belief has seriously affected the efforts of American inventors and capitalists in pushing into the German market, and has undoubtedly done great harm in provoking ill-will between two great countries that have so much in common, and so many good reasons for being close friends.

Dr. Alfred Müller, a well-known solicitor of foreign patents in New York City, and an expert in German patent law, was not at all satisfied with this "deadlock," and entertaining the opinion that one of the ways to cure an evil was to ascertain its extent and real nature, wisely addressed himself to the principal authorities, rehearsing what he understood to be the actions on one side and the grounds of complaint on the other. That letter, written some months ago, has evidently been the subject of study and discussion in the German Patent Office, as we are now able, through the courtesy of Dr. Müller, to give the reply of President Hauss to his communication. We give this highly important document below in English and trust that its appearance in our pages may be the first step toward that harmony and better understanding which always follow when two well-meaning parties to a dispute get a clearer comprehension of the status and arguments of each other. The letter of President Hauss follows:

Your favor of December 27, 1904, touches some questions which, independent of your statements, have been made the subject matter of fundamental considerations in the Imperial Patent Office. These considerations have only been recently brought to a definite close, so that now I am enabled to answer your letter. I assume that an answer, in spite of the delay due to the circumstances, will still be even to-day of some interest to you, and I for my part will gladly make use of an opportunity to explain misunderstandings which seem to be prevalent among American interested parties concerning the practice of the Imperial Patent Office.

In complaining about a too severe definition of the term "invention" you refer especially to the fact that the proof of a "new technical effect" is lately more often required than it appears advisable according to circumstances.

Concerning this point I beg to remark that the said phrase often should only be regarded as an expression to the effect that in the opinion of the examiner there is lacking in the subject matter of the application any considerable effect. Such an estimate, whether the invention, in as far as it is new, exceeds that which also an "ordinary workman" is able to do, must be left to the examiner and the departments of the Patent Office. It is of less importance than the expression that is used by the Patent Office in refusing a patent. However, I have taken care that the phrase requesting to prove a new technical effect is limited to those cases in which an industrial process does not come into question except from the mechanical viewpoint and when the stated technical effect is so improbable that a proof must be demanded.

In the matter itself, the Patent Office does not finally decide as to the standpoint which is to be taken in the estimation of the subject matter of an application as an invention. In the proceedings for the annulment of a patent this question is rather subject to the judgment of the Supreme Court. This institution has set down a series of principles concerning the definition of the term "invention" in numerous decisions which partly have caused the annulment of the patents, principles which the Patent Office cannot leave unobserved in its proceedings for the granting of patents without great injury to the interested industrial branches.

However, the Supreme Court as well as the Patent Office do not at all assume the severe standpoint which is characterized in your letter and the enclosures. If for instance it is said that in Germany "every invention must contain a new principle" or that "that which does not radically differ from a known principle will not be protected" or that "an application is rejected if the theoretical effect is anticipated" or that "the theory of technics is more advanced than the practical side of the industry," or that "an invention is not patentable if the combination contains even a single known element," these are exaggerations which are shown to be such by the reading of German patents, and by the fact that about 10,000 patents are annually granted in Germany, whereas nobody will say that fundamental new inventions are remotely made in any such number.

All this is true of applications by American inventors and in the same degree of applications from other countries, and particularly of Germany. The reproach which is so often made, I regret to say, by Americans, and is also repeated in your letter, to wit: that American applicants are worse treated than Germans must be positively rejected as not based on facts. According to the *Official Statistics*, patents were granted on applications from Germany in 1901, 6,609; in 1903, 6,334, decrease, 4.2 per cent; from the United States, in 1901, 1,094; in 1903, 1,069, decrease, 2.3 per cent. The decrease of patents, therefore, granted to American applicants was about half as large as that for German.

Moreover, the absolute decrease of granting of patents in both countries is no proof, since only the proportion of the patents granted in a certain period with relation to the applications disposed of in the same time can be taken as a true gauge as to better or worse treatment. In this respect separate statistics for the single countries have not been made. If, however, the applications of a certain period are to be compared with the patents granted in the same time, it is shown that on 100 applications of the German Empire an average of 34 patents were granted in the years of 1901 to 1903, whereas on 100 applications from the United States an average of 59 patents were granted, as shown by the statistics referred to. In the year of 1904 the proportion had become still more favorable with respect to the United States, for according to the latest statistics only an average of 31 patents were granted on 100 applications from Germany in the years of 1902 to 1904, whereas on 100 applications from the United States during the same period an average of 59.1 patents were granted.

How in view of these official figures a worse treatment of American inventors can be continually spoken of, is beyond understanding. I leave it to you to give a very large circulation to the figures which show the injustice of such an opinion.

It is true, however, that American applications present special difficulties to the Patent Office in Germany and make constantly repeated criticisms necessary. The reason lies in the difference of the laws and rules of practice of the two countries, and also in this that American inventors and their representatives often think that they can demand that their applications filed in Germany shall be treated according to the laws and rules existing in America. It is very often the case, I regret to say, that, be it at the express wish of the applicant, or be it on account of the lacking experience and the carelessness of the representative, an application is filed here in the same form and with the same claims as it has been filed with in America. The papers, therefore, are not prepared in such a way as to take into consideration the differences between the principles existing in Germany and in the United States. This means a great and unnecessary burden for the German Patent Office. *The American inventors are themselves to blame for the delays which result from their actions.* They cannot demand that the German Patent Office shall cease to enforce the German rules of practice. How far in this direction the baseless demands go is shown by the letter of a firm in Philadelphia enclosed with yours, which firm expresses the desire "that such applications as have passed the rigid examination here could be allowed without further trouble in Germany, unless some new and better reference could be discovered."

If this is meant really in earnest, it cannot even be discussed. The German Patent Office, as long as a treaty does not provide for the contrary, is justified, and is obliged to examine American inventions with respect to the fulfillment of German requirements, just the same as German applications in America are examined by the corresponding authorities of the United States.

In this respect reference should be made to the report of the United States Consul-General, Frank F. Mason, dated September 9, 1901, printed in the Consular Report, Vol. 67, No. 254, page 337, etc. There the true causes of the delays, to which American inventors subject themselves in their dealings with the German Patent Office are shown by a person whose fairness of judgment should certainly be recognized in America. The reading of this report cannot urgently enough be recommended to those of your countrymen who believe themselves to have a reason for complaint, concerning the treatment of their German applications.

Indiana District Independent Telephone Meeting.

The first meeting of the independent telephone men of the Third District in Indiana was held at Logansport on October 28. There were 35 independent telephone companies represented operating about 16,000 telephones. Walter J. Uhl, vice-president of the Third District, presided. It was deemed advisable to make a very close organization in the Third District and to this end a chairman was elected for each county in the district. Thereupon George Seybold, of Logansport, was chosen chairman for Cass County; Dr. J. E. Yarling, Peru, for Miami; Dr. R. F. Blont, Wabash, for Wabash; T. E. Hanway, Monticello, for White; A. B. Diggs, Winainac, for Pulaski; E. B. Walker, Delphi, for Carroll; C. W. Brand, Rensselaer, for Jasper.

Charles F. Norton, of Indianapolis, secretary and treasurer of the State association, explained the method and plan of organizing the respective districts, and made a very flattering and encouraging report of the progress being made in other districts and the remarkable interest manifested at district meetings already held.

George W. Beers, of Ft. Wayne, president of the State association, was present and made an encouraging report, as did also Theodore Thorwood, president of the South Bend Telephone Company. The members agreed to have one and possibly two more district meetings before the meeting of the State association in May, 1906.

The New Power Plant for the U. S. Capitol, Congressional Library and Congressional Office Buildings, Washington.

Bids were received about a month ago by the Department of the Interior, Mr. Elliott Woods, superintendent U. S. Capitol Building and Grounds, for a complete heating, lighting and power plant for what is called the Congressional Buildings in Washington, D. C., comprising besides the Capitol proper, the Library of Congress and the two office buildings for the Senate and the House of Representatives. The work to be done consists of the designing of a complete 8,000-kw power house with sub-stations in the four buildings and with the necessary electric and steam transmissions between power house and sub-stations, and of the furnishing of the necessary material and labor for the erection of the complete plant, which is to be turned over to the Government ready to be put into operation within one year and six months from the date of signing the contract.

The specifications are drawn in general terms only, the object being to have the contractors propose such plant as they consider to be best for the purpose, considering first cost, efficiency, durability, simplicity of construction and ease of operation. This bidding is, therefore, not simply a battle of figures in which the lowest bidder will win, but the nineteen proposals received contain a vast amount of engineering thought, and it is to be expected that the successful bidder will be the one whose design will show the greatest merit from the engineering standpoint.

The general plan provides for a power house containing sixteen (16) boilers of not less than 520 hp each, with suitable superheaters and mechanical stokers, four (4) alternating-current electric generators of 2,000 kw each, with corresponding engines, either of the reciprocating or the turbine type, and all the necessary auxiliary apparatus such as condensers, pumps, feed-water heaters, crane, switchboard, etc., and the required piping and wiring between the different pieces of machinery. Then there will be a sub-station in each of the four buildings mentioned above, and each sub-station is to contain a prescribed number of transformers and rotary converters, with a total capacity of about 6,500 kw and the necessary switchboards. Finally there will be a very complete system of underground conduits containing a set of electric cables as well as the necessary piping for supplying heat to the four different buildings. One of the clauses of the specification stipulates that every piece entering this plant shall be the very best of its respective kind, and the installation as such is to be made a model plant in every way.

Following is a schedule of the bids that were received, from which it will be seen that several of the competitors have put forward one or more alternative projects: Lynch & Woodward, Boston, Mass., $862,726; MacIntosh, Seymour & Co., New York, $903,730; The Scofield Co., Philadelphia, $1,015,450, $974,100; The Hanley, Casey Co., Chicago, $1,047,297.85, $1,031,198.85, $971,197.85, $947,885.85, $1,083,697.85; J. G. White & Co., New York, $1,189,250, $1,059,299, $1,199,868, $1,033,646, $995,675; Muralt & Co., New York, $1,164,700, $1,119,800; The Westinghouse Co., New York, $1,119,584, $1,084,369, $901,736.

To consider these nineteen bids a committee was authorized and has been composed as follows: Col. Charles S. Bromwell, Corps of Engineers, U. S. A., chairman; Mr. C. P. Gliem, chief electrical engineer, U. S. Capitol; Dr. S. W. Stratton, chief Bureau of Standards; Mr. Charles Titlow, chief engineer, Library of Congress; Mr. Richard Harding, electrician, Library of Congress; Prof. S. H. Woodbridge, Institute of Technology, Boston, Mass. This committee is meeting almost daily to look into the advantages of the various proposals, and its members have heard, besides the explanations of the bidders themselves, a series of opinions from eminent experts in the different branches comprised in this project. But the bids are so voluminous and the work of properly considering them, therefore, so arduous that it may be some time yet before any conclusion will be reached.

The New York Central-New Haven Situation as to Traction Systems.

Considerable attention has been attracted to the recent letter of Mr. Frank J. Sprague published in our columns discussing the proposal of the New York, New Haven & Hartford Railroad to operate single-phase locomotives over the direct-current section of the New York Central and into the double-decked terminal at the Grand Central Depot. We have already published Mr. Calvert Townley's comment in reply to Mr. Sprague, and we now note that Vice-President Mr. E. H. McHenry, of the New Haven system, has made some further remarks in the New Haven *Register*. We quote him as follows:

"The new electric engines of the New York, New Haven & Hartford Railroad now under construction by the Westinghouse Electric & Manufacturing Company are of the interchangeable type. They are expressly designed to operate under all practical conditions within wide limits. They will be able to use both alternating current and direct current, high-tension or low-tension alternating currents, to take current from the 'deadly third rail' or from overhead conductors, from high conductors or low conductors at varying heights between 14 ft. and 22 ft., and to operate with equal facility on either or both of the two track levels of the Grand Central Station.

"On sections equipped for direct current they will operate in every respect as direct-current engines of high commercial efficiency, and on sections equipped for alternating current, with still higher efficiency.

"They are subject to but three inherent defects, all of the same order, viz.: They are not able to turn a square corner, to climb a tree or to please Mr. Sprague.

"The adoption of this most flexible type of engine by the New Haven company introduces no new features or difficulties in the track, equipment or operation of the Grand Central terminal, and will not entail upon the New York Central the necessity for the expenditure of an additional dollar nor the transposition of a wire.

"It would certainly seem, therefore, that no departure from the standards established by the Electric Traction Commission of the New York Central Railroad could be less objectionable from any point of view.

"The public is informed that its interests are imperiled by the action of the New Haven company, but so long as travelers resist all temptation to sit on the third rail or to 'skin the cat' on the trolley they can safely ignore the harrowing technicalities elaborated by Mr. Sprague.

"Regarding the multiple-unit system, the New Haven company has been lately assured by competent authority of the perfect feasibility of adapting interchangeable alternating and direct-current motors to such service, subject to disabilities of increased weight and cost, and the New Haven company is, accordingly, not estopped from the use of this kind of equipment should it prove desirable. The adoption of this equipment is, however, subject to other considerations quite independent of motor design and control, and is still under consideration.

"In view of the possibilities above disclosed, it would appear that the 'three years of vacillation' referred to in Mr. Sprague's complaint, have been used to good purpose, and it seems to our company most unfortunate that further time is now lacking in which to 'vacillate' some more.

"In these remarks no discourtesy is intended to our Dr. Jekyll, of the Electric Traction Commission, as it has been made quite clear that he is in no wise responsible for the opinions of that well-known individual in private life, the degenerate, Mr. Hyde."

We are in receipt of the following general rejoinder from Mr. Sprague: "I have noted with some interest the comments called forth by my communication on the subject of the New Haven road's decision to adopt alternating-current locomotives for equipment and operation on the New York & Stamford Division. One of my critics says that I don't know, another that the possible future benefits may warrant any present inconvenience, and a third has it that the New Haven road may 'fly the coop' and abandon the Grand Central Station.

"All very interesting, no doubt, but somewhat wide of the mark, and I recommend to those who disagree with my conclusions a second and more careful reading, keeping in mind the specified existing conditions, before retiring with too much modesty behind a curtain of reluctance to publicly discuss engineering questions of great public interest, or losing themselves in shadowy speculations of a coming electrical millennium.

"With all due respect I beg to say that I see no reason to change my expressed convictions as to the general character of the decision announced by the New Haven people, even if pleading guilty to being 'unfamiliar with the up-to-date development of electric locomotives'—especially the unfulfilled promises—of which defect in my engineering equipment I am, of course, painfully aware.

"Despite my critical attitude, which seems to have given some concern to a few people, and which time will show whether justified, I am beginning to believe that I am a better friend of rational alternating-current development, applied in a rational way to railway operation, while maintaining that the limit of direct-current operation is by no means reached, than a majority of those who sing its praises on a single strident, but ofttimes unmusical note—even if I am unwilling to see its present injection into the densest section of the train movement of two great railway systems, with almost inevitable adverse consequences. Nor is it fair to the alternating-current system itself.

"A proverb says: 'A prudent man seeth the evil and hideth himself; but the simple pass on and suffer for it.' What a lot the future holds for some of us!"

Electrical Engineers of the Times.—XXXV.

PAUL M. LINCOLN.

Paul Martyn Lincoln was born January 1, 1870, in Norwood, Mich. While quite young his parents moved to Painesville, Ohio, where he received his common and high school education, graduating from the high school in 1888. After spending a year at Adelbert College in Cleveland he went to the Ohio State University in 1889 to take a course in electrical engineering. Here he always stood close to or at the head of his class, and taking much interest in athletics, was made captain of the football team in 1890. Early in his senior year he went to work for the Short Electric Company and later for the Brush Electric Company at Cleveland, Ohio, but by continuing his studies outside of school he was enabled to graduate with his class in 1892.

During the year he worked for the Short and Brush companies in Cleveland, Mr. Lincoln was engaged in draughting, experimental and construction work. He left there to enter the employ of the Westinghouse Electric & Manufacturing Company at the Pittsburg factory, where he worked for about two and one-half years doing experimental development work in connection with railway generators and arc machines. He left the Westinghouse Company in May, 1895, to take a position with the Niagara Falls Power Company, where he remained until May, 1902, serving under the various titles of assistant superintendent, electrical superintendent and resident electrician. During this time he had charge of the operation of the electrical plant and the supervision of the various engineering problems arising in connection with the generation, transmission, distribution and use of Niagara power. After serving seven years in this capacity, Mr. Lincoln returned to the Westinghouse Electric & Manufacturing Company; there he did general engineering work, chiefly connected with power transmission work and the development of the single-phase railway system until September, 1904, when he was appointed to his present position of engineer of the power division of the engineering department.

While with the Niagara Power Company, Mr. Lincoln possessed exceptional advantages. In this great plant, which was a pioneer in the use of such large generators and the transmission of power at high voltages, many problems were met and solved, and no small portion of the success of the plant is due to his ability and keen judgment. It was while here that he invented the synchronizer known by his name, for which he received a medal from the Franklin Institute, and also a frequency indicator, both of which are largely used in commercial operation.

Mr. Lincoln has served as a member of the special committee on High-Tension Transmission of Power of the American Institute of Electrical Engineers, before which body he has presented several papers bearing on this subject. In 1901 he presented a paper before the Franklin Institute, Philadelphia, on "The Parallel Operation of Alternators," and the same year read a paper at the annual meeting of the American Institute of Electrical Engineers on the "Synchronizer and Frequency Indicator." Before the Canadian Society of Civil Engineers, in 1903, he presented a paper on "Interurban Traction Systems—A. C. vs. D. C.," and in the following year read a paper before the Engineers' Society of Western Pennsylvania on "The Adaptation of Alternating Currents to Railways."

P. M. LINCOLN.

Mr. Lincoln is a member of the American Institute of Electrical Engineers and was Chairman of the Pittsburg Branch of the Institute during the first two years of its existence. He is also a member of the Engineers' Society of Western Pennsylvania.

CURRENT NEWS AND NOTES.

ELECTRICITY IN CANADA.—The census report of Canada, third volume, just issued, gives the Dominion in 1901 fifty-eight electrical plants, with $11,891,025 capital, and products worth $2,008,017. These were all, probably, central stations. There were also 25 electrical apparatus plants with $5,267,397 capital and products worth $3,032,252

AN INVOLUNTARY ADMISSION.—Considering the hostility of the gas companies to the sale of electricity in competitive fields, it is a trifle amusing to find in the very heart of a gas appliance exhibition incandescent lamps used to demonstrate the beauty and translucent qualities of lamp shades, supposed to be illuminated in practice by gas burners alone. This time the joke is "on" the Boston Consolidated Gas Light Company, as any visitor to the Hub may see for himself at the West Street exhibition rooms, provided he arrives before the gas officials realize their inconsistency!

MAGNETIC CLUB.—The Magnetic Club will hold its annual autumn meeting at the Hoffman House, New York, on Wednesday evening, November 15. Dinner will be served at 6:30 o'clock. Delegates to the annual meeting of the Telegraphers' Mutual Benefit Association, which will be held the same day, will be guests of the Club. Other distinguished guests will also be entertained. The committee of entertainment will provide an interesting programme.

SALE OF LIGHT AND POWER.—The adoption of progressive ideas by the New York Edison Company is again shown in the fact that last week it had a lecture given in the Edison auditorium on the sale of electric light and power, by Mr. A. F. Sheldon, president of the Sheldon School of Scientific Salesmanship. The lecture was very well attended, and the greatest interest was exhibited by the large selling and canvassing force of the company.

ELECTRIFYING WEST SHORE.—Mr. C. S. Saunders, president and general manager of the Buffalo Pole Line and Constructing Company, states that he is ready to begin the preliminary work of electrifying the West Shore Railroad for a distance of 81 miles, between Rochester and Syracuse. It is expected that both freight and passenger business on this section of the West Shore road will be operated by electricity next summer.

REMARKABLE TELEPHONE GROWTH.—The New York Telephone Company announces a gain of 5,015 stations in October, and 27,000 between January 1 and November 1. This is a gain of over 600 a week or 100 every working day. It appears that there are now in service and under contract 233,999 telephones in the five boroughs of Greater New York. It is interesting to note that the gain in Chicago in October was 2,126, giving a total of 137,712. Thus the grand total for the two cities at the end of the month was very close upon 375,000.

WIRELESS FOR CZAR.—A special dispatch of November 3 from Berlin says: "Wireless telegraphy is in use between Peterhof and Memel, the nearest point in Prussian territory at which the government land lines are available. A small German cruiser, the *Luebeck*, lies at Memel, while between there and Peterhof are ten German torpedo boats telegraphing doubtless with the consent of the Russian Emperor. The object, however, is only a subject of conjecture." This is the only report of the use of wireless that has come from Russia during the recent period of line cutting, telegraphers' strikes, etc.

THE CHICAGO TRACTION SITUATION.—Negotiations between the Chicago traction companies and the Local Transportation Committee of the Council have reached a much more business-like stage than ever before. The Council, by two-thirds majority, has a fourth time rejected Mayor Dunne's recommendation to cease negotiations with the traction companies and take other steps for immediately acquiring the lines. In drafting the ordinances, the Local Transportation Committee has called upon Bion J. Arnold for expert estimates on earnings on which to base compensation to the city for the franchise and also to plan routes for the cars through the business district. Mr. Arnold has already reported to the committee on routes, enumerating twelve such, many of them to extend across the city.

TELEPHONE CAB CALL.—A cable dispatch from London of November 4 says: "Some of the so-called progressive papers are this week congratulating the usually slow-to-move post office authorities for putting cab ranks on the telephone system, so that now the shrieks of the porter's whistle, which is the plague of the best residential quarters, will be abolished. Some of the cabmen's shelters have already been joined up, but how does the system work? It is true, one can now call a cab by telephone, but if in a hurry it is better to blow a whistle first of all. The subscriber must call up and say, "Cab rank, please." The exchange then asks what is the cab rank nearest his house and then tells him the number. Next the subscriber must ask to be put on to that number and afterward request that a cab be sent around to him, and by the time it arrives he might have got half a dozen cabs by blowing his whistle at the door."

WESTERN ELECTRIC ROADS.—It is noted that the remark of President Hill that the Far West was well supplied with steam railroads and that increased transportation facilities would probably be in the way of railroads operated by other power, comes at the same time with various reports from the Pacific coast of proposed construction of electric lines. The city council of Portland, Ore., has before it an application for a purchase for an electric railway which is to run through Portland to the Willamette Valley by a route which will open new territory and also tap the Coos Bay region. The road is to be laid with 80-pound rails and standard gauge. The first section of the road is to run to Salem, a distance of 52 miles, with Roseburg, 146 miles farther on, as the objective point. This route would practically parallel the main line of the Southern Pacific to Portland. Another project which is being promoted is the construction of a railroad from Portland to Nebalem and Tillamook on the coast. Grading is now to be rushed. The road will run through heavy timber land.

TURKISH PREJUDICE.—U. S. Consul Thomas H. Norton, of Smyrna, calls attention to the construction of tramways in Asia Minor, and believes that American construction companies may find business there. "The municipal authorities of Koniah have decided upon the construction of a tramway, 2 kilometers in length, connecting the city with the station on the line of the Bagdad Railway line. Specifications are deposited with the governor-general of Koniah, to whom interested parties can direct their correspondence, preferably in French. Material (purchased in Europe) is now on hand for the construction of the tramway in the island of Samos, 50 miles south of Smyrna. The projected tramway in Koniah will be the first attempt at introducing a modern urban transportation system in the interior of Asia Minor. The example will probably be followed by other cities, and the field is worthy of the attention of American construction companies. It is unfortunate that the prejudice against the introduction of electricity as a motive power still continues in Turkey. The construction of horse-car lines here may possibly offer a market for the sale of discarded American street cars."

MARCONI TRANS-ATLANTIC WORK.—According to information received from Halifax the Marconi people contemplate another change in the site of their Cape Breton station. Representatives of the company have been at Lorne Head, near Louisburg, 25 miles from the present station, looking over properties suitable for a site for the proposed new station. This would be the third change, as the second station, which is located at Glace Bay, four miles from Table Head, is only about completed. A chief trouble with the Glace Bay station is that while messages can be transmitted from there, it is not possible with anything like equal facilities to receive. This has been the point where failure has come. It is thought that if a new station at Lorne Head is built it will be used for the reception of messages, while that at Glace Bay is reserved for transmission. The cost of the first Table Head station was practically defrayed by the money given to Marconi by the Dominion Government when he first determined to erect trans-Atlantic stations in Nova Scotia. The present Glace Bay station has cost over $150,000. Nothing definite will be done until Mr. Marconi arrives.

GAS COMPANIES AND PUBLICITY OF ACCOUNTS.—In his presidential address before the recent meeting of the American Gas Light Association at St. Louis, Mr. E. G. Cowdery declared himself in favor of the principle of publicity on the part of all public service corporations, and said that if the results of the efforts and operations of gas companies are published broadcast the greater portions of their troubles will have disappeared. As the purposes of gas companies, he said, are honest in every particular, as it costs something to manufacture gas, something to maintain a plant and distribution system through a series of years, something for the distributing accounting management and taxes, and as the total of these must be represented in a cost upon each 1,000 cu. ft. sold annually, he asked why it would not be better to educate the public to the true facts concerning methods, management and interests, than to allow it to remain under a cloud of obscurity to the detriment of the gas companies. He was opposed to State Commissions like those of Massachusetts and New York, but believed that publicity with good management and with due regard for the rights of the public will prevent any need or call for State Commissions.

AUTOMOBILE CLUB OF AMERICA has reached its 700 limit of active membership and has a long waiting list.

VERMONT ELECTRICAL ASSOCIATION.—At the recent meeting in Rutland, Vt., of the Vermont Electrical Association the following-named officers were elected: President, E. E. Gage, of St. Johnsbury; first vice-president, George S. Haley, of Rutland; second vice-president, E. E. Larrabee, of Bennington; secretary and treasurer, C. C. Wells, of Middlebury.

WIRELESS ON THE PACIFIC COAST.—Two wireless telegraph towers and a station are being erected on Mount Tamalpais in California by the Pacific Wireless Telegraph Company. The towers are 300 ft. high and the distance between them is 100 ft. It is thought that this station will be utilized in communicating with Honolulu and with transpacific liners.

WASHINGTON PLANT ACCIDENT.—At Washington, D. C., on November 1, an explosion occurred in the works of the Washington Electric Light & Power Company, by which two men were killed and six severely injured. The twenty-eight-inch pipehead that blew out, it is said, was a new piece of equipment. A special dispatch says that last winter the President had to complain directly to the District Commissioners that the company was persistently defying the law against the use of soft coal. The smoke from the power plant caused serious annoyance to the occupants of the White House and was blackening the exterior walls of the building.

ENGLISH TROLLEYS POPULAR.—A consular note remarks that the increasing popularity of the electric trolley in Great Britain is shown by the annual railway returns recently published. In 1903 there were only five and one-half millions more third-class railway travelers than the previous year, while the tramways showed an increase of 287,496,000 passengers. The gain in 1904 in third-class railway passengers was a little over 6,000,000, but the tramways gained over 117,000,000 passengers. Since 1890 the tramways have carried each year more passengers than have been carried in the third-class railway cars, and last year the excess was over 700,000,000. An appreciable portion of this excess is from persons who, having the choice of railway trains or electric tram cars, give the preference to the latter. The English railway companies admit the serious character of this competition.

SANITARY TELEPHONE.—It has been asserted many times that the mouthpiece of a telephone transmitter is a veritable hotbed of disease germs, and much inventive ingenuity has been expended upon the problem of rendering them harmless. In England, according to Consul Mahin at Nottingham, a radical treatment has been applied by abolishing the mouthpiece altogether. The receiving and transmitting apparatus is combined in a small metal case, shaped like a watch, which is held continuously to the ear both in speaking and in listening, the transmitting microphone being made so sensitive that it becomes unnecessary to concentrate the sound waves on it by the aid of any mouthpiece such as is ordinarily used. Mounted on a handle, with a speaking key, the new arrangement is exactly similar to the common combined receiver and transmitter, except that there is no mouthpiece, and the speaker, as it were, addresses himself to the world at large, instead of talking into a trumpet-shaped orifice.

THE MILK ROUTE.—Discussing the rural trolley in the *Independent*, Mr. A. H. Ford says: "Finding that the short freight haul was its least lucrative business, many of the railways in the Middle West gracefully yielded this traffic to the competing trolley lines. The farmer who previously drove his milk and produce to some distant railway station now reins up his horses anywhere along the line of trolley, careless as to whether or not he reaches his destination at any given hour, for soon enough he knows a car must come bowling down the streaks of rust and then all that Mr. Farmer has to do is to wave his hand, pull out one through ticket for each ten-gallon can of milk or sack of produce he wishes to ship to town, and tell the conductor where to put them off. It is needless to say that with such a system in operation it was useless for the railways to hope to compete for small freight within thirty miles of a large town served by a competing trolley line."

GAS ASSOCIATIONS.—At the recent annual meeting of the American Gas Light Association one important question before the body was that dealing with the proposed consolidation of the American Gas Light Association, the Western Gas Association and the Ohio Gas Light Association, all three of which have a large membership and have been holding annual conventions, which have been largely attended by the same people. The report of a committee appointed a year ago was presented recommending that the three bodies be united under the name of the American Gas Institute. This was unanimously adopted. Before the consolidation can be effected the other organizations will have to take action, but it was the general opinion of the members present from the Western and Ohio associations that the action would be heartily concurred in. This will make one strong representative association of all gas plant owners, managers and engineers similar to the National Electric Light Association.

YELLOW FEVER AND TELEPHONY.—With the idea that the depression incident to general business in the fever-stricken districts of the South might be serious to the users of telephone service, the Cumberland Telephone & Telegraph Company, a licensee company of the American Telephone & Telegraph Company, sent out word to those of its customers who were subscribing to the measured service contract as follows: "Owing to the yellow fever epidemic and the consequent depression of business throughout the South, we will withhold the furnishing of the regular monthly quota of coupons for the months of September, October and November, 1905, sending only such as you may order unless you advise to continue regular shipments." Although this liberal offer was made to relieve such of its patrons as found the terms of their contracts onerous, it has developed that the telephone business has not been curtailed by the depression in other lines of business, but has actually increased in the fever districts, owing to the restriction of travel and the desire for intercommunication.

THE TELEPHONE HABIT is something that is without cure, according to the *Wall Street Journal*, which at the same time, in noting this fact, deprecates too much telephony. It says: "The only value of competition in the telephone field is to force the monopoly to improve its service and to lower its charges. Actual and potential competition has in various parts of the country performed this work. But in actual operation telephone monopoly is better than telephone competition, provided it is subject to a comprehensive public control. A company enjoying a monopoly of the telephone utility should be made to understand that while it is a private enterprise to the extent that it is a business for profit, yet it is more than that; it is a public enterprise, and the duty which a telephone monopoly owes to the public is paramount to the duty it owes to its own stockholders. This does not make it right for the public to impose such rates and conditions upon the monopoly as to amount to practical confiscation, depriving it of all chance of profit, and on the other hand it does not mean that a telephone monopoly should take advantage of its position to overcharge its patrons."

DETECTIVE USE OF THE RAY.—An item in the New York *Medical Journal* says: "It is a new departure to examine a man with the idea of detecting in his stomach jewelry that had been swallowed to avoid detection, and the chief of police of Davenport, Iowa, deserves full credit for the originality of his researches. It seems that a negro had formed a passing attachment for a diamond ring that he did not own, and, being surprised by the legitimate possessor, promptly swallowed it, notwithstanding the heavy setting that surrounded the stone. This was suspected at once, and the culprit was forthwith locked up in jail with the diamond still in his possession. As he strenuously denied all knowledge of the missing stone, the chief of police promptly sent for the municipal electric apparatus. At the sight of this the man, imagining doubtless, that it was some new method of torture, promptly confessed. The photograph, however, was taken, and it revealed the position of the ring." This is interesting, but hardly correct. The Röntgen ray has already been used to detect the location of hidden gems in cavities of the human body, and the Japanese Government is said to have used it in mints where gold coins were being stamped, to prevent theft.

NAVY WIRELESS ON THE PACIFIC COAST.—Work is to be commenced at once by the Bureau of Equipment of the Navy Department on wireless telegraph stations at Port Arguello, Cal., and Bremerton, Wash. Other sites that have been selected for stations are San Diego and Table Bluff, Cal.; Point Wilson, Cape Flattery and North Head, Wash., and Cape Blanco, Ore.

LIGHTS ON TRANSMISSION TOWERS.—The Niagara, Lockport & Ontario Power Company will place electric lights on each of its transmission towers. The plan is to surmount each tower with three lights, red, white and blue in color, which will be turned on in the summer months only, as the work of renewing the lights would be too great in cold weather. The line of towers will extend from the Devil's Hole, near Niagara, through Buffalo and Rochester to Syracuse.

HIGH-POTENTIAL ELECTRICAL DISCHARGES.—The recent experimental work in connection with the dispersing of London fogs by means of high-potential unidirectional discharges is well known. In order to overcome the difficulties attendant on the use of statical electrical apparatus for supplying the electricity at the proper potential, Sir Oliver Lodge, according to a patent issued October 31, would employ a Ruhmkorff coil giving a secondary potential of about a quarter of a million volts, and would pass the secondary current through a series of mercury vapor rectifiers in order to render the delivered current unidirectional for charging Leyden jars.

N. E. L. A. PROCEEDINGS.—It is expected that the book of *Proceedings* of the twenty-eighth convention of the National Electric Light Association, held at Denver and Colorado Springs, will be ready for distribution about November 20. The papers, reports and discussions presented at the conventions of this association are now so voluminous they can no longer be bound in one volume, and, following last year's precedent, this book will be issued in two volumes, Vol. II containing the Question Box and Wrinkles, which alone comprise over 700 pages. If the association did nothing for its members during the year but publish these reports, every member might feel that his dues were wisely invested; for not only do they contain profit-bringing information and suggestions, but it is information and advice that can be obtained in no other way.

WIRELESS RECEIVER.—A patent issued October 31, 1905, to Mr. Lee De Forest refers to a method by which the range of commercial apparatus may be greatly increased without involving an increase in the power used at the sending station. The inventor states that the available portion of the expanding field of force is in the form of a cylinder having the sending antennæ as its axis. Any one of a number of receiving antennæ, if sufficiently separated from one another, say, 10 ft. for wires 150 ft. long, absorbs a certain amount of this radiated energy regardless of that absorbed by the others. The inventor, therefore, uses multiple antennæ, which method also makes unnecessary the use of choke coils, which have been employed in the local battery circuit at the receiving station in order to prevent the passing of the Hertzian waves from the aerial circuit through the local circuit, instead of by way of the coherer or other responder.

TROLLEYING MONT BLANC.—A special cable dispatch from Geneva, Switzerland, says: "An army of Italian workmen has been brought here to begin construction of the new electric line which is to take tourists nearly to the top of Mt. Blanc. The length of the line will be about 12 miles, and the electric system adopted is the same as the one in use on the Jungfrau. The new line will start from the little village of La Fayet, in the Chamounix Valley, and gradually ascend the northwest side of the mountain, up to the plateau near the Aiguille du Gouter, at an altitude of 11,619 ft. From this plateau the ascent to the top of the mountain can be made on foot in four hours. The trains will consist of a motor and two passenger cars, carrying about 80 passengers on each trip, and will be furnished with three powerful brakes independent of each other. All the stations will be connected by telephones. The cost of construction is estimated at $2,000,000."

TELEGRAPHY IN CANADA.—A telegram of October 28 from Ottawa, Canada, says: "The announcement has just been made that A. Bruce Smith, of Toronto, superintendent of the construction and maintenance departments of the Great Northwestern Telegraph Company, has been appointed manager of telegraphs on the Grand Trunk Pacific Railway. The announcement foreshadows that the Grand Trunk Pacific is to come into the field as a competitor of the Great Northwestern and Canadian Pacific telegraph systems. In this connection the question is now being asked whether Canada within the next five years will become the arena of a great conflict between the Grand Trunk Railway proper and the Goulds, who are the principal stockholders in the Western Union Telegraph Company, which controls and operates the Great Northwestern. If a struggle should transpire it may be marked by all the bitterness that characterized the fight between the Western Union and the Pennsylvania Railway a few years ago. Whatever may be the outcome it is evident that a third independent transcontinental telegraph company is about to make a bid for its share of the Canadian business. That Mr. Smith's appointment is the first aggressive move in a campaign that may result in some interesting developments by the time the last rail is laid on the new Grand Trunk Pacific line is the opinion of those who are familiar with the progress and stated policy of the Grand Trunk Pacific Company."

CITY TRAVEL IN EUROPE.—Mr. C. T. Yerkes, a cable dispatch says, was interviewed recently as to his rapid transit work. He announced his intention of spending the rest of his days in London educating the Londoner up to the benefits and beauties of the Yerkes quick transit system. "The Londoner," he said, "still has no idea how to travel, and till two or three years ago didn't even want to get about his own city quickly, but the 'tubes' are waking him up. The Londoner is much more anxious to hustle than he was. When people say I am building too many tubes in London I tell them I am counting on the hundreds of thousands of people who never dream of traversing London at all; they would travel if they had the facilities, and when I have supplied these to the stay-at-homes I shall have millions of passengers. When my scheme is complete the Londoner will be able to get from one end of the city to the other or all around it for two pence. It may be incredible to the people in the United States, but there are scores of thousands of people living in the north of London who have never seen the south, and positively millions in the eastern districts who have never been in the west end. Londoners are the worst people to get a move on I ever knew. To see them board and get off a train one would think they had a hundred years to do it in; still they are doing better, and in the end I shall work them down to an allowance of thirty seconds. The best people I have seen to grasp the quick transit idea are the Parisians; in Paris they fill the empty cars in the tube in less time than in Boston."

LONG-DISTANCE TICKER SYSTEM.—Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, has developed a ticker system by which stock quotations, etc., may be transmitted direct from the keyboard located in one city, to and recorded on tickers distributed in the offices of the subscribers in other cities at a distance. Heretofore a complete transmitting plant has been required in each city, which, on account of the expense, has limited the ticker service to places where there are a considerable number of subscribers. Two wires are required to operate tickers locally, making it impracticable to carry the circuits to a great distance, because the cost for wires soon becomes a prohibitive expense. Mr. Barclay has, however, succeeded in accomplishing a long-distance transmission over a single wire, operating the local tickers on the usual two wire system, without the intervention of the expensive local transmitting plant, which of course includes the salary of a keyboard operator to send out the quotations, in addition to the Morse operators at each end of the wire supplying the quotations. In Mr. Barclay's new arrangement the wire formerly employed for telegraphing the quotations from one city to another is connected direct to the keyboard in New York, for instance, and to the local ticker circuits in Boston, Philadelphia or any other city desired, and all of the tickers in the other cities record the quotations simultaneously with those in New York. It is obvious that Mr. Barclay's arrangement not only reduces the cost of the ticker plant itself, but also effects such economies in its operation as to make it practicable to give a ticker service in cities where heretofore the expense made it unprofitable. A no less important feature of the new system is the time saved by direct transmission.

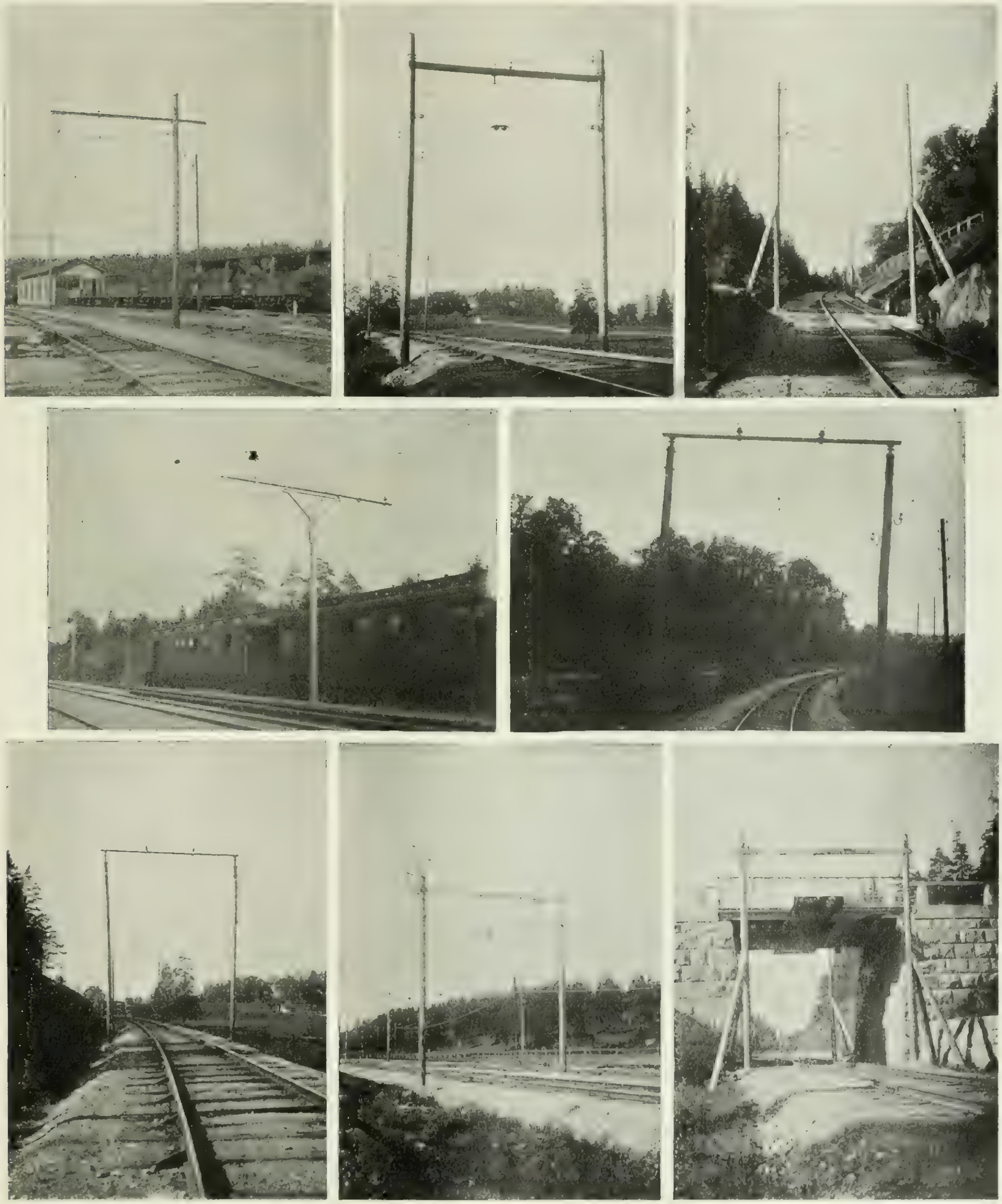
Congress of Swedish Engineers.—III.

By Arvid Westerberg.

SWEDISH GOVERNMENT ELECTRIC TRACTION EXPERIMENTS.

THE paper presented before the congress by Mr. Dahlander, chief electrical engineer of the Swedish Railroad Administration, was without doubt the most important read at any of the sessions, the subject being the experiments with electric traction now being conducted by the Swedish Government. The first portion of the paper dealt with the reasons why the experiments were to be confined to single-phase traction.

Direct-current systems were ruled out as not applicable to long-distance trunk service. The three-phase has a decided advantage over the single-phase motor in its simpler construction and lower weight, and especially in the absence of a commutator. Besides the necessity of a commutator the single-phase motor has a disadvantage due to the pulsating nature of its torque. A single-phase series motor is capable of a maximum torque corresponding to the maximum current, and the torque is nil every time the current curve



Figs. 1 to 8.—Views of Experimental Swedish Single-Phase Railway, Showing Details of Trolley Suspension.

passes through zero. While running this pulsation of the torque does no harm, but at starting it is a disadvantage since it is a cause of slipping. However, if gear wheels are used an elastic effect is introduced which decreases this disadvantage to a certain extent. As a matter of course, the frequency is a factor, since the lower the frequency the greater is the tendency to slip. The tests on this point have only been begun, but it has already been found that a 25-ton locomotive with gear wheels and series motors develops, at 25 cycles, a pulling force of 4 tons.

The greatest advantage of the single-phase motor over the three-phase motor is with respect to economical speed regulation. This is a thing of very great importance for many reasons. On a track with heavy grades a train that has to run with constant speed will, of course, vary more in its current demand than a train that can run economically at any speed. Therefore, in the latter case the power station can be built smaller. The economical gain from this cause in favor of the single-phase motor exceeds by far the few per cent higher efficiency which the three-phase motor has over the single-phase motor at the present time.

The comparison of the motors of the two systems thus shows advantages and disadvantages on both sides. As to supply conductor it is evident that one wire less is a great advantage. The simplicity in this respect involves a secondary advantage, viz.: the possibility of using a higher voltage, which advantage is especially important in the case of a railway system like the Swedish, with its great distances and comparatively sparse traffic. On the Valtellina road a pressure of 3,000 volts is used, at which voltage difficulties have had to be met with respect to insulation between trolley wires, their supporting wires and the trolley arms. Therefore, it is hardly probable that a higher voltage than 3,000 can be used for three-phase. For single-phase, on the other side, there are roads running with 5,000 and 6,000 volts, and the Oerlikon Company has made successful tests with 14,000 and 15,000 volts. On the Swedish experimental track 18,000 volts have been successfully tried and arrangements have been made for raising the voltage on the trolley wire to 20,000 volts.

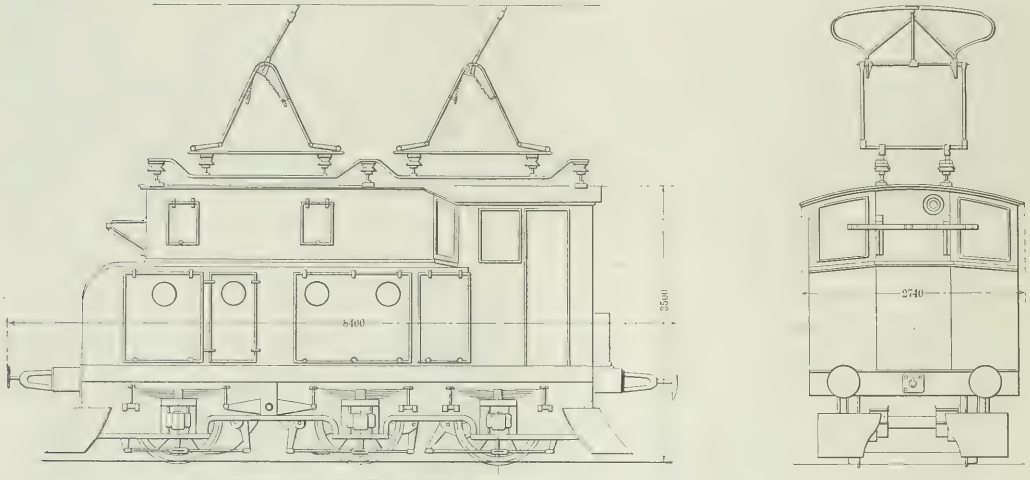


FIG. 9.—SIDE AND END ELEVATIONS OF SIEMENS-SCHUCKERT ELECTRIC LOCOMOTIVE.

On long roads feeders for a still higher voltage than that of the trolley wire will in many cases be required. The three-phase advocates hold out as an advantage for this system that at the same line voltage the copper for a three-phase system will be 33 per cent less than with single-phase system, other conditions being alike. But if the two systems are compared the cost of insulators and line construction is higher for three-phase; the single-phase system is also the most favorable with respect to the feeders.

From the reasons mentioned above, the Royal Railroad Administration decided to choose exclusively the single-phase system for its present experiments.

Mr. Dahlander then proceeded to give a description of the experimental plant and the locomotives and cars to be tested. The power house has a capacity of 350 kw, generated by two De Laval steam-turbine units. The speed is variable so that frequencies of 25 and 15 cycles can be obtained. The voltage of the generators is, at the highest speed, 1,200, which may be raised in two transformers of 300 and 125 k.v.a., respectively, to 3,000, 5,000, 6,000, 10,000, 12,000, 15,000, 18,000 or 20,000 volts. For insulation tests the voltage can be raised to 37,500.

Of the experimental track only 6 km., about 3¾ miles, are ready at present, but 5 km. more are under construction and later more additions will be made. The trolley wire is a round 8-mm., hard-drawn copper wire and is suspended at a height over the rails of 4.7 to 5.7 meters (15 to 18 ft.). Since one object of the experiments is to determine the most suitable method of wire suspension, many different kinds of suspension have been used on different parts of the track. Fig. 1 shows the simplest kind of suspension, an ordinary direct suspension with trolley wire hanger. There is no insulating hanger bell, the porcelain strain insulators that hold the cross span making up the whole insulation of the wire. At every second pole a connection is made to a conductor fastened to an insulator on the top of the bracket arm, and running through two grounded iron rings, held out about a foot from the bracket arm. Now, should a wire break occur, this branch wire comes into contact with one of the iron rings, thus grounding the trolley wire. A similar construction, but on two poles instead of one pole, is shown in Fig. 2. On the greater part of the track the suspension is made by means of one or two steel "messenger" wires as shown in Figs. 3, 4, 5 and 6. Of course, in this way the sag of the contact wire can be almost entirely done away with, thus giving a better contact at higher speeds. The strain on the contact wire can be rendered very small, and also the strain on the messenger wire since this can have a considerable sag without any objection. Figs. 3 and 5 show suspensions of this kind with only one messenger wire and Figs. 5 and 6 show systems with two messenger wires. It is readily seen from the figures that in all these systems the insulation is double, there being one insulator between the pole and the span and cross-bar, and one insulator for the messenger wires. At some places, especially curves, rigid members are necessary in order to hold the wires in the right position, and for this purpose bicycle tubes are used. Fig. 7 shows a section insulator with the section switch mounted on a pole, and Fig. 8 shows the arrangement of the contact wire where the line runs under a road.

Wooden poles are used on the whole line, with the exception of six made of armored concrete located at curves. Of course, the return current goes through the rails, but these are not provided with rail bonds except on a small part of the line. This arrangement is made in order to test whether at the high voltages used, rail bonds will prove necessary or not.

A telephone line runs along the line on the trolley poles. Some experiments regarding the influence of the railway current have shown that the static influence is considerable, the voltage of the telephone line to ground amounting to about 4,000 volts in some cases. In order to correct this two discharging coils were connected between the two telephone wires and ground. These removed the static charge, but the telephones are provided with high-tension insulation.

The rolling stock to be tested consists of two locomotives and two motor cars. One of the locomotives, which was obtained from the British Westinghouse Electric & Manufacturing Company, was constructed at the Westinghouse shops in Pittsburg; the other was delivered by the Siemens-Schuckert Werke, in Berlin. The American locomotive has two axles and a wheel base of 2.54 m. The wheel diameter is 1.04 m., and each wheel axle is driven by a single-phase series motor of a normal capacity of 150 hp, by means of gear wheels with a ratio of 1:3.89. The maximum practicable speed of the motor being 1,350, the maximum speed of the locomotive with this gearing is 62 km. per hour. The gear wheel case is, however, large enough to receive a gearing with the ratio 1:1.75, whereby a much higher speed may be attained. The total weight of the locomotive is about 25 tons. At maximum pulling force the speed is about 28 km. per hour. The primary winding of the transformer is so connected that the locomotive can work with 3,000, 6,000, 12,000, 15,000 or 18,000 volts. Since the details of the Westinghouse railway system is known to American engineers a detailed description of the locomotive, which is shown in Fig. 10, is not necessary. The contact arm shown in this illustration is only a preliminary arrangement consisting of a high-tension insulated contact arm of the same kind that is used on the street cars of Stockholm.

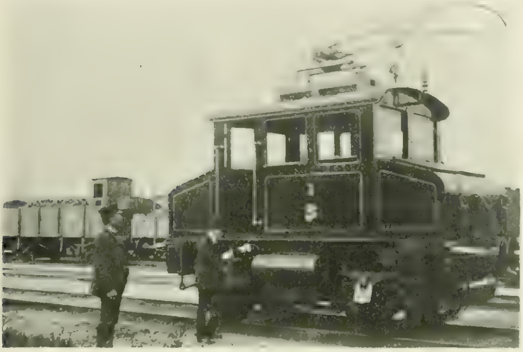


FIG. 10.—PERSPECTIVE VIEW OF LOCOMOTIVE

Fig. 9 is a drawing of the Siemens-Schuckert locomotive. This has three wheel axles, each of which is driven by means of gear wheels by a single-phase series motor with a rated normal capacity of 100 hp. The wheel diameter is 1.1 m. Two sets of gear wheels may be used, with a ratio of 1:5.13 and 1:3, respectively. Since the highest speed of the motors is 1,100 r.p.m., the maximum speed of the locomotive is 45 and 77 km. per hour, respectively. At maximum pulling force the speed is 20 km. per hour and 34 km. per hour, respectively. The speed can be lowered by means of the electric regulating apparatus. The locomotive weighs about 32 tons and with ballast about 36 tons. The center distance between axles being 2.3 and 1.7 meters, respectively, the wheel base has a length of 4 meters. All the controlling and regulating apparatus is located in the motorman's cabin at one end of the locomotive, from which one has an unobstructed view in all directions. The contact arms are of a special construction of the Siemens-Schuckert Werke. The main transformer is located above the middle pair of wheels and its primary winding can be connected for voltages of 5,000, 10,000, 15,000 or 20,000 volts. The cooling oil is circulated by means of a centrifugal pump. The second winding is connected to the starting apparatus, from which the motors obtain current at voltages varying between 150 and 300. The high-tension switch and the reversing switch are mechanically connected to the starting apparatus. The motors are cooled by a special fan, by means of which the capacity of the motors is expected to be considerably increased.

The motor cars were built by the Nya Aktiebolaget Atlas, Stockholm, and their electrical apparatus supplied and installed by the Allgemeine Elektricitäts Gesellschaft, of Berlin. The motor truck of each car has two single-phase motors of Dr. Eichberg's system and construction, each motor having a rated capacity of 120 hp. The wheel diameter is 1 meter and the two gearing sets have a ratio of 1:4.26 and 1:2.96, respectively. The maximum speed of the motors is 1,000 r.p.m., and thus the highest attainable speed of the car is 45 and 65 km. per hour. The motor has the characteristic properties of a series motor regarding speed and torque, but is different in that the windings of the stator and the rotor are separated from each other. The stator is wound for a voltage of 6,000 and receives its current directly from the trolley wire without any transformation. The motor has two pairs of brushes; one pair, as in the case of the usual repulsion motor, is short-circuited, while the other pair is connected to a regulating transformer supplying current at different voltages for the speed regulation. The motors of this car thus do not need any transformer for the main current. This is an advantage, but the system has the disadvantage as compared with the system used on the locomotives, in that only one line voltage can be used; and further, that the motor for high-tension is heavier and more expensive than the low-tension motor. This quickly places a limit on the voltages, which from this reason cannot be as high as would be desirable from other reasons.

The motor car is shown on Fig. 11. As will be seen, each car is provided with two contact arms of a special design. It is further provided with a regulating transformer, controlling apparatus and relays for speed regulation. All high-tension apparatus is located in a special chamber, which is accessible only when the contact arms are pulled down. In each end of the car there is a motorman's cabin The controlling apparatus is like that of the Westinghouse locomotive, being of the multiple-unit system. The auxiliary current for the controlling apparatus is not, however, direct current from a small storage battery, as in the case of the Westinghouse system, but is taken from the mains by means of a transformer. For the heating of the cars an interesting method is used. The current for this purpose is taken from the regulating transformer, so that the heating current is heaviest when the motors take no current, while at full load the heating current almost ceases entirely. The advantage of this arrangement is evident.

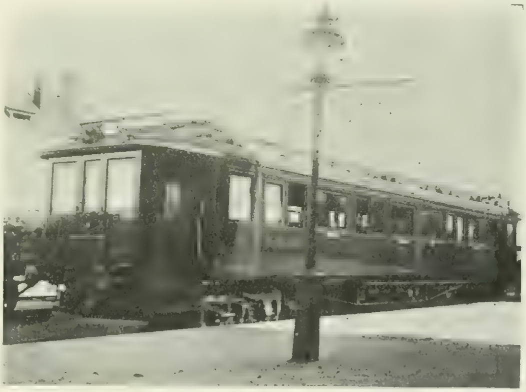


FIG. 11.—VIEW OF MOTOR CAR

As a conclusion Mr. Dahlander stated the preliminary programme for the experiments, as follows:

The electric railway experiments of the Royal Railroad Administrations will cover principally the following subjects:

The Power Station.—1. Devices for generators and transformers to protect against injury from rise of potential and short-circuits. 2. Voltage regulation at varying load.

The Line.—1. Different systems of suspension, different kinds of insulators and other details of the contact line on free track, at bridges and at stations. 2. Devices to protect against danger from fallen high-tension wires. 3. Protective devices at road crossings. 4. Arrangements of the trolley line at stations and its division into section in order to increase the safety of traffic. 5. Measuring the impedance of the trolley wire and of the return circuit, the latter with different kinds of rail bonding. Examination of the state of insulation under various circumstances. 6. Investigation of leakage and vagrant currents and of devices to protect against danger or injury therefrom. 7. The influence of the railway currents on telephone and telegraph circuits running along the road and means to prevent disturbances to such circuits.

Rolling Stock.—1. Properties of the motors regarding torque and speed, heating and capacity on short and extended load periods, with and without forced ventilation; sparking, durability; capacity of overload, the utilization of the adhesion weight at different frequencies; efficiency and power factor at various loads; acceleration; gear wheels. 2. Electric starting and regulating devices of different kinds, especially devices for indirect starting with multiple-unit systems. 3. Contact arms of different designs. 4. Measuring train resistance and motor input at different size of trains and at different speeds. 5. Automatic braking systems with vacuum and compressed air. 6. Heating of trains by electricity. 7. Train lighting. 8. Signaling by means of compressed air. 9. Devices on locomotives and cars for protection against danger from high-tension currents.

The discussion following the reading of Mr. Dahlander's paper treated first of the system of suspension. Some speakers thought the suspension by means of messenger wires too complicated and expensive. The advocates of this system held that it was the only possible one for high speeds, as otherwise the poles would have to be located very close to each other, thus increasing the expense. One speaker recommended the Oerlikon system with the contact wire mounted directly on insulators on the tops of the poles. Mr. Dahlander stated that this system had been taken into consideration, but for many reasons it had been decided not to try it in the present experiments. One member of the congress expressed his doubt whether from a national economic standpoint the electrification of the steam railroad system would be justified. Within a relatively short time, he said, all of the water powers of middle and southern Sweden would be taken up by various manufacturing industries; none should be wasted, but electric railroading by water power involved waste where water storage is not feasible. In reply figures were given showing that the doubts expressed had no grounds whatever. The time when all the water powers of Sweden would be taken up by manufacturing industries was very distant. The water powers and turf pits would be sufficient for all the industries and all the railroads for a long time to come. Furthermore, it was pointed out that by synchronizing some stations they could help each other so that a tolerably constant load can thus be obtained.

Roller Bearings for Electric Cars.

In a paper read before the British Tramways and Light Railways Association, Mr. F. W. How reports the results of tests made upon two cars, one being fitted with roller bearings and the other with ordinary phosphor-bronze bearings, the weather and track conditions being precisely the same. The two cars selected were identical in general construction, and weighed, when empty, 10 tons. During the tests both cars were loaded (inside) with 3 tons dead weight, equal to, say, 53 passengers. For the purpose of measuring accurately the current and energy consumed, a recording ammeter in series with a watt-hour was used, and the route covered in each case was 11 miles. In the case of the car fitted with ordinary bearings 47 stops were made, and the energy consumed was equivalent to .90 watt-hours per mile run. In the case of the car fitted with Empire roller bearings 44 stops were made, the energy consumed being .75 watt-hours per car mile. Records have been kept of the runs of these cars from the start, and between October 1, 1904, and September 30, 1905, 14 of the bogie cars on the Croydon system, fitted with roller bearings, traveled 545,898 miles, and one car, fitted with ordinary bearings, ran during the same period 30,988 miles, the total distance run by the 15 bogie cars being 576,886 miles. Assuming that the 14 bogie cars had not been fitted with roller bearings, the extra energy consumed, based on the difference as obtained from the two tests, would have amounted to 79,155 watt-hours, and, at the price paid for the same—namely, 2d. per watt-hour, renewals at 10 per cent per annum, and a further 10 per cent for depreciation, there is a saving of £37 14s. per car per annum, due to the employment of roller bearings. As regards the cost of roller bearings, Mr. How stated that it had been considerably reduced of late, owing to the possibility of casting the "floating cage" so accurately that the expensive machining and fitting. formerly imperative, could be dispensed with.

Voice Overtones, or Harmonics, as Affecting Long-Distance Telephone Transmission.

By D. MacL. Therrell.

As is well known, the sonorous waves or sounds constituting articulate speech involve various fundamental vibrations which are accompanied by numerous other vibrations, ranging several octaves above their fundamental.

The undulatory current created in the electrical transmission of such sounds must, of course, conform to the wave characteristics of the sound so transmitted, being a resultant wave of the fundamentals, together with the many accompanying over and lower tones differing in amplitude, phase and periodicity.

It is found in practice that the fundamentals and the lower harmonics are of comparatively easy transmission over an electrical circuit, while the higher or upper harmonics, upon which we are dependent for the quality and definition of articulate speech, owing to their feeble values, and the infinitesimal time through which these values are operative, are affected and distorted by the various conditions and reactions of the circuit to such an extent as to be degraded on long circuits to the level of their fundamentals, whereby articulation is lost and the transmitted speech rendered practically unintelligible.

It is therefore worth while to endeavor to ascertain whether or not it is practicable to reinforce and preserve these over-tones or partials, to the end that articulation and definition may be conserved and the character and form of the voice waves maintained to the transmission limit of the fundamentals themselves.

This endeavor has been undertaken and a description will be given thereof and of apparatus and experiments resulting therefrom, which, it is believed, will be of more than passing interest to telephone engineers.

Whenever several sonorous bodies in the surrounding atmosphere simultaneously excite different systems of waves of sound, the changes of density of the air and the displacement and velocities of the particles thereof within the passages of the ear, are each equal to the algebraical sum of the corresponding changes of density, displacements and velocities, which each system of waves would have separately produced if it had acted independently; and we may say in this sense, that all the separate vibrations which the separate waves of sound would have produced co-exist undisturbed, at the same time within the passages of the ear. (Helmholtz, "Sensations of Tone"). This generalization is true, not only for the vibrations of sonorous bodies in the atmosphere, but in principle is equally applicable to all media wherein wave motion may be produced or transmitted, since all wave motions are reducible to and controlled by the same laws of motion, in the ultimate particles of matter; the disturbance of the atomic or molecular arrangement of any given medium or body giving rise to a series of displacements, affecting all the particles within the sphere of propagation and causing each particle, after a certain lapse of time to pass through, in a given plane, all possible positions of value around its place of rest or equilibrium.

Such disturbances are known as wave motion, and are in principle the same for sound, heat, light and electricity.

In dealing with the electrical transmission of sound waves such as represent the sonorous vibrations of articulate speech, it has been customary by many, as a result of our tendency to treat sound from a subjective point of view, to consider only the resultant form of the wave corresponding to any given sound, and to treat such resultant waves as if wholly obeying the laws governing the transmission of simple alternating currents. But, since every sonorous sound, with the exception of the simple tones of a tuning fork, is a compound of many complex vibrations, of varying value and phase relation, it becomes apparent that such waves may not be so considered without doing violence to the constituent elementary waves, whose algebraic sum determines the final or resultant wave form, and which co-exist upon the line, independent and undisturbed from an objective point of view.

Let us consider now the component elements of the human voice and the essentials for transforming the sonorous vibrations into electrical vibrations and transmitting the same over long electrical circuits. Speech tones are composed of some prime or fundamental tone and a series of partial tones ranging as high as the sixteenth or more above the prime. The definition of articulate speech is absolutely dependent upon the relative number and value of these partial tones, and their ratio and phase relation to the prime or fundamental; articulation being good or bad in proportion to their dominance or subservience to the first or lower and louder tone. Now, since these upper partial tones are, in comparison with the fundamental, both feeble and transient, it follows that they are often so mixed up with and dominated by their fundamental as to essentially destroy the articulation of even sonorous speech, requiring resonators to detect their existence. This is especially applicable to such words as are characterized by consonant sounds, which are dependent for recognition upon feeble and aspirant noises of estopment or explosion accompanying the consonant letters. (See Blaserna, Theory of Sound, page 165.)

Such being the case, it has been found impossible to transform the sonorous vibrations of articulate speech into equivalent electrical vibrations without great sacrifice of articulation, even for short distances, only about thirty per cent of the speech so transmitted being understood when severed from explanatory context or position.

To improve this condition of affairs much ingenuity and time have been expended upon both the telephonic apparatus and the line conductor, but so far as I am aware, no one has sought to improve or modify the component electrical waves in themselves so as to reinforce the upper partials by varying their relation to the fundamental, and insuring unto them greater relative values and hence both characteristic dominance over the prime and sufficient individuality to maintain their integrity to the limits of the energy impressed. This has been done by me with most satisfactory, not to say remarkable results. These experiments have also convinced me of the influence of phase relation upon the quality of sound.

The quality of a compound or complex tone or sonorous sound wave, depends upon the number and relative intensity of its partial simple tones, and upon the phase relations under which these partial tones enter into composition.

This may or may not be said to throw light on the old controversy over this question, led upon the one side by the followers of the great Helmholtz and upon the other by the brilliant Dr. Koenig, Lord Rayleigh and others, but the fact seems to remain that for electrical sound waves, at least, my experiments coincide with and confirm the mechanical results obtained by Dr. Koenig with his wave siren.

Aware of the brilliant work of Lord Kelvin, Dr. Lodge and Messrs. Hertz and Heaviside in the mathematical discussion of the laws governing the propagation of electrical waves over long circuits, and fully cognizant of the importance of self inductance as a factor of such transmission, I am, nevertheless, constrained by experiments of a positive character to take issue with such conceptions, with reference to open aerial lines, finding as I have, reasons for considering self-induction somewhat in the nature of a mechanical inertia, leading to an increased line leakage proportional to the line inductance and varying with atmospheric conditions.

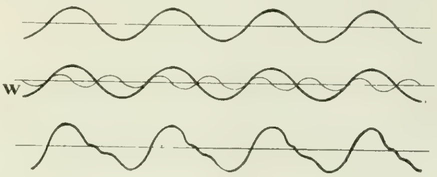
While others have been working to improve the conducting medium so as to increase its conductivity for voice currents, I have, on the contrary, arrived at the conclusion that the conducting medium, as a limiting factor, plays too small a part in the transmission of telephonic currents, to warrant such elaborate and expensive treatment as has been proposed, and instead have sought another solution. From my point of view, the present status of conductors is such as to admit of little improvement, and the problem resolves itself into a question of transmission efficiency, with special reference to over-tones or characteristic partials. This may be stated in other words as follows:

The prime cause of the inability to transmit electrical sound waves without deleterous attenuation lies largely in the human voice itself, whose characteristic partial tones and vocal noises are relatively so feeble in comparison with the fundamentals and lower partials as to be drowned out and lost, even in oral and sonorous sound waves unless particular stress and training is brought into service to conserve and reinforce them. This is amply illustrated by noting the difference in the articulate quality of the speech of children and uncultured persons, as compared with the clear and distinct quality and enunciation in the case of a trained orator, vocalist or elocutionist. In the former case the characteristic partial tones are very feeble and mixed up with the fundamentals, or entirely dormant, while in the latter they are reinforced and controlled as the result of special culture and discrimination. (See Rayleigh, "Theory of Sound," Vol. 2, page 44.)

Consider now the effect upon the resultant of an equivalent electrical voice or sound wave should we selectively reinforce such of the constituent partial tones as are essential to the transmission of the voice characteristics. Suppose that a given series of partial tones be reinforced either mechanically by properly adjusted resonators corresponding to the given partials, or electrically by a proper adjustment of the phase relation so as to superpose or increase their values twice or thrice in proportion to the fundamental and lower harmonics, which are assumed of sufficient intensity; or that such partial tones be superposed or reinforced, while the fundamental and lower tones are reduced. In such a case it is easily seen, that since the intensity of sound increases as the square of the amplitudes, such a relationship would render the partials so treated characteristically dominant over the fundamentals and lower tones whose values have not been raised, or have been relatively reduced. This becomes all the more effective owing to the fact that vibrations of high pitch are more persistent and intense than low ones of the same value, so that for the production of tones of high pitch much less energy is required than for the lower ones, "and yet the higher tones appear to our sensation extraordinarily more powerful than the deep ones." (See Helmholtz, "Sensations of Tone," page 774.)

It is further seen that with such selective reinforcement of the essential partial tones, the attenuation constants of a given circuit may be allowed for and still maintain an ample dominance of the essential characteristics over the lower tones, to the end that articulate quality may be conserved.

Referring to Figs. 1, 2 and 3, Fig. 1 is a graphical curve of a simple sinusoidal wave of an alternating current following the law of sines, and which may be impressed upon a conductor and transmitted according to the well known laws governing the flow of such currents.



FIGS. 1, 2 AND 3.—FORMS OF WAVES.

Fig. 2 shows a compound wave, consisting of a fundamental and its first octave or partial. As explained above, these waves are separate and distinct in the physical or objective sense, and act and re-act upon each other according to the principles of interference, or the "co-existence and superposition of small motions," to form a resultant wave, which is expressed as the algebraic sum of the instantaneous values of the two component waves. The form of this resultant wave which characterizes the vowel *o* is shown in Fig. 3.

Now an analysis of this resultant wave, into its components, as shown in Fig. 2, makes it evident that such a wave in its resultant form cannot be considered as wholly obeying the laws governing the motions and flow of the simple wave shown in Fig. 1, and especially is this true, when such a compound wave is acted upon by line reactions, or modified by other waves either simple or compound.

For instance, the musical note given by such a wave as shown in Fig. 1 may be easily transformed into an equivalent electrical wave and transmitted without distortion of character to any distance within the limits of the energy impressed. Such, however, is not true for the wave shown in Fig. 3, and in a much less degree for more complex waves. For the sinusoid in Fig. 1 may suffer an attenuation of any percentage of its value by the absorption and reactions of the line conductor without affecting its character, such attenuation merely decreasing its amplitude, and hence its intensity; whereas, a like attenuation of the wave shown in Fig. 3 becomes directly perceptible in its character, and if attenuated sufficiently, the smaller wave becomes entirely wiped out, since the intensity thereof decreases as the square of its amplitude, and hence whatsoever of its value that may remain is lost in the dominant value of its fundamental. Therefore, in treating the complex waves entering into articulate speech, it is imperative, if the best results are to be obtained, that we consider not the wave in its resultant form, but rather the elementary waves that go to make up this resultant.

Referring now, to Fig. 2, which represents the vowel *o*, suppose it is desired to transmit this wave over a circuit of great length without material distortion of its character. We know that it is an easy matter to so transmit the fundamental thereof, but unless some provision is made for maintaining the integrity of the partial, the said partial is reduced by the attenuations of the line, until it loses its modifying effect upon the fundamental and is merged therewith and hence the original character of the sound is lost. This is particularly true of the more complex waves corresponding to the human speech. But, if we increase the value of the partial twice or three times while maintaining the fundamental wave at approximately its original value, or reducing it, we shall have the resultant wave reinforced and dominated by its characteristic partial and able to withstand the line attenuation without loss of its character.

Referring now to Fig. 4, where we have three sets of complex waves, *w'*, *w''*, *w'''*, each set being identical with the vowel *o* as shown in Fig. 2, let us consider the laws governing the values of such complex waves when superposed so as to act and re-act upon each other by interference. In this instance we have each set or train of waves displaced by 180 degrees with regard to their fundamentals, or in other words, each set of waves is assumed to lag behind the former by 180 degrees. Now if these series of waves be impressed upon a medium in the order described there will take place a series of actions and reactions by which some of the waves in the constituent series will be destroyed, or neutralized, while others will be increased as the sum of their original intensities.

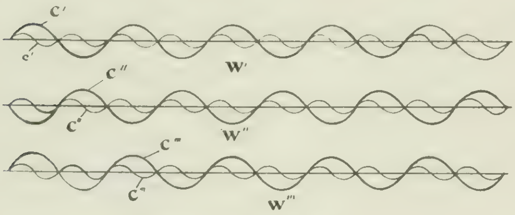


FIG. 4. COMPLEX WAVES.

Since it is a fact that the disturbance of any particle produced by the co-existence of two or more causes, will be the algebraic sum of the disturbances which they would produce separately, let us consider the nature of the displacement produced by the superposition of the action of two waves of the same length on the same particle at a distance, *x*, from the wave front. Upon this assumption, we have for the first wave $d' = \frac{a'}{x} \sin\left[2\pi\frac{vt - x}{\lambda} + A'\right]$ and for the second wave $d'' = \frac{a''}{x} \sin\left[2\pi\frac{vt - x}{\lambda} + A''\right]$ in which d' and d'' equal the displacements; a' and a'' determine the intensities of the sound in the two waves at the units distance; and A' and A'' the places of maximum displacement or angular distance at the expiration of time t. Now if the component wave lengths λ, be equal and uniform and the arc of displacement, $A' - A''$ equal zero, the maximum displacement, $\frac{a}{x}$, which determines the intensity of the sound in the resultant wave, will be

$$\frac{a}{x} = \frac{1}{x}\sqrt{a'^2 + a''^2 + 2a'a''\cos(A' - A'')}$$

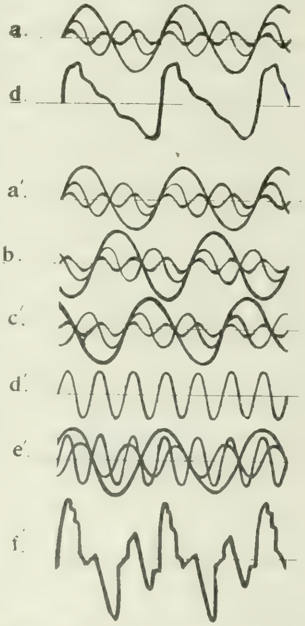
(See Bartlett, Acoustics and Optics, [illegible]) In other words the waves being directly superposed [illegible] have their maximum value, which will equal the direct sum of the two waves, and since the intensity of sound is [illegible] proportional to the square of the amplitude, the intensity of sound in the resultant wave is quadruple that of either of the component waves. This also applies to the wave [illegible]

the formula becomes the well known electrical equation for the resultant of two waves of different value or phase relation:

$$r = \sqrt{a^2 + a'^2 + 2aa'\cos\phi},$$

where, *r* is the resultant, *a*, and *a'*, the component waves and ϕ the phase angle, corresponding to $\frac{a}{x}$, a' and a'' and $A' - A''$, in the acoustical formula.

Now, if a' and a'' are equal and we make $A' - A''$ equal 180 degrees, then the equation gives $\frac{a}{x}$ = zero and one wave completely neutralizes the other. Thus, in Fig. 4, it will be seen that the fundamental wave *C'* encounters an interference from the fundamental *C''* of wave *w''* which is of an opposite sign, and being equal in value and wave length, according to the equation, *a'* equals *a''* and *A'* — *A''* being equal to 180 degrees the two waves mutually destroy each other. This is not the case, however, for the waves *c'* and *c''*, representing the partials, an octave above the primes, for where the primes, or fundamentals, are exactly 180 degrees apart and of opposite sign, thus neutralizing each other, the partials are coincident and, $\frac{a}{x} = \frac{1}{x}\sqrt{a'^2 + a''^2 + 2a'a''\cos(A' - A'')}$, the two waves are directly superposed while the fundamentals are destroyed. Now, wave *w'''* is impressed upon the line in the same manner as *w'* and *w''* and the same actions and reactions as have been detailed for *w'* and *w''* are performed by this wave for each cycle or wave length.



FIGS. 5 AND 6.—FUNDAMENTAL AND RESULTANT WAVE FORMS.

In this case, however, it will be readily seen, that since the fundamental *C'* and *C''* of waves *w'* and *w''* are operating to neutralize each other, the fundamental *C'''* of wave *w'''* is unopposed and impresses its full value upon the conductor. Also that the partial *c'''* of wave *w'''* being in phase with partials *c'* and *c''* is directly superposed, according to the formula, which results in the value of the resultant partial being increased to the sum of the values of the three components and corresponding partials, while the fundamentals are so placed in their phase relations that the first two cancel each other, and only the third remains effective.

From such a system of superposed component waves, it will be seen that we get a resultant wave wherein the characteristic partial or partials has three times the relative amplitude of its prime, and hence modifies the prime with the essential sonorous characteristics for articulation. An inspection of these curves will show that the same principle applies for any number of partial tones, the evenly numbered partials, or harmonics being superposed at every instant while the unevenly numbered partials, are partially neutralized or destroyed.

This principle may be employed to neutralize the evenly numbered as well as the unevenly numbered partials of a complex wave, whenever desired, by so varying the phase relations of the superposed trains of waves as to satisfy the terms of the equation.

From a special research of the matter, I have discovered, however, that for speech tones and the necessary characteristics thereof, the best results are obtained by so arranging the phase relations as to superpose and reinforce, relatively to the prime or fundamental, the greatest practicable number of odd and even partials, which is obtained by separating the original current into three component parts and reassembling the said parts or components under phase relations of 90 degrees, or 120 degrees, as regards fundamentals.

Referring now to Figs. 5 and 6, where we have a series of curves of waves consisting of the fundamentals and the first two partials, together with several resultant wave forms, let us now consider the proposition of superposing the unevenly numbered partials of a compound electrical wave corresponding to a sonorous sound wave.

The first unevenly numbered partial is the third partial, or the second harmonic. Therefore, if we so arrange matters as to reinforce the third partial, we shall at the same time reinforce every partial throughout the series which is a multiple thereof, and to a less degree all others within the neighborhood of this reinforcement.

Referring to Fig. 5, at *a*, we have the curves of a complex wave composed of the first three partials, and at *d*, a curve showing the resultant curve or wave form which is the algebraic sum of the series shown at *a*.

In Fig. 6, we have a set of curves, *a'*, *b'*, *c'*, identical with those shown at *a*, in Fig. 5, displaced relatively to each other by 120 degrees, or one-third of a harmonic cycle. From these curves it will be readily seen that for the series the algebraic sum is zero for all except the third partial, which is undisturbed, this is also the case for all multiples of this third partial. This resultant curve is shown at *d'*.

Now, if instead of impressing all three sets of these waves upon a conductor, related as shown, we impress only two sets and shunt most of the third train of the series, say *b'* or *c'*, so as to maintain the integrity of the system, while only impressing upon the line the other sets, we shall have instead of the simple curve shown at *d'*, an entirely new complex series, as shown, *e'*, the resultant of which is shown as *f'*.

Comparing *f'* of Fig. 6 with *d*, of Fig. 5, the difference is at once seen to be one of a rather remarkable kind. The resultant fundamental has been shortened by 60 degrees, the third partial has become independent thereof, and the characteristic discontinuities are seen to be wonderfully more marked and abrupt than at *d*, in Fig. 5, where the wave is long and gradually sloping with ill-defined characteristics. This holds also for all multiples of the third partial present in the harmonic series. It may be generally laid down, as a rule, that the force or loudness of the upper partial tones is the greater, the sharper the discontinuities of the resultant wave. When the wave alters uniformly and gradually answering to the nature of a smooth vibrational curve, only the deeper partials and the prime have any perceptible intensity. (See Helmholtz, Sensations of Tone, page 35.) Therefore, it is seen by these curves, where the third partial is reinforced relatively to the prime and second partial, that the answer to the theory is a positive one

Again referring to Fig. 6, it will be noted that there are three separate series of complex waves, displaced by a given angular distance. The voice, or sonorous waves acting upon a telephonic transmitter in the well-known manner, generate a corresponding series of electrical waves in the transmitter circuit which are, by induction, impressed upon the line conductors. Now, in order to obtain the condition of affairs upon the line conductors which is shown in Fig. 6, and required by theory, this corresponding electrical complex wave must be divided into three separate series, or its equivalent, and again brought together and impressed upon the line conductors, displaced from each other by 120 degrees, or one-third of the harmonic cycle. To do this special apparatus and circuits have been designed upon the triphase principle, which have proved confirmatory of the selective theory involved, and afforded most remarkable results upon actual long distance tests.

The circuit arrangements used are shown in Fig. 7. In this figure we have the terminals shown at *A* and *B* connected by the ordinary line conductors. *T* and *T'* are the transmitters, *b* and *b'*, C_2 and C_2' are the batteries and transmitter primaries at *A* and *B*, respectively. As the apparatus at *A* and *B* are identical they may be considered and described under references at *A*. 1 and 2 are the secondaries of primary coil C_2 and operate through an inductance *L* and condensers *K* and *K'* into primaries P_1 and P_2 inductively related to secondaries S_1 and S_2 which are connected to line as shown.

As this drawing may not be readily understood as shown, let us consider first, Fig. 8, where P_1 and P_2 are two primary coils of the transformers *A'*, *B'* and *C' D'*, inductively related to the secondaries S_1 and S_2, connected together at *D'* and to lines 1, 2 and 3.

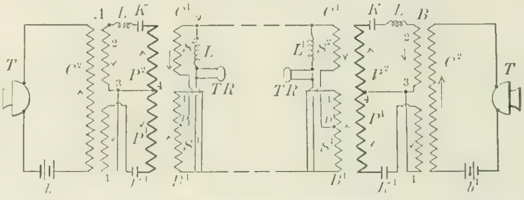


FIG. 7.—ARRANGEMENT OF CIRCUITS.

Now, if the currents in the primaries P_1 and P_2 differ in phase by 90 degrees, the same difference of phase will be impressed upon the electromotive forces generated in the secondaries of these coils.

If we now consider a triangle, *A C B*, Fig. 8, in which the length of each side is equal to unity, and let a line, *C D*, bisect the angle *C*, then *C D* is perpendicular to *A B* and bisects *A B*; hence $A D = \frac{1}{2}$, and $C D = \sqrt{1 - \frac{1}{4}} = \sqrt{\frac{3}{4}} = \frac{1}{2}\sqrt{3}$. In the right triangle, *A D C*, the angle *A C D* equals 30°, and the angle *C A D* equals 60°, whence $sin\ 30° = cos\ 60° = \frac{1}{2}\ cos\ 30° = sin\ 60° = \frac{1}{2}\sqrt{3}$, $tan\ 30° = cot\ 60° = \frac{1}{\sqrt{3}}$. Therefore, if the secondary, S_2, corresponding to *C'D'*, has $\frac{\sqrt{3}}{2}$ times as many turns as the secondary, S_1, corresponding to *A'B'*, then the e.m.f. between the terminals *C'* and *B'* or *C'* and *A'*, is the resultant of two components, one being the full e.m.f. generated in the secondary of P_2 and the other half of the e.m.f. generated in the secondary of P_1, the latter component being, moreover, displaced by 90° as regards the former component, and the terminal pressures pass through zero at intervals of 120° and are thus impressed upon the lines. Now, if the terminals, *C'* and *A'* of coils S_1 and S_2 be connected to a metallic circuit, while the other terminal, *B'*, be connected directly or through an inductance to *C'*, we will have the counterpart of the line circuits and coils S_1 and S_2 of Fig. 7, whereby the currents are impressed upon the line as per the curves shown in Fig. 6 above described.

It will be noted that the method of securing the diphase currents displaced by 90°, in P_1 and P_2 of Fig. 8, and therefore required in P_1 and P_2 of Fig. 7, has not been described. This is done as follows: Let a current be flowing through the primary of C_2. This generates an e.m.f. in its secondaries, 1 and 2, which form two closed circuits through the coils P_1 and P_2, and are connected together at 3 and 4. As will be noted, these closed circuits include an inductance, *L*, and capacities *K* and *K'*.

Since capacity and inductance, or self-induction act in opposite directions upon a periodic electric current as affecting its phase, it is apparent that by adjusting these values with regard to each other and the resistance of the circuits, we may vary the phase relations of these circuits by 90° or more. The phase difference required by theory is one of 90°, and since the power factor is to be considered even in these circuits, it is preferable to so adjust these values as to make one circuit lag in phase by 45°, while the other leads by the same phase angle, thus balancing the power factor of the system, and impressing upon the primaries, P_1 and P_2, a current of 90° difference of phase, which acts upon the secondaries, S_1 and

S_2, as described heretofore in reference to Fig. 8.

In arranging this phase displacement, certain circuit constants and functions must be observed, and a certain current frequency must be adopted as a base.

Consider now the question of frequency, *n*. It has been seen that theory calls for the reinforcement or boosting of the upper partials, or in this case the multiples of the third partial. It is claimed by many telephonic authorities that the highest essential frequency of telephonic transmission falls near 750 p.p.s., but since there have been discovered in the human voice as many as 16 partial tones, to say nothing of the characteristic noises accompanying consonant sounds, it seems that much might be gained by considering frequencies much higher than this as speech characteristics. Therefore, in calculating for angles of lag and lead, a frequency of *n* equals 250 p.p.s. has been assumed as a base, this frequency coming near the average voice fundamental. The third of this base is 750 p.p.s., and from the theory all necessary frequencies are cared for above this throughout the harmonic series.

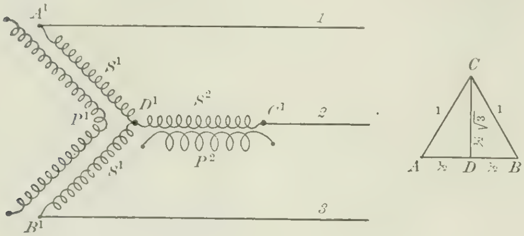


FIG. 8.—DIAGRAM OF PHASES.

One case and one type of apparatus therefor will be illustrated in order that the principle may be clearly understood. From what has been said of the effects of resistance, capacity and inductance, in determining the phase of the current in a given circuit, we may calculate for any given phase angle. The formula is $\tan\phi = \dfrac{2\pi nL - \dfrac{10^6}{2\pi nK}}{R}$, from which it will be seen that with three of the terms, *n*, *L*, *K* and *R*, given, we may transpose and find the required value of the other term or constant for any predetermined value of ϕ, which represents the phase angle. To illustrate, suppose ϕ be required equal to 45° of lag, then we have the equation

$$\tan\phi = 1 = \frac{2\pi nL - \dfrac{10^6}{2\pi nK}}{R},\text{ where}$$

n = frequency of the impressed e.m.f.,
L = the inductance in henrys,
K = the capacity in microfarads,
R = the resistance of the circuit in ohms.

Given the frequency, *n*, as 250 p.p.s., the inductance, *L*, as .021 henry, and the resistance as 1.1 ohm, and it is required to find the value of *K*, where the current is required to lag 45°, or the inductance or positive component is to dominate. Then $45° = \phi$, $\tan\phi = 1$, and

$$\frac{\dfrac{10^6}{2\pi nL - R}}{2\pi n} = K = 10.96 \text{ microfarads.}$$

For the same given constants, where the current is required to lead by 45°, or the capacity effect is to dominate, the formula becomes $\phi = -45°$, $\tan\phi$ and

$$\frac{\dfrac{10^6}{2\pi nL + R}}{2\pi n} = K = 18.67 \text{ microfarads.}$$

In this connection it will be observed that when the expression $2\pi nL - \dfrac{10^6}{2\pi nK}$ is positive— that is, where *L* is of greater effect than *K*—the current lags, whereas when it becomes negative—that is, where *K* is greater in effect than *L*—the current leads the e.m.f.

As it is required to maintain as much current as possible in the primaries, P_1 and P_2, of coils *A′* and *B′*, it becomes necessary to keep the resistances of the secondaries of C_2 and the primaries, P_1 and P_2, as low as is practicable. In the case under consideration the secondaries 1 and 2 of primary C_2 contained, each, 480 turns of No. 17 wire and measured .6 ohm, while the primaries, P_1 and P_2, contained 377 turns of No. 18 wire, and measured .5 ohm, making the total resistance of the circuit 1.1 ohm. For this low resistance it was not necessary to insert the inductance coil, *L*, since the self-induction of the coil P_2 itself amounted to 21 millihenrys (computed). This involves larger values for *K* than will be necessary when *R* and *L* are increased, and also shows that *L*, *R* and *K* may be varied within wide limits without materially affecting the results. It should be mentioned in this connection, however, that since the two secondaries of coil C_2 are practically on short-circuit, thus neutralizing the self-induction of their primary, a very large current will flow therein, giving rise to hysteresis and eddy-current losses proportional to the frequency, *n*, and the square of the frequency, respectively. It is, therefore, necessary to design the magnetic circuit of coil C_2 so as to work at the lowest magnetic density compatible with efficiency.

It is also of great importance to maintain the highest degree of insulation between the condenser terminals, as leakage losses and dielectric absorption may readily turn success into failure.

New York Central Generating Plant.

The accompanying illustrations show the main characteristics of the two stations now being built by the New York Central & Hudson River Railroad to furnish power for its terminal electric traction service. The size of the main building is 167 ft. wide, 237 ft. long and 105 ft. high. Each will have an ultimate capacity of 30,000 kw, and they will be cross-connected electrically. The number of cubic feet per kilowatt capacity is 102, and the number of square feet of building per kilowatt is 1.49. The switching equipment will be in small buildings about 110 ft. distant from the power house.

One of the buildings is located at Yonkers on the Hudson Division, and the other at Port Morris, on the Harlem Division. The site of the latter was dry ground and the foundations were carried down to rock. At Yonkers, however, the location for the building was entirely in the Hudson River, the water running from a depth of 8 ft. near the shore to 16 ft. at the outer end. The foundation here rests on piles and consists of a concrete structure, water-proofed at one horizontal plane by alternate layers of coal tar, pitch and felt and strengthened above this plane by two courses of round steel rods one inch in diameter laid at right angles to each other in the bed of the concrete.

The two power houses, aside from the foundations, are similar in general design. The base and floors are of concrete, the framework of steel, the walls of brick and tile and the roofs of concrete roofing slabs covered with copper. Special attention was given to the architectural appearance of the stations and an excellent effect is produced merely by the use of common brick and terra cotta of the same general color, relieved through the careful design of the openings and recesses. Special consideration was given to the design of the windows, not only to obtain a well-lighted interior, but also to present an attractive appearance from the exterior at night, since both power houses are adjacent to railroad lines and along the lines of important water travel.

Each power house has two chimneys, 15 ft. 6 in. inside diameter and 250 ft. high above the grate level. The stations are divided by a brick wall into generating room 69 ft. by 231 ft. 8 in., which is open to the roof, and a boiler room 88 ft. wide and of the same length, over which are placed the coal bunkers having a capacity of 3,500 tons. At Port Morris there are three galleries on one side of the turbine room, the first being used as a shop, the second as an operating gallery and the third for offices. At Yonkers the level of the first gallery is carried across the room and is the operating floor with walkways between the generators. The exciters are placed

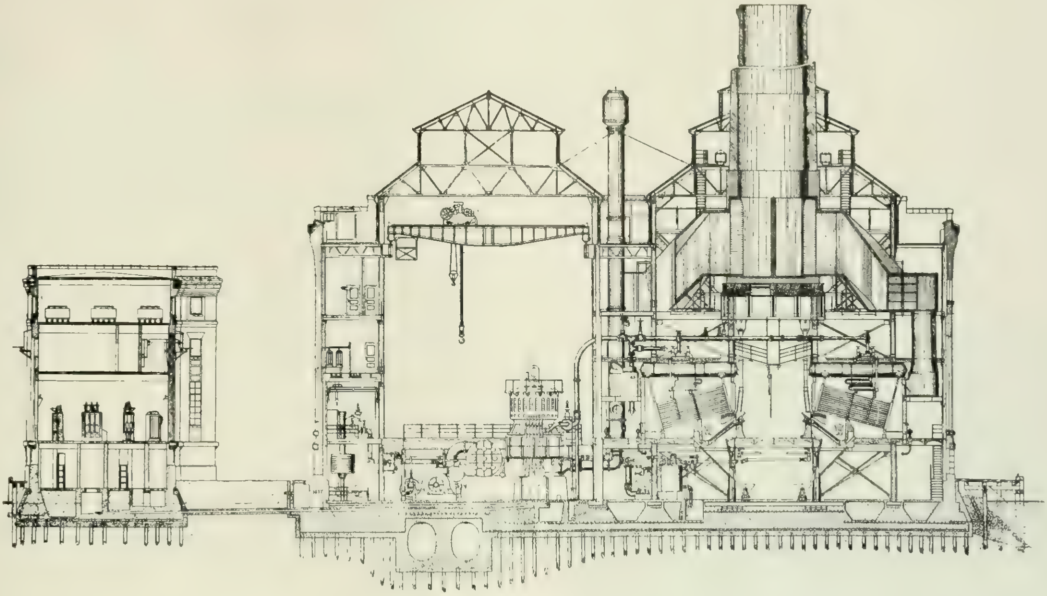


Fig. 1.—Cross-Sectional Views of Sub-Station and Power Station at Yonkers, N. Y.

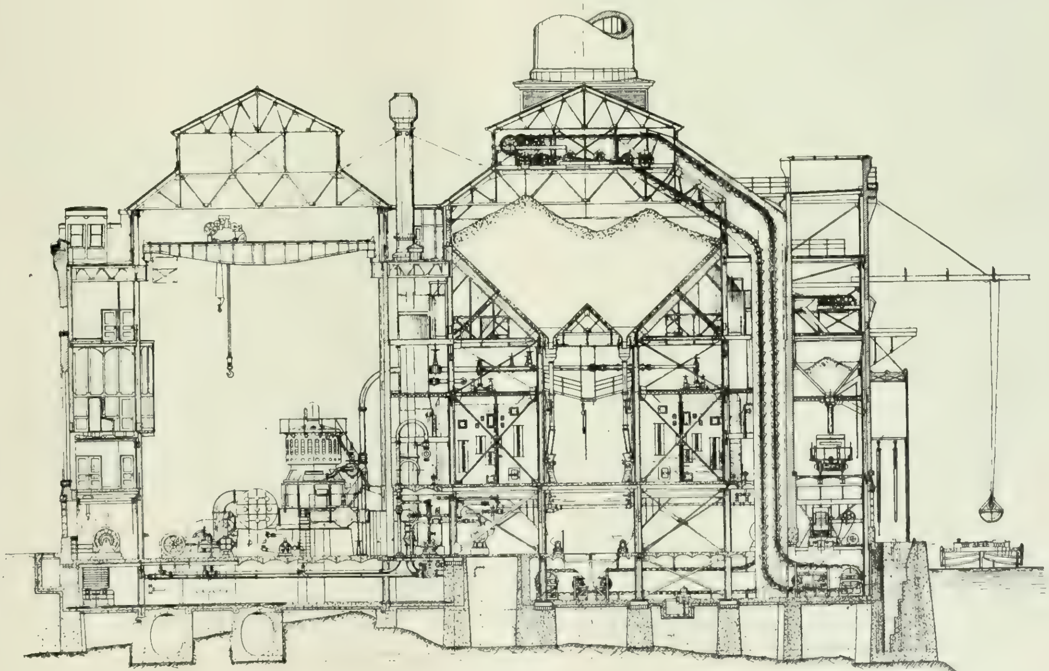


Fig. 2.—Cross-Sectional View of Power Station at Port Morris, N. Y.

NEW YORK CENTRAL GENERATING PLANT.

under the galleries on the level of the operating floor, the operating gallery being immediately above them, the top gallery is used for offices and shops. Each turbine room will be equipped with a 50-ton traveling crane having a 10-ton auxiliary hoist.

The coal and ash handling plant is very complete, though having no particularly novel features. All the apparatus except a steam hoist for unloading coal from boats, is driven by 220 volt, three-phase induction motors, varying in capacity from 7½ hp for the ash conveyor to 40 hp for the coal crusher and conveyors.

In each station accommodation will be provided for 24 Babcock & Wilcox water-tube boilers, each having a grate area of 112 sq. ft. and heating surface of 6,250 sq. ft., thus giving a ratio of 55.8. They are rated at 625 hp each; the steam pressure is 185 pounds per square inch. Sixteen boilers will be installed for initial operation. The steam will be superheated 200° F. by superheaters in each boiler having 1,230 sq. ft. of heating surface.

Each power station is designed to accommodate six 5,000 kw turbo-generators, four of which are being installed for initial operation. The turbines are of the Curtis five-stage vertical type. These machines are about 15 ft. in diameter at the base and 35 ft. high from the floor to the top of the generator.

FIG. 3.—YONKERS POWER STATION.

The turbine structure is mounted upon a cast-iron base, forming an exhaust chamber, in which is provided the opening to the condenser and to free atmospheric exhaust. The shaft of the turbine is separated from that of the generator above, the connection between the two being made by a coupling, so that the machine can be readily taken apart. The shaft is borne by a step bearing consisting of two cast-iron blocks, between which water is used for lubrication under a pressure of 800 pounds per square inch, exerting a sufficient force to raise the moving structure slightly. One individual pump is provided for each turbine for the lubricating system, and in addition to this two larger pumps, in connection with two accumulators, insure uninterrupted pressure at the step bearings.

The governing will be effected by successive opening and closing of automatic hydraulically-operated valves, which deliver steam to the different sections of two sets of nozzles. The turbines will be fitted with two centrifugal devices to check any excess of speed. After either one of these devices operates the next revolution of the machine will bring it into engagement with a lever, which will trip the main steam valve, cutting off immediately the driving power and allowing the machine to come to rest in the shortest possible time.

The condensing apparatus is external to the turbines. The condensers are of the Worthington counter-current surface type, and each is directly connected to its turbine base and contains about 17,000 sq. ft. of cooling surface. They are guaranteed under full load to maintain a vacuum of 28 in. [illegible] water at a temperature of 70° F., 30 in. barometer.

The auxiliary condensing apparatus [illegible] independent units. Circulating water pumps are of the centrifugal type, directly driven by horizontal reciprocating engines. The dry vacuum pumps are of the rotative fly-wheel type, with air and steam cylinders in tandem, erected on a common base. The hot-well pumps are of the two-stage turbine type, and are driven by direct-connected, direct-current electric motors.

As an evidence of the high efficiency expected of the condensing system, it may be stated that the manufacturer has guaranteed that the temperature of condensed steam measured in the condenser hot well will be within 1° F. of that corresponding to the pressure measured in the condenser. All parts of the machinery have been designed to operate smoothly and quietly under all loads up to 50 per cent above the normally rated capacity of the turbines. The intake and discharge circulating tunnels for the condensing system are elliptic in shape, 7 ft. 3⅜ in. by 9 ft. 11 in.

The generators each have a capacity of 5,000 kw, and are wound for three-phase currents of 25 cycles and 11,000 volts pressure. The armatures are star-connected, and the neutrals are grounded through individual cast-iron grid resistances connected to a common ground bus, limiting the ground current to an amount sufficient to operate the line overload relays. The leads of the generators are brought down to the floor through brass pipes to the ducts leading to the high-tension switches, the arrangement being such that no high-tension conductors are exposed in the turbine room.

The exciter system at each power station will consist of two 150-kw turbo-generators and one 150-kw induction motor-generator, furnishing current at 125 volts pressure; also one exciter storage battery consisting of 74 cells, type R-21, having a capacity of 1,200 amp. for one hour, with spare space in the tanks for increasing the capacity to 1,800 amp. for one hour. The exciter generators and battery are connected to two independent positive buses and one common negative bus. The battery has two end cell switches on the positive side. One positive bus serves for field excitation of the 5,000-kw generators only, while the other serves for certain lights and motors in the station.

The stations will be operated from the operating gallery on the north side of the turbine room. The arrangement of the switchboards in this gallery is symmetrical, and all cables and copper connections running to the switchboards are carried in concrete trenches under an Alberene stone floor. The main operating switchboard containing all the control switches and the instruments necessary for the operation of the station is located in the center of the operating gallery. A set of two exciter switchboards is located on each side; the main operating switchboard as well as the exciter switchboards are enclosed in an operating booth constructed of steel and wire glass. Three field switchboard panels are located outside on each side of the operating booth. An alternating-current and a direct-current light and power switchboard on either end of the operating gallery complete the switchboard installation in the turbine room.

FIG. 4.—PORT MORRIS POWER STATION.

At both power stations switch houses have been provided, separate from the main building, with the idea of obtaining the best conditions for the installation of high-tension switching apparatus, and at the same time increasing the safety of operation. At Port Morris the switch house is 50 ft. 10 in. wide by 100 ft. long. At Yonkers the switch house and the sub-station for that district are combined in one building, 37 ft. 4 in. wide by 255 ft. 4 in. long; the switch house occupies 147 ft. 8 in. of the length and the sub-station 107 ft. 8 in. In the switch houses are installed the high-tension switching equipment, consisting of bus-bars, oil switches, instrument transformers, etc.; also such instruments as are required for the complete equipment of generating stations, but which are not essential for the operator.

The switch house also contains auxiliary boards, which allow the main operating switchboard in the turbine room to be put out of service if it should be desirable for the purpose of cleaning and repairs. These boards will also permit the operation of the station should by an accident the main operating board become disabled.

Two high-tension buses, to which the generators are connected by means of a main switch and two selector switches, are installed in the basement of the switch houses. The feeders are equipped with selector switches only. Overload relays are installed in the generator and feeder circuits, but the generator relays will operate only under very extreme conditions. In the generator circuits, in addition to overload relays, reverse-current relays will be installed; these, however, are connected to indicating lamps only, not tripping the oil switches. All relays are of the inverse time limit, bellows type.

All high-tension connections and apparatus are located in the basement of the switch house, and no such apparatus is located on the first floor, except the oil switches, to which connections are made from the basement through the floor. The basement is made inaccessible to any but authorized workmen. This precaution and the removal of the high-tension apparatus from the power house itself into a confined space in a separate building reduce the danger of coming in contact with high-tension apparatus to a minimum.

On the second floor are located the load dispatcher's office, the exciter battery with booster and switchboard, laboratory, storeroom, toilet rooms and the apparatus for the hot-air heating and ventilating systems.

The arrangement of oil switches and connections is such that the apparatus belonging to one generator and three feeders form a unit which is entirely separated from the others by fire-proof walls in the basement. All connections between oil switches and bus-bars are made with bare copper tubing 1¼ in. outside diameter, the construction being such that practically no insulators will be required. The buses are enclosed in vertical brick and Alberene stone compartments, and all high-tension connections will be separated by brick or Alberene stone barriers. The oil switches can be disconnected from the high-tension system by means of knife switches located in the bottom of the oil switches accessible from the first floor. This arrangement prevents accidents which might be made by mistake in disconnecting switches from live parts. All cables coming through the duct system from the power house enter manholes in the basement of the switch house, and are so arranged that the high-tension cables enter the high-tension compartments entirely separated. Low-tension cables enter through manholes in a passage separated from the high-tension compartments by a fire-proof wall, and are brought up in enclosed chases in the wall, so that they are positively insured against any accidental connection with high-tension conductors. The oil switches have a rated capacity of 500 amp., except the bus-tie switches, which have a rating of 1,200 amp. The switches are of the General Electric motor-operated type, and have all recent improvements.

All high-tension cables and the majority of the single-conductor, low-tension cables are cambric-insulated and lead-covered. The insulation is 10-32 in. for high-tension cables and 4-32 in. for low-tension cables, with a lead cover 3-32 in. Multiple conductor cables for instrument and control wiring have a combined cambric and rubber insulation. Single conductor cables will be used for connecting the generators with the oil switches.

About 1,000 incandescent and thirty-six arc lamps will be required for lighting the Port Morris power station, and 1,000 incandescent and forty-two arc lamps for lighting the Yonkers power station. The amount of power required for operating auxiliary machinery equals 240 hp alternating current and 1880 hp direct current at Port Morris, and 260 hp alternating current and 180 hp direct current at the Yonkers power station.

The organization of the engineering department of the New York Central Railroad which has charge of the design and construction of the generating stations is as follows: At the head is Fifth Vice-President William J. Wilgus, and there are three principal departments: Electrification, construction and architecture. The first-mentioned comprises the Electric Traction Commission, consisting of Mr. Wilgus, chairman, J. F. Deems, Bion J. Arnold and Frank J. Sprague; Mr. Edwin B. Katte is electrical engineer of this branch, with the following staff: J. D. Keiley, assistant electrical engineer; C. Schwartz, assistant engineer, and E. L. Broome, assistant steam engineer. The second department—construction—is sub-divided into designs and execution. In the former are Messrs. G. A. Harwood and V. Spangenberg, designing engineers; Mr. C. P. Marsh, bridge engineer, and Mr. W. H. Elliott, signal engineer. In the latter, Mr. W. H. Knowlton is principal assistant engineer, with Mr. G. A. Berry as assistant, and Mr. A. B. Corthill as terminal engineer. The architectural design is placed with Messrs. Reed and Stern for Grand Central terminal and Warren and Wetmore for power and sub-stations, with Mr. Chas. A. Reed as executor. Among the contractors on the work are as follows: Turbo-generators and complete switching equipment, General Electric Company; exciter storage batteries, Electric Storage Battery Company; boilers, Babcock & Wilcox Company; piping, M. W. Kellogg & Company; valves, Best Manufacturing Company; chimneys, Alphons-Custodies Chimney Construction Company; condensers, Henry R. Worthington; feed-water heaters, Taunton Locomotive Manufacturing Company; boiler feed pumps, Epping-Carpenter Company; flues, B. F. Hart, Jr., & Company; coal and ash-handling apparatus, Exeter Machine Works; mechanical stokers, Westinghouse Machine Company; electrical traveling cranes, Alfred Box Company; light and power equipment, Thompson-Starrett Company.

Stone Wireless Telegraph Patents.

About a year ago 40 patents relating to wireless telegraphy were issued to Mr. John Stone Stone, and on October 24 a budget of 16 patents were issued to the same inventor, also dealing with space telegraphy, and containing a total of 129 claims.

On November 25, 1903, applications were filed for two patents relating to the transmitter of a system of selective electric signaling, which employs a method of increasing the amplitude of the oscillations developed by the sonorous circuit, and of increasing the persistency of these oscillations. In addition to the usual closed circuit connecting the spark-gap with the primary of the step-up transformer through an isolated inductance coil and a condenser, there is a second sonorous circuit in parallel to the spark-gap and containing a separate condenser and an inductance coil. Each of these sonorous circuits is adjusted to the natural frequency of the vertical radiating conductor. On February 23, 1904, applications were filed for two patents relating to receivers for selective wireless telegraphy. According to these patents, the receiving conductor is attuned to the frequency of the waves, the energy of which is to be received, while the receiving circuit which is associated therewith is likewise attuned to the same frequency, and a third resonant circuit is also inductively associated with the receiving conductor. This disposition of the circuits is adopted in order to prevent the receiving system from responding to extraneous electrical impulses of improper frequency. Two additional patents issued on applications filed February 23, 1904, refer to receiver circuits which differ from those just described in that the receiver circuit is conductively, and not inductively, connected to the receiver conductor.

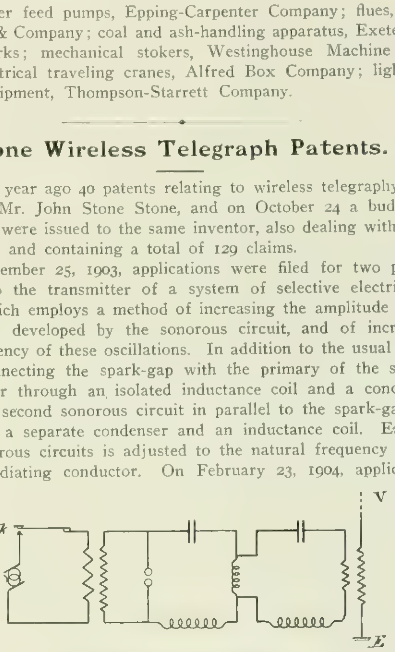


FIG. 1 TRANSMITTER CIRCUITS

Fig. 1 shows transmitting circuits, application for the patent of which was filed on December 16, 1904. The elevated conductor system is inductively associated with a resonant circuit which is conductively connected to a sonorous circuit which is adapted to develop electrical oscillations of a definite frequency.

A patent issued on an application filed March 31, 1905, relates to syntonic receiving circuits. The elevated receiving conductor is adapted to present a definite reactance for the frequency of the waves, the energy of which is to be received. To this conductor is conductively connected a parallel branch circuit containing capacity in one branch and inductance in the other, so proportioned as to present for a persistent train of electrical oscillations of the chosen frequency a reactance equal and opposite to that of the elevated conductor considered alone. The wave detector is conductively associated with one of the parallel branches.

On May 4, 1904, four applications were filed for patents dealing with apparatus for the receiving stations. Two of these patents refer to modifications of the patent just described, while the other two treat of receiving apparatus composed of an elevated conductor to the lower end of which is connected an electrical system consisting of a plurality of coils and condensers having for the wave lengths employed such capacity and inductance that the reactance of the system for the corresponding frequencies is equal to that of the elevated conductor. (See Fig. 2.)

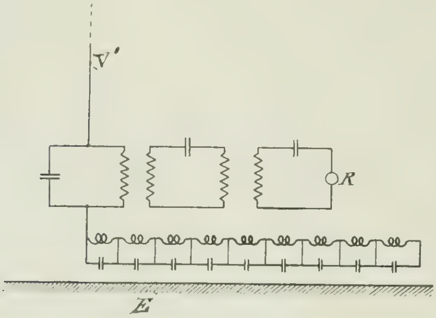


FIG. 2.—RECEIVER CIRCUITS.

A multiplex system of space telegraphy, in which the transmitting stations may selectively transmit their signals, each to a particular receiving station simultaneously without interference, is disclosed in two patents for which applications were filed May 10, 1905. There is associated with the elevated conductor a plurality of persistently oscillating circuits attuned respectively to different definite frequencies, and separate circuits likewise associated with the elevated conductor and containing such capacity and inductance as to render the reactance of the elevated conductor system as a whole zero for persistent trains of oscillations of the desired definite frequencies.

Fig. 3 shows a method of increasing the amount of energy that may be radiated in the form of simple harmonic electromagnetic waves, as disclosed in two patents for which applications were filed June 20, 1905. Each of the sonorous circuits is adapted to develop simple harmonic electrical oscillations of the same definite frequency, and all are connected in parallel to a common spark-gap, the radiating conductor being inductively associated with all of the sonorous circuits, as indicated in the diagram.

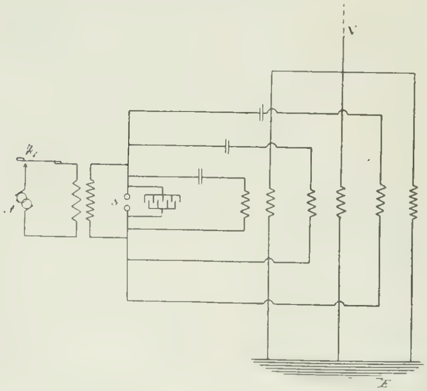


FIG. 3.—TRANSMITTER WITH PLURALITY OF SONOROUS CIRCUITS.

On October 31 the same inventor obtained two additional patents, the applications for which were filed June 20, 1905. These patents relate to wireless telephony. With a transmitting conductor there is associated a sonorous circuit which is adopted to develop a substantially continuous train of electrical oscillations of substantially constant amplitude. The amplitude of these waves is modified in accordance with the vibrations of air accompanying vocal sounds. A variable-resistance type telephone transmitter is connected in a locally-closed circuit which contains a reactance coil and a condenser and which is inductively associated with the sonorous circuit. A change in the resistance of the transmitter, due to vocal sounds, produces a corresponding change in the constants of the sonorous circuits, and thereby alters the amplitude and frequency of the oscillation in the transmitting aerial. At the receiving station a telephone receiver is connected in a local circuit which contains a battery and which is joined in parallel with a wireless receiver of the bolometer type.

The frequency of the simple harmonic electrical oscillations developed in the radiating conductor by the continuously oscillating circuits, is, of course, far above the limit of audibility, but by the means described such oscillations have their amplitude modified in accordance with the sound waves which affect the transmitter, and, accordingly, there results the radiation of a continuous train of electromagnetic waves having its amplitude correspondingly modified. Such continuous train of high-frequency simple harmonic electromagnetic waves, whose amplitude is so modified by the slower periodic vibrations of the frequency corresponding to the pitch of an audible tone or combination of tones, develops oscillatory electric currents of corresponding frequency and modified amplitude by impinging upon an elevated receiving conductor at a distant station. Such surrents so developed in the elevator receiving conductor system are selectively absorbed by the resonant receiving circuits, attuned to the frequency of such currents.

Recent Electrochemical Developments.

ELECTROLYTIC PROCESSES.

Metallic sodium is made commercially at Niagara Falls by the Castner process which electrolyzes caustic soda in a single cell. A patent recently granted to E. A. Ashcroft proposes the use of a double-cell which, in some respects, resembles the Castner-Kellner and the Acker cells for electrolysis of sodium chloride. As in the Castner-Kellner process, Ashcroft uses an intermediate bipolar electrode which forms the connection between the two cells; but he electrolyzes fused salt and, therefore, cannot use mercury for the bipolar electrode, but uses instead fused lead, as is done in the Acker process. In this first compartment Ashcroft electrolyzes fused sodium chloride. The sodium set free by the cathodic reaction alloys with the fused lead and is transferred into the second compartment where it passes again into the electrolyte which is fused caustic soda. In this cell metallic sodium is then obtained as a cathodic product.

Another process in which a fused electrolyte is employed, is described in a patent of H. S. Blackmore. It may be best described in its application to the production of a copper-aluminum alloy. Copper aluminate is dissolved in a fused mixture of lithium and calcium oxides, and on electrolysis of this fused solution, a copper-aluminum alloy is obtained.

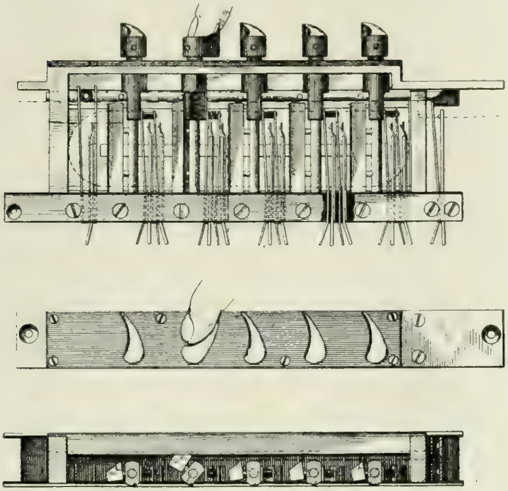
In all metallurgical processes, metals are purified by means of slags which combine with the impurities and thus remove them from the metallic bath. A modification of this method is proposed in a recent patent of H. M. Chance, who holds the metal in molten state in contact with an electrolyte which on electrolysis yields the purifying agent. Thus he proposes to purify molten iron by making it a cathode, in contact with fused calcium chloride as electrolyte; calcium is then set free by the current and serves as a purifying agent.

Chlorates are made commercially by electrolysis of aqueous solutions of the chlorides in a cell without a diaphragm at a temperature of about 70° C.; this process is in use by the National Electrolytic Company, at Niagara Falls. A process recently patented by A. E. Gibbs yields simultaneously chlorate and bichromate. It depends upon the reaction between chromate and chlorine gas, yielding bichromate, chlorate and chloride. Either a stream of chlorine gas from a reservoir is pumped through a solution of chromate, or the chlorine is electrolytically formed in the cell itself. In the latter case the cell contains both chromate and chloride, and a diaphragm cell is employed.

New Telephone Patents.

CENTRAL OFFICE APPLIANCES.

In the cut is shown a machine ringer for selective party-line work. Such a key can be used to advantage upon the incoming end of trunks operated upon the calling circuit basis. It will be seen that a cam upon a rotating shaft drives the individual signal current springs, as well as oscillates the longitudinal bar associated with the switching contacts. As any shaft is rotated a soft-iron armature bar attached to it is thrown against the poles of an electromagnet, which forms a part of the key, and as long as the magnet is energized the key remains thrown. The current is, of course, cut off the magnet by some auxiliary device. F. H. Loveridge is the inventor of this key, he having assigned his patent to the Western Electric Company.



MACHINE RINGER.

Georg Deisenhofer, of Germany, has patented a main distributing frame, the terminal bars of which are arranged in pairs, the two bars of a pair being close together. This saves in the length of a frame by the saving of one-half the clear space usually required for working on cross-connections.

The so-called horizontal type switchboard is almost obsolete in this country, and thus a multiple cable hanger for such a switchboard, patented by G. Lambert, of Charlottenberg, Germany, is of but slight interest. This hanger consists of a series of loops of webbing, each of the proper length to hang the cable to correspond with its jack strip.

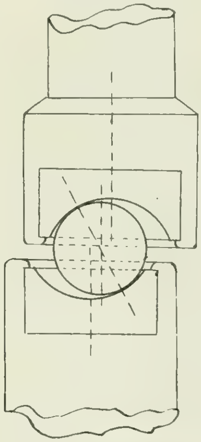
Letter to the Editors.

"How Can the Ball Roll?"

To the Editors of Electrical World and Engineer:

Sirs:—The communication in your issue of October 21, entitled "How can the ball roll?" by Prof. Hallock, reminds the writer forcibly of the old tale of one Christopher Columbus, and the egg.

The solution in this case is equally simple: The balls and the jewels are not absolutely perfect, thus causing a slight motion of the ball; there is also a displacement of the axis of the moving element caused by the torques of the magnets. The sketch herewith shows the position taken by the ball when there is a load on the meter. It will be seen that the ball will roll, describing an irregular path which will vary with changes in load, vibration, and other disturbing elements, thus constantly presenting new surfaces of contact.



BALL AND BEARINGS.

Wilkinsburg, Pa. Paul MacGahan.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Converters.—Corsepius.—In an article on electrical exhibits in the Exposition at Liege, a new type of converter is mentioned, the so-called "permutatrice" of Rouge-Faget, built by the Societe Anonyme Egyptienne d'Electricite. This machine has a vertical axle, and when producing current, no other portion revolves except the axle and the brushes. The commutator, which is at the top of the machine, is stationary. A diagram of the machine is shown in Fig. 1. The explanation given of the action of the machine is not very clear, and is as follows: "A motor generator consists of two separate machines, hence there are two magnetic fields independent of each other. If these two fields are united in a synchronous machine for the purpose of transforming three-phase currents into direct-current the ordinary rotary converter is obtained. If the two fields are united in a non-synchronous machine for the same purpose, the permutatrice is obtained." According to the inventor, "the synchronous displacement in the machine serves simply for utilizing the electromotive force in form of direct-current, without having any inductive effect. The practical result is that converters never weigh less than 33 kilogram per kilowatt, while the permutatrice weighs 20 kg for small machines and 15 kg for large machines (over 30 kw)." The stator of a non-synchronous motor is wound as a direct-current armature and is provided with a commutator. The lines of magnetic flux pass through the inner space and complete the magnetic circuit partly in the stator and partly in the rotor. The rotor runs synchronously as a result of the introduction of a direct current, which is taken as a part from the current produced by the machine. The bridge of the brushes also runs synchronously, so that direct current can be taken from two slip rings connected to the brushes. "The position of the brushes in the permutatrice influences the wattless current, which is taken from the network. The direct-current voltage changes according to the cosine of the angle of displacement of the brushes. The reaction of the energy component of the three-phase currents and that of the direct current upon the magnetic field do not compensate each other at all points of the circumference. The magnetizing action of the three-phase currents is proportional to the sine of that angle while that of the direct current changes from a fixed positive to a fixed negative value. There is, therefore, an imperfect transformer action on account of a stray field. This may be counteracted by very strong saturation in the teeth, which, however, has certain disadvantages." The inventor uses another device in which a winding is placed on the stator in such a way that a sinusoidal distribution of the ampere turns on the interior circumference results. A 300 kw machine requires a foundation space of 2.25 square meters (24 square feet). Special attention has been paid to the brush construction. Tests of an 8-kw machine have given the following results. The power factor is 0.9 and increases to 0.93 when the machine is overloaded. The efficiency is a maximum (80 per cent) at normal load. A 25-kw machine has a power factor of 0.9 and an efficiency of 0.88, a 150-kw machine a power factor of 0.96 and an efficiency of 0.93. The chief application of the new machine is said to be for converting alternating current into direct current for traction, and it is emphasized that this machine is suitable for small capacities and, therefore, for a large number of converter stations of, say, 100 kw. It is started in a simple way by closing the primary switch. A 150-kw permutatrice runs up to synchronism in three seconds.—*Elek. Zeit.*, October 12.

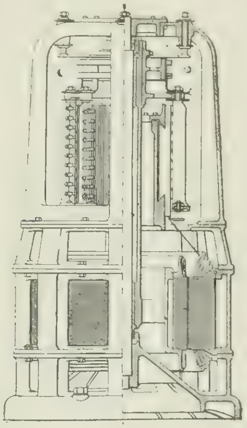
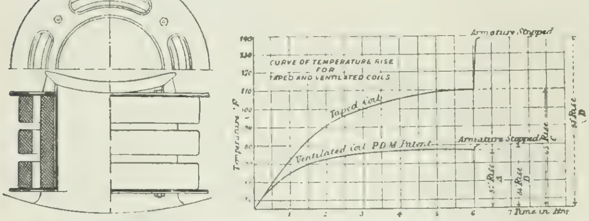


FIG. 1.—SECTIONAL ELEVATIONS OF CONVERTER.

Converter.—REYVAL.—An illustrated description of the "cascade converter" of the Arnold system. This machine consists essentially of an ordinary induction motor, the rotor of which is keyed to the shaft of a rotary converter. The cascade converter of this type, which was exhibited in Liege, as described on page 698 of our issue for October 21, 1905, is treated at great length, and its design dimensions are given in detail. It is stated that for three-wire distribution the cascade converter possesses an exceptionally advantageous feature in that it is sufficient to connect the external wires to the positive and negative bus-bars and the neutral wire to the neutral point of the rotor. In this case the converter acts also as a compensator. The automatic regulation thus obtained is so efficient that with one-half of the system loaded and the other half open the difference between the voltages of the two halves is not more than three per cent.—*L'Eclairage Elec.*, October 7.



FIGS. 2 AND 3.—DIRECT CURRENT DYNAMO.

Direct Current Dynamo.—In the report on exhibits at the Olympia Exposition in London, direct-current machines built by the Phoenix Dynamo Co., are described in which commutation poles are used, as was noticed previously in the Digest. The peculiarity of the commutation poles in this case is that their faces decrease in breadth in the direction of motion for the purpose of equalizing the field. It is stated that a 3.5-hp shunt-wound motor fitted with auxiliary poles was varied in speed from 470 to 2,400 revolutions per minute by field control. It took 22 amperes at 220 volts and showed no signs of sparking at any speed. In order to improve the ventilation the field coils are provided with ducts, as shown in Fig. 2. The effect of radiation is clearly shown by the curves in Fig. 3. In the ordinary coil the external temperature rose to about double that of the ventilated coil on the same machine; while after the machine was stopped and the air blast consequently absent, the ordinary coil rose very much higher again showing that its internal temperature was far greater than that of the other.—Lond. *Elec.*, October 20.

LIGHTS AND LIGHTING.

Street Lighting.—Some figures on the comparative cost of electric light and gas for street lighting. S. L. Pearce, of the Manchester central station, gives some comparative figures as to the cost of gas and electricity and the relative amount of light obtained in commercial use in a street in Gorton. His figures show that with electric light 75 per cent more illumination was obtained for an 18 per cent increase in price compared with incandescent gas lighting. He then gives some figures for lighting Fleet Street by flame arcs either by short-hour lamps (16 hours) or by long-hour lamps (45 hours). He concludes with the following comparative figures showing the selling costs of different systems of illumination for 1,000 effective cp-hours per year with electricity at 3 cents per kw-hour:

Flame arcs (long hour)	1.025
Flame arcs (short hour)	1.35
Ordinary carbons, single enclosure, long hour (Manchester)	1.6
Fleet Street (incandescent gas)	2.4

Some figures are also given from London practice and the subject is discussed in a long editorial, in which it is emphasized that in spite of the recent improvements in connection with the incandescent gas mantle, street lighting by electricity remains far cheaper than street lighting by gas.—Lond. *Elec.*, October 20.

Selection of Incandescent Lamps.—DAWSON.—The author points out that the real root of the problem of the most suitable lamp to use consists not simply in the ascertaining of the most efficient or the cheapest lamp on the market per se, but in the obtaining of candle-power-hours at the lowest total costs, and one of the most important determining factors in deciding this, one which is only too often completely overlooked, is the cost of electrical energy with which the lamp or lamps are to be supplied. In cases where electrical energy is cheap, the efficiency of the lamp is not such an important factor as the life and the cost of the lamp renewals, and conversely in cases where electrical energy is dear, the efficiency of the lamp is the most important item, and that of life and cost of lamp renewals are only of secondary importance. The relative values of the various items composing the total cost per cp-hour are set forth in the following formula: Total cost per cp-hour =

$$\frac{\textit{cost of lamp in cents}}{\textit{life in hours} \times \textit{average cp}} + \text{average watts per cp} \times \text{cost in cents}$$

of 1 watt-hour of electrical energy. A serious difficulty in the application of this formula is that several factors in it can be ascertained only by means of extended tests under actual working conditions. The author suggests that central stations should institute a careful and systematic testing of various makes of lamps on the market for candle-power, current and life.—Lond. *Elec. Rev.*, October 13.

Alternating Current Arc.—SIMON.—An account of an experimental investigation of the relation between current and voltage in the alternating-current arc. The author has determined what he calls the dynamic characteristic, taking simultaneous instantaneous values of voltage and current when the current is varying periodically. It appears that the principal determining factor for the voltage required for a given current is the product of the temperature and surface of the negative crater. It is immaterial how the value of this product is produced, that is, whether the necessary temperature is produced by the current itself or through externally applied heat.—*Elek. Zeit.*, August 31 and September 7; an English translation in abstract in Lond. *Elec. Eng.*, October 20.

POWER.

Gas Producers.—RICHARDS.—In a continuation of his serial on metallurgical calculations the author takes up the subject of producers for making artificial furnace gas and deals in the present installment with simple producers, that is, those which use ordinary fuels, such as wood, peat, lignite, bituminous coal or anthracite, and in which no water or water vapor is introduced other than the water in the fuel itself, and the normal moisture of the air used. The calculations which are of immediate interest to make, and the results of which are of immediate value to the metallurgist are those concerned with the volume of gas produced per unit of fuel, its calorific power compared to that of the fuel from which it is produced, the items of the heat losses during the operation of transforming the solid fuel into gaseous fuel, the function of steam in the producer, the limits up to which the use of steam is permissible, the increase of efficiency of the gas by subsequently drying it, and the advantages as to final efficiency which are gained by gasifying the fuel over burning solid fuel directly. Several numerical examples are given.—*Electrochem. and Met. Ind.*, November.

Producer Gas.—An illustrated article on a small producer gas plant which has been in successful operation with soft coal for nearly two years in Indiana. The electric equipment consists of a 75-kw, 250-volt generator and nine motors.—*Eng'ing Record,* October 28.

Modern Power Plant Design.—KOESTER.—The conclusion of his well-illustrated serial on modern power plant design and economics. In the present installment he deals with the electric equipment of the generating room. Modern practice tends toward the general adoption of electrically-driven auxiliaries, viz., water and air pumps, exciter sets, etc. Individual electric-motor drive for the machinery of the boiler house, such as coal and ash-handling apparatus, stokers, draught fans and economizers, scrapers, etc., has long been recognized to be the best practice. When the individual motor-drive system is adopted, a storage battery should always be installed to supply power in case of a breakdown (the cause of which may be either inside the plant itself or outside on the line) unless the auxiliary generator is steam-driven and the circuit is kept an entirely distinct system from the main line. The battery is also desirable during a heavy load for maintaining a steady voltage on the exciter bus-bars. As the storage battery is often employed for the operation of the automatic switches, it preferably should be installed of sufficient capacity to supply power in case of emergency. Although cost of installation and maintenance is great, the storage battery is usually a paying investment—depending, of course, on the type of service. The author then discusses at some length the arrangement of the switchboard.—*Eng'ing Mag.,* November.

Power Plant of Department Store.—A long illustrated description of the power plant of the new Wanamaker store in Philadelphia. The electric equipment will consist of four 500-kw and six 175-kw steam-driven generators, operating on the three-wire system with the lights on the 115-volt circuits, and the power taken from the 230-volt combination.—*Eng'ing Record,* October 28.

Electric Hoist.—GUARINI.—An illustrated description of an electric hoist installed at the Tiremande colliery in Belgium with a novel arrangement in which the hoist is placed at the top of the head frame.—*Mines and Minerals,* October.

Steam Boilers.—WATSON.—A discussion of steam boilers of the past and present with illustrations of the principal types.—*Eng'ing Mag.,* November.

TRACTION.

New York Central-New Haven Situation.—TOWNLEY, BELL, BOYNTON.—Three letters in reply to the article of Sprague who criticised severely the decision of the New Haven road to use a single-phase locomotive and made a plea in favor of direct-current multiple-unit trains The present three authors defend the decision of the New Haven road. Bells says it looks as though this railroad in this latest move, sensational though it be, is building, not for the terminal service, which will soon be inaugurated, but for the far larger work to which the carefully worked out third-rail, direct-current system is not even the prelude. If the single-phase locomotive is successful, "then a problem of engineering infinitely greater than even the New York terminal system will have been solved, and the way will be open for very great changes. In short, I do not think it a sound conclusion to assume that the New York, New Haven and Hartford Railroad has recklessly butted into a huge experiment at the peril of its passenger service merely for the sake of its trains to Stamford. It is after larger game, and game that cannot be brought to bay by any weapon yet discovered in the direct-current armory. If the experimental stage is safely passed with the alternating-current locomotives, then the question will be, not how conveniently they can be accommodated by the existing direct-current terminal system, but how long that system can keep up under the new conditions without accommodating its equipment to modern improvements." "It must be granted even from the standpoint of conservatism, that if the alternating-current locomotive makes a success in heavy traction it will have a wider field of usefulness in big work than can be hoped for by 500-volt or 600-volt or 800-volt direct-current motors, tied up as they are to the third-rail scheme of feeding. As it is, the railroad wins much if the experiment succeeds and loses little if it fails."—*St. R'y. Jour.*, October 28.

High Tension Direct-Current Traction in Vienna. BOEHM-RAFFAY.—Between the stations Praterstern to Hauptzellamt, of the Vienna city railroad (which is operated at present with steam), a trial will be made with the direct-current three-wire system, the rails forming the middle wire and two trolley wires the outers. The voltage will be 2 x 1,500. The installation is made by the firm of Krizik. The experimental road is only 1.4 kilometer long. The four 200-hp motors of the locomotive are either connected all in series or in two groups of two in parallel. The central point of the set of motors is connected to earth through the rails. The load on the two outers or the two halves of the three-wire system is, therefore, exactly balanced so that the running rails are without current or carry only a very weak current. The trolley wires are suspended by means of side poles and span wires, each trolley wire being placed perpendicularly over one rail, in order to prevent trouble from the smoke of the steam locomotive. An electric locomotive of 800 hp will be used, containing four motors each of 200 hp. The voltage of 2 x 1,500 is used only on the line between the stations while in the stations themselves where lower speed is used, the motors are connected between one outer and the rails so that the voltage is only 1,500.—*Elek. Anz.*, October 15.

High Speed Traction Tests.—A long report illustrated by many diagrams on the results of the Berlin-Zossen tests of 1902 with respect to the air resistance and its relation to the shape of the car and the other resistances to the train movement.—*St. R'y. Jour.*, October 28.

Steel for Motor Cars.—GUILLET.—An illustrated paper discussing the different steels used in France in the actual construction of motor cars. These special steels are classified as follows: 1. Steels with low percentages of carbon and nickel (pearlite steels) which are used for parts which require cementing and quenching—i. e., shafts, gears which engage directly, etc. 2. Steels with medium percentages of carbon and low percentages of nickel, used after quenching and reheating, for a large number of parts, shafts, gearing, pinions, etc. 3. Steels low in carbon and with high percentages of nickel, used for valves. 4. Chromium steels, with high carbon and low chromium percentages, used for bearings. 5. Silicon steels, used for springs and for gearing. 6. Nickel-chromium steels, with low percentages of nickel and of chromium, employed for numerous parts requiring resistance to shock, and a certain degree of hardness. 7. A steel known as "N. Y." the composition of which has not been published.—Lond. *Eng'ing,* October 13.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Liquid Controller.—An illustrated description of a liquid controller exhibited at the Olympia Exposition in London by Steel, Peech and Tozer. This controller, which is shown in Figs. 4 and 5, combines a circuit-breaking and direction-reversing arrangement with a regulating resistance. It consists essentially of a tank, *K,* in its lower part, which contains the resistance liquid. In this dips a contact plate, *O,* which can be lowered into or raised out of the liquid by means of a shaft, *R,* which works in a roller bearing arrangement, *P.* At its upper end the shaft, *C,* is provided with a roller, *Q,* which works in a slot, *S,* of peculiar form, made in the cylindrically-shaped portion, *T,* which can be revolved by means of the vertical spindle and the hand wheel, *H.* Owing to the form of the slot, *S,* the plate, *O,* which is shown in its highest position, and clear of the liquid, will be lowered, if the hand wheel is revolved either to the right or left hand, these motions determining the direction of rotation of the motor to which the switch is connected. Just above the liquid in the tank will be observed curved overhanging plates, *N,* cast solid with the tank itself. These are to prevent splashing, should the switch be mounted on machinery subject to motion. Underneath the hand wheel is a box which has an insulating base of slate. On this base and concentric with the spindle, *H*, are three metallic contact rings, *L*, *M* and *N*. The inside and outside rings, *L* and *N*, are complete, but the middle ring, *M*, is broken in two places, the space between the two halves of the ring being filled up with an insulation material worked up level with the surface of the metal. Attached to the spindle, *G*, is a bar of insulating material, having arms of unequal length. This is revolved when the hand-wheel is turned, and it carries two contact pieces, *K* and *K′*, the first of which revolves in the space between the rings, *M* and *N*, while the second revolves in between *L* and *M*. Both contact pieces are provided with a spring, which ensures electric contact between those rings which it is desired to connect together. The positive terminal of the generator supplying current to the motor is connected to the ring, *L*. One-half of the ring, *M*, is connected to one terminal of the motor and the other half to the other terminal, while the ring, *N*, is connected to the dipping plate, *O*. The tank, and hence the liquid, is connected to one terminal of the motor fields, the other field terminal being connected to the negative main. Suppose, now, the contact arm to be in the position shown by the full lines, then the ring, *L*, is in electric contact with the left-hand half of the ring, *M*, and the ring, *N*, is in contact with the right half of *M* by reason of the contact pieces, *K* and *K′*, as already explained. In this position the current from the positive main travels from the ring, *L*, through the contact piece, *K*, to the left-hand half of the ring, *M*. From there it goes direct to the right-hand motor brush. The left-hand motor brush is connected, as already mentioned, to the right-hand half of the ring, *M*. The current, therefore, flows to this, and thence by the contact piece, *K*, and the ring, *N*, to the dipper, *O*, the liquid tank and the motor field to the negative main. This disposition of the apparatus would cause the motor to revolve in one direction. If it is desired to reverse the direction or rotation, the arm, F^1F^2 is moved to the position shown by the dotted lines. The current would then travel by way of the ring, *L*, the contact piece, *K′*, and the right-hand portion of the ring, *M*, to the left-hand terminal of the motor, thus passing through the armature in the reverse direction, and flowing away by the left-hand portion of the ring, *M*, the contact piece, *K*, the ring, *N*, to the negative main, through the liquid tank and the motor field. The direction of the current in the field is, therefore, the same in either case, and only the direction through the armature is changed.— Lond. *Elec.*, October 13.

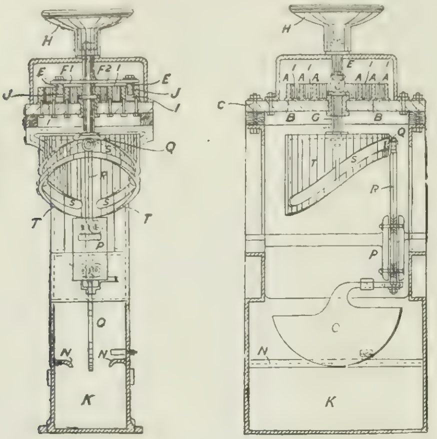


FIG. 4.—LIQUID CONTROLLER.

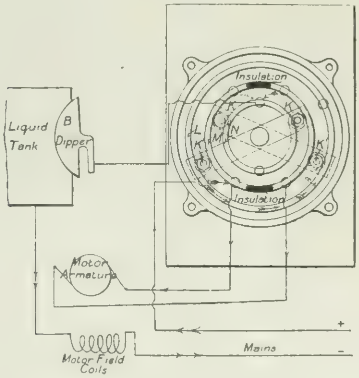


FIG. 5.—LIQUID CONTROLLER.

Choice of Supply Voltage for New Stations.—Wikander.—In 1897 Germany began to follow the English fad of raising the supply voltage of direct-current three-wire systems from 2 x 110 to 2 x 220 volts. In recent years, however, the situation is no longer so favorable to the higher voltage. There are now several new lamps like the tantalum and the osmium lamps for which an e.m.f. of 220 volts is not suitable. The Bremer arc lamps cannot be made for high voltages, and if the voltage is 220, at least four of them must be connected in series, which greatly reduces their field of usefulness. Only the Nernst lamp is suitable for 220 volts, but this voltage is available also between the outers of a 2 x 110 system. Moreover, carbon-filament incandescent lamp for 220 volts have now been recognized to be much inferior to 110-volt lamps. "For instance, new 16-cp lamps consume at 220 volts about 3.75 watt per candle against 3.1 to 3.5 watt at 110 volts, but the candle-power of the former decreases much more quickly, so that the average consumption of power per candle is at least 15 or 20 per cent higher." The author concluded that under these circumstances the supply at 2 x 110 or 2 x 120 volts represents at present the best practice. Against this system the objection has sometimes been raised that it is desirable to be able to furnish from the lighting dynamos, current at 500 to 600 volts for traction. To accomplish this, each prime mover is to be coupled with two 220-volt dynamos, which are connected in series for traction. Such double machines are a little more expensive than simple machines and require a more complicated switching arrangement, but they have certain advantages. For instance, a street railway conduit may be operated with +300 volts in the one conductor and —300 volts in the other conductor. The double machines are reliable in operation and have the advantage for lighting that one is able to give current even if the other one is out of order. The author then discusses the advantage of a neutral wire in alternating-current networks. All the advantages of a high-secondary voltage can be retained and nevertheless a voltage of 110 to 120 volts be used at the lamps, if the secondary network is built with an earthed neutral wire. With single-phase current three-conductor cables and with the three-phase system four-conductor cables are to be used. The neutral wire is to be earthed at one point in the middle of the network. The advantages of this method are discussed.—*Elek. Zeit.*, October 12.

ELECTROPHYSICS AND MAGNETISM.

The Relation Between Dielectric Constant of Air and Density.—Occhialini.—An account of experiments in which the author studied the variation of the dielectric constant of air with increasing pressure up to 200 atmospheres. The method was based on the comparison of two condensers, one of which contained air of varying pressure as dielectric. The results are given in the following table:

K	D	x	κ^2
1.0101	20	169×10^{-6}	1.0116
1.0196	40	162×10^{-6}	1.0237
1.0294	60	162×10^{-6}	1.0357
1.0387	80	159×10^{-6}	1.0477
1.0482	100	158×10^{-6}	1.0601
1.0579	120	158×10^{-6}	1.0721
1.0674	140	157×10^{-6}	1.0845
1.0760	160	154×10^{-6}	1.0971
1.0845	180	152×10^{-6}	1.1092

In the first column the dielectric constant, *K*, is given, in the second column density, *D*, in the third column the value

$$x = \frac{1}{D} \frac{K-1}{K+2},$$

which should be constant, according to the theory of Mossotti. It will be seen that this value is not constant, but decreases gradually with increasing pressure. The last column contains the square of the refractive index. Since it refers to a wave length of the visible spectrum it cannot be exactly equal to the dielectric constant. The difference between K and n^2 represents the dispersion which increases with the density of the medium. If Mossotti's formula is considered as approximately correct in the form $x = 0.00016$, then it is possible to calculate from this formula the dielectric constant of liquid air. If the density of the latter compared with air is 871 one finds $K = 1.475$ which agrees pretty well with the value of Dewar, which was 1.495.—*Phys. Zeit.*, October 15.

Point Discharges in Pure Gases.—Ewers.—An account of a long investigation of the point discharge in monatomic and diatomic gases under conditions likely to secure the greatest attainable purity. The gases examined were helium and argon as monatomic specimens, and hydrogen and nitrogen as representatives of the diatomic class. The author is able to extend Roentgen's law to monatomic gases, and to state that the product of the minimum potential and the square root of the mean free path, divided by the root of the number of atoms in the molecule, is nearly the same for all gases under standard conditions. He finally arrives at the simple rule that for various barometric pressures and for any given e.m.f. the current through the gas is simply proportional to the mean free path of the molecules, a rule which allies gaseous conduction to metallic conduction on substituting electrons for molecules.—Lond. *Elec.*, October 13; from *Ann. d. Physik*, No. 10.

The Problem of Secret Telephony.

By Edward P. Thompson.

If first class or sealed mail matter were abolished, and if people were obliged to correspond by open letters or postal cards only, all mail matter thus being open to inspection by those through whose hands it passed, it seems evident that both business and social intercourse by correspondence would be seriously crippled. The postal revenue would be reduced also. The public would object to the fact that all their correspondence could be read by post office employees. As a somewhat parallel case, telephone engineers have always known, but subscribers are only becoming aware, that present telephonic communications are no more private than postal card messages. The objectionable abuses of the operator's power to "listen in," being known, telephone business men, engineers and inventors have taken steps to remedy the deficiency.

Telephone users, in general, experience inconvenience and annoyance resulting from operators listening in. In some instances communication is seriously impaired. For example, the private branch exchange operator in a business office can become familiar, by listening in, with the most confidential affairs of the firm. Again, much of the private life of those in modern apartments is an open book to the girl who sits at the foot of the stairs.

The National Inter-State Telephone Association, at the June convention, agreed that "On modern systems, no listening whatever is necessary," and formulated a rule against listening. This quotation is from their Standard Operating Rules.

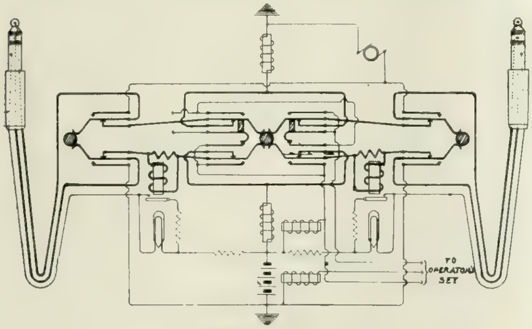


Fig. 1.—Diagram of Cord Circuits.

Mr. W. Napier, at a recent meeting of the British Institution of Electrical Engineers, in commenting upon similar views of Mr. Herbert Laws Webb in a paper read before the society, approved the latter's remarks by observing that the necessity of listening in on the part of the operator is obviated. To make rules and to show that listening in is not necessary, proves that such listening is objectionable (perhaps as much so as are open letters by mail), but do not prove that the evil is thereby remedied.

Richard M. Beard, chief engineer and vice-president of the International District Telephone Company of New York, is becoming well known through his success in demonstrating that through the adoption of a few simple expedients, listening in by the operators may be absolutely prevented without detrimental effects in the handling of the traffic. That he has completely solved the problem is established by the sixty-seven claims allowed or granted to him by the Patent Office. One of the broader claims reads as follows: "Listening keys, an operator's circuit normally connected to said keys, and means automatically preventing more than one said listening key being connected to said circuit in listening phase at a time."

Telephone men especially, may be interested in an exposition of the practical construction for carrying out this generic conception, which could be practiced in various ways, all of which, however, if done by others, would constitute infringement. The particular manner in which Mr. Beard has constructed plants when applied either to a cord or cordless switchboard, comprises the old elements of an exchange together with the usual listening keys, each having a pair of contacts normally open to the respective subscriber's lines, and an operator's circuit to which said contacts are multipled, the listening keys having spring contacts preventing said open contacts of any key from being connected to more than one of said subscriber's lines at a time. All the installations in the world, therefore, could be transformed into secret systems, simply by incorporating a few extra contacts in the right places in the listening keys.

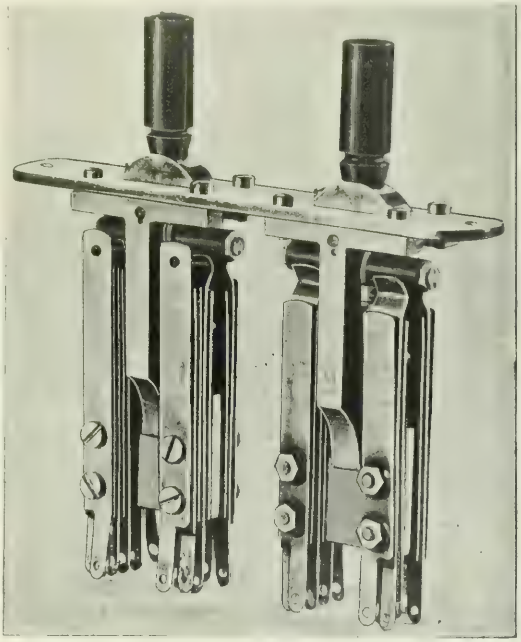


Fig. 2.—Two-Way Listening and Two-Way Ringing Key.

The cord circuit in the accompanying diagram, Fig. 1, shows the usual arrangement of lamp supervisory signals and a well known method of connecting to common battery. It is not claimed that this is the only arrangement or even the best, but one of the many ways of applying this circuit in common battery exchanges. By tracing the circuits, it will be clearly seen that it is imposible for an operator to listen in while two subscribers are in conversation.

Fig. 2 shows a two-way listening and a two-way ringing key mounted on the same escutcheon plate. From this it will be seen that the keys look about like those usually employed in switchboards. The invention, therefore, is not one of complicated apparatus, but a simple arrangement of circuits. It is interesting, furthermore, to note that the estimated extra manufacturing cost of equipping a new one hundred line board is less than ten dollars.

Regarding the former state of the art, perhaps no other invention approaches the solution of the problem so closely as does the old and abandoned common call wire system, in which the operator connects any two subscribers' lines by a pair of cords having no connection with her telephone. The system became obsolete on account of the dire confusion produced by any number of subscribers trying simultaneously to address the operator who listens continuously on the common call wire. It lacked complete secrecy, as the orders of any calling subscriber could be heard by any one or all of the other subscribers. It has no bearing upon modern telephone traffic, because it is a thing of the past. It is dead, except in places like Glasgow, in the municipal plant, and there is moribund.

As in the art of watchmen's clocks (which until recently have defied the cunning of the night watchman in vain), so in the art of the telephone, former inventors have attempted to devise a system which would be perfect, and that would be independent of the employee's sense of honor. The principal attempts in secret telephony will be briefly mentioned.

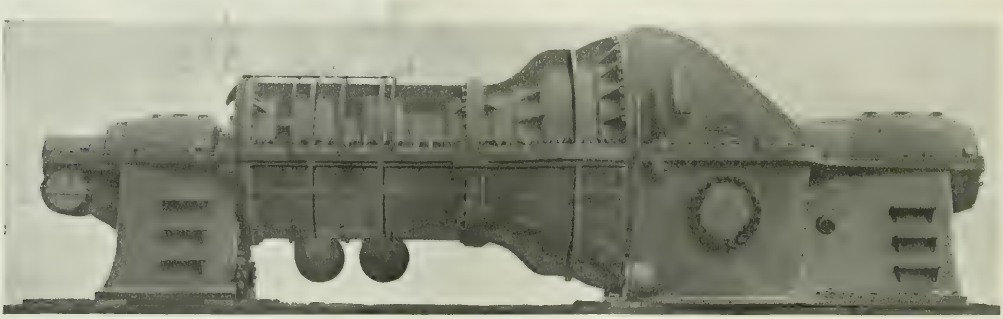
A patent, No. 756,424, of April 5, 1904, is upon an invention entitled "Secrecy System for Telephone Switchboards." However, this system is deficient in failing to provide for one important contingency. Practically and theoretically, the secrecy seems to depend upon the operator being so stupid as not to think of listening by merely connecting the two subscribers with plugs of different pairs, connecting the two plugs together by maintaining her telephone set connected with each pair of cords, and thus listening to the conversation between the subscribers. Operators become extremely intimate with their switchboards, and therefore this expedient would soon occur to their minds.

In patent No. 785,673, of March 21, 1905, an invention is described for the alleged purpose of securing secrecy, but it should properly be classed with the abandoned common call wire system as equally useless; for when the signaling generator is brought into circuit to signal on any one subscriber's line, the signaling current will pass to every subscriber's station where the receiver is on the hook. All or none of the subscribers would be signaled, according to whether the generator is powerful enough to ring all the subscriber's signals in parallel. Independently of this prohibitive feature, the jacks and plugs disclosed in the patent could be manipulated for listening in on the "connections" almost as conveniently as by the ordinary bridging key. Thus is chronicled another effort toward the desired end, but which still falls short of attaining it.

Heretofore, others have alleged a solution of the problem of secret telephony, but the evidence, it seems to me, shows, as in the instance cited, that Mr. Beard is the first and sole inventor of a system that is in itself, operative, simple and practical—as secret as a sealed message—and at the same time differing radically from the abandoned common call wire installation and former attempts generally, in being readily applicable to the modern and standard cord or cordless telephone exchange switchboard, and still not involving visionary and undesirable complications, like relays, "attachments," or intricate mechanisms. For these reasons, it was thought by the writer, that an article on the subject might be of interest to the readers of the leading electrical periodical. Recently the invention was installed and given a thorough trial in actual service, in the exchange at Elizabeth, N. J. The result indicated a successful solution of this important problem. On the whole, the invention appears to be the most marked advance in the telephone art in recent years.

Allis-Chalmers Steam Turbine for the Brooklyn Rapid Transit Power House.

The sixth of the huge power plants to be constructed for the Brooklyn Rapid Transit Company will show, in some respects, a radical departure from the features usually found in stations where reciprocating engines are installed. Among the more important of these is the small floor space needed for the machinery. The engine room of the ordinary station requires 60 per cent of the total ground space, and the boiler section 40 per cent. In the new plant the turbine floor occupies but two-thirds the space required for the boilers. The new Williamsburg station, which has been erected near the bridge of that name, is designed to accommodate a total of nine steam-turbine and generator units, three of which are now being installed. One of the most interesting of these is the Allis-Chalmers 9,000-hp unit. A view of the body of the turbine, as it appeared when loaded on a 36-ft. flat car for shipment from the West Allis Works of Allis-Chalmers Company, is shown in the illustration herewith. The turbine is of the horizontal multiple expansion, all-around parallel flow type, generally known as the Parsons type, operating at 750 r.p.m. The generator is a Bullock alternating-current machine built by the Allis-Chalmers Company at its Cincinnati works. It will carry 25 per cent overload continuously and 50 per cent overload for three hours with but small temperature rise.



Body of 9,000-hp Steam Turbine for New Williamsburg Power House of the Brooklyn Rapid Transit Company.

A noteworthy feature in the construction of the turbine is the blading. The blades are made of a special alloy and of such form and dimensions as are calculated to secure the highest economy. The individual blades are mounted in groups, each group forming one-half of a circular row. The inner ends of the blades are swaged, firmly secured in accurately spaced slots in foundation rings and riveted in slots in their respective channel-shaped shrouds. The blade rings are secured by special calking strips in accurately machined grooves in the cylinder and rotor, thus absolutely insuring against throwing out due to centrifugal force.

The channel-shaped shroud secures the blades in a substantial manner at the proper angle and spacing and eliminates the danger of stripping, permitting the turbine to be safely operated with a minimum radial clearance. This special design of blading does away with hand work. The machine construction insures great strength, perfect alignment and uniformity in the spacing of the blades.

The lubricating arrangement is free from complication, complete and efficient. It is equipped with a direct-acting steam pump for use on starting up the turbine. The turbine and generator rotors are direct-connected by a flexible coupling, each being carried in two bearings of the ball and socket type.

In the generator design especial attention has been given to thorough ventilation. The turbo-generating unit measures approximately 47 ft. in length, over all, 13 ft. 3 in. in width and 11 ft. 6 in. in height above the engine room floor. Its height above the foundation is scarcely more than that of the low-pressure cylinder of a reciprocating engine of equal capacity, above the upper platform, and such cylinders are frequently more than 30 ft. above the engine foundations.

Electrical Equipment of a Paper Box and Bag Factory.

By F. F. Coleman.

One of the handsomest and most interesting industrial power plants ever erected in Greater New York is the new installation which has just been completed by the Allis-Chalmers Co., of Milwaukee, for the Robert Gair Company, of Brooklyn.

The power equipment was entirely furnished by the Allis-Chalmers Co. The three main units consist of its well-known Reynolds-Corliss heavy-duty type engines, direct-connected to Bullock engine-type generators. A smaller sized engine and a Bullock direct-connected generator together with a Bullock switchboard admirably adapted by its design for the distribution of the power, complete the power equipment of the plant.

From the day when Mr. Gair opened his first factory and salesroom at 163 Chambers St., New York City, in 1864, the engines and power equipment of each plant were chosen to represent the very best of their time. They were always placed with discrimination at points from which power could be distributed throughout the plants evenly and without strain, thereby ensuring the duration and good condition of the driving machinery. This branch of Mr. Gair's factory departments was a matter of personal interest and a source of pride with him.

Mr. Gair's first power equipment of forty years ago consisted of a hot-air engine of 7 hp. A comparison of this with the Allis-Chalmers Co.'s extensive, modern power plant just installed tells eloquently the story of the Robert Gair Co.'s strides. This engine was soon replaced by a Baxter engine of 15 hp, and a year or two later a Buckeye engine of 30 hp was installed. As the expanding business required the occupancy of one building after another until it filled four four-story structures, two on Chambers St. and two on Reade St., a second Buckeye engine of the same capacity was added.

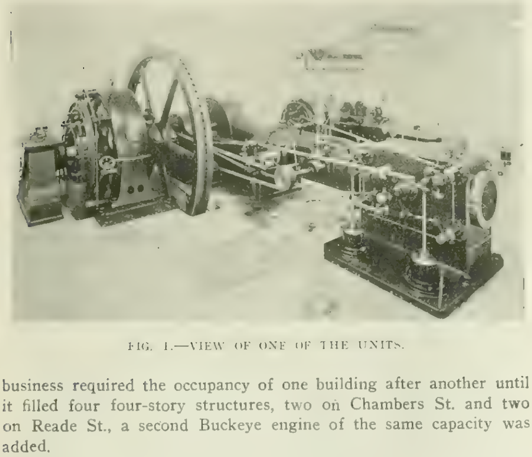


FIG. 1.—VIEW OF ONE OF THE UNITS.

The basis of the Robert Gair Company's business was the manufacture of folding paper boxes and paper bags. The development of what are now commercial necessities in extensive demand began with the manufacture of a simple folding box for carrying notions and a grocer's bag, and from the production of these Mr. Gair's business expanded in all directions to meet the conditions and opportunities which he discerned. Crude wrappers were replaced by handsomely designed cartons and the modern inclination to pack and market goods attractively was allowed scope. Individuality was given to packages and advertisers, led by both instinct and necessity, employed the goods so widely that the manufacture of folding cartons has become a vast industry, entailing not only the use of intricate machinery but also the employment of artists, designers, etchers and printers. The Robert Gair Company at present not only manufactures paper cartons and bags, but also envelopes, corrugated paper, lace papers, solid paper boxes, embossed show cards and paper specialties. In addition it has an extensive label printing plant, equipped with the very best facilities for electrotyping, engraving and ink making. In almost every line produced by this firm Mr. Gair was the pioneer, and the double task of educating the public to the uses and advantages of its manufactures and of constructing the special machinery required were undertaken with widely recognized success.

When the four buildings in Manhattan were no longer adequate the business was transferred to Brooklyn and in 1891, the first of the three factories, of which the plant now consists, was erected under the shadow of the Brooklyn Bridge, covering the block on Washington Street, between Plymouth and Water Streets. This factory is 100x200 ft., and six stories tall. The power plant for Factory No. 1 consisted of a Watts-Campbell Corliss engine, with a 16x18-in. cylinder, developing 125 hp at 70 r.p.m. Electric lights were introduced into this factory and the lighting plant consisted of an 8x10-in. Payne engine belted to an Edison 110-volt, 600-light generator.

Soon more room was required and a large plant, known as Factory No. 3, at John and Gold Streets, and another, known as Factory No. 2, opposite Factory No. 1 in Washington Street, were added. Each factory was provided with its own separate plant. The power plant at Factory No. 3, where solid boxes, lace papers and corrugated paper are manufactured, consisted of a Wright-Corliss, 80-hp engine, and the lighting was cared for by a Mather generator, belt-driven, which furnished current for 300 110-volt lamps. The equipment at Factory No. 2, which was the label printing plant, was composed of two Weston high-speed engines. Electric drive for some of the machinery was first introduced into this factory and current at 110 volts for operating them was furnished by two Westinghouse and two Siemens & Halske generators—each of 75 kw capacity.

The necessity for more room became apparent last year, and the work of erecting a new factory covering the block on Water Street, between Washington and Adams Streets, was begun. At the same time plans were made for doing away with the three separate power and lighting plants by erecting and equipping a new central power plant and other improvements.

The new factory, the power house and a new stable on Main Street are all constructed of reinforced cement. The new factory is a conspicuous object from the Brooklyn Bridge, and the novel method and material of construction have attracted much attention from there as the work progressed. The new factory is nine stories in height and measures 100x230 ft. in area. Each of the three concrete buildings forms a solid monolith. The value of this form of construction is particularly apparent in the power house where walls, floors and engine foundations are all intimately joined together.

The new power house stands in the rear of Factory No. 1, and faces on Water Street. It is 44 ft. wide, 130 ft. long and one story high. The front wall is of brick to match the older building beside it. All the rest is of cement concrete. The engine-room opens on the street and runs back 70 ft. Wide doors give ease of access, and windows and skylights furnish light and ventilation in ample degree.

The switchboard occupies a place near the front of the room, to the right hand as one enters and side by side down the length of the room, each with its longitudinal line running across the room are the direct connected Allis-Chalmers engines and Bullock generators which replace the entire three older plants and furnish power and light to the entire works. At the rear of the room opposite the switchboard is a 100,000-gal. fire pump.

The first feature of the room which attracts the attention of the observer is the absence of piping. Except where some short pipes reach through the rear wall to the steam pump and to the 50-kw unit, there is not the vestige of a steam pipe in the room. Both the live steam and exhaust pipes are carried under the floor. Neither is there a wire conduit nor a wire in sight except at the back of the switchboard. All the connecting wires are carried in conduits built into the solid concrete flooring and walls.

There are four steam-electric units so sized and arranged as to provide any amount of current needed from 50 kw, by steps of 50 kw. First in order as they are set as well as in importance come two 200-kw units. Next is one 100-kw unit and last a 50-kw unit.

Each of the 200-kw units and the 100-kw unit consists of a Reynolds-Corliss engine of the heavy duty type with a direct-connected Bullock engine type generator. The larger engines have cylinders 22 in. in diameter with a 36-in. stroke. Steam is furnished at a pressure of 100 lb. to the inch at the throttle and the engines run at 100 r.p.m. The throttle valves of all the engines are under the floor with the stands and handwheels rising beside the engines near the cylinders on the valve gear side.

The 200-kw engines have balance wheels 14 ft. in diameter. The wheels are made in halves. They have square rims with barring-holes cast in the rims. The wheels weigh 20,000 lbs. each.

The valve gear is of the double eccentric style with a long range cut off. The valves are double ported. Richardson feed oil pumps supply lubrication to the cylinders.

The engine of the 100-kw unit is of the same type as the larger ones and differs from them only in size. Its cylinder is 16 in. in diameter and 36-in. stroke. It operates at 100 r.p.m. It has a balance wheel 12 ft. in diameter weighing 12,000 lbs. The main journals measure 8 in. in diameter and 15 in. in length, and the crosshead pin is 4 in. long and 4 in. in diameter. All three of the engines have counterbalanced disc cranks.

The 50-kw unit, which was also furnished by the Allis-Chalmers Company, has a Harrisburg-Fleming side crank, self-oiling engine of 80 hp, running at 275 r.p.m. It cuts off at ¼ stroke. Owing to a difficulty in providing condensing water as well as a desire to use the exhaust for heating purposes the entire plant is non-condensing.

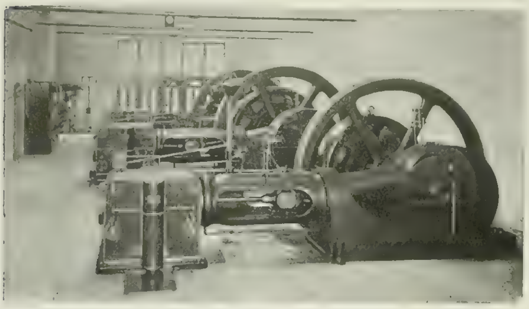


FIG. 2.—GENERAL VIEW OF ENGINE ROOM.

The engines are guaranteed when running on a full and even load with 100 lbs. steam pressure and no back pressure, not to consume more than 25 pounds of dry steam per i.h.p.-hour. They are also guaranteed not to vary in speed more than 2 per cent above or below the normal under all changes of load within their capacity.

The four Bullock generators are all of the direct-current engine type and have the following characteristics:

Number of Units	Type.	Normal Speed R.P.M.	Normal Rated Capacity in K-W.	Normal range E.M.F. in volts. from	to	Normal Current Capacity in Amperes
2	Engine	100	200	115	120	1,666
1	"	100	100	115	120	833
1	"	275	50	115	120	416.6

Each is guaranteed to be capable of carrying its full normal load continuously for 24 hours without sparking and without heating the windings more than 40° C. or the commutator more than 45° C. above the temperature of the surrounding atmosphere. They are capable of taking a 25 per cent overload for two hours following a full day's run at full load without heating more than 100° C. above the figures for the day's run, and if required will carry a momentary overload of 75 per cent without flashing. They will go from no load to 25 per cent overload without shifting the brushes.

The switchboard is so designed that current from any one of the generators, all of them, or any combination of them, may be distributed to the three factories at will, either for lighting or for power. It contains ten panels.

The panels are built of black enameled slate, each finished with beveled front edges and mounted on a rigid angle iron frame. The panels are 70 in. in height with a base panel 20 in. wide. Beside its regular instruments each panel is provided with a lamp and shade mounted on a bracket. Each has its bus-bars and connections complete. One panel, corresponding to the others, is left vacant for future use.

The first panel carries at 150-volt Weston voltmeter on a swinging bracket. There are four generator panels, one for the 50-kw unit, one for the 100-kw unit, and one each for the two 200-kw units. Each carries a laminated type circuit-breaker, a Weston ammeter, a three-point, single throw knife switch, and a voltmeter switch, all of proper capacity, and each has its rheostat mounted on the back of the board.

The feeder panels for Factories Nos. 2 and 3, are each 16 in. wide and contain one 2,500-ampere, 110-volt, two-wire integrating wattmeter and two 1,000-ampere knife switches with fuses on the rear of the board. The feeder panel for Factory No. 1 is of like width, and its instruments are similar, except that the wattmeter is of 1,250-ampere capacity and the switches of 1,000-ampere capacity each. There are two distributing panels each 24 in. wide. Distribution panel No. 1 contains a 600-ampere Weston ammeter with 8 shunts and an 8-point ammeter switch, and 8 400-ampere, double-pole, single-throw, knife switches.

Distribution panel No. 2 contains a 300-ampere Weston ammeter with 8 shunts, an 8-point ammeter switch and 10 200-ampere, double-pole, single-throw knife switches.

The foundations for all the engines form one solid mass of concrete 70 ft. long, 12 ft. wide and 14 ft. thick with wings 12 ft. long and 6 ft. wide added for each heavy duty engine to support the cylinder end. The wings reach straight down to the earth level excepting the one under the 16x36-in. engine which has its foot cut away at a slant to allow room for turning a boiler in case it becomes necessary to take any of them in or out for repairs or replacement. Along the continuous 70-ft. side the foundation mass has added to it the 30-in. outer wall of the building, while over it all and forming one with it is the 5-in. thick concrete floor reaching to a 36-in. wall, on the opposite side.

Except for the subdued sound of the valve gear the engines run noiselessly and so smoothly that not the slightest tremor can be discovered, when a coin is balanced edgewise on the cylinder with its face line transverse to the line of action of the piston rod.

The boiler room is in the rear of the engine room and is 44 ft. wide and 60 ft. long. It rises in the clear 30 ft. from the basement level to the roof and is plentifully supplied with light and air from skylights, and from vault lights at the front of the open passage beside the engine foundations. It contains six Basshor & Sons' horizontal tubular boilers, each 6x18 ft. and containing 104 3½-in. tubes. The smoke flues connect to a header flue which leads directly to a steel stack 5 ft. in diameter and 140 ft. tall. The steam from all the boilers is received by a straight header 12 in. in diameter which runs directly under the three larger engines and is connected to each by suitable piping. The two 22 by 36-in. engines have 8-in. connections and the 16 by 26-in. has a 5-in. pipe. The boilers are so arranged that any one of them can be cut out, whether one or all of the engines are running. In addition to this, two of the boilers which back up against the engine room wall are arranged so as to be connected independently with either the fire pump or the Harrisburg engine. This arrangement permits of the independent operation of the 50-kw. unit. This is important for this unit ordinarily furnishes the lighting current and is used also to operate the elevators and any small part of the works where it might be necessary to carry on work at night or other times when the general plant is shut down.

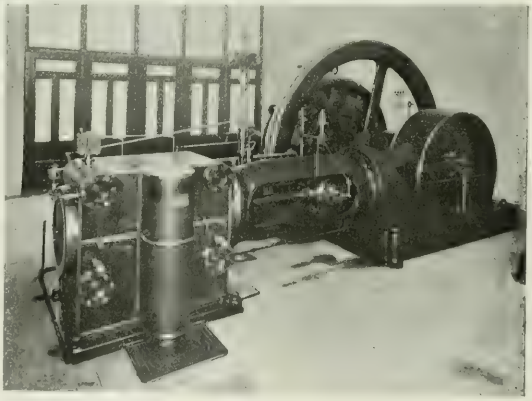


FIG. 3.—SIDE VIEW OF ONE OF THE UNITS.

The exhaust steam pipe returns in a line parallel to that of the live steam pipe. It brings the exhaust steam to a "Utility" feed-water heater and purifier. Here the oil is trapped and sent into the sewer and feed water is heated.

The exhaust steam escapes from the heater into a 12-in. header, from which it is sent out to Factories Nos. 1, 2 and 3 through 6-in. pipes. When it is not needed for heating purposes in the buildings it is allowed to escape into the atmosphere through pipes which lead to the roof of each building. When heat is needed the steam is drawn through the system of heating pipes by a pump in the boiler room which brings all the steam back into the heater, but this time it passes into the feed water section.

Oil for lubrication is circulated through a system of pipes by gravity from a tank situated about 15 ft. above the engines. After passing through the engines it goes to a filter and is there pumped back to the tank.

With the installation of the machinery in the new concrete factory No. 3, the Robert Gair Company will complete the equipment of its works with electric drive. Besides 2,000 16-cp incandescent lights to be maintained, the variety of the operation carried on by electric power in the plant is almost infinite.

This work includes printing, lithographing, embossing, punching and all the complex operations which are necessary in producing a variety of paper goods which ranges from the rough corrugated paper used for packing purposes to the filmy lace papers used to grace delicate confections, or to decorate the table.

There is hardly a household in the land where the products of the Robert Gair Co. are not known. Uneeda biscuit boxes, Pearline and Fels Naphtha packages are among these and compartment cigar cases, candy boxes, labels, enameled show cards and envelopes for seeds, gloves and other goods are turned out by the millions.

"If it's made of paper, we have it" was the motto of the firm for years, but recently it has been compelled to restrict its product to a few score of specialties. Between 1,100 and 1,200 machines of various kinds are employed in the making of the goods. Many of these were invented and built in the works. Something like 60 motors or more, big and little, will be employed to keep all of these machines in motion when the electrical equipment is complete. The motors will range in size from 5 hp to 30 hp each.

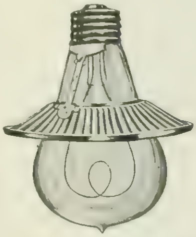
Telephone Transposition Insulator for High-Potential Power Lines.

When telephone wires are placed upon the same poles with high-potential power lines, it is desirable that a high degree of insulation be used with the telephone wires in order to minimize the liability of current jumping from the pole or tower on to the telephone wires and thereby working destruction sometimes of both life and property. The accompanying illustration shows the No. 8A transposition insulator of the Locke Insulator Manufacturing Company, Victor, N. Y., which has been designed for the support of telephone wires on the same poles which carry the high-voltage wires. A prominent feature of the insulator is the great arcing distance between the telephone wires and the support. It will be noted further that there has been provided between the two telephone wires a small petticoat which affords ample insulation between them. This insulator is made in one piece, and is characterized by great mechanical and electrical strength.

TELEPHONE TRANSPOSITION INSULATOR.

Monarch Aluminum Reflectors.

The illustration herewith shows a device which, when placed on an incandescent lamp, serves to increase the light in a downward direction, and at the same time allows sufficient light to pass upward in order to avoid dark spots on the ceiling. The reflector is made of aluminum, and, although being of small weight, it is very durable. This device, which is called the "two-light" reflector, is manufactured by the Sarco Company, 906 Sixth Ave., New York, for the American Electrical Novelty & Manufacturing Company.



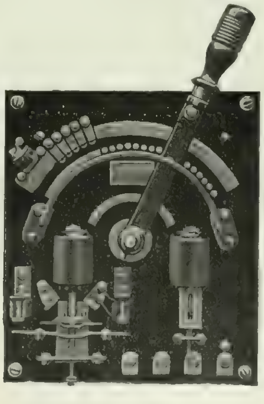
"TWO-LIGHT" REFLECTOR.

Printing Press Controller.

The accompanying illustration shows a 3-hp, 125-volt Ward Leonard printing press controller designed to occupy but little mounting space and equipped with apparatus for obtaining speed regulation by both armature and field control. The armature circuit is made and broken by a quick-acting solenoid switch, so that no arcing can take place due to improper manipulation of the controlling lever.

The design is such that should an overload occur the solenoid switch quickly breaks the circuit and the circuit cannot be made again until the speed-controlling lever is moved to the proper starting position. The no-voltage release device is responsive solely to the line voltage and is entirely independent of the field current or of the armature current.

The controller is protected against overload at all times. The overload circuit-breaker has laminated contacts to carry the current, and it has six independent points at which the circuit is opened, each of the two laminated contacts being protected by two auxiliary contacts. The final breaking points are equipped with magnetic blow-outs. The lever must be held squarely on the controlling contacts. There is no strain upon the controlling arm. The movable contacts are of the skate-shoe type, able to ride over any obstruction standing 1/16 in. above the contact surface.



PRINTING PRESS CONTROLLER.

Self-Contained Electrical Fountain.

The electro-luminous fountain shown in Figs. 1 and 2 is an exceptionally attractive decorative device, which has recently been placed upon the market in this country. The device consists of a small electric motor and a pump, the latter being placed in the interior of a basin and connected directly to the motor shaft. The pump draws water from the bottom of the basin, and conveys it to a length of pipe, circular in form, in which are placed numerous nozzles through which water passes to produce cascades. In the center is placed an incandescent lamp, the light from which passes through a varicolored shade which is revolved by the impact of the water from an internal nozzle, and which serves to protect the lamp from the water of the cascades. The water from the cascades falls on the revolving shade and returns to the basin, and is again drawn into the pump. When the basin is once filled it is unnecessary to renew the water for a considerable length of time. It is worthy of note that the piping of the device is self contained, and that no external water piping is needed. The only external connection is made through a substantial lamp cord from any convenient lamp socket.

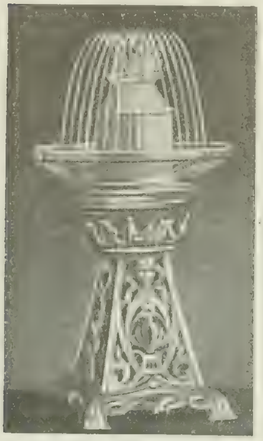


FIG. 1.—ELECTRO-LUMINOUS FOUNTAIN.

These fountains furnish excellent decorations for private houses, and they serve to keep the air cool and moist. In addition to those for private houses, special designs have been built for lobbies and parlors of hotels, theatres, florist stores and as decorations for dinner parties and for show windows. They can be moved from one place to another without trouble, since there are no water pipe connections, and the electrical circuits can be substituted for or connected to those of any incandescent lamp. A United States patent for this device has been issued to Max Levy, of Berlin, Germany. It is stated that since they were placed on the market in Germany many have been sold, and the demand for them is increasing rapidly. Several of them have already been introduced in this country. The sole agent for this fountain for the United States and Canada is the Electrical Accessaries Company, 1135 Broadway, New York.

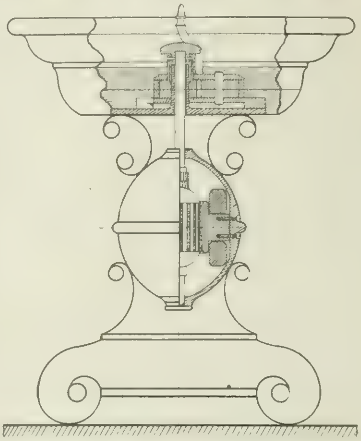
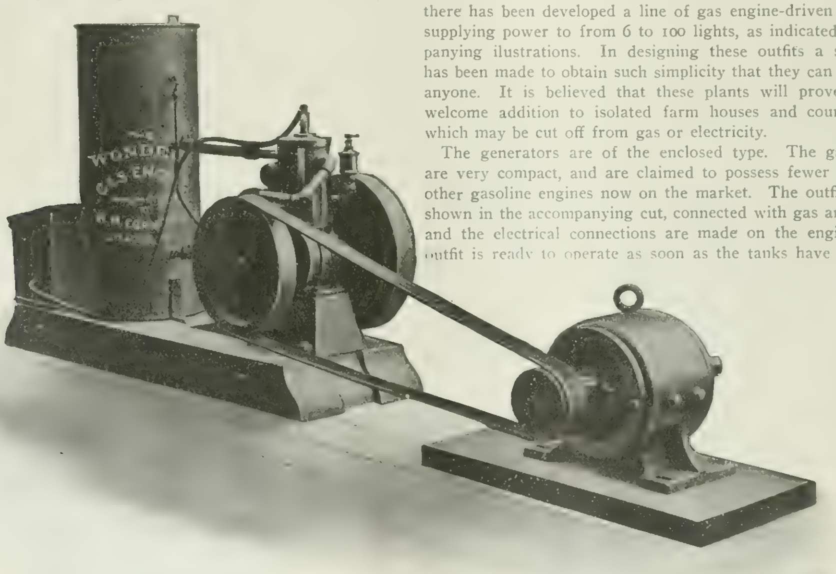


FIG. 2.—PART SECTIONAL VIEW OF ELECTRICAL FOUNTAIN.

"Wonder" Electric Lighting Outfits.

In order to meet the demand for complete electric lighting outfits for private residences, farm houses, house boats, shops and stores, there has been developed a line of gas engine-driven generators for supplying power to from 6 to 100 lights, as indicated in the accompanying ilustrations. In designing these outfits a special attempt has been made to obtain such simplicity that they can be operated by anyone. It is believed that these plants will prove an especially welcome addition to isolated farm houses and country residences which may be cut off from gas or electricity.

The generators are of the enclosed type. The gasoline engines are very compact, and are claimed to possess fewer parts than any other gasoline engines now on the market. The outfit is shipped as shown in the accompanying cut, connected with gas and water tanks, and the electrical connections are made on the engine so that the outfit is ready to operate as soon as the tanks have been filled. It is stated that the cost of operating the engine is about one cent per hp-hour, or about one-tenth of a cent per hour for each 16-cp lamp.



"Wonder" Gasoline Engine Belted to Enclosed Generator.

These equipments are manufactured by the R. M. Cornwell Company, Syracuse, N. Y., and are designed to conform to the requirements of the Board of Underwriters.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade has been stimulated by the colder weather and seasonable merchandise is moving freely. Leading branches of manufactures are making good progress, most mills and factories having orders for more remote delivery than is customary, and especially favorable statements are made respecting lumber and flour mills. It is no longer cause for comment when new records of output are established, as this has become the rule rather than the exception. Iron and steel in all forms are active as never before at this late stage of the year. A large sale of iron, 40,000 tons, has been made to the leading interest, which cleans up about all the Bessemer iron available for the remainder of the year. Other points note similar scarcity of other grades. Finished products are actively in demand, and the mills are pushed for deliveries, although close to full capacities are employed. Bessemer iron is quoted at $17, valley furnace, with $18 predicted before January 1. At Chicago, foundry iron is 50 cents up, and $3 higher than the low point of the year. Large sales for the first half of 1906 are reported. The car shortage still affects coke and coal shipments, and the movement of these commodities this winter is a serious problem. Although the congestion in railway matters has been relieved at some points, notably at lake and rail centers, complaints as to car shortages affecting the movement of grain and collections come from the northwest; coke and coal movements are menaced in the central west, and the lumber movement in the Pacific northwest is hampered. Collections generally are freer, and there are signs of the return movement of currency from the country balancing the outgo. Labor is occupied as rarely if ever before at this season; fear of cotton-mill strikes has faded, and reports from factories in widely separated sections are that they are running to their fullest capacities. Dullness characterized the copper market, and a few sales were made at slightly lower quotations. Lake and electrolytic are quoted at 16.50c and casting stock 16.25c. In their circular, D. Houston & Co. say this of the copper situation: The phenomenal domestic consumption of copper is fully attested by the intensely active conditions prevailing at the brass and copper mills of the country. Manufacturers have orders in hand which for months ahead will tax the utmost capacity of their plants, and the first three to six months of 1906 are expected to be an exceedingly busy period. The outlook for great activity in copper next year is most promising, and if values are kept at a reasonable level a very urgent demand practically seems assured. Consumption has developed to immense proportions, and it may be expected to increase with production. If there is a plentiful supply of copper to feed the new demands arising for its use, consumption will have a better chance to expand and demand will increase in importance as a factor of unprecedented force. It is thoroughly demonstrated that there is enough copper for electrical uses and the new modern utilities thus far, and therefore the development of these recent improvements can be promoted rapidly. Failures for October, says *Bradstreet's*, are at the minimum for that month, numbering 804, a decrease of 4.4 per cent from a year ago, and an aggregate practically as low as the lowest reported in October for 13 years past. One-third of the total liabilities of $12,600,683 for the month of October is accounted for by three bank failures. The number of failures reported for the week ending November 2 is 160, against 178 the week previous and 200 the corresponding week last year.

ELECTRIC RAILWAY EQUIPMENT.—The Ocean Shore Railway Company, which is constructing a double-track electric road from San Francisco to Santa Cruz, has closed contracts for its electric equipment and power house plant. The power house will be erected at Balboa on Half-Moon Bay, by Charles C. Moore & Co., of San Francisco, who have the contract to supply and erect everything except the electric equipment. The General Electric Company will supply all of the electrical plant. Two 2,000-kw, 2,300-volt, 25-cycle flywheel-type generators will be direct connected to two McIntosh & Seymour vertical cross-compound engines making 107 r.p.m. Of the two 125-kw exciters one will be driven by a Harrisburg engine and the other by an electric motor. Seven 1,000 kw oil-cooled transformers will raise the voltage from 2,300 to 30,000 volts. Thirty 250-kw lowering transformers will reduce the current to 440 volts at the sub-stations, where ten 6-phase rotary converters will furnish direct current at 500 volts to the trolley wires. Eight sub-stations will be located at intervals of about ten miles, and two will be mounted on cars so as to be portable. Forty 4-motor car equipments, each motor of 125 horse-power, have been ordered arranged for multiple control, although as a rule single cars will be operated except when there is a rush of traffic. The overhead work will be of catenary construction insulated for 6,000 volts, so that whenever it becomes advisable the line can easily be changed over to an alternating-motor system. The boiler plant will include five 600-hp Babcock & Wilcox wrought-steel boilers, carrying 200 pounds pressure and equipped with superheaters. Wheeler condensing apparatus will be installed, and all auxiliaries will be steam driven. A salt water pumping system will supply circulating water from the bay. Crank and flywheel air pumps of the Edwards type will be used and centrifugal circulating pumps. Improved oil-burning apparatus will supply the furnaces. There will be a Weber concrete steel stack, eight feet in diameter and 125 feet high.

JERSEY MEADOW IMPROVEMENTS.—The New Jersey Terminal Dock and Improvement Company, recently incorporated at Trenton, has bought the meadow tract known as the "Pike estate," extending from Harrison to the west bank of the Hackensack River, opposite Jersey City. The company is capitalized at $3,000,000, and is also authorized to issue $3,000,000 in bonds. Of this amount $1,800,000 has already been issued. Walter G. Oakman, of New York, is president, and Pliny Fisk, the banker, is vice-president. The other directors are Andrew Friedman, William M. Barnum, W. L. Lane, Charles D. Barney, George R. Sheldon and W. C. Kinney. With two exceptions, all these are directors in the Hudson Street Railroad Company, whose object is to build trolley roads from all the towns in Hudson County to connect with the tunnels under the Hudson River to Morton and Cortlandt Streets. The New Jersey Terminal Dock & Improvement Company, the Hudson Street Railroad Company, and the Hudson Companies, which are building the tunnels, are practically one enterprise. The meadow tract, comprising about 4,000 acres, has been acquired for general purposes, such as a central power house and car sheds.

GESELLSCHAFT FÜR DRAHTLOSE TELEGRAPHIE, Berlin, reports increased activity in the installation of apparatus for wireless telegraphy. The enormous station of 1,500 km range, ordered by the German Post Office, will not, as first intended, be erected at Borkum, but at Norddeich, near Norden (North Sea). The laying of the foundations has so far progressed, that the building of the towers 65 m high can soon be taken in hand. The "Kaiserliche Marine" has ordered two coast stations on the Baltic Sea. Two complete overland stations have been ordered for Rost and Soervagen, Norway. The construction of stations for the fortresses Almeria and Melilla, in Spain, will soon be begun. The Dutch Navy has ordered three stations of 500 km range. A cruiser looking after the interest of the Danish fishing trade in the seas of Iceland will soon be equipped with wireless apparatus. Instructions have been received from the authorities of the pilot and life boat service of Finland to equip the lighthouse Marieham and Bogoker with telefunken stations. The Argentine Navy has Telefunken apparatus in use on four warships, namely, Julio, Patria, Libertad and Independencia.

THE S. MORGAN SMITH COMPANY, of York, Pa., has recently completed the installation of six turbine water wheels for the Berkshire Power Company, at Canaan, Conn. Each turbine is to develop 120 horse-power under 11 ft. head. These turbines are installed in sets of three, each three turbines being geared to a jack shaft which is coupled directly to an electrical generator. The current generated is to be used for lighting and power purposes. The company has also furnished recently two horizontal water wheels to the Lombard Governor Company, at Ashland, Mass. These wheels are to be used for supplying power to its factory, and also to be used in connection with testing water wheel governors, the manufacture of which is the principal business of this company.

NATIONAL LEAD COMPANY.—The Atlantic works of the National Lead Company, of Brooklyn, N. Y., the largest factory for the production of white lead in the United States, is being reconstructed so as to distribute all power electrically. Plans have been completed for displacing 14 steam engines of various sizes and over 40 steam pumps located throughout the works by one 600-hp, tandem, compound, condensing engine direct-connected to an electric generator supplying two-phase induction motors. The contracts have already been let for part of the apparatus, and it is expected the rejuvenated plant will be put in operation in January. Henry Floy, of the St. Paul Building, New York, consulting engineer, for the National Lead Company, has the matter in charge.

ALLIS-CHALMERS.—It is stated from Chicago that President Whiteside has denied the rumor that the Allis-Chalmers Chicago shops are to be moved to Milwaukee.

RECENT WESTINGHOUSE-PARSONS TURBINE ORDERS.—The Westinghouse Machine Company, of East Pittsburg, Pa., has within the last few weeks received numerous orders for its turbines, among them being one from the Lumberton Cotton Mills, Lumberton, N. C., for one 300 kw turbine; from the Waltham Gas Light Company, Waltham, Mass., for four 500 kw turbines; from the Gulfport & Mississippi Coast Traction Company, Gulfport, Miss., for two 500 kw turbines; from the Suburban Electric Company, Scranton, Pa., for one 500 kw turbine; from the Pennsylvania Light & Power Company, Pittsburg, Pa., for one 500 kw turbine; from the Water, Light & Gas Company, Hutchinson, Kan., for one 500 kw turbine, and from the Winston-Salem Power Company, Winston-Salem, N. C., for one 750 kw turbine. The turbine ordered by the Lumberton Cotton Mills will be of the well-known multiple expansion parallel-flow type driving a 60-cycle direct-connected generator running at 3,600 r.p.m. It will operate at 150 lbs. steam pressure and 26-in. vacuum and deliver three-phase current at 440 volts. The turbines for the Waltham Gas Light Company will be of the same type and frequency, operating at 3,600 r.p.m. with dry saturated steam at 175 pounds gauge pressure and 28-in. vaccum. The alternating current generators will be of the rotating field turbo type delivering three-phase current at 2,300 volts. The Suburban Electric Company's turbine with characteristics similar to the above will operate with dry saturated steam at the throttle of 150 lbs. gauge pressure and with atmospheric pressure in exhaust pipe, and will be capable of developing 750 hp. The turbines for the Gulfport & Mississippi Coast Traction Company will operate under 150 pounds pressure, 28-in. vacuum and 100 deg. Fahr. superheat, and will be direct connected to 60-cycle turbo generators running at 3,600 r.p.m.

NEW ENGLAND POWER PLANTS.—The S. Morgan Smith Company, of York, Pa., is installing for the American Optical Company at Southbridge, Mass., two pair of horizontal turbines, with an aggregate of 500 hp under 11 ft. head. Each pair of these wheels is connected to a belt-driven generator, and the current is to be used for operating the machinery of the latter company. The speed of each pair of turbines is regulated by a Lombard governor, and the arrangement will be such that, although each pair of wheels is in a separate power house and the engine room at a third location, either pair of turbines can be stopped or started and the speed controlled from the switchboard which is located in the engine room. The S. Morgan Smith Company is also furnishing the International Paper Company for its power plant at Livermore Falls, Me., a hydraulic equipment, consisting of six pair of turbines, each pair to develop over 1,300 hp under 32 ft. head; also one small wheel to drive an exciter unit. These wheels are all mounted on horizontal shafts and set in steel cases and are direct-connected to pulp grinders and electrical generators. The S. Morgan Smith Company is also installing for the Otis Fibre Board Company at Russell, Mass., two pair of horizontal wheels, each pair to develop 400 hp under 22 ft. head. These wheels are to be direct-connected to electrical generators, the current from which will be used for industrial purposes. This installation is unusual, from the fact that the wheels and generators are all inside of the dam, the wheels setting in concrete flumes, and the walls of the generator room being of water-tight concrete construction. The wheel pits and tailraces are formed by arches underneath the dam.

INCREASING EXPORT TRADE.—The American Consul at Prague, Urbain J. Ledoux, has, on the pattern of a chamber of commerce, established a special bureau called the commercial intelligence department of the Prague consulate, affording every opportunity for the registration and examination of catalogues of all kinds, and so classified that importers and exporters can be posted immediately upon the possibility of their doing business. The catalogues, prices current, discount sheets, etc., must naturally be so arranged so that anybody seeking information can find it at once. Catalogues without prices or discount lists would be useless; moreover, the weights and measures should be reduced to the standards adopted in the country of their destination. Lists of references should also be added. The catalogues and other printed matter are classified according to the different branches, so that the visitor may easily find what he wants. In order that the filing can be done effectually, it is necessary that parties sending printed matter should, at the same time, advise our consuls regarding the various specialties they handle, so as to save tedious searching and to facilitate registration.

TURBINES IN WASHINGTON TERMINAL STATION.—When the large Union station at the Washington terminal of the Pennsylvania Railroad is completed, it will be one of the finest and best-equipped railroad stations in the world, serving all incoming and outgoing trains at the National Capital. In conformity with the rest of the station the power plant will be equipped with the most up-to-date and best machinery obtainable, steam turbines being selected as prime movers partially on account of the limited amount of space devoted to that purpose. Four 500 kw steam turbines have been ordered from the Westinghouse Machine Company, of East Pittsburg, Pa., adapted for driving alternating current 60-cycle generators running at 3,600 r.p.m. Dry saturated steam will be used at 150 pounds pressure and 25-inch vacuum, and the turbines will be capable of developing 670 e.h.p. each. The alternating current generators will be of the turbo rotating field type with two poles and a frequency of 60 cycles at a normal speed of 3,600 r.p.m. They will deliver three-phase current at 2,300 volts, and, being of the enclosed type, will operate practically without noise.

DRAINAGE CANAL CONTRACTS.—The engineering committee of the Drainage Board, on Oct. 30, recommended the award of contracts aggregating $200,000 for the work necessary to transmit the power to be generated by the sanitary district canal at Lockport and Joliet to Chicago, as follows: Switchboards and transformers, the Stanley Electrical & Manufacturing Company, $3,546; oil circuit breakers and switches, the Arthur Frantzen Company, $13,836; rheostats for generators, the Stanley Electric Company, $1,515; bus bar compartments, the Arthur Frantzen Company, $8,629; conduits and wiring connections, the Brennan Electric Construction Company, $6,285.87; transformers and lightning arresters, the General Electric Company, $74,888; aluminum conductors, the Western Electric Company, $423 a mile; erecting aluminum conductors, the Brennan Electric Construction Company, $1,350; high-tension insulators, the Porter & Berg Company, $5,920; electric crane, the Whiting Foundry & Equipment Company, $5,800.

TECHNICAL PUBLICITY ASSOCIATION.—At a meeting and banquet of the Technical Publicity Association, held at the Aldine Club, New York, Friday evening, Nov. 3, the following officers were elected: President, C. B. Morse, Ingersoll-Rand Drill Company; first vice-president, H. M. Cleaver, Niles-Bement-Pond Company; second vice-president, Frank H. Gale, General Electric Company; secretary, Rodman Gilder, Crocker-Wheeler Company; treasurer, H. M. Davis, Sprague Electric Company. Members of Executive Committee—Graham Smith, Westinghouse Companies, and Chas. M. Manfred, Johns-Manville Company. Mr. H. M. Davis addressed the association on "The Advertising Appropriation." An informal discussion followed, in which the members exchanged views on the disposition of advertising appropriations, the relative amount that should be spent in magazine and circular advertising, the relation between the advertising appropriation and the volume of business, etc.

PRODUCTION OF LEAD AND ZINC.—The report of the Geological Survey on the lead and zinc industries of the United States for the year 1905 shows that the production of lead was 307,000 short tons, valued at $26,402,000. The increase in production was marked in Southern Missouri, Southeastern Kansas, Colorado, Utah and Idaho. The lead contents of the output of the Cœur d'Alene district of Idaho is given as 108,854 short tons. The production of spelter in the United States in 1904 amounted to 186,702 short tons, valued at $18,670,200, as compared with a production of 159,219 tons in 1903. The principal increase in the production of zinc has taken place in Kansas, where new plants were started.

WELDED WIRE FENCE.—According to the *Iron Age*, a new development in electric welding is the automatic production of continuous rolls of wire fencing. A number of galvanized wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these are cut off lengths of wire which are fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect they are welded together by means of small transformers. The welded section then moves forward a predetermined distance and the operation is repeated.

HYDRO-ELECTRIC PLANT AT LOWELL, KAN.—The Arnold Company, Marquette Building, Chicago, has issued as Bulletin No. 13 a well-prepared description of the hydro-electric plant of the Spring River Power Company at Lowell, Kas. This plant supplies power to Galena, Joplin and Webb City over a thirty-mile transmission line, the circuit e.m.f. being 33,000 volts. The bulletin deals with all features of the equipment, numerous views being given of the power plant, transmission lines, substations, secondary distributing circuits and motor installations.

PLANT AT WASHINGTON, N. J.—A sale of the Washington Electric Light Company has just been effected by the Gas & Electric Development Company, of Philadelphia, which will also have charge of the extensive improvements to be made immediately and the future operation of the plant. The Washington company has always been a paying enterprise, but under the new management it is expected the earnings will be largely increased.

THE STROMBERG-CARLSON TEL. MFG. CO., Rochester, N. Y., reports having closed contracts for switchboards for the following places: Varna, Ill.; Varich, Mo.; Bouton, Ia.; Atalissa, Ia.; Leonard, Mich.; Stuttgart, Kan.; Stromsburg, Neb.; Stelhensport, Ky., and Yates City, Ill.

ELECTRIC ELEVATOR.—A new electric elevator is to be installed in the city hall at Grand Rapids, Mich. The Common Council has authorized its purchase.

Financial Intelligence.

THE WEEK IN WALL STREET.—Strength and activity characterized the stock market, the centre of interest being almost entirely in the manipulation of such specialties as Reading, Smelting and American Locomotive, in which, as well as in certain other industrials and neglected railroad shares, new price records were established. National Lead, a hitherto neglected specialty, attracted attention, it being claimed that the deal by which it is to be combined with other lead interests is likely to prove successful. Early in the week some portions of the list developed more or less heaviness, prominent among these being Metropolitan Street Railway and Metropolitan Securities, which seemed to be the most vulnerable of the so-called franchise group, and were for a time boldly attacked by the bear traders on the ground that the municipal campaign now in progress in New York City involves a possibility of serious danger to such organizations. Later on, however, the Metropolitan group recovered ground, apparently on covering by the shorts in them. The quarterly report of the United States Steel Corporation was favorably received, though it did not at first produce any great effect upon the position of the stock; later on, however, United States Steel preferred sold up to 105¾, thus establishing a new high-price record for that security. The electric and traction stocks closed firm and prices were generally higher. Allis-Chalmers, both issues, closed with net gains, at 19⅜ for the common and 62 for preferred, the advances being ⅝-point and 2¾ points, respectively. General Electric ranged between 183½ and 189¾, closing at 186, which represents a net gain of 1 point. Westinghouse gained 5¼ points net, closing at 174. American Locomotive common closed at 68⅝ and preferred at 115½, both being net gains—2⅞ for the former and 1 point for the latter. One hundred and fifty-three thousand and two hundred shares of Brooklyn Rapid Transit were sold at prices ranging between 76 and 77⅞, the closing quotation being 76, an advance of 1½ points. Metropolitan Street Railway is up 2⅝. The lowest figure of the week was 117¾, but much of the loss was recovered, the closing price being 121⅝. Interborough Rapid Transit closed at 210, which is a net loss of 1¾. New York & New Jersey Telephone rights closed at 13. Western Union is a shade higher, closing at 93⅜, and American District Telegraph advanced 5¾, the closing quotation being 43. On the curb, prices showed some strength early in the week, but later eased off in sympathy with stock exchange prices. The heaviest trading was in Chciago Subway, 90,000 shares changing hands on a recovery of about 5 points to above 50. Mackay common shares were very strong with a use of more than 4 points to above 50, with talk of an increase in the dividend. Preferred seemed to be pressed for sale, and closed lower than a week ago. Following are the closing quotations of Nov. 8:

NEW YORK

	Oct. 31	Nov. 8		Oct. 31	Nov.
Allis-Chalmers Co	19⅛	19⅜	General Electric	187¾	183
Allis-Chalmers Co. pfd	60	61	Hudson River Tel	..	..
American Dist. Tel	39	40	Interborough Rap. Tran	211	210
American Locomotive	69⅞	68⅝	Mackay Cos	46⅜	48⅝
American Locomotive pfd	114¾	114	Mackay Cos. pfd	72¾	73
American Tel. & Cable	92	92	Marconi Tel	..	..
American Tel. & Tel	136	136	Metropolitan St. Ry	119	121
Brooklyn Rapid Transit	75¾	75⅞	N. Y. & N. J. Tel	..	..
Electric Boat	30	32	Western Union Tel	93	93
Electric Boat pfd	70	70	Westinghouse com.	170½	171
Electric Vehicle	15	15	Westinghouse pfd	..	.
Electric Vehicle pfd	23	20			

BOSTON

	Oct. 31	Nov. 8		Oct. 31	Nov. 8
American Tel. & Tel	138⅛	136¼	Mass. Elec. Ry. pfd	56¾	55½
Cumberland Telephone	122¾	122¾	Mexican Telephone	1½	1⅜
Edison Elec. Illum	*248	246	New England Telephone	*136	*136
General Electric	186½	182	Western Tel. & Tel	13	13
Mass. Elec. Ry	13	13	Western Tel. & Tel. pfd	90	89½

PHILADELPHIA

	Oct. 31	Nov. 8		Oct 31	Nov. 8
American Railways	51	52	Phila. Electric	8⅛	8½
Elec. Co. of America	11	11⅛	Phila. Rapid Trans	27½	27¾
Elec. Storage Battery	82	80	Phila. Traction	..	..
Elec. Storage Battery pfd	.	..			

CHICAGO

	Oct. 31	Nov. 8		Oct. 31	Nov.
Chicago City Ry	*206	200	National Carbon	63	64
Chicago Edison	.	..	National Carbon pfd	116	114
Chicago Subway	.		Union Traction	.	..
Chicago Tel. Co	.		Union Traction pfd	..	..
Metropolitan Elev. com	28	28			

* Asked.

INDIANAPOLIS TELEPHONE SITUATION.—The failure of the Indianapolis Telephone Company to pay, on Nov. 1, the guaranteed quarterly dividend of 1½ per cent on the $400,000 common stock of the New Telephone Company, the "independent" organization, has caused so decided a sensation among those stockholders that an investigation of the affairs of the company will probably follow. It is said that the capital stock of the New Telephone Company was appropriated by the organizers of the company; that no money was ever paid into the company for it, and that it may now be liable to assessment to its full valuation. It is also said by some that the plant is not worth more than its mortgage indebtedness, and that the stockholders have known nothing about the true condition of the company. The public statements on which the stock has been sold, it is charged, have shown the mortgage indebtedness of the New Telephone Company as amounting to only $800,000, consisting of a $500,000 first mortgage bonds and $300,000 second mortgage bonds, while it is now discovered there is a $150,000 third mortgage, and on top of all this between $315,000 and $350,000 floating indebtedness. It is also charged that the published statements of the liabilities of the company have not shown the interest on this third mortgage and the floating indebtedness. It is also said that the company has been forced, in order to pay dividends for some time, to continue and increase indebtedness. The control of the Indianapolis Telephone Company has passed recently into the hands of St. Louis capitalists, as noted already in these columns.

KEYSTONE TELEPHONE BONDS.—In their bond circular, Fisk & Robinson have the following to say in regard to the Keystone Telephone Company, of Philadelphia: "In response to the demand for additional telephone service, work of extension has been rapidly pushed. Additional conduits have been laid in the northwestern part of the city and in the Manayunk district, and extensions will be made to Chestnut Hill. A large force of men are already at work in West Philadelphia and the switchboard of that exchange has been extended. The West Philadelphia section has been built up so rapidly that the conduit system will have to be extended from the present terminal, which is about Fiftieth Street, west on all the principal thoroughfares to City Line. Nearly $200,000 worth of additional cable has been ordered, and about two-thirds of it has been installed in the conduits and will be put in service at an early day. The Keystone State Telephone & Telegraph Company is also doing a great deal of extension work in the surrounding counties. A line has been completed to Newtown, Bucks County, and a new exchange installed at that place. Three additional exchanges at suburban points will shortly be established."

HUNGERFORD ELECTRIC & MFG. CO.—Schedules in bankruptcy of the Hungerford Electric & Manufacturing Company, insulated wire, at 156 Fifth Avenue and Belleville, N. J., show liabilities of $56,339, of which $25,109 are secured, $1,001 taxes and $640 wages. The nominal assets are $84,538, consisting of factory at Belleville, $47,314, mortgaged for $19,000; machinery, $32,973, chattel mortgaged for $4,775; furniture and fixtures, $4,051, and materials, $200. Among the creditors are the Rubber Goods Manufacturing Company, $19,636, secured by mortgage on factory; Charles E. Parker, E. B. Smith and S. G. Goodwin, jointly, $5,473, secured by chattel mortgage; E. B. Smith, attorney for O. T. Hungerford, $11,941 for salary, loans and commissions, the amount in dispute; Edward B. Smith, $5,249, and William T. Redfreed, $2,478.

WESTERN TELEPHONE.—The preferred stock of the Western Telephone Company has recently been sold down to 91, against a high price of 104 last February. The common has declined from 22½ to 14. There is $16,000,000 of each issue outstanding. While there has been no very heavy selling pressure, still there has been an absence of any buying orders, and the market for both common and preferred has been very narrow. The decline is believed to foreshadow the early issue of new securities.

ABSORPTION BY THE BELL.—Authentic announcement was made November 3d that the Missouri and Kansas Telephone Company has absorbed the Southwest Telephone Company's lines. The purchased property covers Barry, McDonald, Newton, Jasper, Green and Lawrence counties. Local Manager A. F. Lewis says the Bell people will begin at once improving the main exchanges which are at Carthage, Springfield, Aurora, Monett, Pierce City, Scott City, Neosho and Mount Vernon.

MONTREAL TROLLEYS.—The Montreal Street Railway Company shows for 1905 a gross of $2,707,474, a growth from 1902 of nearly $700,000. The net for the year is $1,056,908, and after charges of $363,739 and dividends of $691,667, a balance is left of $1,502. The number of passengers carried was 66,631,206. The bonds amount to $2,509,000, and the capital stock is $7,000,000.

DIVIDENDS.—Pratt & Whitney declared the regular preferred quarterly dividend of 1½ per cent, payable Nov. 15. Niles-Bement-Pond Company has declared the regular preferred 1½ per cent. quarterly dividend, payable, Nov. 15. The directors of the New York Consolidated Gas Company have declared the regular quarterly dividend of 2 per cent., payable Dec. 15.

SOUTHERN NEW ENGLAND TELEPHONE.—The stockholders of the Southern New England Telephone Company have approved the resolution to increase the company's capital stock from $5,000,000 to $10,000,000.

WESTINGHOUSE MACHINE.—The stockholders of the Westinghouse Machine Company will hold a special meeting on Dec. 23 to vote on an increase of capital stock from $5,000,000 to $10,000,000.

General News of the Week

The Telephone.

MOBILE, ALA.—The Home Telephone Company has absorbed the Eastern Shore Telephone Company and will immediately spend $[illegible] in improving the system.

EARLE, ARK.—The Earle & [illegible] Telephone & Telegraph Company has been formed with a capital stock of $[illegible]. Incorporated by John F. Rhodes, president, and John M. Taylor, secretary.

CASTLEDALE, CAL.—A franchise has been granted by the County Commissioners to R. G. Miller and associates for a telephone system. This concern recently absorbed the Carbon and Emery county line, and is to make connections with the Rocky Mountain Bell system which now extends as far east as Colton.

OAKLAND, CAL.—The Pacific States Telephone Company will lay its wires in conduits in this city, at a cost of $[illegible].

BOISE, IDAHO.—The Star Independent Telephone Company has been organized with a capital of $10,000 by H. D. Andrews and J. S. Wehr.

VIENNA, ILL.—The Interior Telephone Company has increased its capital from $300 to $50,000.

NEW MILFORD, ILL.—L. E. Pell and Arthur Chase are reorganizing an independent telephone company here. The capital stock will be $5,000.

MOLINE, ILL.—The Central Union Telephone Company contemplates placing its wires underground in the business section of the city.

[illegible], N. Y.—The Foster Valley Telephone Company has been formed with a capital of $[illegible], by Vernon Cornell and Albert Mason.

CHICAGO, ILL.—The city has abandoned its plans for the municipal ownership of the telephones used by the police and fire departments, and City Electrician Carroll will award a contract to the Chicago Telephone Company for the rental of instruments. The company, however, will lose $1,600 a year through the city's threat to purchase its own supplies, charging only one-third the former rental.

MARION, IND.—O. L. Barger has petitioned the Marion Board of Public Works for a franchise to establish an automatic telephone system in this city.

BROWNSTONE, IND.—The Brownstone Telephone Company has closed a deal with the Union Telephone Company, by which it has placed in service over [illegible] additional telephones.

BENGAL, IND.—The Bengal Telephone Company has succeeded in its effort to raise enough money to put in a trunk line from Needham to Marietta, and a first-class switchboard which will soon be in operation.

OSCEOLA, IND.—The Dunlap Telephone Company has filed articles of incorporation with the secretary of state. The capital stock is $20,000. Marion D. Pancake, Wm. D. Kauffman and others are the incorporators.

RICHMOND, IND.—The Converse Telephone Company, which for the past two years has been a sub-licensee of the Central Union Telephone Company, has severed its connection with the Bell interests and now connects only with the independent systems.

MONTICELLO, IND.—An agreement has been ratified between the Monticello Telephone Company and the Yeoman Telephone Company, which provides for the connection of the two exchanges. The new toll lines necessary to connect both companies will be built at once.

TERRE HAUTE, IND.—The Citizens' Telephone Company has ordered plans and will soon ask for bids for the construction of a large exchange building. The controlling interest of this company has been secured by the Kinloch people of St. Louis, and the new management announces that other improvements will be made and new equipment installed.

SOUTH BEND, IND.—It having been reported about the city that the Home Telephone Company intends raising the rates for service in Mishawaka, President Theodore Thorward, of South Bend, has stated emphatically that the Home Company has never had the remotest idea of raising local rates here, and even if it desired to do so, the franchise granted by the city would not permit any advance in rates.

WATERLOO, IND.—The Central Union Telephone Company is extending its toll line [illegible]. The company will probably take in the Farmers telephone line at Angola, as it is considered to belong to the Bell telephone syndicate. The extension of these lines will greatly improve the service of the Central Union in this section.

TERRE HAUTE, IND.—The report first given out to the effect that the Toledo and St. Louis syndicate, which secured control of the Indianapolis Telephone Company and the New Long-Distance Telephone Company, had also taken over the Citizens' Telephone Company of Terre Haute, is not true. On the contrary the Kinloch interests alone have secured the majority of the stock and the property has passed to their control. The capital stock will be increased to $375,000 and improvements costing $250,000 will be made. A special building for exchange purposes will be erected. The company was reorganized on Oct. 28. C. M. Foster, president of the Kinloch Company, of St. Louis, was elected president. W. P. [illegible], formerly president, was made vice-president and Roy McCann, secretary of the Kinloch, was made secretary-treasurer of the Terre Haute Company.

MUSKOGEE, I. T.—The Pioneer Telephone and Telegraph Company, with headquarters in Muskogee, has added another [illegible] to the number it owns and controls in the two territories. This is the South McAlester exchange, which also includes the exchanges in the [illegible] mining [illegible] of that district. The Pioneer Company has purchased [illegible] telephone exchanges and toll lines in the two territories and is rapidly absorbing what is left and merging them into the big company.

LONG GROVE, IA.—The Long Grove Mutual Telephone Company has been formed, with a capital of $[illegible], by R. K. Brownlie, president, and Dr. G. B. Maxwell, secretary and treasurer.

ESTHERVILLE, IA.—The Western Electric Company is to build a line to [illegible].

BURLINGTON, IA.—Great interest has been aroused here by the fight between Mayor [illegible] and the members of the City Council on a proposition to permit the Iowa Telephone Company to put its wires underground. The company's franchise ran out last year and the Mayor contends that the Iowa Telephone had no legal existence in Burlington, and that the city could not legally grant it anything. The company claims that its franchises is practically a perpetual one.

ROCKFORD, ILL.—The Winnebago County Telephone Company has completed the [illegible] of its line here. Cables have been put in to do away with some of the [illegible] wires and all the latest improvements made.

SHEPHERD, MICH.—The Union Telephone Company is extending its lines. Orders are coming in for extensions and for new telephones faster than they can be filled.

BRAINERD, MINN.—The Morrison County Telephone Company will build a line to St. Wendell.

SLEEPY EYE, MINN.—The Sleepy Eye Telephone Company is extending its rural lines in various directions.

FORSYTHE, MONT.—The Forsythe Telephone Company has been formed. The capital is $50,000. The incorporators are: J. E. Edwards, C. H. Blair and others.

PLEASANT HILL, MO.—The Pleasant Hill Hotel, Light and Water Company, of Pleasant Hill, has been incorporated with a capital stock of $40,000, all paid. The incorporators are John Holloway, J. F. Wilson, Ben D. Stephens, Edwin Foote, J. M. Elliot, Wm. H. Allen and others.

ST. LOUIS, MO.—The State Board of Equalization has made a large reduction in the assessed valuation of the properties of the Bell and Kinloch telephone companies this year, as compared with the levy in 1904. In 1904 the valuation of the property of the Bell Telephone Company, as returned by the board, was $1,241,162.26; in 1905, the valuation is $654,780.26, a reduction of nearly 50 per cent. The Kinloch's assessment in 1904 was $700,000 and in 1905 it is $584,850.

ST. LOUIS, MO.—The Missouri & Kansas Telephone Company showed a gain of nearly 14 per cent in the number of subscribers during the first six months of the present year. On January 1, 1905, the company had a total of 35,570 subscribers. On July 1 the number had increased to 38,606. In figuring the actual gain, however, there should be added to the 38,606 subscribers as of July 1, 2,896 subscribers, who were transferred to the Pioneer Telephone Company at the time the Missouri & Kansas sold its Oklahoma and Indian Territory field to that company. The total increase would, therefore, be 5,932 subscribers in six months.

YERINGTON, NEV.—The Yerington Electric Company will extend its telephone line from Yerington south at an early date. The line will be run up to Plummers and Modryke and then on to Smith Valley. Eventually it will be continued to Pine Grove and Rockland, and probably to Dayton. From Smith Valley the company operating in that place will build to Bodie, Bridgeport and Aurora, and the line from Bodie to Hawthorne will be connected with the line from Sodaville to Tonopah.

TONOPAH, NEV.—The Southern Nevada Consolidated Telephone & Telegraph Company will erect a new exchange in Goldfield.

PERTH AMBOY, N. J.—The Perth Amboy city government has just signed a contract with the New York and New Jersey Telephone Company for a private telephone line from Perth Amboy to the City Pumping Station, at Runyon, the distance being 8 miles. There were two bidders for this work—the Hudson & Middlesex Telephone Company and the New York and New Jersey Telephone Company. The Hudson & Middlesex Company, however, were unable to fulfill their bid, owing to their inability to obtain right of way to set poles from Perth Amboy to Runyon. The New York & New Jersey Company was able to obtain the necessary right of way, and is now setting the poles.

GOUVERNEUR, N. Y.—The proposition to issue $25,000 bonds for a municipal telephone system is to be submitted to a vote.

UNDERWOOD, N. D.—A franchise has been granted the Missouri Valley Telephone Company.

GRANVILLE, N. D.—The Northwestern Telephone Company has been granted right of way in Granville.

CARRINGTON, N. D.—The North Dakota Central Telephone Company has been incorporated with $50,000 capital stock.

NEW LEXINGTON, OHIO.—The Perry County Telephone Company is preparing to rebuild its plant at this place. The directors held a meeting here recently and decided to spend at least $8,000 on the new plant. All the wires inside the corporation will be cabled. There will be over two miles of cable that will carry 400 single wires. The new exchange will be in the Weiland building.

FORT LAWN, S. C.—A company has been organized with L. A. Abernathy as president and M. Chapman, manager, to construct a local telephone system.

CUSTER, S. D.—The Eldorado Mutual Telephone Company has been formed with a capital of $[illegible]. It was incorporated by Wm. Nevin and T. V. [illegible].

RAPID CITY, S. D.—The Rapid Valley Telephone Company has been incorporated with a capital of $10,000.

BUTLER, S. D.—The Butler Telephone Company has been organized with a capital stock of $10,000, by L. C. Goodel, president, and N. E. Bjerke, secretary.

SHAMROCK, TEX.—The Walker Telephone Company, of Shamrock, has been incorporated with a capital of $10,000. The incorporators are J. E. Walker, Barnett Blossom and Rea Blossom.

PULASKI, TENN.—Much comment has been raised here by a called meeting of the Board of Mayor and Aldermen which concluded a contract with the Cumberland Telephone Company for the payment of $300 per year until February 11, 1910, for the exclusive franchise of the streets. The Board of Aldermen passed on second reading a bill to grant to the Long Distance Telephone Company a franchise along with the Cumberland. This was referred to a committee and it was resolved to hold an election to ascertain the sentiment of the people as to the granting of a new franchise. The proposition of the Cumberland company was submitted in private to the Aldermen, and at a private meeting was accepted, and was afterwards ratified at a formal public meeting of the Aldermen.

LITTLETOWN, VA.—The Union Telephone Company has completed its organization, the officers being: President, L. Delbrugge, and secretary, Chas. Stumm.

CHEHALIS, WASH.—The Sunset Telephone Company will make extensive improvements to the local system here.

WALLA WALLA, WASH.—Mr. Charles E. Sumner has applied to the city council for a telephone franchise in this city.

DEEP RIVER, WASH.—The North Shore Telephone Company, of Deep River, has been incorporated. The capital stock is $1,500. The incorporators are W. N. Meserve, William Anderson, P. J. Boix and A. Olsen.

NELSON, WIS.—The farmers of this section have purchased the Dr. Asbury telephone line and will form a stock company and extend the line.

CUMBERLAND, WIS.—The Cumberland Telephone Company has changed hands. The service will be extended and improved.

NORTH MILWAUKEE, WIS.—A local telephone exchange is being built by the Wisconsin Telephone Company at North Milwaukee, like those at West Allis and Wauwatosa. There will be 100 subscribers at the start. No toll charge will be made to North Milwaukee as in the past. Persons within one and one-half miles will be given telephone rates the same as those in Milwaukee.

KENOSHA, WIS.—It is stated that the Wisconsin Telephone Company may retire from Kenosha within a short time and leave the field to an independent company. Negotiations are now pending between the officials of the Wisconsin Company and those of the Citizens' Company of this city for a consolidation of the two plants under a new holding company. The price of the combined plants is said to be $200,000. The deal will eliminate telephone competition in Kenosha and will give the holding company a business of more than 1,800 subscribers. It is understood that the company will continue the long distance service by the Wisconsin company's wires.

PORT ARTHUR, ONT.—The ratepayers have passed a by-law to expend $15,000 on improving the municipal telephone service.

MONTREAL, QUE.—The Canadian Pacific Railway Company has strung 3,000 miles of telegraph wire during the present year, half of which was copper.

LAS CRUCES, N. M.—A permit to do business in Texas has been granted the Texas and New Mexico Telephone Company of Las Cruces, N. M., having a capital stock of $15,000 and principal Texas office with the Southwestern Telegraph & Telephone Company, at El Paso.

Electric Light and Power.

SPRINGDALE, ARK.—Spencer Owen has secured the franchise for constructing an electric light plant.

LOS ANGELES, CAL.—The City Council has approved a contract with the Los Angeles Gas and Electric Company for lighting the streets of this city for the next three years at a cost of $75.00 a year for each light. The present price is $81.

RANDSBURG, CAL.—The Kern Rand Company, recently incorporated in Arizona, and with offices at Los Angeles, Cal., is planning the erection of a power house on the south fork of the Kern River, and the construction of an electrical transmission line to Randsburg.

MERCED, CAL.—The Merced Falls Gas & Electric Company has purchased 80 acres of land in Mariposa County, on which a power plant of 5,000 horse-power capacity will be built. From this plant power will be transmitted to Merced and vicinity over a line about 70 miles long.

LOS ANGELES, CAL.—A corporation is being formed for the purpose of erecting a large power plant. The company will build dams and lay pipes for the distribution of 7,500 inches of water to certain points. The plant is to be constructed at Victor Narrows, and will develop 15,000 horse-power.

MOUNTAIN VIEW, CAL.—A committee consisting of W. A. Clark, D. B. Frink and O. Becker has been appointed by the Board of Trade to take preliminary steps looking to the establishment of a municipal light and power plant at this place. Power is at present supplied by the United Gas & Electric Company, of San Jose.

SAN ANDREAS, CAL.—The Supervisors have accepted the bid of the Sierra Nevada Water & Power Company for a 50-year franchise, to establish electric pole lines and conduits over the county. The company is constructing a dam near Railroad Flat, which is to impound the waters of two rivers. Work here is under the personal supervision of C. Martel, the president of the company.

GILROY, CAL.—Engineer Thirber, of San Jose, who was employed by the City Council to furnish an estimate of the cost of an electric lighting plant, has submitted an estimate calling for $14,500. This is somewhat in excess of the funds available, but the council has decided to advertise for bids for the construction of the plant according to specifications and for the material needed for transmission lines.

RED BLUFF, CAL.—Geo. W. Bush, of Redding, has filed claims on [illegible] miner's inches of water in Battle Creek below the mouth of Baldwin Creek for the purpose of generating electric power. Water is to be conducted in a canal 25 ft. wide and 6 ft. deep, and in wooden pipes 10 ft. in diameter, for a distance of six miles on the north side of Battle Creek to the vicinity of Horseshoe Bend.

CALISTOGA, CAL.—The Calistoga Electric Light & Power Company has filed articles of incorporation and proposes to establish an electric lighting and power plant that will supply all of its needs and those of the big wineries in this vicinity. The articles also provide for the establishment of a gas plant. The capital of the company is $20,000. The directors are G. W. Cutler, E. L. Armstrong and Mrs. Edna Brown, of Calistoga, and District Attorney Raymond Benjamin, of Napa.

VISALIA, CAL.—The Commissioner of the U. S. Land Office has affirmed the decision of the register and receiver of the Visalia office in the case of A. G. Wishon, protestant and adverse claimant, against the Globe Light & Power Company, the applicant for a power site, transmission line, conduit, etc., in favor of the defendant power company. The action was brought by Wishon to prevent the Globe Light & Power Company from securing a permit to build a power plant above Springville, the application of Wishon for the same site having previously been rejected, and that of the Globe Light & Power Company approved.

SAN FRANCISCO, CAL.—The Sierra Nevada Water & Power Company's deed of trust has been recorded whereby it mortgages to the Union Trust Company, of San Francisco, all of its property, including water rights, franchises, etc., in Calaveras County and elsewhere in California. The Union Trust Company has guaranteed the payment of the Water & Power Company's 20-year 5 per cent bonds, issued last month, to the amount of $3,000,000.

SAN FRANCISCO, CAL.—The Oro Water, Light & Power Company, J. W. Goodwin, president, has closed a contract with the General Electric Company for two 1,000-kw., 3-phase generators for its electric power plant which is to transmit current 16 miles to Oroville, Cal. The Schaw-Batcher Company has secured the contract for 6,000 ft. of steel pipe line from 44 ins. down to 30 ins. in diameter. Each unit will consist of two water wheels, one at each end of a shaft with the generator at the center, so that either one or two wheels can be used for driving. Cory, Meredith & Allen are engineers for the company.

SAN FRANCISCO, CAL.—The management of the Platt Iron Works Pacific Coast district agency has received reports of very successful tests of the new water wheel now in operation at the Seattle-Tacoma Power Company's plant at Snoqualmie Falls, Wash. The Type B. Victor turbine wheel direct connected to a Westinghouse 5,000-kw, 3-phase generator tested at full gate developed 8,000 kw at the switchboard. This makes the capacity of the wheel 11,200 hp when operated at 300 r.p.m. under a head of 270 ft. of water. This increase of capacity will be of much benefit to the company's service in the Puget Sound cities.

SAN FRANCISCO, CAL.—The consummation of the deal by which the Pacific Gas & Electric Company is to take over the California Gas & Electric Corporation and the San Francisco Gas & Electric Company is now assured, as 105,656 shares, the requisite two-thirds of the issued stock of the latter company, has been placed in escrow with the Union Trust Company. The minority stockholders will have until Nov. 15 to sign the agreement and take their $25 per share in cash and $65 per share in 5 per cent 30-year general mortgage and collateral trust gold bonds of the new company. An official says that the change of management of the San Francisco Gas & Electric Company will take place Jan. 1, 1906.

GUILFORD, CONN.—Preliminary operations have been inaugurated for an electric light circuit to Madison for which an independent power house will be erected in the near future, the location of which is not definitely decided upon.

HARTFORD, CONN.—The entire electrical system of the city is about to be changed over from direct to alternating current, and all the power will be supplied from the new station at Black Rock. The company has gradually been changing over the system until now only the central section of the city is operated from the steam station in Chestnut Street. When the entire system is changed it will mean the abandonment of the Chestnut Street power station as a source of supply.

NEW HAVEN, CONN.—The committee on public lighting adopted a resolution to be presented to the Board of Aldermen that the committee be instructed to confer with the United Illuminating Company, which has been furnishing the lights, and obtain terms for the renewal of the existing contract for electric arc street lights, expiring December 31. The resolution also instructed the committee to hold a public hearing in the matter and report for the consideration of the Board of Aldermen a draft of the contract between the city and the United Illuminating Company.

ZIONSVILLE, IND.—The Zionsville Lumber Company has decided to construct an electric light plant.

GENEVA, IND.—W. R. Thurston, of Bern, who recently secured a franchise to construct an electric light plant in Geneva, has decided to organize a stock company.

BURT, IA.—The citizens of this city have voted for an electric light plant and a water works system.

HAMILTON, MD.—The Hamilton Water, Light & Power Company has been incorporated with a capital of $35,000 to supply water and light to Hamilton and Lauraville.

FALL RIVER, MASS.—The Fall River Electric Light Company is preparing plans for a power station to be located on the easterly shore of Taunton River. Harry Bottomley is superintendent.

WORCESTER, MASS.—The new 105-kw. generator for the power laboratory at the Worcester Polytechnic Institute has been received from the Westinghouse Company. It is for direct connection to the 175-hp. Westinghouse engine, which is now being set up. This unit is the first to be installed for the new service plant at the Institute.

EVANSVILLE, IND.—The Evansville Gas & Electric Light Company has made contracts with interurban lines entering Evansville to furnish all necessary power. The company will expend about $150,000 on improvements to its power plant.

GRAND RAPIDS, MICH.—The Board of Public Works has awarded the contract for the equipment for the new municipal lighting plant to the Fort Wayne Electric Works, of Fort Wayne, Ind. The contract provides for a 105-kw generator and a 14 x 15 Skinner engine. The price for the two is $3,554.

LAKE LINDEN, MICH.—The Calumet & Hecla Copper Mining Company is building a power plant here of 10,000-hp capacity. A transformer house is being built at Calumet. Power for the mines, shops and waterworks will be distributed from this transformer house, to which power will be delivered at high voltage.

DILLON, MONT.—The Dillon Electric Light & Power Company has begun the reconstruction of its entire system in this city. The steam plant is to be improved at a cost of $6,000 and the transmission line between the plant and the city, which now consists of No. 8 copper wire, is to be replaced by No. 4 copper wire.

FREMONT, NEB.—It is proposed to install three new boilers and make other improvements at the municipal electric light plant.

KEARNEY, NEB.—Col. F. W. Blees has disposed of his stock in the Northeastern Electric Heat & Power Company and retired from the business November 1. The new owners of the company are gentlemen who are largely interested in like enterprises in various places and are thoroughly experienced and have ample capital. The name of the company remains the same. William E. McCully, of Macon, Mo., is secretary, treasurer and general manager of the company. He will spend about half of his time in this city, notwithstanding his extensive interests elsewhere. He is secretary, treasurer and general manager of the following corporations: Macon Gas and Electric Light Company; Marshall (Mo.) Electric Light and Power Company; Palmyra (Mo.) Light and Water Company. The new president of the company is Thomas E. Wardell and the vice-president is Fred H. Tedford. The resident manager will be S. J. Duncan. L. E. Watson, who has been manager of the plant under the ownership of Col. Blees, has accepted the position of manager of the Beatrice (Neb.) electric plant.

GOLDFIELD, NEV.—The California-Nevada Mining, Milling & Power Company is said to have secured all the water rights along Pine Creek in Inyo County, Cal., and will erect an electric power plant near Alvord, Cal., from which point a transmission line will be constructed to the Bullfrog mining district at a cost of about $150,000.

ROANOKE RAPIDS, N. C.—Engineers are now preparing plans for the power house and electrical installation of the Roanoke Rapids Power Company. It is proposed to construct a dam across Roanoke River at this point, which for the first development will give the company about 9,500 horsepower. Later it is proposed to raise the dam so as to give about 25,000 horse-power for 11½ hours per day. C. P. E. Burgwyn, Richmond, Va., is the engineer in charge.

FARGO, N. D.—The gas and electric light plant at Fargo has been sold by Mainland Bros., to New York capitalists.

OYSTER BAY, N. Y.—After a fight that has lasted for years, the Nassau Electric Light and Power Company has absorbed the Oyster Bay Light and Power Company. Interested in the Nassau Company are Edwin D. Morgan, Clarence H. Mackay, Percy Chubb and other well-known men. The Oyster Bay company made a hard fight to keep the Nassau Company out of its territory, but at last had to succumb. The struggle between the rival companies was accompanied by many lively incidents. The Nassau people would start in to put up poles at night, but the local managers were always on the watch, and lawyers were sometimes routed out of bed at midnight to give an opinion as to the legality of the Nassau company's action. Men were sent out by the local company to chop down poles when it was thought they had been erected in violation of the law, and in some cases men employed by the Nassau company climbed to the tops of the objectionable poles and stayed there, defying their opponents to cut down the poles.

JUNCTION CITY, ORE.—J. N. Fellener is preparing to erect an electric light plant at this place.

SALEM, ORE.—The Calbe Cove Power Company, of Sumpter, has filed articles of incorporation, with $100,000 capital. O. C. Wright, T. C. Gray and E. Ray Jones are the incorporators.

JUNCTION CITY, ORE.—The Gilmore Water-Power Company has been incorporated here by S. P. Gilmore, Emma Gilmore and Eliza Gilmore for the purpose of establishing water works for irrigation and other purposes.

JAMESTOWN, OHIO.—The city council has granted a franchise to the Jamestown Electric Light Company, which has been lighting the streets without a franchise.

CLEVELAND, OHIO.—The city council of Cleveland has adopted resolutions to submit to referendum votes general franchises to two lighting, heating and power companies, to compete with the present company.

BAMBERG, S. C.—It was voted on October 24 to issue $15,000 bonds for the construction of an electric light plant. The Board of Public Works will have charge of the construction.

NASHVILLE, TENN.—The Chattanooga & Tennessee River Power Company has amended its charter by increasing its capital stock from $3,000,000 to $3,500,000.

WALLA WALLA, WASH.—The Northwestern Gas & Electric Company has decided to install a new power plant on the upper Walla Walla River.

BALLARD, WASH.—The entire plant and franchise of the Ballard Electric Company has been sold to the Seattle Electric Company, and it is stated that many improvements and additions will be made to the plant.

PORT WASHINGTON, WIS.—An ordinance was passed and approved on Oct. 23 providing for the construction of an electric light plant and water works. Wm. A. Tholan is city clerk.

PEMBROKE, ONT.—The Pembroke Electric Light Company will increase its capital stock from $50,000 to 150,000, and will enlarge its plant.

The Electric Railway.

LITTLE ROCK, ARK.—Arrangements have been completed for the financing of the Little Rock-Hot Springs interurban project and officials of the company declare that the actual work of construction will probably begin by Jan. 1.

PALO ALTO, CAL.—Arthur Crane has applied to the Town Trustees for a 35-year franchise for an electric railway through the principal streets.

SAN DIEGO, CAL.—Property recently purchased in the San Luis Rey section is said to have been secured in the interest of H. E. Huntington, who is desirous of obtaining control of the water power on the San Luis Rey River. Practically the entire right of way for the proposed railway from San Diego to Santa Ana has already been secured.

AVA, ILL.—St. Louis capitalists have organized a company to construct an electric railway from Carbondale to East St. Louis.

EAST ST. LOUIS, ILL.—The Electric Railway Express Company, of St. Louis, Mo., with a capital stock of $100,000, has been incorporated to do business in Illinois, with a capital stock of $50,000.

SPRINGFIELD, ILL.—The secretary of state has issued a license to incorporate the Decatur, Sullivan & Mattoon Transit Company. The principal office is to be at Mattoon. The capital stock is nominally $25,000. The incorporators and first board of directors are: R. J. M. Clokey and J. H. Culver, Decatur; George B. Spitzler, Mount Zion; John R. Hamilton and Edward C. Craig, Mattoon.

MARION, IND.—W. B. Dodds is promoting an electric railway between Marion and Union City.

SCOTTSBURG, IND.—The town board has granted a franchise to the Louisville & Indianapolis Traction Company for a right of way through the town.

ELLETSVILLE, IND.—The Northwestern Indiana Interurban & Street Railway Company has been incorporated with a capital of $10,000, by Franklin Knight and Edwin Knight.

FORT WAYNE, IND.—Complete service between this city and Lima, O., has been inaugurated by the Fort Wayne, Vanwert & Lima Traction Company. The line is 60 miles long. The power will be obtained from the power station of the Western Ohio Traction Company at St. Marys, Ohio, until the new Fort Wayne power station is completed.

INDIANAPOLIS, IND.—The officials of the Union Railway Company are letting contracts for the improvement work of the Union Station, which is to cost approximately $75,000. The contracts for the electrical work and the heating and lighting are the most important and expensive. The company expects to erect the heating and lighting plant in three months.

PERU, IND.—The franchise granted to the Winona-Peru Traction Company is so unsatisfactory that the company has declined to accept it. The company objects to the provision compelling the traction company to light and sprinkle the streets over the route of the line. The company has notified the council that unless a more liberal franchise is granted it will build its line either to Wabash or Logansport. The franchise has been referred back for further consideration.

CHICKASHA, I. T.—Application has been made to the City Council for a franchise for an electric street railway system. J. G. V. Redmon, W. T. Crosless, W. S. Jones and W. G. Shannon are named as the grantees.

OSAWATOMIE, KAN.—The City Council has passed an ordinance granting an electric railway franchise to W. H. Murphy, of Osawatomie.

TEXARKANA, KAN.—The Texarkana Electric Street Railway, owned and operated by the Texarkana Light and Traction Company, has gone into the hands of Col. E. J. Spencer, of St. Louis, as receiver, on an order issued by Judge Rogers of the United States District Court, at Fort Smith. The railway, it is said, has not paid any interest on the money invested during the last 18 months.

TOPEKA, KAN.—A charter has been granted to the Falls City, Sycamore Springs, Sabetha & Southwestern Railroad Company, capitalized at $100,000. The company proposes to build an electric railway from Sycamore Springs to Topeka. A line is also proposed to run in a westerly direction from Sycamore Springs to the west line of the state. The directors and incorporators are: Samuel Kimmel, E. S. Towle, W. H. Crook, W. E. Dorrington, Albert Maust, J. H. Miles and Edwin A. Towle, all of Falls City, Neb.; E. V. Kauffman and H. Reeding, of Sabetha; W. A. S. Bird, of Topeka; J. T. Slusher and Roy Hasseltine, of Sabetha; George Boone, Jr., of St. Joseph, Mo., and George L. Campen, of Lincoln, Neb.

BOSTON, MASS.—The Western Massachusetts Street Railroad Company has petitioned the Railroad Commissioners for the construction of its road. The company's capital stock is also $300,000.

BOSTON, MASS.—The Railroad Commission has approved the extension of the Boston Elevated Railway Company's tracks from the Mount Auburn district along the westerly shore of Fresh Pond and in Concord Avenue to Belmont.

BOSTON, MASS.—The Railroad Commissioners have given their approval to the lease of the railway franchise and property of the Springfield & Eastern Street Railway to the Springfield Street Railway Company, a corporation owned by the Consolidated Railways Company.

FREDERICK, MD.—The directors of the Washington, Frederick & Gettysburg Railway Company has organized by electing the following-named officers: President, D. Columbus Kemp; vice-presidents, D. C. Wine-Brener and Alexander Ramsburg; secretary, Charles C. Waters; treasurer, Dr. F. B. Smith; attorney, William H. Hinks.

BOSTON, MASS.—The Nahant & Lynn Street Railway Company has petitioned the Railroad Commissioners to issue $100,000 mortgage bonds to pay for the construction and equipping of its road. The company's capital stock is $100,000. It has no funded debt.

BATTLE CREEK, MICH.—The Battle Creek & Southeastern Railway Company has been incorporated, with a capital stock of $500,000 for the purpose of building a line of road from Coldwater to Battle Creek, a distance of about 30 miles, to be operated by any motive power other than steam engines. The general offices of the company are at Battle Creek, Mich., and the directors are William E. Ware and Edward F. Pangburn, of Battle Creek, and Howard H. Zigler, Martin E. Murphy and Charles E. Miles, of Columbus.

CARTERVILLE, MO.—At the annual meeting of the Southwest Missouri Electric Railway Company, held in Carterville, officers were re-elected as follows: President, A. H. Rogers; vice-president, Samuel Reynolds; secretary, E. Z. Wallower; treasurer, Charles Schifferdecker.

ST. LOUIS, MO.—The franchise of the St. Louis County Street Railway Company, which was granted in September, 1902, for a line out the Olive Street road to Creve Coeur Lake, was declared forfeited by the county court last week. The forfeiture releases $1000 which the company posted as a guarantee of good faith. This reverts to the county. Judge Henry Bond was president; George Autenreith, secretary, and John Dolan, treasurer of the company. An application of the St. Louis, Fern Ridge & Western Railway Company, which was filed several weeks ago, asking for permission to build along practically the same as the forfeited St. Louis County Railway Company's route is now pending before the court.

NEW YORK, N. Y.—The annual report of the American Light & Traction Company for the year ending Sept. 30 shows an increase in gross earnings of $166,000 and in profits of $165,000. The dividends paid during the year by the company involved $731,000, an increase of $97,000 over the previous year. The surplus was $496,936, an increase of $67,720.

BUFFALO, N. Y.—At the annual meeting of the International Traction Company, held recently, the following directors and officers were elected: Directors: Dewitt Cuyler, N. Robinson, T. E. Mitten, G. N. Boissevain, P. White, A. Robinson, H. J. Pierce, G. B. Schley and A. H. Payne. President, H. J. Pierce; vice-president, Nelson Robinson; secretary and treasurer, F. L. Slocum; auditor, E. Emmerich.

MARYSVILLE, OHIO.—Indications are now that the Columbus, Urbana and Western Electric Road, which is in the hands of the Schoepf syndicate, will be built through Union County.

CLEVELAND, OHIO.—The Northern Ohio Traction & Light Company has placed a contract with the General Electric Company for a 2,000-kw. Curtis turbine and for a 1,000-kw motor-generator set. A substation outfit will be installed in the present station at Bedford.

OKLAHOMA CITY, OKLA.—The Oklahoma Traction Company, of which C. V. Eggleston is president, has been granted a franchise by the City Council to build an interurban line from this city to Norman and thence to Shawnee.

PORTLAND, ORE.—The Portland Railway Company, which has taken over the properties of the Portland Consolidated Railway Company, has organized as follows: President and general manager, F. I. Fuller, Portland; vice-president, E. W. Clark, Philadelphia; secretary and assistant treasurer, G. L. Estabrook, Philadelphia; treasurer and assistant secretary, C. N. Huggins, Portland; assistant manager, F. S. Drake, Portland; superintendent of transportation, F. Cooper, Portland; purchasing agent, J. E. Coldwell.

YORK, PA.—A contract has just been closed between the York Haven Power Company and the Philadelphia, Lancaster & Harrisburg Railway by which the former will furnish power to operate the trolley line now being constructed between those cities.

ALTOONA, PA.—The Southern Traction Street Railway, incorporated in Pennsylvania last March with $250,000 capital stock to build an electric railway from Altoona to Roaring Springs, Pa., 18 miles, has made a mortgage to the Real Estate Title & Trust Company, of Altoona, trustee, to secure an issue of $500,000 6 per cent bonds, dated Sept. 15, 1905, and due 1915, but subject to call in 1910 at 103 at option of company. The officers are: President, F. G. Patterson; secretary and treasurer, F. J. Thompson.

EVERETT, WASH.—Surveys have been started on the proposed Everett & Eastern interurban railway.

ANACORTES, WASH.—E. G. English and others have applied for a franchise for an electric railway to Mt. Vernon.

WELLSBURG, W. VA.—The Wellsburg & Washington Electric Railway Company has been incorporated with a capital of $10,000, for the purpose of building an electric railway from Wellsboro, W. Va., to Washington, Pa. The incorporators are: H. G. Lasear, S. George, H. G. Emery and others.

MADISON, WIS.—The Milwaukee Northern Railroad Company has been organized; capital, $100,000. Incorporated by John E. Uselding, of Port Washington, and John M. Seamann, of Sheboygan. The company intends to build an interurban electric railway from Sheboygan to Milwaukee.

WAUKEGAN, WIS.—It is stated at Waukegan that the Chicago and Milwaukee Electric Railway Company has definitely decided to locate the new half-million dollar power plant at Waukegan, rather than at Kenosha. Work on the plant will not be started until early spring.

MANILA, P. I.—The first annual statement of the Manila Electric Railroad & Lighting Corporation for the year ending Sept. 1, 1905, is as follows: Net earnings, $273,580; interest charges, $123,028; surplus, $150,552. J. G. White & Company, who built and operate the plant, say in connection with this report that while it is an annual one, the earnings up to April 10 were only from the sale of current for power and lighting purposes, as it was not until that date that the street railway was opened to the public. There is still considerable work to do before the railway and lighting system will attain its maximum efficiency, and up to the present time the full mileage of the railway lines is not in operation.

LONDON, ONT.—The London Street Railway Company will expend a large sum in remodeling the system.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Street R. R. Co. has taken over the Winnipeg, Selkirk & Lake Winnipeg Street R. R., and will operate it by electricity. Address Wilford Phillips, manager.

New Industrial Companies.

THE CARTER AUTO-MAGNETIC ORE SEPARATOR COMPANY, of Union, N. J., has been incorporated with a capital of $50,000, by John W. Carter, John E. Winn and August A. Schlegel.

THE STANDARD VITRIFIED CONDUIT COMPANY, of New York, has been incorporated, with a capital stock of $1,000. The directors are W. T. Chapman, Jr., C. R. Ganter and E. H. Sykes, of New York.

THE HALL TELEPHONE MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $50,000. The incorporators are Richard B. Constantine, John P. Gillis and Edward J. Hall.

THE STATE LAND AND POWER COMPANY, of Milwaukee, Wis., has been incorporated with a capital stock of $25,000. The incorporators are Frederick H. Remington, John H. Hurley and Bernard C. Roloff.

THE ELECTRIC TIME SWITCH MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $100,000. The directors are: Renie L. Spiegel, Louis Spiegel and Adolph Fanto, of New York.

THE NEW AMSTERDAM MOTOR COMPANY, of Owego, N. Y., has been incorporated with a capital of $75,000. The directors are Charles Morgan, of South Orange, N. J., and E. F. Terry and Alfred Brotherhood, of New York.

THE FEDERAL ELECTRIC CONSTRUCTION COMPANY, at Brantford, Ont., has been incorporated, with a capital of $40,000 to manufacture meters, motors and all kinds of electrical machinery. Directors, G. H. Kilmer and W. H. Irving, Toronto.

THE NEW YORK DIE COMPANY, of Owego, N. Y., has been incorporated to conduct a business as mechanical and electrical engineers. The capital stock is $25,000. The directors are: L. J. Doolittle and H. W. Forsyth, of New York, and W. A. Babson, of South Orange, N. J.

THE MUNCIE AUTO PARTS COMPANY, of Muncie, Ind., has filed articles of incorporation. It is capitalized at $15,000. The object of the company is to manufacture and supply parts of automobiles, also electrical equipment. Hugh L. Warner, H. L. Hoke and C. P. Quale are the directors.

THE CAPITAL CITY ELECTRIC COMPANY, of Indianapolis, Ind., has filed articles of incorporation with the secretary of state. The capital stock is $5,000. The company proposes to manufacture, buy and sell electrical and steam appliances and machinery of all kinds. Wm. Phipps, L. D. Phipps and A. F. Eggers are directors.

THE NEW GLOBE ELECTRIC MANUFACTURING COMPANY, of Amsterdam, N. Y., has been incorporated to manufacture electrical apparatus. The directors are R. W. Brown, G. I. Herrick, J. E. Larrabee, W. C. Schaufler and Richard Murphy, of Amsterdam, and Eugene Moore and F. D. Oliver, of Johnstown. The capital stock is $250,000.

THE RAIL JOINT COMPANY, of Troy, N. Y., has been incorporated to manufacture rail joints and other railroad appliances. The capital is $100,000. The directors are: L. F. Braine, Percy Holbrook, New York; F. T. Fearry, East Orange, N. J.; G. G. Frelinghuysen, Morristown, N. J.; M. L. Ward, Newark, N. J.; C. P. Wheeler, Chicago, and E. Y. Webber, Stamford, Conn.

THE GRADOLPH-HAHNE ELECTRIC TRANSMISSION COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $10,000, fully paid. It will do a general electrical business, and build, equip and maintain electrical plants. The incorporators are W. F. Gradolph and W. C. Hahne, M. W. Wambaugh, F. D. Hager and H. McK. Wilson, E. R. Rombauer and M. K. Blake.

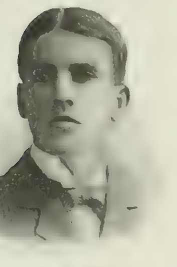
Legal.

TAX ON POLES.—By a recent decision, the Wisconsin Telephone Company is immune from any effect of an ordinance passed by the Milwaukee common council, which required a license fee of $1 for each of the company's poles set within the city limits on the city street. As the company had 6,900 poles, it meant a tax of $6,900. The company brought injunction proceedings to restrain the city from enforcing the ordinance and the city won in the lower court. The city answered the company's injunctional complaint, to this answer the company demurred and the demurrer was overruled. The company appealed from the order overruling the demurrer to the answer to the complaint. The opinion is written by Justice Kerwin. The question hinged upon whether the license was an exercise of police powers over the streets, or was an attempt to collect a tax for purposes of revenue. The company operates under a state franchise, and the court held that the license fee was so large as to be plainly for purposes of revenue rather than for police regulation, and therefore reversed the decision of the lower court.

Educational.

UNIVERSITY OF ILLINOIS.—An electrical engineering fraternity, known as Eta Kappa Nu, has been established at the University of Illinois. The qualifications, so far as they may be judged from the personnel of the membership, are evidently interested in the profession as shown by interest in the engineering societies of the University and by practical work in the field of engineering. Members have not been elected before the junior year. The emblem of the fraternity is a conventionalized Wheatstone bridge.

Personal.



A. P. PECK.

MR. A. P. PECK, who is well-known in the Middle West as a successful electrical engineer and salesman of electrical machinery, has joined the Allis-Chalmers Company and will hereafter be connected with the New York office of that company, giving attention particularly to the sale of power and electrical machinery. Mr. Peck is an associate member of the American Institute of Electrical Engineers. He is a native of Chicago. He was graduated from Purdue University in 1892, with the degrees of B.M.E. and E.E. Immediately upon being graduated he secured a place with the World's Columbian Exposition Company, and was identified with the electrical engineering department of the Chicago World's Fair, until January, 1894, as assistant engineer of arc lighting. From 1894 to 1896 he was with the Westinghouse Electric & Manufacturing Company. It was under his supervision during this time that the motors and wiring were installed in the cars of the Chicago City Railway Company. Mr. Peck began his career as a salesman in 1896, and in 1898 he became identified with the manufacture of electric signs, and was engaged in that business for three years thereafter. His next connection was with the engineering department of the Chicago Edison Company, selling power and lighting apparatus. About three years ago, he joined the National Electric Company as electrical sales agent and made Milwaukee his headquarters. His territory included northern Michigan, Wisconsin, Iowa and Missouri.

MR. J. P. MITCHELL has been appointed manager and superintendent of the Gallup Light and Power Company, Gallup, New Mexico.

MR. EUGENE KLAPP has resigned as chief engineer of the Brooklyn Rapid Transit Company to become associated with William Barclay Parsons. The new B. R. T. Chief Engineer is W. S. Menden.

MR. C. T. MALCOLMSON, electrical and mechanical engineer, is to be married at St. Louis, Mo., on Nov. 22 to Miss Margaret Ewing Wilkinson, daughter of Mr. and Mrs. John Cabell Wilkinson, of that city.

MR. CHARLES C. REMSEN, of the Sprague Electric Company, and Miss Mary Edna Fiske were married in St. Paul's Methodist Episcopal Church, Newark, N. J. Mr. and Mrs. Remsen have gone South on their wedding trip.

MR. OSCAR T. CROSBY'S fascinating book, "Tibet and Turkestan," has just been issued by G. P. Putnam's Sons, New York, and presents this well-known electrical engineer in his role of a brilliant and indefatigable explorer. The price is $2.50 net.

MR. JAMES R. CRAVATH, Western editor of the ELECTRICAL WORLD AND ENGINEER, lectured on "Illuminating Engineering" before the Chicago Architectural Club the evening of Oct. 30. The growing interest of architects in this subject is a hopeful feature of the work.

MR. W. E. DAVIS.—Advices from Sanford, Me., state that Mr. W. E. Davis, of Sanford, has been appointed electrical engineer of the Atlantic Shore Line Railway Company, and also the Alfred Light & Power Company, succeeding in the former position C. E. Sawyer, resigned. Mr. Davis still retains his connection with the Sanford Mill.

MR. ALFRED I. BRADDELL, the well-known electrical engineer and electrical inspector for the Underwriters' Association of the Middle Department, Philadelphia, has resigned that position and on December 1 will enter the conduit department of the Sprague Electric Company in New York City. Mr. Braddell has a large circle of acquaintances in metropolitan and other electrical circles.

PROF. H. S. CARHART, of the University of Michigan, [illegible] from [illegible] week by the [illegible]. After attending the meeting of the British Association for the Advancement of Science in South Africa, he [illegible] and participated in the conference on standards [illegible] at the [illegible]. He is [illegible] the work.

MR. H. D. ENDERISS has associated himself with Mr. [illegible], 12[illegible] Real Estate Trust Building, Philadelphia. The latter, it will be remembered, has for some time represented the Landis Electric Company, the Chase-Shawmut Company, and several other concerns in eastern Pennsylvania and surrounding States. The firm has [illegible] added the Keystone Electrical Instrument Company.

MR. ALEX. P. BROWNE, [illegible] State Street, Boston, Mass., has associated Mr. George K. Woodworth with him in the practice of patent law, to which Mr. Browne has devoted his attention for thirty years. Mr. Woodworth, who is an E. E. and M. E. of Cornell, has had experience for six years past as an examiner in the U. S. Patent Office, including more than four years in the electrical division. He will give special attention to the electrical work of the firm.

MR. C. W. KELLOGG.—Mr. C. W. Kellogg, who has had charge of the Brockton plant of the Edison Electric Illuminating Company, succeeding Mr. Preston Player, who was promoted [illegible] months ago to the Blue Hill station, has been notified that Stone & Webster propose to transfer him to their plant in El Paso, Tex. There he will have charge of the station which furnishes light for the city, and power for the trolley lines. Mr. A. F. Nelson will succeed him in charge, and the Brockton and Lowell plants will be combined, it is said, under the district management of Mr. N. T. Wilcox, of Lowell.

MR. C. H. HADDRELL, since the incorporation of the Barriett Electric Manufacturing Company, of Cincinnati, in July, 1905, has been general manager and chief engineer of that company, and has been engaged in the design of a line of variable-speed motors for machine tool work, and improving the constant-speed motors. Mr. Haddrell started on his engineering career with the New Zealand Government and was for a number of years in the State Locomotive Engineer's office, engaged in design and general engineering work; then he went to London and studied electricity under Prof. S. P. Thompson. In 1900 he became inspector in the works of Siemens Bros., and a year later joined the staff of the Johnson-Lundell Electric Traction Company, and was engaged in dynamo design and in traction work. In the latter part of 1902 he came to the United States and was employed in the mechanical engineering department of the Westinghouse Electric & Manufacturing Company, upon some of the largest machines. In 1904, he was engaged by the Bullock Electric Company as senior draftsman for alternating-current machines. He is an associate of the Institution of Electrical Engineers of Great Britain.

Trade Publications.

TEST OF STEAM TURBINE.—The General Electric Company, Schenectady, N. Y., has issued a pamphlet describing a test of a 2,000-kilowatt Curtis steam turbine, which was made by Sargent & Lundy on May 3, 1905.

MOTOR-DRIVEN LAUNDERER.—The latest issue of the *Pigeon Hole* describes an interesting application of the electric motor in the form of a laundry extractor direct-connected to a direct-current motor made by the Peerless Electric Company, Warren, Ohio.

MERCURY-ARC RECTIFIERS.—The paper descriptive of the General Electric mercury arc rectifiers, which was read by Mr. P. D. Wagoner before the National Electric Light Association at the recent Denver-Colorado Springs convention, has been reprinted as publication No. 3341 by the General Electric Company, Schenectady, N. Y.

BELT-DRIVEN ALTERNATORS.—Bulletin No. 358 of the National Electric Company, Milwaukee, Wis., gives a complete discussion of the constructional features of revolving-field type belt-driven alternating-current generators. These machines are built for one, two or three phases, in capacities ranging from 32.5 kw to 750 kw.

LIGHTING SPECIALTIES.—The Yost Electric Manufacturing Company, Toledo, Ohio, has issued illustrated leaflets dealing with "Fiberite" shades, double "Falcon" wrenches for fixture work and "Electrogrip" for attaching electric lamps to desks, benches, machines, etc. This device will fit any socket. It is made of spring steel wire and the jaws are covered with rubber.

M. TOWNSLEY & SONS, of 1082 Seventeenth Street, Minneapolis, issue a small pamphlet with regard to their copper cable lightning rod, in connection with the utilization of which they have a neat little thunderstorm apparatus to illustrate how the lightning stroke can be averted. Their product consists of a very heavy cable made of pure copper, which is handled through the hardware trade.

PARTY-LINE SYSTEMS.—The Dean Electric Company, Elyria, Ohio, has issued as bulletin No. 100 an article by W. W. Dean on "Harmonic Party-Line Systems," which first appeared in the *American Telephone Journal*. The bulletin is well illustrated, numerous views being given of commercial party-line systems. In addition to the matter contained in the article there is given a complete description of the Dean harmonic party-line system.

FLY-WHEEL EXPLOSIONS.—The Fidelity and Casualty Company, 97 Cedar St., New York, has issued as a supplement to its MONTHLY BULLETIN for August, 1905, a reprint of an article on "Fly-Wheel Explosions" by Mr. Wm. H. B[illegible], which appeared in the June number of *Insurance Engineering*. Formulas are developed for determining the stress in fly-wheel rims, and a table is given for showing the safe working speed of cast-iron flywheels.

HYDRAULIC ACCUMULATORS.—Under this title the Watson-Stillman Company, New York, has issued a pamphlet describing and illustrating a variety of hydraulic accumulators manufactured by it. These machines absorb [illegible] less than the momentary demand of the machine, and deliver it when the demand is above the normal. The different types of machines are [illegible] and with each illustration is given a table of dimensions, [illegible]. Some general hydraulic engineering information is [illegible].

YALE & TOWNE MANUFACTURING COMPANY, 9 Murray Street, New York City, [illegible] a handsome pamphlet—coarse brown paper embossed [illegible] illustrated [illegible] pages devoted to their portable electric hoists [illegible] service for 110 and 220-volt [illegible]rd, and for other voltages to order. The motor-driven trolley [illegible] flange of I-beam track, and is a very useful [illegible] around the mill or factory. It is also built to travel [illegible] track. The illustrations of the devices are clear, in perspective and diagram.

ELECTRICAL INSTRUMENTS.—The Keystone Electrical Instrument Company, Philadelphia, Pa., has just issued catalogue No. XIII, dealing with direct-current measuring instruments. These instruments are constructed on the principle of the Deprez-d'Arsonval galvanometer. They are equipped with permanent magnets having soft-steel pole pieces between which moves a light coil which carries the current to be measured. The catalogue is well illustrated, numerous views being given of the internal mechanism of the instruments. The company has also issued a pamphlet on the patent situation with reference to electrical instruments, in which it states that it has successfully defended every suit brought to final hearing against it, and that no court has, at final hearing, ever decreed any Keystone instrument to be an infringement of any patent.

HOLOPHANE DATA.—The Holophane Glass Company, sales department, 227 Fulton Street, New York, has just sent out a new loose-leaf publication entitled "Engineering Data and Catalog of the Holophane System of Illumination, comprising Holophane Globes and Holophane Pagoda Reflectors," upon which a great amount of thought and money has been expended. It contains not only the usual material that goes into a catalogue of globes and reflectors, but gives in addition the photometric curves, showing the distribution of light with nearly all the various types of Holophane globes and Pagoda reflectors. These data are of the greatest value to the illuminating engineer in planning installations using Holophane material. In fact, it is necessary that he should have such information before he can plan intelligently, although in the past in many cases it has not been obtainable. The tests shown were all made by the Electrical Testing Laboratories of New York, and hence are from an entirely unbiased source, and furthermore a source that is splendidly equipped, both by apparatus and experience to make such tests. The catalogue is handsomely bound in a morocco leather cover, pocket size, and being on the loose-leaf system, additional leaves can be added from time to time and obsolete ones discarded. The company has spent a large amount of money in getting up the catalogue in this form and in having tests made in the belief that by placing exact engineering information of this kind before possible customers its interest can be furthered better than in any other way.

News of the Trade.

GILLINDER & SONS, INC., 135 Oxford Street, Philadelphia, are pushing their "Q" arc light globes which are of medium weight and well adapted for their purpose.

AMERICAN ELECTRIC SIGN COMPANY, 133 Summer Street, Boston, Mass., has just removed to 44 High Street, and will have larger facilities there for the production of its specialties.

WETTENGEL BROS., 6122 Kirkwood Street, Pittsburg, Pa., have entered the electric lighting and supply business and would be pleased to receive catalogues, price lists and discount sheets of electric lighting and wiring materials.

ELECTRIC HEATERS.—The American Electrical Heater Company, of Detroit, has removed its New York headquarter offices and salesrooms from 35 Dey Street to 7 and 9 Warren Street, where Mr. B. H. Scranton, the president, directs operations personally.

THE WILLIAMS GAUGE COMPANY has opened an office at 311 Hennen Building, New Orleans, La. It is conducted by Mr. Charles L. Smith. Any inquiries for the Williams feed water regulator, steam trap and pump governor directed to Mr. Smith will receive his prompt and careful attention.

HIGH VOLTAGE POWER APPARATUS.—The Gregory Electric Company is offering a large lot of high voltage-power transmission apparatus at attractive prices. It has just dismantled the entire plant of the Navaho Gold Mining Company, Bland, New Mexico. The plant consisted of 17,000 volt transmission equipment, including the step up transformers, and all the supplies and motors going with the same.

THE NATIONAL ELECTRIC COMPANY, of Milwaukee, manufacturer of Christensen air brakes, air compressors and electrical machinery, has opened a Cleveland office at 410 Electric Building, in charge of Mr. George S. Hastings, who will handle the complete line throughout Ohio, Indiana, Michigan, West Virginia and New York as far east as Schenectady, and electrical machinery only in Pennsylvania as far east as Johnstown.

THE ELECTRO DYNAMIC COMPANY, of New York, is preparing an interesting exhibit for the New York Electrical Show, to be held Dec. 12 to 23. One of the features of this exhibit will be an Inter-Pole motor driving another as a generator, the current to be used in the electric illumination of their booth. Another feature of the exhibit will consist in a display of the different sizes of frames showing how small and light the Inter-Pole motor is in proportion to its power. The ball bearings, which add so much to the efficiency of this type of motor will be another feature of the exhibit. This exhibit will also include demonstrations of the Moloney transformers, to show very high efficiency and low iron and idle load loss.

THE WILLIAMS GAUGE COMPANY has reported the sale, within the last six months, of 520,000-hp safety feed water regulators. Among the purchasers are the Philadelphia Rapid Transit Company, Illinois Central Railroad, New York Central and Hudson River Railroad, Delaware & Hudson Company, the Erie Railroad, Proctor & Gamble, Carnegie Steel Company, American Steel & Wire Company, etc. The demand for this regulator is increasing. The claims made for it by the company are that it will effect a fuel economy of from 4 to 12 per cent, a guaranteed assurance of dry steam constantly, and increased boiler efficiency. It is used on about 3,500,000 hp in the largest plants in the country, and has been on the market for upwards of seven years. This company also manufactures a steam operated trap, which it claims is the only trap with a valve which gives a full pipe opening instantly.

CORRECTIONS.—Due to an error by the printer in placing the type for pages 692 and 694 of our issue for October 21, three lines which should have appeared at the bottom of the second column on page 692 were transposed to the bottom of the second column on page 694. What should have been the second line of the sixth paragraph on page 694 was lifted out entirely. The first sentence of this paragraph should read as follows: "The controlling switch employed for this type of motor effects various combinations of the field and armature circuits of the separate motors, and of both motors, in series and parallel across the battery." As our readers are probably aware, under the modern system of machine typsetting, a correction anywhere in a line involves the removal of the whole line; and careless men in the printing office in changing the lines, after the editors have read the galley or page proofs, sometimes play all kinds of funny and exasperating tricks with the lines of type, which they omit or insert in wrong places.

NATIONAL METER COMPANY.—The exhibit of the National Meter Company, of 84 Chambers Street, New York, at the Madison Square Garden electrical show, to be held from Dec. 12 to 23, will be principally devoted to the exploitation of the uses of its gas engines for operating on producer gas or gasoline. The main exhibit for this purpose will consist of a 50-hp multiple-cylinder, direct-connected Nash gas engine of the self-oiling enclosed type, direct-connected to a 30-kw C & C generator. This engine will supply current to 560 16-cp electric lamps, of which the signs for this company's space will be composed. The practical purpose of this exhibit is to demonstrate to electrical and construction engineers particularly the value of devices of this character in carrying late night or peak loads while operating on producer gas. This engine insures a very close regulation of the lights—as constant, so the company states, as central station lighting, even under variable loads. That this equipment may be economically operated is indicated by a plant in St. Joseph, Mich., which is furnishing 125 arc lamps, extending over 4½ miles of streets, at the rate of one horse-power per hour for less than a pound of coal.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 31, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

802,993. TROLLEY WHEEL BEARING; Robert Kissinger, Columbus, O. App. filed Mar. 27, 1905. The trolley wheel has a split bushing, the parts of which are spring pressed apart so as to bear constantly against the trolley wheel and make efficient contact therewith.

802,994. TERMINAL CONNECTOR FOR ELECTRIC CONDUCTORS; John H. Kliegl and Anton T. Kliegl, New York, N. Y. App. filed Dec. 8, 1904. A terminal for insulated conductors formed of a T-shaped metal plate of which the wings are bent together in a die press so as to envelope and contact with the conductor.

802,999. FUSE BLOCK OR CUT-OUT; Harry W. Lawrence, Denver, Colo. App. filed Apr. 30, 1904. A porcelain or other insulating box having a central partition and a cover which is capable of an interlocking engagement with the box. The sides of the box are cut away to permit ready access and the cover has projecting wings to close such cut-away portions when it is in position.

803,010. INSULATOR; Elmer P. Morris, East Orange, N. J. App. filed June 6, 1904. A method of supporting high potential wires so as to avoid crippling the system when the wooden supporting arms burn off and allow wires to fall. Ribbed insulating plates are provided upon which the wires may rest under these circumstances.

803,020. CONTROLLER FOR ELECTRIC CARS; Francis A. Roche and Francis J. Roche, Somerville, Mass. App. filed Mar. 15, 1905. A construction of controller which shall prevent a too rapid initial movement of the handle, but which shall permit back and forth intermediate movements freely. Steel balls are contained in an annular recess which co-operate with lugs to produce the desired effect.

803,107. TRANSMISSION OF ELECTRIC CURRENTS; Isidor Kitsee, Philadelphia, Pa. App. filed May 20, 1904.

803,108. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed June 24, 1904.

803,109. TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY; Isidor Kitsee, Philadelphia, Pa. App. filed Sept. 17, 1904.

803,110. TRANSMISSION OF ELECTRIC CURRENTS; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 28, 1904.

803,111. TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY; Isidor Kitsee, Philadelphia, Pa. App. filed Mar. 8, 1905.

803,112. TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY; Isidor Kitsee, Philadelphia, Pa. App. filed April 10, 1905.

[illegible] CONDUIT SECTION FOR MANHOLE TERMINALS; Robert W. Lyle, New York, N. Y. App. filed Jan. 13, 1905. A terminal for telephone conduits having a pair of hopper-shaped boxes which are designed to be embedded in the masonry of the manhole.

[illegible] ELECTRIC SWITCH; John J. Ruddick, Newton, Mass. App. filed Nov. 27, 1903. At the entrance to a block section a box is placed on the trolley wire which has a pair of tappets or contactors extending into proximity with the trolley wheel. These are effective to step around a pair of ratchet wheels for making the signal circuit.

803,147. ELECTRIC FURNACE; Edwin Appleby, Chicago, Ill. App. filed January 28, 1905.

803,180. MEANS FOR PRODUCING HIGH POTENTIAL ELECTRICAL DISCHARGES; Oliver Joseph Lodge, Birmingham, England. App. filed Oct. 10, 1904. (See Current News and Notes).

803,190. SPACE TELEPHONY; John Stone Stone, Cambridge, Mass. App. filed June 29, 1905. (See page 825.)

803,208. TROLLEY CATCHER; Warren W. Annable, Grand Rapids, Mich. App. filed Mar. 31, 1905. A retrieving apparatus for trolleys involving a sliding carriage upon the trolley pole. The cord makes a turn around this carriage which in the case of a quick movement binds upon the trolley pole and prevents the latter from rising.

803,209. CONTROL SYSTEM FOR ELECTRIC MOTORS; Ralph E. Bates, Wilkinsburg, Pa. App. filed Feb. 1, 1905. A system for steering boats involving a series of segments with which an arm upon the rudder contacts, and a steering wheel, also having segments which make contacts to operate an electric motor until a follower arm has come into a position corresponding to the rudder of the boat.

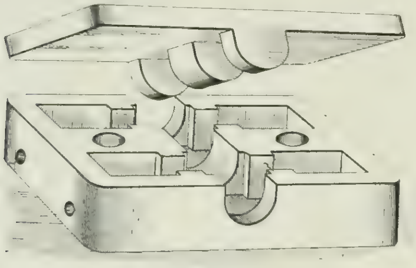
803,210. TROLLEY RETRIEVING DEVICE; Henry B. Clarke, Chicago, Ill. App. filed Jan. 16, 1905. A trolley retriever in which the rope passes over a pivoted arm which controls an air valve. A suddent movement admits air against a diaphragm which releases a spring drum to retrieve the trolley.

803,212. SWITCH FOR ELECTRIC CIRCUITS; Frank Conrad, Edgewood Park and Arthur B. Reynders, Wilkinsburg, Pa. App. filed Nov. 21, 1903. A switch for heavy currents in which the final movement of the knife blade lever engages a cam surface which expands the knife blade endwise into wedging contact with the terminal plates.

803,213. ALTERNATING-CURRENT SYSTEM OF CONTROL; Frank Conrad, Edgewood Park, Pa. App. filed Apr. 3, 1905. A system for equalizing the potential on alternating-current railway motors involving a couple of regulator motors and an intermediate transformer. When a difference of potential occurs the transformer becomes effective to assist one regulator and oppose the other, so that their speed varies and equalizes the potential of the main motors.

803,214. CONTROLLING SYSTEM FOR RAILWAY VEHICLES AND TRAINS; John L. Crouse, New York, N. Y. App. filed Jan. 22, 1903. A system for operating the emergency brakes in case a motorman falls asleep or becomes disabled. The controller arm has a tappet thereon which operates a switch for stopping the motor and applying the emergency brake, when the controller arm is released, unless a button is maintained depressed by the motorman.

803,215. OVERHEAD STRUCTURE FOR ELECTRIC RAILWAYS; Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Oct. 19, 1904. A mechanical arrangement for connecting insulated trolley wire sections employing a wooden strip or board with fixtures secured to each end for the attachment of the trolley wires. The board is sustained at both ends from insulators.



802,999.—Fuse-Block or Cut-Out.

803,216.—SUSPENSION DEVICE FOR TROLLEY CONDUCTORS; Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Jan. 17, 1905. A trolley wire is suspended in absolutely rectilinear relation by a pair of messenger cables with V-shaped fixtures depending therefrom by which the trolley wire is clasped.

803,233. ELECTRIC CONTROL SYSTEM; Henry D. James, Pittsburg, Pa. App. filed Apr. 3, 1905. Provides means by which all changes and connections from the transformer to the controlling device in an alternating-current system, are accomplished when no current flows through the circuits that are in use.

803,237. ELECTRIC RELAY; Isidor Kitsee, Philadelphia, Pa. App. filed May 3, 1905.

803,245. PLUG OR CONNECTION FOR ELECTRIC LIGHT LINE WIRES; Charles P. Parnell, New York, N. Y. App. filed Apr. 19, 1904. A pair of plugs each having a threaded shell, which are engaged with an intermediate threaded connecting member also constituting a fuse plug.

803,246. ELECTRIC LAMP SOCKET; Charles P. Parnell, New York, N. Y. App. filed May 18, 1904. Especially designed for marine and railroad work where the vibration is liable to loosen the ordinary form. The usual stud on the lamp has cavities in which a spring pressed toothed plate engage to hold the lamp against rotation.

803,252. TROLLEY FOR ELECTRICALLY PROPELLED VEHICLES; Normal W. Storer, Pittsburg, Pa. App. filed Feb. 15, 1905. Specially applicable to high-speed railways in which the ordinary trolley wheel cannot be used. A horizontal plate is supported to slidably contact with the wire and has grooves to contain a lubricant.

803,253. ELECTRIC REGULATOR OR CONTROLLER; Harve R. Stuart, Wilkinsburg, Pa. App. filed Sept. 26, 1903. A form of regulating transformer having a helical primary winding which is rotated spirally against the contact so as to gradually cut out the wire.. The apparatus is used successively to cut out the main transformer windings step by step.

803,254. METHOD OF REGULATING ALTERNATING-CURRENT ELECTROMOTIVE FORCE; Harvey R. Stuart, Wilkinsburg, Pa. App. filed Sept. 26, 1903. Claims the method of the above described apparatus.

803,263. ELECTROLYTIC CELL; Henry S. Anderson, El Paso, Texas. App. filed June 21, 1905.

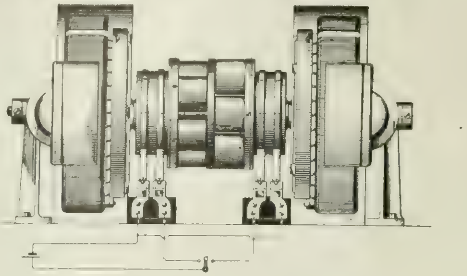
803,322. MOTOR ACTUATOR; Daniel Bacon, New York, N. Y. App. filed Feb. 25, 1905. A pair of motor armatures are rotated continuously in opposite directions, and carry magnets which can be energized to carry around an iron disk. The circuits of such magnets can be manipulated at will so that the disk can be rotated in either direction as desired.

803,365. ELECTRIC RAILWAY; Maurice C. Rypinski, Schenectady, N. Y. App. filed Mar. 31, 1902. Four-toothed gears are placed at intervals along the track so as to be rotated one tooth by a tappet on a passing train. If a following train passes the gear prematurely, the latter will be rotated another notch or tooth, which will throw a main switch and stop the train.

803,378. CONTROL OF ELECTRIC ELEVATORS; George A. P. Weymouth, Melbourne, Victoria, Australia. App. filed Apr. 3, 1905. At each floor fingers are supported which are moved to alternate positions by the passage of the car. These serve to control the direction of the elevator motor so that the closing of a switch at any floor will always propel the car in the right direction.

803,403. LONG-DISTANCE ELECTRIC CIRCUIT; Mark S. Lewis, Medford, Mass. App. filed May 4, 1905.

803,410. ELECTROMAGNET; Arthur C. Eastwood, Cleveland, O. App. filed Apr. 1, 1904. At each end of the magnet coil iron heads are provided which have openings closely surrounding the core. These exert a magnetic damping effect and arrest the oscillations of the core.



803,322.—Motor Actuator.

803,414.—REMOTE CONTROL REGULATOR; John L. Hall and William C. Yates, Schenectady, N. Y. App. filed Mar. 20, 1905. The rheostat arm may be propelled in either direction by oppositely directed ratchet pawls upon the same lever which are respectively made effective by the action of one or another operating magnet.

803,423. ELECTRIC LAMP SOCKET; Normal Marchall, Newton, Mass. App. filed Dec. 24, 1900. A Z-shaped strip is fastened to one side of a porcelain base so as to project centrally thereof and constitute the central contact member of the lamp socket.

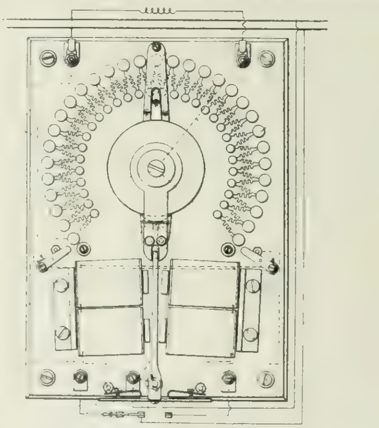
803,442. APPARATUS FOR SHORT-CIRCUITING TURNS IN ARMATURE COILS; John F. Shoemaker, Madison, Wis. App. filed Apr. 13, 1905. An apparatus for short circuiting the rotor of an induction motor after it attains speed, comprising a plate having a circumferential row of knife blade switches and an additional plate movable in parallel relation thereto for closing said switches when desired.

803,451. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 1, 1904. The resistance elements are wound upon parallel spools and a spiral blade swings between said elements so as to contact with different turns progressively, first on one spool and then on the other.

803,452. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 12, 1904. A modified form of the above in which the coils are wound upon parallel cores as before and a blade swings in a plane tangential of the windings so as to successively cut in or out successive turns.

803,453. RHEOSTAT; George E. Stevens, Lynn, Mass. App. filed Oct. 12, 1904. A fixed resistance embodying a frame from which depend two rods upon which are wound the resistance elements.

803,462. ALTERNATING CURRENT MOTOR CONTROL; Charles E. Barry, Schenectady, N. Y. App. filed June 24, 1904. Supplies the motors from two independent sources of current, such as the secondaries of two transformers and provides a switch adapted to connect these secondaries in parallel and in series so as to vary the potential impressed upon the motor circuit.



803,414.—Remote Control Regulator.

803,486. MAGNETICALLY OPERATED SWITCH; George H. Hill, Schnectady, N. Y. App. filed June 13, 1904. A construction of conductor in which the operating magnet has a stem with blades thereon which switch the operating current on to the next contactor. The main circuit is broken between the curved blades adjacent to the pole of the blow-out magnet so as to eliminate the arc.

803,502. RAILWAY SIGNAL SYSTEM;James C. Mock, Detroit, Mich. App. filed Jan. 11, 1904. A system of railroad signals adapted for switch crossings employing a spring blade adjacent to the usual rails with which the wheels make contact in passing. The plate is insulated from the rails.

803,513. SPACE TELEPHONY; John Stone Stone, Cambridge, Mass. App. filed June 29, 1905. (See page 825.)

802,981. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed Dec. 10, 1902. (See Current News and Notes.)

812,394. CONTROLLER; John P. Durkin, Philadelphia, Pa. App. filed Sept. 21, 1905. The usual controller arm has a pawl which may be thrown outward by centrifugal force. If the motion of the controller arm is too rapid, the pawl catches on notches, but immediately drops back so as to permit further movement of the controller arm.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, NOVEMBER 18, 1905. No. 21.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..........1139 Monadnock Block
PHILADELPHIA OFFICE..........929 Chestnut Street
CLEVELAND OFFICE..........402 Cuyahoga Building
EUROPEAN OFFICE..........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **633,000.**

NEW YORK, SATURDAY, NOVEMBER 18, 1905.

CONTENTS.

Editorial 847
No Electric Bid Entertained at Lowell, Mass 850
The Rejuvenated Sons of Jove 850
Electrification of the N. Y., N. H. & H. R. R. R 850
Independent Telephony in New England 851
A Central Station Daily Newspaper in a Franchise Fight 851
Comparison of Electric Traction Systems 851
Furnishing the Election Returns 852
Electrical Engineers of the Times. XXXVI. Mr. Van Rensselaer Lansingh 853
Current News and Notes 854
Niagara Power in the Gorge. I 857
Heavy Electric Railroading. By Bela Valatin 860
A Central Station Campaign at Niagara Falls 863
The Patent Law Situation. By Ludwig Gutmann 864
Electric Towing 865
New York City Destructor Plant for Lighting 866
New Telephone Patents 868
LETTER TO THE EDITORS:
Measuring the Power of Induction Motors. By Allen H. Babcock 868
Digest of Current Electrical Literature 869
"Graft" in an Electrical Manufacturing Concern 873
New Flaming Arc Lamp 873
Automatic Switchless Telephone 874
Portable Movable-Coil Galvanometer 875
A Safety Line Disconnector 875
Split Porcelain Insulator 876
Volt-Ammeter for Battery Circuits 876
A Pocket Live Wire Indicator 876
Blower for Hot Gases 877
Battery Fan Motors 877
Industrial and Commercial News 878
General News of the Week 881

THE CENTRAL STATION SITUATION.

It is now a well known fact that central station business is passing through a period of somewhat restrained growth. The immense annual increase of the last decade of the nineteenth century has in the past few years subsided to more modest figures. Perhaps this is merely a manifestation of the general law that demand for any commodity is limited and must ultimately be filled by the supply, but the central station business is one in which we are very keenly interested, and we purpose to make a careful examination of the existing conditions with a view of seeing in how far they proceed from general economic causes and in how far from causes that may fairly be called preventable. Every industry responds quickly to the influence of both external and internal causes. It declines when the demand for its product falls off through changes in fashion or through the competition of similar products, or when through unwise administration the market is not met in price or quality. It improves on the other hand when the general market quickens, competition is overcome or improved technical and business methods are brought into action. In our judgment the present central station conditions are the result of various causes, no one of which can be charged with anything like exclusive responsibility. We have no panacea to offer, but we intend to take up seriatim some of the sociological, financial and technical questions involved in the hope of at least suggesting remedial measures. The central stations of the country represent an enormous invested capital which should be, through improvements in the art and through the rapid growth of the country, increasingly productive. If it fails to show the returns apparently justified there must be good reason therefor, and we hope that our friends in the business will aid our inquiry by such suggestions as seem pertinent.

SCARCITY OF WATER FOR CALIFORNIA PLANTS.

The prolonged dry season in California has again shown up the weak points of the extensive water power transmission development in the state. Comparatively few power companies, with the exception of the California Gas & Electric Corporation, have large reserve water storage, and the Corporation itself has had its resources taxed by the fact that there has been practically no rain since last May. By making the most of the steam plants at Oakland, San Jose and Sacramento, the water shortage on the South Yuba and Standard transmission lines has been offset or minimized to a certain extent. By next summer there will be more storage capacity available, and the gas engine reserve plant now nearing completion six miles from San Francisco can be utilized in connection with the transmission lines. With two or three additional water power transmission companies heading for San Francisco, and the consolidation of power companies in the city, the time is not far distant when the various lines can help each other out in emergencies. Then the effects of exceptionally dry seasons, such as the present, will not be feared. There are yet a few watersheds high up in the Sierras where numerous mountain lakes fed by melting snows can furnish water power for future transmission plants that will not suffer from a diminished flow in summer. A good many transmission projects are in course of development, that will prove profitable, but reserve plants of extensive water storage will be necessary to tide them over such a season as the present. Such a situation emphasizes more than ever the vital necessity of large storage reserve in connection with most of the modern hydro-electric systems.

British Institution of Electrical Engineers.

The annual report of the Institution of Electrical Engineers of Great Britain has recently been published in the *Transactions* of that body. The Institution was founded thirty-four years ago, and is, therefore, thirteen years older than the American Institute of Electrical Engineers. The report shows that the total membership of the Institution in May, 1905, amounted to 5,671, an increase of about 5 per cent over the corresponding total for the year preceding. There are six classes of membership in the Institution, three of which had held their numbers stationary during the preceding year, or substantially so; namely, honorary members, foreign members and members. The associate members gained 175, but the associates lost a nearly equal number, equivalent, therefore, to a transfer in bulk from the lower to the higher of these two grades. The number of students increased nearly 20 per cent. The administrative activity of the Institution is reflected in the fact that no less than 87 council and committee meetings were held during the year, as against 17 general meetings. Twelve papers were read in the London meetings, and twenty-eight papers or addresses read at the section meetings are either printed or abstracted in the *Transactions*. There are six sections of the Institution in the British Islands, besides one in India and another in South Africa. These branch sections collectively initiate more papers than the London parent stem, and play, therefore, even more important a part in the proceedings of the body than do the twenty-five branch sections of the American Institute of Electrical Engineers. An important policy of the Institution is in the maintenance of scholarships and bestowal of prizes for papers. Six scholarships were awarded last year and twelve premiums for papers. Against this record the American Institute of Electrical Engineers at present offers only the Edison Medal. But on the other hand the sad state of technical education in Great Britain lends justification to a diversion of income to purely pedagogical purposes which would be lacking in this country.

◆

Single-Phase and Direct-Current Transmission.

Although on the basis of equality of the measurable electromotive force between transmission wires, the three-phase is of all systems the most economical with reference to the weight of the conducting material, and while in this country it is the only system which has been adopted for transmission on a large scale, it is not proper to assume that there may not arise conditions under which other systems may prove more advantageous, as indicated by the installations of high-potential, direct-current transmission systems, to which attention was recently directed by Prof. W. E. Ayrton, in a lecture before the British Association for the Advancement of Science. Laying aside the claims presented by the advocates of the Thury system as to the relative advantages of maintaining a constant current in a series circuit, instead of attempting to maintain a constant electromotive force in parallel circuits, it is interesting to investigate the relative economy of conducting material of three-phase and direct-current systems. Although doubtless when solid dielectrics are used, the electric strain which can be withstood by a chosen thickness depends approximately upon the effective value of the electromotive force, with gaseous dielectrics the determining factor seems to be the maximum value of the electromotive force. Thus, if one assumes that the electromotive force is sinusoidal, an alternating e.m.f. of 7,070 volts is approximately equivalent to 10,000 direct volts so far as rupturing a certain thickness of air is concerned. In order that a three-phase system shall require the same total amount of conducting material as a 10,000-volt direct-current system it is necessary that the transmission e.m.f. be 8,660 volts. If, therefore, the assumptions made above are applicable to aerial transmission circuits, the three-phase system with the same strength of insulation can operate at only $\sqrt{2/3}$ of the measurable e.m.f. of the direct-current system, or it will require 50 per cent more conducting material than the latter system to transmit the same power at the same loss.

The seeming relative economy of the direct-current system, as outlined above, is based exclusively on the difference in the character of direct and alternating current. It is well in this connection to call attention to a few facts connected with the comparison of three-phase and single-phase system with reference to the required conducting material. If one assumes that the neutral point of the three-phase system is connected to earth, say through a water-resistance static discharger, and that metallic poles and cross arms are used, then the e.m.f. which each insulator must withstand is that between the line wire and the neutral point. It may be shown that all symmetrical transmission systems possess the same economy of conducting material, irrespective of the number of phases, when compared on the basis of equality of maximum measurable electromotive force to the neutral point. Since the single-phase system requires only two-thirds as many wires and insulators as the three-phase system, it would seem that for the transmission circuit treated exclusively, the former system possesses some advantages with reference both to the cost of installation and the simplicity of operation. Although polyphase generators are less expensive than single-phase machines, and for general power distribution polyphase circuits are more desirable than the single-phase, for alternating-current railway work, the simple single-phase system possesses features that should not be overlooked.

◆

Contact With Dielectrics.

A recent number of the *Philosophical Magazine* contains a paper (abstracted recently in the Digest) by Mr. Rollo Appleyard giving the results of a research concerning the contact resistance between metal-foil and insulators. It is well known that when two cleansed metallic surfaces are brought into contact there is a certain small resistance in or near the contact surface. This contact resistance is especially noticeable when the two metals are different; but it exists even when the two metals are the same, and even when the surfaces brought into contact have been carefully planed and smoothed. This contact resistance has been found to diminish with increase in the pressure with which the contact is maintained. In the case of the accurate contact of cleaned smoothed surfaces of similar metal, under considerable pressure, this contact resistance is very small. The experiments described in the above-mentioned paper indicate, however, that when a conductor like tin-foil is brought into contact with a fibrous insulator like press-spahn, there may be a very appreciable contact resistance. This contact resistance tends to be reduced by pressure over the contact surface. The contact resistance is often so large that computed values of resistivity, or specific resistance, of an insulator, referred to a unit cube, from measurements made on sheets of the material coated with tin-foil electrodes, may be widely in error.

It appears that when the pressure upon the contact surface is increased to 400 grammes per square centimeter, the apparent resistance of the insulator becomes fairly uniform, and perhaps only about half that which appears under a very small initial pressure. When the pressure on the contact surface was increased in the experiments beyond a certain critical value, the apparent resistance of the insulator began to rise again. At the same time there was a danger of crushing the material, and the increase in resistance was attributable to a change in the structural condition of the substance, rather than to a reversed variation in contact resistance. As might be supposed, the effect of increasing the voltage between the tin-foil electrodes was to reduce the resistance, as though the mechanical pressure were increased without increase in voltage. Of course, the electric force between the tin-foil electrodes would determine a mechanical pressure by electric attraction; but this would be too small to account for the results on the basis of increase in contact pressure. It is very difficult to ascertain the physical conditions of a substance at its external surface. It is, however, clearly evident that conditions exist at the surface which are very different from those existing within the mass of the material. The surface tension alone gives rise to remarkable phenomena. Some maintain that the layer of air immediately in contact with a metallic surface may be kept almost in a liquid state, by virtue of the tensions developed at the bounding surface. However that may be, it is certain that the electric contact between tin-foil and a dielectric may be very imperfect unless considerable pressure acts upon the contact. Moreover, a relatively small electric potential gradient is capable of exerting a sensible influence upon the remarkable local conditions in the immediate neighborhood of the discontinuity.

When mercury electrodes were substituted for tin-foil electrodes in the experiments referred to, the dielectric resistance was substantially the same with different voltages, and was also substantially constant during the continued application of the voltage. It would seem, therefore, that mercury is not only useful for securing good contact between a metallic cup and an electrode immersed therein, but that it is also useful for securing good contact with a mass of insulating substance. A curious series of observations is reported upon the retentive force between a tin-foil electrode and a sheet of dielectric material across which an electric gradient is established. The tin-foil tends to cling to the surface as though by electric attraction, after the voltage and electrification have been withdrawn, so that there can be no electric attraction, in the ordinary sense, remaining. This retentive mechanical force was found to increase rapidly with the voltage applied. The precise actions involved in this retentive force are not clear. The suggestion is made that perhaps small variations between the capacity of a condenser tested at different voltages may be due to more intimate contact between the electrodes and the dielectrics at the higher voltages.

THE PATENT QUESTION AGAIN.

We print this week another addition to the growing literature of discontent with the present status of patents. That reform of some sort is needed we have no doubt, but that reform is difficult is all too certain. The situation in which the American inventor finds himself is not an agreeable one. He obtains a patent which is granted after a search which is apparently rigid, and then is sued for infringement under prior patents which were well within the knowledge of the examiner who made the search and which were perhaps fully discussed with the applicant's attorney before the patent was granted. But the matter is now out of the hands of the technical experts of the Patent Office and before non-technical judges who have to pass not only on the legal questions involved but on technical matters of interpretation, viewed of necessity from the standpoint of a changed art in spite of the most conscientious effort to revert to the original conditions. No wonder that decisions often seem conflicting and unfair. The often suggested plan of technical advisors for the Court would afford some relief if carried out, but courts are slow in favoring such a step, both on account of the difficulty of securing unprejudiced advice, and by reason of the mass of patent law that involves the broad facts of the case in a haze of uncertainty. We think that the former difficulty is overestimated, for even in the case of the polyphase patents there could have been found at least half a dozen men quite as far unbiased by previous technical affiliations as the courts have been by the popular impressions of the situation.

However this may be, there is another side to the matter deserving of serious thought. Is not the view of invention taken by our Patent Office too liberal as compared, for instance, with the German view? And has there not grown up a laxness of interpretation which permits the existence of claims entirely without the real scope of the invention, as shown in the specification? If the claims of a patent were rigorously confined to the plain intention of the specification, there would be much less ensuing litigation. But through custom an inventor is permitted to draw a loose and vague specification, often expressed in terms designed to avoid clashes with prior art, and then to append to it multifarious claims constructed on the plan of writing down all the possible permutations and combinations of the details. To our minds the German plan of holding the inventor sharply to his specification and giving him claims bearing directly upon what is novel and useful in that specification is preferable to our own. One solution of the present difficulties indeed would be to draw the lines closer on the matter of invention and to estop infringement suits against the inventor who actually and rigorously follows the specifications on which his claims were based. It very often happens now that the specification is merely a nucleus around which other people's ideas are assembled in actual manufacture, so that the completed aggregation not only has wandered from the original intent but actually includes items belonging distinctly to other inventors and subject to their patents. If the now merely perfunctory phrase "substantially as set forth," were reinforced by insistence on a clear and definite specification and then rigorously enforced in the subsequent interpretation of the claims, there would be a great reduction of litigation.

The German system greatly reduces the number of patents allowed and perhaps attaches too great importance to what our courts have called "the expected skill of the calling," but it at least does not err in allowing loose generalized claims to slip through to become later a source of danger to really well defined subsequent inventions. And, moreover, while appreciating the suggestion that a Patent Court should be constituted in connection with the Patent Office, we fail to see why that office should have returned to it for review the results of its own mistakes. If the examiners are fully qualified and competent to interpret the patents ultimately brought before them as judges, they are also able to interpret the same patents when passing through their hands as examiners, and to refuse to pass specifications and claims which lack novelty or conflict with patents already issued. It rarely happens that a really pertinent reference is entirely overlooked by the examiner, and a reference over which the patent has been allowed should certainly not be permitted as a citation against it in litigation. If a patent once allowed were incontestable so far as the right to manufacture under it is concerned, and the Patent Office on its own initiative settled once for all in allowing the patent its scope with respect to prior patents, there would, to be sure, be fewer allowances, but litigation would be limited to exceptional and unusual cases in which there had been early public use, or in which there was dispute as to the real inventor. Such procedure is perhaps too revolutionary to be immediately practicable, but revolutionary steps of some sort are needed. A patent once issued ought to carry with it the highest presumption of full valadity and should protect its owner in the right of manufacture. It is not always easy to draw a line between two involved sets of claims, but the real fault is in passing claims so involved as to make the facts in the case uncertain. The existence of a complicated train of a score or two of claims is, save in very exceptional cases, a mere incentive to needless litigation.

No Electric Bid Entertained at Lowell, Mass.

Comment was made recently in these columns on the electric lighting situation at Lowell, Mass., and the award of a large gas contract there for street lighting. Considerable misinformation has found publicity as to the nature and scope of this contract, which was quite peculiar in the conditions of its granting. We are indebted to Mr. N. T. Wilcox, manager of the Lowell Electric Light Corporation, for the subjoined interesting explanation of affairs in Lowell.

"Regarding the street lighting situation in this city, would state that we are now operating 525 alternating-current arcs in the streets of this city, and have quite a number of 25-cp incandescent lamps in the towns adjoining the City of Lowell, which are tributary to our station.

"The law in Lowell in rather peculiar, in that the chief of the Fire Department, who is ex-officio Superintendent of Lighting, makes the contract for the street light, this being a heritage from the old gas days, when gas lamps were operated by the department. The contract does not become binding upon the city until approved by the Mayor.

"The present chief is a strong gas partisan, and early made the statement that the Electric Company should not have any more of the city business than at present, which you will note is the larger part of it. We determined if possible to obtain this business, making a bid strictly on its merits, and presented a contract to furnish 1,100 single-glower, 220-volt Nernst lamps at $22.75 per lamp per year for 4,000-hour service. The Gas Company shortly after submitted a proposition for $28.50 per lamp per year for the Welsbach burner type of lamp. This proposition was put up to the Mayor for examination without signature. The Mayor immediately returned the contract to the superintendent and furnished to the papers his letter accompanying the contract. The result was that there was a great deal of discussion in the papers, during which discussion the papers uniformly came out in favor of the electric light, as we had made several demonstrations on the street showing the superiority of this lamp. We even went so far as to make careful tests of the candle-power of the lamps in position and found that with a series of ten of the Welsbach lamps the average candle-power as operated was only 36 candles, which was unusually good due to the excellent maintenance conditions under which these lamps were operated.

"After the discussion had been on for some little time, and the gas people seemed to be getting the worst of it, the superintendent wrote to several gas lamp companies asking for sealed bids. The result of this was that but two of these companies furnished bids; the Welsbach Street Lighting Company of America made a bid of $26.75 per lamp per year for 4,000-hour service, and the Cleveland Lighting Company bid $24.20 per lamp per year for the same service. The superintendent publicly stated that no electric bid would be considered. After these bids had been received the Mayor agreed with the local gas company to approve a five-year contract with them provided they would meet our price of $22.75, which they did without delay. The whole proceeding was an arbitrary one and was severely criticized.

"Actual tests made by Prof. C. A. Adams, who also made the Welsbach lamp tests, showed that the Nernst lamps were much superior to the gas lamps, even after allowing for the depreciation, which, of course, was nothing as compared with the depreciation of the Welsbach burners.

"The principal argument brought up against us was that poles should not be placed upon some of the streets where we were not located. If it had not been for this and the extreme partisanship of the contract-making power, there would have been no doubt about our obtaining the contract, as if it had been submitted to popular vote I think there is no question but that we would have won 'hands down' and by a very handsome margin."

The Rejuvenated Sons of Jove.

The fourth Jovian congress of the Order of Rejuvenated Sons of Jove—the only fraternal organization of those engaged in the advancement of electricity—was held at Dallas, Texas, October 14, 1905, at which time the following officers were unanimously elected for the ensuing year: Jupiter, C. A. Newning, No. 2, Houston, Texas; Neptune, L. G. Reed, No. 200, Sandusky, Ohio; Pluto, W. M. Brooke, No. 18, Dallas, Texas; Vulcan, J. H. La Roche, No. 185, Cohoes, N. Y.; Mercury, C. B. Roulet, No. 213, Dallas, Texas; Hercules, P. R. Boole, No. 155, Chicago, Ill.; Mars, F. C. R. Spence, No. 67, Marshall, Texas; Apollo, J. P. Tufts, No. 71, Dallas, Texas; Avrenim, W. G. Handley, No. 152, Cincinnati, Ohio.

The Order of Rejuvenated Sons of Jove was born among the leading spirits of the Southwestern Gas, Electrical and Street Railway Association at an annual convention held at Austin, Texas, in 1899. Since that time it has grown with a rapidity astonishing to its founders—who were men from many States and holding responsible offices in the electrical world, although to date its meetings have been confined to the annual association gatherings in the Southwest and in Ohio. Mercury says on the subject: "The foundation of the Jovian Order was inspired to bring devotees of the science of electricity and its allied interests into closer communication and membership, to the end that information and learning might be more general and effectively diffused; that love and pride of profession might be installed in every heart; brotherly feeling engendered, and that ties and links be forged at the anvil of Vulcan, which shall lengthen until it shall encircle the globe—thus cementing its members in a common bond of good fellowship. Of the ritual nothing can be written. To enjoy its beauties and understand its lessons it will be necessary to approach the shrine of Jupiter and to become a Rejuvenated Son of Jove."

It is the intention of the present Jovian congress to hold rejuvenations at the next annual conventions of the National Electric Light Association, the National Electrical Contractors' Association, the National Electric Jobbers' Association and the Southwestern Electrical and Gas Association, at which time candidates are requested to present themselves for rejuvenation. Mythological basis, application blanks and constitution and by-laws of the order may be secured by addressing the office of Mercury, C. B. Roulet, Wilson Building, Dallas, Texas.

Electrification of the N. Y., N. H. & H. R. R.

Wm. S. Murray, electrical engineer for the New York, New Haven & Hartford Railroad, has issued the following statement on the electrification of the New York division of that road, the details of which have given rise to so much discussion:

Concerning the proposed method of electrification it is interesting to note the unsolicited general concordance of opinion on the part of certain engineers and gratifying in the main to note a temerity in expressing a concrete opinion of our decision.

Without a full appreciation of the relevant factors in the case one could hardly view with a more kindly eye a hearty endorsement of our conclusion than a condemnation of it. Certainly the first indication of a real engineer is his reservation of an opinion until all these relevant factors have, in the full knowledge of their true bearing, been assembled. To-day a conclusion is worth nothing that is not a compromise. A compromise is the true algebraic sum of all the relevant factors.

After six months careful study of the possible methods of electrification a conclusion has been reached. The work has been too initiative, the ground too new and the opportunity too exceptional not to have kept an accurate log upon the method of procedure. Were it possible to devote time to things other than an expeditious and careful continuance of the work begun we would gladly segregate this conclusion into its relevant factors and discuss it with those engineers who by the reservation of their concrete opinion have shown a silent wish to later agree or disagree with its plans.

To the two great electrical manufacturing companies who have placed the genius of their engineering in our hands for consideration we have nothing but the highest tribute to pay. It has been no mean privilege to make a minute study of their individual view point of the problem. It is true their analysis of the situation has dictated widely separated conclusions and those engineers who appreciate the trust imposed in this decision for the New Haven road can readily understand that the divergence of opinion has served only to double the responsibility of the conclusion, but by which the engineers for the New Haven road are in no way disturbed.

To those minds prone to a conclusion without the assistance of the relevant factors it may be a helping thought to say that throughout the study of the New Haven's electrification the Central's plans have been a constant and most relevant factor. The conditions of the New Haven problem, however, are widely different. It has been deemed that alternating-current is pertinent to their proper fulfillment. Because the New Haven locomotives will be operative either on direct or alternating-current in no way emphasizes the importance of their interchangeability. The condition imposed in effect makes valuable the double characteristic. A criticism of the Central's plans is irrelevant and unnecessary; direct-current propulsion is the judgment of their engineers. Our concern is its effect upon us, and it is read in the direct-current characteristic of our locomotive.

Independent Telephony in New England.

A convention of the independent telephone companies of Vermont and New Hampshire was held at Hotel Wentworth, Woodsville, N. H., on November 2. There was a large attendance present from all parts of both States. The object of this convention was to form an independent telephone association of all companies in Vermont and New Hampshire, the aim and purpose of the association being to cement together in a firmer union all independent telephone interests in this section for the purpose of promoting uniformity of operation, maintenance and construction; to protect and defend all independent telephone interests by moral efforts, co-operation and such other available means as may be deemed advisable; to prevent the enactment of hostile legislation and any and all other purposes that are deemed to the best interests of the association and of the independent telephone movement.

An organization was formed and the following officers elected: H. W. Buchanan, Barton Landing, president; C. D. Eastman, Woodsville, N. H., vice-president; G. W. Buzzell, St. Johnsbury, Vt., secretary and treasurer. There were twenty vice-presidents elected to serve as committees of arrangements. The association will be called the "Vermont and New Hampshire Independent Telephone Association." The National Interstate Independent Telephone Association emblem, adopted at the national convention, held in Chicago last June, was adopted. Other meetings are arranged for the near future.

A Central Station Daily Newspaper in a Franchise Fight.

Central station managers will be interested in the manner in which the Maryville (Mo.) Electric Light & Power Company succeeded in keeping a gas plant out of Maryville, notwithstanding that the press, Mayor and City Council were enlisted in favor of such a plant. The Mayor and City Council maintained that the electric light company was extortionate in charging $8 per month each for 39 street arc lamps consuming 480 watts, and $2 per month each for nine 32-cp incandescent lamps. It may be added that the contract also provided that the City Hall should be lighted free of charge. Failing to come to an agreement, the lighting company was notified before the contract had expired that if the lights were continued after September 1 the company would be paid only $7 for each arc light. The Council also decided to make an investigation regarding the prices of gas and electricity in other cities of about Maryville's size and sent the Mayor, an Alderman and an attorney to investigate. Glowing accounts of the Council's investigation appeared in the Maryville *Daily Tribune*, which boiled with enthusiasm over water gas.

When the lighting contract expired the company, feeling that it was impossible to furnish the service at the arbitrary rate settled upon by the board, shut off the lights and the city was in darkness for ten days. The citizens of Maryville now took a hand in the situation and pressure was brought to bear on the Mayor, who called on the president of the electric light company one evening and requested that the lights be again turned on, stating that the city would pay the old rate until such time as the Council and the company might agree upon a price. This proposition was accepted.

Not many days after a Chicago capitalist appeared before the Council and requested a franchise to build a $70,000 coal gas plant. The Council thereupon went into executive session and passed ordinance No. 90, also signing a secret agreement wherein they pledged the city to enter into a 10-year contract with the gas company ten days after the ratification of the ordinance to light the city with 120 60-cp gas mantle lamps at the rate of $3,500 per annum. Just about this time the *Daily Tribune* decided that its glowing descriptions of water gas were all wrong and that coal gas excelled it as the glory of the mid-day sun does the gleam on the lightning bug. It was also startlingly discovered that such cities as Boston, Bridgeport, Brooklyn, St. Louis, Milwaukee, New York, Omaha and San Francisco had within recent years discarded electricity for street lighting and adopted gas mantle lights for economy and efficiency. Notices were posted calling for a special election to vote on "Ordinance No. 90, passed by the board October 23, 1905." Though the ordinance had not been communicated to the public, the notice concluded with the statement, "If you vote 'yes' it will be taken by the board that you have assented to the granting of the franchise in the manner and form and according to all the provisions provided by said Ordinance No. 90."

Failing to obtain justice from the press in Maryville the electric light company played a trump card and began the publication of the *Daily Gas News*. This was a four-page paper in regular newspaper form and appearance, having as its motto, "We favor a square deal." The reasons why the company took this step are best given in its own words, which follow:

"First, as we are in the lighting business we are naturally opposed to having the city lighting contract bodily taken from us without giving the public a chance to acquaint themselves with the provisions of the contract. We consider such action unfair to us.

"Second, we do not think it fair to the public, either, to attempt to wrest from the city a ten-year's contract without the citizens being aware of is nature.

"Third, from a standpoint of economy the light company has decided that the cheapest way to give the truth to the public is by means of a separate newspaper, since the *Tribune* refuses to print the arguments presented by the light company except at advertising rates. This journal, with its characteristic regard for the interests of the public, is glad to publish column after column free of charge for the gas franchise and against the light company, but when the light company presented its answer during the month of September it was charged $6.20 for the space, and its notice was placed in the patent medicine columns in as obscure a place as could be found. The light company has decided, therefore, that the cheapest and best way to acquaint the public with the truth of this matter is by a daily paper of its own.

"The reason, then, for our action is not fear of competition. We would not fight a reasonable FRANCHISE for a minute. We are not fighting gas; we are fighting the PLAN of the city officials and others who dictate to them in trying to wrest from the city an outrageous contract in an illegal manner."

The paper was ably edited and filled with material which struck straight from the shoulder, the people lined up with it and after four issues of the *Daily Gas News*, the Chicago capitalist withdrew his proposition to the City Council. The result is that there is no gas in Maryville, nor is there likely to be any for some time to come. The campaign was carried on by Mr. J. C. Donnell, the manager of the Maryville Electric Light & Power Company.

Comparison of Electric Traction Systems.

At the Brooklyn Polytechnic Institute, on November 8, Mr. Albert H. Armstrong, of the railway department of the General Electric Company, delivered a lecture on the "Influence of Traffic Conditions on Motor Specifications." Mr. Armstrong introduced the subject by pointing out the three broad classes of service conditions, namely, short haul service, long haul service and grade work. After briefly outlining the requirements to be fulfilled in each of these classes the lecturer presented definitions of the different types of railway motors, covering the direct-current series motor, the direct-current shunt motor, the three-phase motor and the single-phase commutator motor.

The direct-current series motor he defined as an all-around satisfactory motor, but not as good as one especially designed to fulfill special conditions. The installation of the direct-current shunt motor might be warranted under conditions where its ability to return energy to the line on down grades would be an important factor. The three-phase motor has two important characteristics in common with the direct-current shunt motor, as it also runs at constant speed and returns energy to the line. In general the three phase motor possesses qualities which cannot be ignored and make it preferable, under certain conditions, even to the direct-current series motor. The single-phase commutator motor, he said, consists essentially of a field and armature in series with each other and which are identical in construction with a direct-current series motor except that the field winding is distributed around the inner surface of the field, similar to a three-phase induction motor, instead of having poles on which coils are mounted as in direct-current motors. The armature is like a direct-current armature except that it is wound for 200 volts instead of the 500-600 volts standard for direct-current series railway motors. This 200 volts is the limiting potential for which such alternating motors of any magnitude can be designed—in fact, the larger the motor, the smaller the limiting voltage. While small alternating motors have been run successfully on 600 volts, as in air compressor work on alternating-current railways, they are not feasible for motors of say 75 hp and above. One additional feature in the field of this motor, necessitated by the fact that the armature turns carry alternating instead of direct current, is the use of a compensating winding to overcome the reactance of the armature winding. This is a series winding placed in slots in the pole faces in electrical space quadrature to the magnetizing winding of the field. The compensating winding is in series with the armature and carries the same current that energizes the armature. It is the counter flux set up by this winding that makes the armature non-inductive. The single-phase commutator motor has variable speed torque, so that its torque increases and its speed falls on up grades, producing a speed torque curve similar in every way to that of the direct-current series motor.

In certain classes of work the single-phase motor is a strong rival of the direct-current series motor. This rivalry is not due to superiority in design, performance, lesser cost or weight, but because the first-mentioned motor effects certain fundamental changes that greatly reduce the cost of the distribution system and line.

There is still another method of electric operation, namely, by motor-generators, which scheme allows the use of large induction or direct-current motors carried either on the locomotive or in a tender behind. A field for motor-generator operation has been opened up by the encroachment of electricity on the steam trunk lines, necessitating the employment of very heavy and bulky apparatus which cannot be placed under standard passenger cars, nor would it be practicable to have separate motor equipments for freight cars. The single-phase commutator motor carries with it certain restrictions in design which make it questionable whether it could be successfully operated and built on such lines. Where conditions are too severe for the consideration of the single-phase motor, or where the profile of the road or general characteristics are not suitable for three phase motors, the direct current motor has been considered for operation in connection with an alternating direct-current motor generator set carried on the locomotive itself. In other words, as the direct-current series motor is excellently qualified to change electric to mechanical power at the highest efficiency and lowest cost in the least space, it may be advisable to install motor-generator sets and fall back on the old direct-current series motor where considerable restrictions are placed on space, weight or capacity of the locomotive.

Mr. Armstrong then discussed hand, multiple-unit and alternating-current potential control systems. Hand control, he said, practically reaches its limit when a larger equipment than four 50-hp motors is used, mainly because the controller becomes too heavy and bulky for the car platforms. Hence, for equipments above this capacity it is better to subdivide the control system, placing the main apparatus under the car, and actuate the motors through a series of contactors, which may be electrically or pneumatically operated. Alternating-current potential control is becoming the recognized method of controlling single-phase railway motors, the speed depending upon the potential supplied. This method is very economical and simple, the speeds being varied by changing the connections of the car transformer taps. For motor-generator work direct-current potential control is used.

A typical speed time run, Mr. Armstrong said, can be considered in several different ways. Taking it up in its fundamental state, it consists of a period of acceleration, a certain amount of free running and a period of braking. Given intervals must intervene between acceleration, running and braking, and the all-day duty of the motor consists of a repetition of similar runs. Mr. Armstrong exhibited diagrams showing typical speed-time curves and explained how the relations of the various portions are affected by the running conditions. For instance, when stops are frequent, acceleration must be rapid, and the motor must operate at a heavy load factor for a short time, while in interurban service high acceleration is less important and for the greater part of the run the motor carries a normal load.

Furnishing the Election Returns.

All over the country, as usual, the telegraph, the telephone and the electric light played a prominent part this year in furnishing election returns and in notifying the public of the broad results. Increased use was made of the telephone, and one of the most interesting exemplifications was that given by the Keystone system in Philadelphia. The Keystone Company, realizing that the interest in the election this year was as great if not greater than in the Presidential election, arranged to give out the returns in a special manner. One transmitter, the regular Keystone subscribers' transmitter, was used, the regular 24-volt battery supplying power. The primary circuit being connected through five master repeating coils, each of fifteen sec-

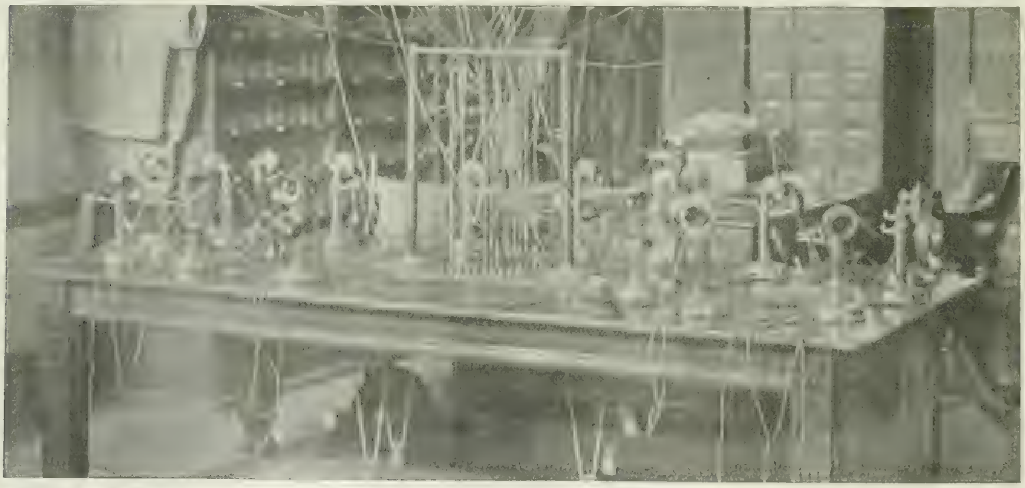


Fig. 1.—Transmitting Election Returns by Telephone

ondaries were connected to a transmission circuit. Ten of these transmission circuits were connected to the local exchanges. The others were connected to Atlantic City, Camden, Trenton, Chester and the suburban exchanges of the Keystone State Telephone Company. Each of the transmission circuits upon reaching the exchange was connected to a repeater operating a local primary circuit through ten repeating coils feeding thirty secondary circuits. These secondary circuits were connected to the multiple jacks and the subscribers were connected with them in the regular way.

The continuous bulletin service started at 7 p.m. and ended at 1 a.m. The bulletins were received over special wires from the office of the *Evening Telegraph*, of Philadelphia, which paper placed its entire news gathering facilities at the company's disposal. The bulletins were written in duplicate, one copy going directly to the man operating the transmission circuit, the other copy going to the typewriters for duplication, all the returns and music being sent out over the one circuit, everybody getting them at the same time.

A special feature of the service was the concert furnished by means of a Victor talking machine, accompanied by an excellent selection of music. This feature was so successful that it is the intention of the Keystone Company to give similar concerts during the winter. All the subscribers will have to do will be to take the telephone off the hook and ask the operator to connect them with the concert.

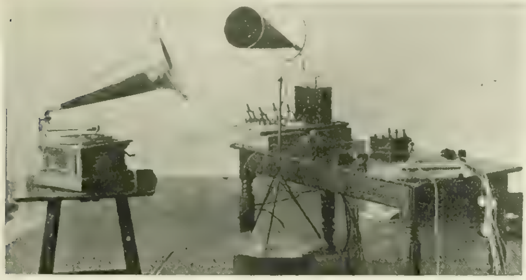


FIG. 2.—CONCERT BY TELEPHONE.

In addition to the continuous returns service, special questions were answered by the *Evening Telegraph* Information Bureau, Main 1800, by twenty operators, in connection with a special information bureau located at one of the exchanges, with a duplicate outfit with twenty operators. Special arrangements were made so that each of the operators could disconnect his instrument from the switchboard, leaving the plug hanging in the air in front of an operator that did all the plugging. This arrangement made it possible for the twenty operators to be located in any part of the room. These forty operators did nothing but answer special questions relative to the election.

During the evening it was found possible to use a transmitter with an ordinary mouthpiece and be heard satisfactorily by the thousands of people listening on the circuit, Atlantic City, Trenton and Chester hearing equally as well as Philadelphia.

As an evidence that the Keystone experts were satisfied in advance that their circuits would work all right, the only part duplicated was the master transmitter, a switching key allowing either one of two transmitters to be used.

Chicago Municipal Ownership.

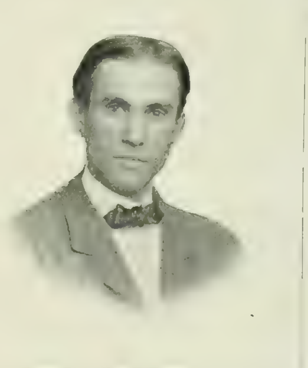
Another ordinance in behalf of municipal ownership of the street railways in Chicago was submitted to the City Council on November 13 by Mayor Dunne. The ordinance was accompanied by a message to the Aldermen which gave three ways in which Mayor Dunne asserted he would be able to bring about municipal ownership. The first plan is by reaching an agreement with the traction companies by which their property would be transferred to the city at a price decided upon by arbiters. The second is by condemnation of the property of the street railway companies under the provisions of the Mueller act. The third method is the Mayor's alternative to his contract plan, providing for the construction of municipal lines to parallel the lines of existing companies. The ordinance is drawn to place on ballots at the spring election the question whether the city shall issue Mueller bill certificates for $75,000,000 for reconstruction of lines and purchase of unexpired franchise rights. The ordinance was referred to a committee on local transportation, which decided the fate of the other propositions submitted by the Mayor in regard to municipalization of street railways. Another ordinance, submitted by Mayor Dunne, provides for 75-cent gas and lower electric light rates.

Electrical Engineers of the Times.—XXXVI.

MR. VAN RENSSELAER LANSINGH.

Van Rensselaer Lansingh was born at Albany, New York, in 1873, and received his early education in the public schools of the City of New York and in the College of the City of New York. In 1892 he entered the University of Chicago, from which he was graduated in 1896, having specialized in mathematics and physics. Two years later, in 1898, he graduated from the electrical engineering department of Massachusetts Institute of Technology, having also taken extra work in mechanical engineering during this course.

During the Spanish-American war Mr. Lansingh enlisted in the Second Regiment of United States Volunteer Engineers. At the close of the war, after working a short time in Boston, Mr. Lansingh went into the dynamo and motor testing department of the Western Electric Company, at Chicago, from which he was promoted to the engineering department of that company. In 1900 he resigned and traveled abroad, attending the Paris Exposition. Upon his return to this country he accepted the position of assistant to Mr. H. H. Wait, then assistant electrical engineer of the Western Electric Company, taking executive charge of the engineering department. In 1901 he resigned to engage in consulting and contracting electrical engineering in Chicago on his own account.



MR. VAN RENSSELAER LANSINGH.

Believing that the importance of the branch of illuminating engineering was sufficient to justify a specialist in that line, he began to concentrate all his efforts upon it, and in 1901 put out his card as illuminating engineer, being probably the first engineer in the country to begin professional practice under this name, which was almost unknown at the time he assumed it. In the latter part of 1901, he took the agency for the Holophane Glass Company for Chicago, and began the exploitation of the Holophane globes and reflectors in a scientific engineering way. His success was such that in July, 1902, six states surrounding Chicago were added to his territory, and the V. R. Lansingh Company was organized in which Mr. Lansingh as engineer perfected a selling and business organization to supplement his engineering work. In 1903 his company was given all the territory west of the Appalachian Mountains for selling Holophane products. The following year the Holophane Glass Company underwent a reorganization, in which it was divided into manufacturing and selling departments, and Mr. Lansingh was made general manager of the sales department, which change necessitated his removal from Chicago to New York, where he now lives.

Mr. Lansingh's success in the commercial field has been due almost entirely to the fact that his methods have followed engineering lines. His contribution to technical progress has been important in directing attention to the importance of illuminating engineering and in steadfastly advocating the application of sound engineering principles instead of guesswork in the planning of artificial illumination. He is the author of a number of articles in the technical press, and in 1902 presented before the Northwestern Electrical Association at Milwaukee a paper on the "Best Use of Lights for Desirable Illumination," and in 1903 before the Western Society of Engineers at Chicago read a paper on the "Engineering of Illumination." Mr. Lansingh has been an associate member in the American Institute of Electrical Engineers since 1890. He is also a member of the American Electrochemical Society.

CURRENT NEWS AND NOTES.

NEW YORK ELECTRICAL SOCIETY.—Mr. O. S. Lyford, Jr., will deliver a lecture before the New York Electrical Society at 19 West Forty-fourth Street, Wednesday evening, November 22, on "The Electrification of the Long Island Railroad."

NEW TELEPHONE EXCHANGE IN NEW YORK.—On November 12 the New York Telephone Company opened a new central office under the name of "Bryant." Subscribers in the section of the city bounded by the north side of Thirty-ninth Street, the south side of Forty-ninth Street, the west side of Fifth Avenue and the Hudson River now receive service from the "Bryant" office. They were formerly included in the Thirty-eighth Street office service.

ANOTHER ELECTRIFIED ROAD.—The Pennsylvania Railroad Company has decided to go ahead with the plan to equip with electric power the old West Jersey & Seashore Railroad to Atlantic City and some of the suburban lines out of Camden. This was announced during the present week by Samuel Rea, third vice-president of the company, and chairman of the special committee having the matter in charge. He said it would take a year to complete the work.

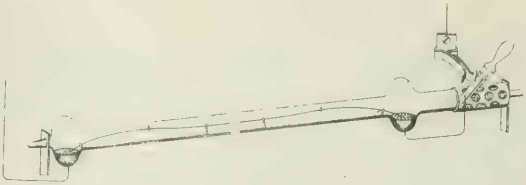
HIGH FRANCHISE PRICE.—Chief Engineer Nichols, of the New York Comptroller's Bureau of Franchises, has submitted a report to the Board of Estimate recommending that the Portchester Electric Railroad be charged for its franchise far in excess of any price heretofore paid. The rental is to be 10 cents per foot of single track for the first ten years and 20 cents a foot for the remainder, and also 3 per cent of the gross traffic receipts for the first ten years and 5 per cent thereafter.

LITTLE ELECTRICAL THINGS.—The New York Edison Company made quite a hit during the past week with its large "ad" in the daily papers: "Electricity for Little Things as Well as Big." It offers a number of excellent suggestions, aside from lighting, as to Christmas devices and presents; small power for the household, sanitary and labor saving, cleaning; the arc as a substitute for sunlight; the electric sign, etc. It is stated that more than 100,000 hp in electric motors is now furnished by the company, and that 4,557 hp was signed up in October. The "ad" is moreover takingly illustrated.

PRESERVATION OF NIAGARA FALLS.—It is stated that President Roosevelt will, in his annual message, make a strong recommendation to Congress on the subject of Niagara Falls. Officials of the American Civic Association called upon the President a few days ago and pointed out the alleged danger of the scenic beauty of the American falls being destroyed by the extensive development of electric power now in contemplation. The President, it is stated, expressed himself as willing to do all in his power to further the plans of the association and said he might bring the matter to the attention of Congress in his forthcoming message. It is thought that President Roosevelt's interest in the matter indicates that possibly before long the Federal Government will assume control over the Niagara Free Park and with the Dominion of Canada prevent any further inroads by power companies that might hurt the great cataract.

RATE REGULATION IN ILLINOIS.—Mayor Dunne, of Chicago, who, it will be remembered, was elected last spring on a platform of "immediate municipal ownership of" the street railways, having made little or no progress in that direction, is beginning to turn his attention to gas and electric light companies, and is attempting to get them to reduce their rates. A suit to test the validity of an ordinance regulating rates charged by the Peoria Gas & Electric Company is now before the United States Supreme Court. Attorneys for the city of Chicago have asked permission to file a brief in this case also.

STARTER FOR MERCURY VAPOR LAMP.—The accompanying illustration shows a device for starting mercury vapor lamps, as disclosed in a patent issued to Mr. A. D. Lunt, on November 7. The lamp tube is provided near its opposite ends with bulbs in each of which a certain supply of mercury is retained. These bodies of mercury before the lamp is started are electrically connected by means of a carbon filament. In order to start the lamp the handle is pushed so as to rotate the lamp and at the same time to bring the switch arm, to which the handle is attached, into engagement with the fixed switch member. As soon as the switch is closed current flows through the lamp by way of the carbon filament. Upon further movement of the switch the upper end of the filament is rotated out of the mercury and there is formed an arc which extends along the tube and thus puts the lamp into operation. Further movement of the handle rotates the lower end of the filament out of the mercury electrode, and thus cuts the filament completely out of the circuit.



MUNICIPAL PLANT AT NEWARK, N. J.—City Counsel Coult, of Newark, N. J., has advised the Board of Works that under the existing laws it is not authorized to construct and maintain a municipal lighting plant, but that application for such power must be secured from the Legislature before proceeding in the matter. Mr. Coult's opinion was given in response to a request made by the board when the question of establishing a lighting plant, to be run by the city of Belleville, was recommended by the special committee appointed to look into and report on the whole question. Mr. Coult's opinion was in part as follows: "I have examined the laws of this State to ascertain whether any legislative authority has been given to you to raise or expend money to construct and operate works for public lighting. The power of this board over the subject of public lighting is found in a supplement to the act under which the board was organized, approved June 13, 1898, Laws of '98, page 491. This act amends Section 11 of the act creating the board, and is as follows: 'The Board of Street and Water Commissioners, by this act authorized, shall have entire control and full authority to provide for the public lighting of streets, avenues, lanes, alleys, highways, docks, bridges, public parks and buildings of such city under the government, control and management of any such board. * * * Said Board of Street and Water Commissioners shall be substituted for and shall be in the place of any board or authority in any such city heretofore or theretofore charged with the duty of lighting the said streets, etc. * * * The board created by this act in every such city is hereby invested with the exclusive power and charged with the duty of making contracts for the public lighting under its control and management as aforesaid, and for such term or terms not exceeding five years, as in the judgment of the said board shall be deemed for the best interest of such city, with the consent of the Mayor thereof; the board of authority of any such city having the power and charged with the duty of making and adopting the annual tax levy or tax ordinance of such city shall appropriate the amount necessary each year for paying the cost of such lighting or the fulfillment of any such contract or contracts.' * * * I am, therefore, of opinion that there is no law now which authorizes this board to contract for the construction and maintenance of a plant for public lighting and that application will necessarily be made to the Legislature if power is sought for this purpose."

UNDERGROUND TELEPHONE CABLES.—The Bell Telephone Company, of Philadelphia, and the American Telephone & Telegraph Company are laying Pupin underground cables between Wilmington and New York. The estimated cost of the work is $2,500,000. With other changes the cost will be brought up to $3,000,000.

TIME SIGNALS AT NIGHT.—The Western Union Telegraph Company, in addition to dropping the time ball at noon, now flashes each hour after dark a green electric light from the tower of its building at No. 195 Broadway. The light flashes precisely on the hour, and remains lighted ten seconds, so that mariners can take their reckoning either from the time the light flashes or from the time it disappears.

AN AMUSING SCHEME.—A special cable dispatch from Paris of November 11 says: "If Mr. Neill, a Canadian inventor, is successful in obtaining the telephone concession for which he is now negotiating with the French Government, America can prepare for an invasion of 2,000 Paris "hello" girls, who are pretty, of course. Mr. Neill, to offset the objection made against his automatic device that it would deprive 2,000 telephone girls of employment, has made a business proposal to M. Berard, director of the telephone service, to send the girls to Canada and the United States, where he undertakes to find husbands for them."

RADIUM ORE IN CALIFORNIA.—A despatch from San Francisco states that a deposit of uranium, or radium ore, has been found in Kern County by H. C. Jones. Mr. Jones declines to give the exact location, as it is on private property. Samples were shown of uranite, carnotite, black oxide, and pitchblende, all of which contain salts of uranium rich in radium. This is the first deposit of this ore found in California, and the second in the United States, others being in Gilpin County, Colorado. Mr. Jones says the ore is not in ledge formation, but is a deposit and evidently of volcanic origin. He estimates that it will take about 2,000 tons to produce an ounce of radium, which is worth about $12,000,000.

NOVEL NIAGARA DAM.—A concrete column erected in Victoria Park on the Canadian side of the falls after the plans of Isham Randolph, of Chicago, and designed to be a dam in prostrate form was tipped over on the afternoon of November 9 in the presence of a large crowd, many of them engineers, who had gathered to witness the event. The column was 7 ft. 4 in. square and stood 50 ft. high on a trestle that was 20 ft. above the ground level. Its approximate weight was 200 tons, and extending through the center was a heavy chain to keep the sections together after the column had been broken into six parts by wooden wedges inserted every 8 ft. The column was tipped by three jacks operated at the base of the trestle. It fell in nice shape, broke as desired, and raised the water in the intake 10½ in., which is believed to be sufficient for the needs of the city and the electric railway that use the intake jointly. This artificial barrier lies quite near the brink of the Horseshoe. It will be interesting to see how it withstands ice.

INDUSTRIAL DEVELOPMENT IN ITALY.—That Italy is rapidly assuming an important position among the industrial and commercial nations of Europe is shown by a recent report of Consul Cuneo at Turin. Her money is again at par and from her citizens in all parts of the world a steady golden stream is pouring into her banks and industrial institutions. The water in her hills is helping to regain a good deal that was lost because of the absence of coal. Power is rendered plentiful by her Alpine and Apennine streams. At the same time Consul Dunning, of Milan, points out that Italy's foreign trade is making remarkable strides, the gain in imports for the six months of 1905 being $9,873,135 over the same time in 1904, while exports increased $12,463,987. These increases indicate something of the rapid power of Italy to not only supply herself, either by first origin or by purchase at good terms, but also to enter many of the world's markets. Italy is determined to further extend her hold on South American markets and steps have been taken to bring the country into closer trade relations with Mexico. To place American goods in Italy means to meet the sharpest competition of wide-awake manufacturers, who are at last fully alive to their own capabilities and to the opportunities offered in their home territory.

OSCILLATORY-CURRENT RECTIFIER.—A patent issued November 7 to Prof. J. A. Fleming, of London, deals with the rectification of oscillatory electric currents for the purpose of allowing their values to be measured by means of an ordinary galvanometer. The patent is based on the discovery of the fact that if two conductors are enclosed in a vessel in which a good vacuum is made, one being heated to a high temperature, the space between the hot and cold conductors possesses a unilateral electric conductivity, and negative electricity can pass from the hot conductor, but not in the reverse direction. As the hot conductor should be heated to a very high temperature, say about 1,700° C., it is made of carbon, in the form of a filament such as is used in an ordinary incandescent electric lamp. The cold conductor may be of platinum or aluminum or else carbon. The two conductors are enclosed in a glass bulb similar to that of an incandescent lamp. The carbon filament is joined in a local battery circuit which serves to keep it heated to the proper temperature. By the use of two bulbs, so arranged that one permits negative electricity to flow in only one direction and the other allows negative electricity to flow in the opposite direction through it, it is possible to make use of the whole of the energy of the alternating current instead of discarding half of it. In this manner very feeble electrical oscillations can be detected by a sensitive mirror galvanometer.

JAPANESE COTTON MILLS.—Special Agent Crist, of the United States Bureau of Manufactures, in a report published by the Department of Commerce and Labor, says: "In view of the past favor which the output of Japanese cotton mills has met both here and in China, there is a strong tendency to turn to England to obtain the equipment for the enlargement and modernizing of the cotton weaving industry. This should be a fine opportunity for American manufacturers of spinning, weaving and power machinery to obtain a large share of this if they will send out expert men able to thoroughly demonstrate the economy, efficiency and simplicity of their machines. The situation is being closely watched by American importing houses having branches in New York, and there is a strong belief that steam turbo-generators, which are looked upon with high favor by the Japanese, with electric motors adapted to running looms or spindles in numbers of eight or ten, will meet with success. The engineer of the American Trading Company informs me he is making a close study of this question and that manufacturers of steam turbo-generators, motors or dynamos can obtain full information in regard to this matter by corresponding with the New York office of that company. I am also informed that this particular matter is being closely watched by representatives of English and German concerns."

THE WATER OF NIAGARA.—Resolutions passed by the International Deep Waterway Commission, recommending that no more franchises be granted for taking water from the Niagara River, the outlet of Lake Erie, and St. Marys River, the outlet of Lake Superior, have reached the War Department. Copies of the resolutions will be transmitted to the Governors of New York and Michigan, as the jurisdiction of the United States Government has been questioned. The extent of the authority of the Federal Government was discussed by the members of the commission at their recent session, and the opinion was expressed that the Federal Government undoubtedly had authority over water levels of navigable streams and lakes, although the title to the beds of the Niagara and St. Marys Rivers might be in serious doubt. It was declared that the National Government took undisputed control over the water level of Lake Michigan when the question was raised as to the right of the Chicago Drainage Commission to take water from Lake Michigan to drain the city of Chicago to the south and west, and finally to the Mississippi River. Possibly the point will be raised that in taking water from Niagara River below the rapids and at the Falls of Niagara, and from St. Marys River, below the Sault Ste. Marie rapids the levels of the lakes cannot be affected, and further, that the streams from which the water is taken are not navigable streams and for this reason are not under the control of the Federal Government. There seems to be no question about the authority of the Canadian Government to regulate the taking of water from the streams. It is stated that any action of the Canadian Government will be final, and that the regulation will not depend upon the provincial government of Ontario.

A LONDON WALDORF.—London is to have a superb "Waldorf" Hotel, with all the modern refinements in electric light, motors, elevators, etc. J. G. White & Co. are the contractors. An initial expenditure of $1,500,000 will be made.

"OPEN SHOP."—Mr. F. A. Swan, of the Swan Electric Company, Boston, chairman of the Ways and Means Committee of the new organization there to protect the interests of the "open shop" and push the campaign, informs us that it is desired and intended to issue an "open shop directory." Data are now being collected as to all "open shop" electrical contractors, and it is requested that such send their names, addresses, etc., to the Open Shop Committee, Electrical Contractors' Association, 88 Broad Street, Boston. Another meeting is to be held soon at the rooms of the Employers' Association.

AT THE COAL PIT.—It is said to be the intention to put in the center of the Indiana coal fields a large power plant for the generation of electricity which is to furnish all the power needed for the traction lines of the central and southern parts of the State. Those interested in the project claim that the power can be generated and transmitted to the sub-stations by electric lines more cheaply than the coal can be carted to the present stations and burned in separate plants. The first installation is expected to be in the neighborhood of 10,000 hp and the estimated cost is about $1,000,000.

ELECTRIFYING THE WEST.—A good deal of new railroad building is predicted, and it is certain that much of it will be electrical. It is noted that the extension of the rural telephone, which has reached over the Middle West to a surprising degree is to be followed by a trolley extension in the next half decade. The country communities are ready to vote bonds for trolley lines and there is said to be a rich harvest for the promoters first in the field. The railroads are trying to anticipate the coming of the trolley by placing gasoline cars on their branch lines, but this cannot interfere with cross-country electric lines.

OWNERSHIP AT LITTLE ROCK.—Municipal ownership of all public utilities, including the street railway, electric and gas lighting plant and telephone systems, will be demanded by the platform which will be adopted by the Socialists at the first city convention, which will be held at Little Rock, Ark., Thursday, November 23. It is said, also, that a plank will be included in the platform pledging the enactment of legislation for free legal advice, the abolition of the fee system in all courts, free medical attendance, pension for all public employes when disabled in the service, the establishment of municipal labor bureaus, bakeries, ice houses, wood and coalyards and the abolition of the contract system for all municipal work.

NEW TYPE OF POLE.—According to the *Iron Age* a new system of electric line poles is attracting considerable attention in Europe. A wooden pole with spikes fitted in it forms a core. Around the outside of these spikes is wound a sheet of wire gauze of large mesh, while a layer of cement 2 in. thick is put over the gauze. This is found to make a very solid pole, which is not acted upon by the weather; it lasts as well as an iron pole and costs only about one-half as much. Cross arms are fitted by means of curved iron pieces bolted so as to embrace the pole. A line 30 miles in length has been erected. The poles are 45 ft. apart, measure 12 in. in diameter at the base and 8 at the top and are about 40 ft. long. The portion planted in the ground measures about 5 ft. in length.

PILING UP DEBT.—Sir Edwin Cornwall, chairman of the London County Council, has rather startled Londoners by the recital of some of the stupendous figures in his budget speech. Within sixteen years the debt of the County Council has increased from £17,563,262 ($87,816,310) to £44,620,266 ($223,101,330), and the amount expended on the local government of London is greater than that of Norway and Sweden combined, double that of Roumania and four times that of Denmark. But the Council has further debt projects in view. A new scheme of food relief is to cost over £4,500,000 ($22,500,000), and the Council is now responsible for the work that used to be done by the London School Board; it costs £4 1s. 3d. ($20.35) a year to educate a child in London. This is a higher sum than anywhere else," said Sir Edwin, "with the single exception of New York."

TELEPHONY ON THE COAST.—Mr. J. E. McGillivray, manager of the Lewiston-Clark Home Telephone Company, Limited, of Lewiston, Idaho, writes us as follows: "I wrote you some time ago that we had projected an independent telephone movement here and succeeded in getting in a very short time a larger number of contracts than the Pacific States Company had subscribers at this point. You made a note of it in your news column, and I now write you to give you further details of what we are doing. It has been decided to abandon the project of installing a local independent plant here. We all appreciate the harmful effects on a business community of having two telephone systems, and inasmuch as the Pacific States Company seems disposed to act in a very fair and generous spirit in reference to improvements, our local commercial club took the matter up and made a thorough investigation, after which they recommended that we retire from the field. The Pacific States Company have made a guarantee that they will install, within six months, a common battery multiple plant and improve their outside construction work greatly, provided the field is left clear for them. It was decided, after going into the matter thoroughly, that the best interests of the community would be served by taking advantage of their proposal and the matter is now a closed incident."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Fifty-second meeting of the American Society of Mechanical Engineers will be held in New York City during the first week in December. The headquarters, instead of being at the Society House, 12 West Thirty-first Street, as in previous years, will be at the Edison Auditorium, 44 West Twenty-seventh Street, the two upper floors being used. The opening session at which President John R. Freeman will present the annual address will be held there on Tuesday evening, December 5. The second or business session will be held Wednesday morning in the main saloon of the steamship *Amerika* at the docks of the Hamburg-American Line at Hoboken, N. J. Following this session a special train will take those desiring to make the excursion to the new Worthington hydraulic works at Harrison, N. J. Wednesday evening there will be an illustrated lecture at the Edison Auditorium by Prof. R. W. Wood, of Johns Hopkins University on "Photography of Invisible Phenomena." The third session will be on Thursday morning and besides the presentation of professional papers there will be a discussion on the subject of "Bearings." Thursday afternoon there will be a reception at the New York School of Automobile Engineers, 146 West Fifty-sixth Street. The usual reception at Sherry's will occur on Thursday evening. The closing session will be held on Friday morning and will be devoted to the presentation of professional papers.

NEW HEATING SYSTEM IN CANADA.—United States Consul M. K. Moorhead, of St. Thomas, Ontario, sends an account of a new method of utilizing exhaust steam for purposes of heating. Two public buildings of St. Thomas are heated in this way by the exhaust steam of the engines used in the street railway and electric power houses. The steam is made to pass around small copper tubes filled with water, the hot water being conducted to the buildings in well-protected 4-in. tubes. The report says: "The exhaust steam is carried through a heater which is filled with small, corrugated copper tubes, these tubes being filled with water. In passing through this heater the water is heated to a temperature the same as the steam. Then, by means of a force pump, it is forced through a main pipe, 4 in. in diameter, to the buildings, where it is attached to the mains and the radiators in the buildings. There is also a return pipe which carries the water back after passing through the radiators, when it is again heated to any desired extent, the heating being regulated either by the speed of the pump or by control valves placed on the mains as they enter each building. The 4-in. mains and the return pipe which carry heat to the buildings are laid underground. They are covered with asbestos wool to prevent the heat escaping, and then wrapped with hemp packing and enclosed in a 12-in. vitrified tile with cement joints. The saving of this system will be practically the whole cost of heating the buildings with coal. There will also be the saving of the labor attending the firing of the furnaces."

Niagara Power in the Gorge.—I.

IT was a gala day at Niagara Falls. Music and celebration marked the turning of the first sod for the development of power in the gorge. This was in the summer of 1853. According to the plans of the promoters, water was to be diverted from Niagara River about one mile above the falls, led across the village of Niagara Falls by a canal, and then used to develop power by dropping into the gorge, some half a mile down stream from the American cataract. In this way a water head of nearly 220 ft. was to be obtained. This plan, as far as execution went, was then new.

During fully a century and a quarter, or since 1725, the fall along the rapids between the New York bank and Goat Island, which amounted to about 50 ft., had been utilized for lumber, grist and paper mills. But prior to 1853 no one seems to have been hardy enough to attempt the development of power in the gorge below the falls, though Augustus Porter is said to have suggested such a plan as early as 1842.

From that summer day in 1853, when the little village of Niagara Falls seemed about to develop the greatest water power in the world, it was a score of years before any useful work was done, and then the canal had been discharging water into the gorge, and thus forming a miniature Niagara, for a decade. In explanation of this condition, it may be stated that the Niagara Falls Hydraulic Company, which began work on the canal in 1853, reached the limit of its financial resources in about 16 months, and work had to stop. In September, 1860, Horace H. Day secured control of the abandoned work, and completed a canal 4,400 ft. long, 36 ft. wide and about 8 ft. deep, on July 1, 1860. Then the Civil War arrested most lines of industrial development, and one of the finest water power developments on the continent remained unused during more than a decade.

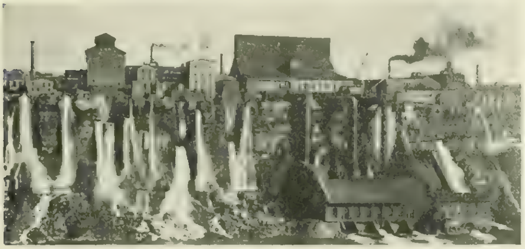


FIG. 1.—POWER HOUSES OF THE CLIFF PAPER CO. AND THE HYDRAULIC POWER & MFG. CO.

FIG. 2.—WINTER VIEW OF GORGE BELOW NIAGARA FALLS.

In the year 1871 C. B. Gaskill built a gristmill at the lower end of the canal, excavated a wheel pit some 25 ft. deep from the top of the cliff, and then a horizontal tunnel from the bottom of this pit to the gorge. In this pit vertical wheels of 100 hp capacity were placed, and thus the development of power by the diversion of Niagara water from the upper to the lower river began. During twenty years, or until 1892, this type of development was multiplied along the edge of the cliff at the lower end of the canal, and the results may now be seen in the discharge from nearly a score of tunnels that enter the gorge from 100 to 175 ft. above the river level. Meantime the canal with terminal areas fronting on the upper and lower river was purchased by the late Jacob F. Schoellkopf and the late Abram Chesborough, in 1877, who organized the Niagara Falls Hydraulic Power & Manufacturing Company.

As developed by this company, the hydraulic site includes a frontage of 800 ft. on the upper river, a width of 100 ft. over the entire length of the canal, and a frontage of nearly a mile along the high bank of the gorge. The upper end of the canal on the river front has a depth of 14 ft., and at the lower end there is a basin 1,000 ft. long and 70 ft. wide near the edge of the cliff. In 1881 the first electric station of the Niagara Falls Hydraulic Power & Manufacturing Company, and the first to supply street and commercial lighting at the falls, began to be operated in what was then Quigley's Mill, now the mill of the Cliff Paper Company, with water from the canal.

Down to 1892 all the power developments with water from the canal, whether by the Hydraulic Company or its lessees, were made with pits sunk from the top of the cliff, and with horizontal tunnels running from the bottoms of these pits to the face of the cliff, as above described. In that year, however, the Cliff Paper Company decided to do what no one had done before; that is, build a power plant and mill in the gorge, some 200 ft. beneath the top of the cliff, and just above the river level. Prior to this time the development of power had been confined to the comparatively low heads of water utilized along the top of the cliff, because of the supposed difficulty of building turbine wheels to operate under water pressures of more than 100 ft. Twelve years earlier, in 1880, a prominent manufacturer of turbines had tried three times before he succeeded in making some 48-in. wheels strong enough to operate under a head of 83 ft., in one of the above pits.

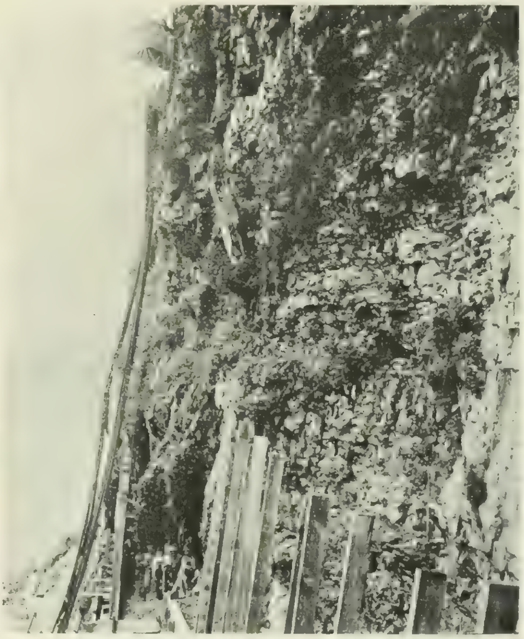


FIG. 3.—VIEW OF ALUMINUM CONDUCTORS, SHOWING CONCRETE FACING IN PROCESS OF CONSTRUCTION.

In 1892 the Cliff Paper Company was utilizing water drawn from the canal in a wheel pit where the head was 75 ft., and the water was then discharged into the gorge. Water was charged for according to the volume used, and the paper company decided to more than double its power per cubic foot, by using the entire available head. To do this a penstock was connected with the tail water of the wheels in the 75-ft. pit, and by extending this penstock down the face of the cliff nearly to the river level a head of 125 ft. was obtained for another set of wheels there located, and using water which came down from those above.

Twenty-five hundred horse-power developed by this, the first plant in the gorge, is used to grind wood pulp. The penstock springing from the face of the cliff, also the covered conveyor for the wood and pulp between the top of the cliff and the mill at its foot, may be noted in Fig. 1.

By 1895 the prospect for the sale of electric energy at Niagara Falls was such that the Hydraulic Power & Manufacturing Company decided to build another electric station, and what was more notable, to do what no one else at the falls had done, not only erect the new electric plant in the gorge, but also use in each set of wheels substantially the entire head of water afforded by the falls and upper rapids. The site selected for this first electric power house in the gorge was on a narrow shelf of rock 200 ft. below the top of the cliff and another 200 ft. above the bottom of the river that washes its edge, close to the pulp mill of the Cliff Paper Company. On this site the electric station was erected in three sections, the first of which began to operate on October 13, 1896.

In construction the electric station is a one-story stone building rising from a layer of hard limestone and capped with a steel truss roof. As to floor area, the station is 170 ft. long parallel with the river, and 100 ft. wide between the river and the cliff. Between the face of the cliff and the river, at one end of the station, a thick and high masonry wall has been built to protect the station from any possible damage by reason of the small mountain of ice that accumulates at the face of the cliff every winter, by the freezing of the tail water from its numerous tunnels (see Fig. 2).

The cliff at this point, as along most of the Niagara gorge, is made up of alternate horizontal layers of soft shale and hard limestone, which the action of water and frost is constantly disintegrating. As the cliff almost overhangs the electric station, it was decided a year or two ago to protect the latter by covering the entire face of the former with a layer of concrete, so that all danger of falling rock would be averted. This facing of concrete runs up the cliff 150.5 ft., and is reinforced at intervals by abutments that rise to about 78 ft. above the base. Steel rods with one end of each secured in the cliff run out horizontally into the concrete facing and abutments and serve to hold them in position. As the facing is nearly vertical along much of its height, the method of placing it was to erect temporary wooden forms at such distances from the face of the cliff as to give the desired thicknesses of concrete, and then, after cleaning the cliff, to fill in the space between it and the forms with concrete, as indicated in Fig. 3.

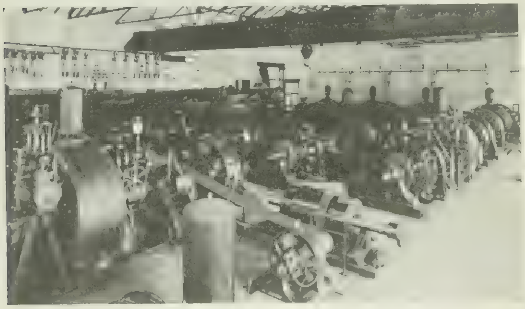


FIG. 4.—INTERIOR OF POWER HOUSE, SHOWING SWITCHBOARD.

On its interior the electric station consists of a single room with the horizontal turbine water wheels and direct-connected electric generators mounted side by side on the concrete floor. At the cliff side of the station and on a raised gallery is the switchboard, as shown in Fig. 4, and above all, spanning the entire width, is the traveling crane. Water wheels and electric generators are arranged in three groups or sections, numbered one, two and three in the order of their erection. Each group contains a row of water wheels at right angles to the river and the face of the cliff, and beneath each row of wheels there is a tail race which discharges into the river over a low dam, whose crest is at an elevation 344 ft. above tide water. These dams at the mouths of the tail races stand a few feet above the normal river level, and their use is desirable to maintain a fairly constant head on the wheels, because of the great rise and fall of the water surface in Niagara gorge.

Above the tail races the floor of the station is at such an elevation that draft tubes 25 ft. long are used with the wheels. In the forebay, at the top of the cliff, the mean low water level is 213 ft. above the crest of the dam at the outlet of each tail race, and the net head of water on the turbine is about 210 ft. This head is greater by many feet than that on the wheels of any other power station about Niagara Falls.

Water for the three groups of wheels in the station comes down from the forebay in three penstocks, one of which has a diameter of 8.5 ft., and each of the other two a diameter of 11 ft. The group connected with the 8.5-ft. penstock, which was the first to be installed, contains four pairs of Leffel wheels with a combined rating of 6,850 hp. Each of three of these pairs of wheels is rated at 1,650 hp, and the fourth at 1,900 hp.

One of the 11-ft. penstocks connects with five pairs of horizontal wheels that have a total capacity of 13,200 hp. This capacity is made up of two sets of wheels of 2,300 hp each, two sets of 2,900 hp each, and one set of 2,800 hp. Five sets of wheels are connected to the third penstock and the total rating of these wheels is 13,300 hp, made up with two sets of 2,300 hp, and three sets of 2,900 hp each. These five sets of wheels are all of the I. P. Morris make. All the above turbines are of the horizontal type, and each has an electric generator direct-connected on each end of its shaft. Besides the above, there is one turbine of 250 hp, and one of 550 hp rating, both horizontal, which bring the total wheel capacity of the station up to 34,150 hp.

FIG. 5.—DETAILS OF TRANSMISSION LINE.

Each of the 11-ft. penstocks under the total head of 213 ft. is said to represent a greater power capacity than any elsewhere in the world. All of the turbine wheels operate with the effective head of about 210 ft. The 1,900-hp wheels operate at 300 r.p.m., the 2,800-hp wheels at 257, the 250-hp wheels at 600, the 550-hp wheels at 450, and all of the other turbines named at 250 r.p.m.

Each of the 1,650-hp wheels drive a pair of continuous-current Westinghouse generators that are rated at 280 volts, 2,000 amp. and 560 kw, individually, or 1,120 kw together. These six generators, with a combined capacity of 3,360 kw, supply energy to the Pittsburg Reduction Company, whose works are at the top of the cliff above the electric station. Connected to the 1,900-hp wheels are two 560-kw, 550-volt, continuous-current generators, and a belt from their common shaft drives 135-volt dynamos of 200 kw capacity.

One of the 550-volt generators carries a commercial load of stationary motors, and the other supplies current for the Niagara gorge electric road. A booster is also belted to this 1,900-hp wheel, and is connected in the feeder circuit of the Youngstown & Lewiston road, which extends 14 miles from the station. Power from the 135-volt dynamo goes to the National Electrolytic Company. Aside from the booster, the capacity of the electric machines driven by this wheel is 1,320 kw. Both the generators and the booster are of the General Electric make.

One of the 2,800-hp wheel sets is direct-connected to an 875-kw, 175-volt, continuous-current generator of General Electric make, which supplies power to the National Electrolytic Company, and also to a Bullock alternator rated at 1,000 kw and 11,000 volts, three-phase, which feeds into a distribution line for large power users. The total capacity of generators driven by this set of wheels is thus 1,875 kw. Both of the generators are direct-connected to one of the 2,900-hp pairs of wheels and were made by the General Electric Company, and their combined capacity is 1,875 kw. One of these generators, rated at 875 kw, supplies 5,000 amp. at 175 volts to the National Electrolytic Company, and the other, rated at 1,000 kw, develops 3,100 amp. at 325 volts for the Acker Process Company.

Another of the 2,900-hp wheels is direct-connected to a pair of General Electric generators, each of which has a capacity of 1,000 kw, 325 volts, and 3,100 amp., giving a total of 2,000 kw on this turbine, for the Acker Process Company. Each of two 2,300-hp pairs of wheels is direct-connected to a pair of 750-kw, 300-volt, continuous-current generators of Westinghouse make, and devoted to the work of the Pittsburg Reduction Company. The generator capacity of the two machines driven by each of these wheels is thus 1,500 kilowatts.

A third 2,900-hp wheel has a 1,000-kw, 11,000-volt, three-phase Bullock alternator at one end of its shaft, and a 700-kw, 2,200-volt, single-phase, Walker alternator at the other, giving it a load of 1,700 kw. The 700-kw alternator supplies a large percentage of the energy distributed by the Buffalo & Niagara Falls Electric Light & Power Company, which operates the electrical supply system in the city of Niagara Falls.

Each of the two remaining 2,900-hp sets of wheels drives a pair of 1,000-kw, 300-volt, continuous-current generators for the Pittsburg Reduction Company, so that there is a capacity of 2,000 kw connected to each set. A pair of 750-kw generators that supply current for the Pittsburg Reduction Company are coupled to each of the two remaining 2,300-hp wheels. Both the 1,000-kw and the 750-kw generators last named were made by the Westinghouse Company. The 250-hp turbine drives an exciting dynamo for the above alternators, the capacity being 150 kw at 125 volts. To the 550-hp turbine there is connected a 400-kw, 500-volt generator for commercial motor service. Including the exciter, the above list of electric equipment gives the first generating station in Niagara gorge a present capacity of 22,680 kw.

The two 1,000-kw, 11,000-volt, three-phase alternators above named, installed in 1902 and 1903, respectively, were the first alternating-current generators put into service for its own distribution lines by the Hydraulic Power & Manufacturing Company, though the 2,200-volt alternator supplying the local electric light company went into use at an earlier date. Power from these 11,000-volt alternators passes from the switchboard in the generating station through three-conductor, lead-covered cables to a terminal station at the top of the cliff. At this point the e.m.f. of a part of the power is transformed to 2,200 volts for nearby distribution, and the remainder is transmitted over a 11,000-volt, three-phase line to a large tract of land owned by the Hydraulic Power & Manufacturing Company, at the north end of the city.

The switchboard in the generating station, which is shown in Fig. 4, is about 100 ft. long. It contains 32 panels of Vermont marble and carries some very large switches. In spite of the variety of voltages at which continuous current is generated in the station, the switchboard is so arranged that there is a relay for every machine in case of trouble.

In addition to developing electric energy, the company supplies water from its canal for hydraulic power to the extent of 2,500 hp to the Cliff Paper Company, 700 hp to the Cataract City Milling Company, 2,200 hp to the Petebone Cataract Paper Company, 300 hp to the Oneida Community, Limited, 400 hp to the City Water Works and 1,800 hp to the Niagara Falls Milling Company, making a total of 7,900 hp.

As the electric generating capacity of the power company increases it is to be expected that some of the plants now using water from the canal at comparatively low heads will substitute electric motors for water wheels. In this way it is not improbable that the discharge of water from tunnels high up on the face of the cliff will be gradually discontinued.

After leaving the terminal station at the top of the cliff by way of underground cables, the 11,000-volt, three-phase circuits rise through the interiors of hollow wooden poles to junction boxes near their tops, as indicated in Fig. 5, and then run along a line of these poles to the land owned by the Hydraulic Power Company at the north end of the city. Each of these poles carries two cross arms and are arranged for two three-phase circuits. The cross arms are 3¾ by 4¾ in. in cross-section, and on each pole the lower arm is 5 and the upper arm 7 ft long. Insulators for the three conductors of each 11,000-volt circuit are supported on one side of each pole, two on the upper and one on the lower arm, so that the lines connecting them form an equilateral triangle with 24-in. sides. From the lower outside edge of each insulator to the cross arm the distance is three inches, and the greatest external diameter of each insulator is about six inches.

The transmission conductors are of No. 2 hard-drawn copper wire, and they are insulated because of their location within the city limits. At one point the overhead line crosses the tracks of the New York Central Railway, and a sort of steel net is suspended beneath the 11,000-volt conductors. For the purpose of this net a pair of steel cables, each made up of seven No. 12 B. & S. gauge wires, are strung over the railway at a distance of nearly 3 ft. beneath the lower power wires, and about 8 ft 7 in. apart. These cables are supported at the ends of a third cross arm on each pole, and about 5 ft. beyond each pole they are secured to a common guy wire. At intervals of about 10½ ft. along the span of this pair of cables they are connected by steel cross wires of No. 6 B. & S. gauge. This steel net is grounded by a wire that runs down one of the poles to which the net is attached.

At the north end of the city, on the large tract of land owned by the Hydraulic Power Company, the 11,000-volt line enters a transformer house, and a part of the transmitted power is reduced in pressure for distribution to the factories located there. Two of the largest of these factories are those of the Carter-Crume Company, and of the Central Machine Company. Motors of the following numbers and capacities are supplied with current by the 11,000-volt, three-phase line:

	No.	Voltage.	H.P. each.	Total H.P.
	1	11,000	875	875
	1	2,200	100	100
	1	440	75	75
	2	440	50	100
	3	440	40	120
	6	440	30	180
	2	440	20	40
	1	440	15	15
	2	440	7½	15
	1	440	5	5
	2	440	3	6
	1	400	20	20
	1	400	5	5
	2	400	1	2
	1	220	50	50
	1	220	40	40
	3	220	30	90
	1	220	10	10
	1	220	5	5
	1	220	3	3
	1	220	2	2
Total,	35			1758

Besides these motors that are supplied with alternating current, there is a large aggregate capacity in direct-current motors, operated by means of the two 500 to 550-volt generators of 960 kw combined rating, named above. Railway work is done by one 560-kw generator and a booster.

The three electric generators which are devoted to the work of the National Electrolytic Company have a combined rating of 1,950 kw, and two of them are competent to supply 10,000 amp. at 175 volts. A capacity of 3,000 kw and 9,240 amp. in three generators is devoted to the operations of the Acker Process Company, the pressure being 325 volts. In the plant of the Pittsburg Reduction Company, the output of eighteen generators, with a total rating of 13,360 kw and 37,866 amp. at 300 volts, is utilized. All three of these companies using large direct currents at low pressures have their works located not far from the edge of the cliff above the electric generating station of the Hydraulic Power Company in the gorge, and very large conductors are necessarily used to transmit the power from the generators to the electrolytic furnaces, as may be noted in one of the cuts.

Between the electric power station and the works of the Acker Process Company the distance is about 1,600 ft., and the current is carried by large bundles of aluminum conductors laid underground. The circuit from the generating plant to the furnaces of the Pittsburg Reduction Company consists of 60 copper cables of 500,000 c.m. each, and 100 aluminum cables of 1,000,000 c.m. each, in each leg, and, as seen in Fig. 3, these great conductors, without insulation, hang over the face of the cliff.

◆

The Reichsanstalt Standards.

In a note, the London *Electrician* says that in January, 1904, the four standard manganin resistances were checked against the mercury resistance standards, and the average resistance measured was 1.001730 ohm at 18° C., as compared with 1.001741 ohm, the mean of the measurements of the previous 10 years. A number of experiments were (and are still being) made to determine the exact relation between the thermal and electric units, and it is stated provisionally that the gramme calorie at 15° C. corresponds to 4.19 watt-seconds.

Heavy Electric Railroading.

By Bela Valatin.

THE well-known disadvantages of the direct-current traction system with a pressure of 500 to 750 volts in the working conductor, consist in the large capital outlay which the great current transmission and rotary converter sub-stations necessitate, and in the inconveniences and troubles caused by the position of the working conductor located at the track level when a third rail is used. These disadvantages have brought about a desire of solving the problem of electric traction by the use of other than the direct-current system.

The first new system to be adopted was the high-tension, three-phase system, which was put to practical use on the Valtellina line, an electric railway in Italy, and was also seriously considered for the electrification of the London Underground Railway. Three-phase current had already been employed on several railways in Switzerland, which were installed by Brown, Boveri & Co., and was also used on the Berlin-Zossen high-speed test line.

Many engineers have believed that the three phase system presented difficulties owing to the need for two overhead wires, and to the assumption that no suitable speed control could be found for it. They, therefore, welcomed the development of the single-phase commutator motor with which they could see the possibility of using only one wire and could obtain an easy and economical speed control. It had been the general opinion that the single-phase would be the ideal traction system for heavy train service, but a suitable motor had not been produced, as the single-phase commutator motor had not been considered suitable for this purpose on account of the destructive sparking.

After a few firms succeeded in constructing single-phase commutator motors which were not subject to destructive sparking, it was generally believed that there had been found a system which would supersede all others. The use of only one contact wire and also the starting without rheostat seemed greatly to influence the electrical engineers.

COMPARISON OF THE WEIGHTS OF ELECTRIC RAILWAY MOTORS.

No.	Name of Manufacturer. Type of Motor.	Name of the Line Where the Motor was Used.	HP.	RPM. = n	E.M.F.	Frequency.	Method of Driving.	Gear Ratio.	Weight=G Inc. Gears. Kilograms.	Weight=G Without Gears. Kilograms.	Weight Factor. $\frac{nG}{100 \text{ HP.}}$
	(A) DIRECT-CURRENT MOTORS.										
1.	Union & General Electric Co., "GE 57"		50	580	...	..	Geared	...	....	1350	157
2.	Westinghouse, "56"		55	475	...	..	Geared	...	1360	1222	105
3.	Siemens & Halske, D 17 30	Berlin Elevated and Subway	60	800	750	..	Geared	1:4	1575	1400	187
4.	Westinghouse, 56		75	400	...	..	Geared	...	1040	1800	118
5.	Siemens & Halske, D 16 30		85	720	750	..	Geared	...	1750	1550	132
6.	General Electric Co.	Central London, Motor Car. 1st Type	100	475	500	..	Geared	1:2.7	....	1820	86
7.	Westinghouse, 50 C		150	550	...	..	Geared	..	2400	2250	81
8.	Oerlikon	Freiburg-Musten Line Motor Car	150	400	750	..	Geared	1:4	3050	2700	101
9.	General Electric Co., "GE 55"	Central London Ry., New Locomotive	166	500	...	..	Geared	1:3.3	....	2460	74
10.	General Electric Co.	Central London Ry., Old Locomotive	200	152	500	..	Direct connected	...	....	5420	41
11.	Siemens & Halske, D 25 50		210	520	...	..	Direct connected	...	4800	4100	101
12.	General Electric Co.	N. Y. C. & H. R. R., Locomotive	550	300	600	..	Direct connected	...	....	....	...
	(B) SINGLE-PHASE MOTORS.										
13.	Oerlikon	Experimental Motor	35	1000	200	25	Geared	...	....	1000	286[1]
14.	AEG Union, WE 31	Stubaithal Motor Car	40	800	550	40	Geared	1:5.07	....	1385	277[2]
15.	General Electric Co., GEA 604	Schenectady-Ballston Line	50	...	200	25	Geared	1:3.74	....	....	...[3]
16.	General Electric Co., GEA 605	Bloomington, Pontiac & Joliet Line	75	1500	200	25	Geared	1:4.3	....	2220	444[4]
17.	Siemens-Schuckert	Murnau-Oberammergau	100	530	270	16	Geared	1:5	....	....	...[5]
18.	AEG-Union	Spindlersfeld Railway	100-120	800	6000	25	Geared	...	2360	2100	168-140
19.	Westinghouse	Swedish Government Locomotive	150	1270	200	25	Geared	1:3.88	....	2500	210
20.	Oerlikon	Proposed Locomotive	200	650-1000	...	15	Geared	...	....	3000	98-150[6]
21.	Westinghouse	Experimental Locomotive	225	300	140-325	..	Geared	1:5.27	....	....	...[7]
	(C) POLYPHASE MOTORS.										
22.	Brown-Boveri	Burgdorf-Thun, Motor Car	60	600	750	40	Geared	1:3	....	1500	150[8]
23.	Brown-Boveri	Burgdorf-Thun, Locomotive	150	300	750	40	Geared	1:1.88	....	4000	80
24.	Brown Boveri	Jungfrau, Locomotive	120	750	500	38	Geared	...	....	2100	132
25.	Siemens & Halske	Marienfelde-Zossen High-Speed Ry.	250 norm. 750 max	900	1150-1880	45-50	Direct connected	...	....	3200	123-41
26.	AEG.	Marienfelde-Zossen High-Speed Ry.	250 norm. 750 max	900	435	50	Direct connected	...	....	4075	146-49
27.	Ganz & Comp.	Wollersdorfer Locomotive	75	600	3000	42	Geared	1:6	1440	1065	85
28.	Ganz & Comp.	Canada, Motor Car	120	750	1100	25	Geared	1:3.27	....	1750	109[9]
29.	Ganz & Comp.	Port Madoc, Locomotive	180	750	600	50	Geared and driven by coupling rod	1:3	....	1610	67
30.	Ganz & Comp.	Valtellina, Old Locomotive	225	128	3000	15	Direct connected	...	....	4900	28
31.	Ganz & Comp.	Valtellina, Motor Car	250	300	3000	15	Direct connected	...	....	3800	45.6
32.	Ganz & Comp.	Proposed Locomotive, Interurban	400	168	2000	14	Coupling rod	...	....	6950	29
33.	Ganz & Comp.	Proposed Motor Car, Interurban	350	900	3000	30	Geared	1:3.1	2800	2550	65.6
34.	Ganz & Comp.	Proposed Locomotive	600	225	3000	15	Direct connected	...	....	6700	25
35.	Ganz & Comp.	New Valtellina Locomotive Without Cascade Motor	600	225	3000	15	Coupling rod	...	....	8150	30.5[10]
36.	Ganz & Comp.	New Valtellina Locomotive With Cascade Motor	450	112.5	3000	15	Coupling rod	..	....	12400	31

[1] Street Railway Journal, 1905, IV., 8. [2] Elek. Bahn. & Betrieb, 1905, p. 297. [3] Direct-current and alternating-current motor. [4] Street Railway Journal, 1905, p. 812. [5] Elektrische Bahnen & Betriebe, 1905, p. 388. [6] Street Railway Journal, 1905, IV., 8. [7] Street Railway Journal. [8] Siegfried Herzog: Die elektrischen Anlagen der Schweiz, Vol I. [9] Combined polyphase and direct-current motor. [10] Weight without Cascade motor.

The high-tension, three-phase system had in the meantime been developed by Ganz & Co., and results have been reached which numerous electrical engineers had believed impossible.

There are, therefore, now three competitive systems, the direct-current, the single-phase and the three-phase, and it is possible that each will find adoption in particular cases. A comparison of the three different systems, particularly for such installations which are to be used for moving heavy train units and where electricity is to replace the steam locomotive, is given below. The principal points which enter into electric traction for main line railway service, and which determine the choice of any particular system, comprise the amount of capital outlay, the economy of operation, security of service, and flexibility of the system to meet the special requirements of traffic on a main line railway.

From a railway technical point of view it is of greatest advantage that the motor should make the same number of revolutions per minute as the car axle in order to avoid the energy losses otherwise caused by the gearing used to transmit the power from the motor shaft to the car axle. It is necessary, however, that the gearless driving motor be thoroughly spring suspended, as otherwise poor results similar to those obtained with the gearless locomotive of the London Central Railway might be expected. Where the motor has been flexibly suspended on the car axle, as is the case on the Valtellina motor cars, the results have been exceedingly satisfactory. With the newest type of Valtellina locomotive there is employed another way of driving the axle at the same number of revolutions, as the motor, viz., by means of a connecting rod. By this new method an advantage is gained over the direct-coupling of the motor to the axle, in that the motor is made independent of the locomotive axles and wheels. The mechanical efficiency of this new method is very high. Tests have shown that the use of connecting rods does not increase the friction losses over those due to direct connection.

Much has been said theoretically with reference to motor weights, but it will be admitted that the practical results obtained in actual construction of the various types furnish the only correct basis of comparisons. An examination of the single-phase railway motors now in use, shows that their weight factor is generally twice as much as that of the heavy three-phase motors constructed by Ganz & Co.

The accompanying table gives a comprehensive comparison of traction motors of the direct-current, single-phase and three-phase types. The table indicates the output capacity of each motor when operated at a load which will cause an increase of temperature not exceeding 75° C. in one hour. The speed of the motor when operating at this load is also shown. It will be observed that the weight factors of the polyphase motors indicates that these machines give the best output for the amount of material used.

Experience shows that it is possible to design direct-current and three-phase motors of high efficiency with a small number of revolutions, for direct-connection to the driving axle, while the single-phase motor requires a speed reducing ratio in most cases between 5 to 1 and 6 to 1. The heavy weight of the single-phase motor also necessitates a large space for housing which peculiarity partly accounts for the inability to design a motor of large output and a low number of revolutions.

For the construction of large motors with a low number of revolutions, the three-phase motors are specially well suited owing to their ability of better utilizing the space, inasmuch as the collector rings can be placed outside of the frame, a construction that is practically impossible with the commutator motors. The weight of a three-phase motor is less than that of a direct-current motor, partly because collector rings of the former add much less to the weight than the commutator of the latter. The reduced efficiency, the corresponding increased losses, the larger commutator, the pulsating magnetic field, all cause the weight of the single-phase motor to be greater than that of the direct-current motor.

It has often been asserted that the reduced weight of the three-phase motor has been secured at the cost of security, by dangerous reduction of air-gap. The practical experience with three-phase motors has proven that this assertion is unwarranted and to confirm this statement it need here only be mentioned that the bearings of the motor cars of the Valtellina line after a service of 125,000 miles did not require to be replaced.

It has frequently been affirmed that the equipment for cascade regulation used by Ganz & Co. compares unfavorably in regard to weight with the control apparatus used in other systems. This assertion rests partly on the fact that the power for the low pressure (secondary) motor has to pass through the primary motor, so that the internal losses are increased under cascade connection. It has been found, however, that even with the decreased efficiency of the primary motor the three-phase system is more advantageous than any system using other motors.

The statement that the cascade regulation involves a dead weight because at the maximum speed one motor is disconnected is by itself unsupportable. The cascade regulation is used principally to allow the ascending of grades at a decreased speed and to insure a higher economy at starting. In the first case, the cascade connection permits a greater drawbar pull without the great energy consumption on steep grades and it is no disadvantage if at a greater speed the reduced drawbar pull can be distributed over fewer motors, allowing some of them to be disconnected. In the second case, where the cascade connection is used for starting, it is an advantage that during the higher speed, when great acceleration is of no importance, the current consumption and thus the current rush is decreased by using a less number of motors.

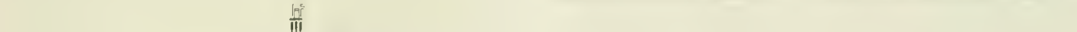


Fig. 1.—Series-Parallel Arrangement of High-Tension, Three-Phase Motors.

There is, however, no difficulty in using all motors in parallel under high tension. Fig. 1 shows an arrangement, due to Koloman v. Kando, by which both motors can be used under high tension, and work in parallel at high speed. In cascade connection a transformer is put in circuit between the starting rheostat and the high-tension side of the secondary motor. This transformer is used only when starting, and it can, therefore, be very small, it does not influence the economy, inasmuch as the transformer losses simply replace a part of the rheostat losses. The fact that this connection has so far not been practically used proves the correctness of the previously stated argument in favor of cascade regulation with high-tension and low-tension motors.

It has often been claimed that the three-phase system could not be as economical as other systems on roads with a variable profile inasmuch as it operates at a constant speed on all grades. This, it is claimed, would increase the internal losses of the three-phase motors, and also their weight. Even if this statement could be substantiated, it would be found that the increase of weight would be of very little consequence. On the other hand, it will be found that the efficiency of the three-phase motor is generally so much better than that of the series motor, that the change in load does not greatly increase the internal losses. Fig. 2 shows the efficiency curve of the motors of the Valtellina motor cars. (The larger motors of the new Valtellina locomotives are much more efficient.)

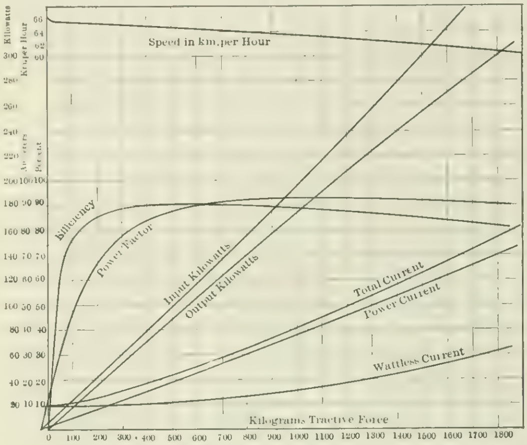


FIG. 2.—CHARACTERISTICS OF VALTELLINA 15-CYCLE, THREE-PHASE MOTORS.

The capital outlay for the electric equipment of the vehicles depends very much on the motor weights. The standard direct-current system has the advantage over the high tension system, though the difference is not of importance. The single-phase system is, however, quite disadvantageous, requiring, as it does, a step down and regulating transformer, thereby increasing the weight and at the same time the capital outlay. Of further importance and unfavorable to the single-phase system, particularly with locomotives, is the pulsating torque of the single-phase motor, which does not allow a full utilization of the adhesion weight, thus requiring an increased locomotive weight..

With reference to the operating cost, the energy consumption for each of the three systems can cause considerable differences, particularly when water power cannot be obtained. In considering the energy economy of various systems, two kinds of railway service have to be judged, namely, those with few stops, and those with many stops. In the first case the economy in starting is of no particular importance, while for the second case it is of prime importance.

On lines where trains run long distances without stopping the single-phase motor is less advantageous than the direct-current and three-phase motors. The 225-hp series motor of the Westinghouse Company, according to recent publication, shows a maximum efficiency of 86 per cent, the direct-current motors of the N. Y. Central locomotives 93 per cent, and the three-phase motors of the new Valtellina locomotives 95 per cent.

Of much more consequence than the efficiency of the motors on railway lines with long distance stops is whether the energy transmitted to the moving trains on down grades must be mechanically braked, or can be returned to the line to be used by other trains. The recuperation is of special importance when the returned energy can be used immediately, this would be the case where there is a dense traffic or where the central station is also called upon to supply energy for other purposes than the moving of trains. The experience on the Valtellina line shows that the recuperation on light down grades is used to advantage even though no other train is simultaneously on the line to absorb the same.

On roads having frequent stops the starting losses are of great importance. With direct-current motors the start up to two-thirds of the maximum speed, is made by the use of the rheostat; beyond that speed the acceleration is accomplished without the rheostat. To stop the train the mechanical brakes are applied to destroy the kinetic energy of the train. The acceleration of the single-phase motors is accomplished by voltage control, thus avoiding the rheostat losses. The stop has to be made in the same way as with direct-current motors. Starting without the use of the rheostat appears ideal at the first glance. It should, however, be considered that the efficiency of a single-phase motor at a low speed is very much less than that of the direct-current motor, and that there are losses in the control transformer. As a matter of fact, the run diagrams of the Spindlerfelde single-phase road with voltage control show about the same energy consumption as has been calculated for direct-current motors. Still more unfavorable is the energy consumption for single-phase motors when the comparison is made on the basis of train-kilometer instead of ton-kilometer, on account of the electric equipment which amounts to about 7.5 per cent more than the direct-current equipment.

Single-phase has the advantage over direct-current of saving the transmission losses caused by the rotary converters, estimated at from 10 to 20 per cent. This advantage is also possessed by three-phase current.

With reference to starting, three-phase has the disadvantage that the rheostat losses are larger than with direct-current, inasmuch as the last part of the acceleration has also to be made by the use of the rheostat and not according to motor curve as is the case with direct-current. With the use of cascade regulation these losses can be reduced by half, but they are still larger than with direct-current. Three-phase current has, however, the advantage that when stopping a part of the kinetic energy of the train can be saved through cascade regulation. Experience on the Valtellina line shows that the recuperation obtained by cascade braking will offset the extra rheostat losses caused when starting.

With reference to the cost of maintenance of the electric equipment, exclusive of motors, there can be no important differences if the equipment for each system has been constructed in a workmanlike manner. It is otherwise, however, concerning the motor; the three-phase certainly has the advantage owing to the fact that no commutator is required. With the modern type of direct-current motors, the interruptions of service and repairs caused by the commutator are much less than formerly. Nevertheless, statistics show that even now most of the interruptions and repairs are traceable to the commutator. With single-phase motors, the chances of sparking and the dimensions of the commutator are greater than with the direct-current machines, hence the cost of maintenance must also be greater.

Of the high-tension systems the single-phase is particularly praised, because only one overhead wire is required. This advantage of the single-phase is being lauded particularly by the promoters of single-phase traction who claim that it simplifies the transmission line, that it is safer in service and considerably cheaper in first cost and in maintenance.

The existing installation of three-phase roads, particularly the Valtellina, have fully proven that the two-wire high-tension equipment fully conforms to the most severe exigencies for safety of service demanded by the important traffic of a main line railway, notwithstanding that the Valtellina installation employs wooden poles and a wire having a cross-section of 50 sq. mm. without longitudinal steel cable hangers. The experiences on the Valtellina have shown that the safety of service and durability of construction of the overhead equipment depend on the suitability of the current collector, and the cylindrical roller contact has given great satisfaction.

The air switches on the Valtellina line, even in station yards having 6 to 10 parallel tracks, have given very satisfactory results, and there exists no doubt that yards far more complicated can be equipped with this system to comply with the most intricate service.

The difference between the three-phase and single-phase system, with reference to the first cost of the contact wire, is due principally to the saving of a second wire, and the corresponding number of insulators, and in the consequent simplification of air switches.

It is worthy of note that with three-phase motors the trains on the line act as flywheels and thereby lessen the current rush. To illustrate this it may be stated that on the Valtellina from repeated plotting of the load diagram at the power house with 5 to 6 trains simultaneously on the line (see Fig. 3) the ratio of maximum load to the average load has been found to be from 1.6 to 1.8.

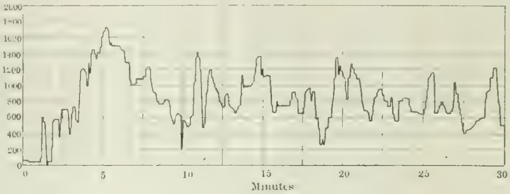


FIG. 3.—DIAGRAM SHOWING DEMAND FOR POWER.

In conclusion, it may be stated that for heavy electric traction the three-phase system is far superior to all others. If the single-phase system had not the advantage of requiring only one wire, instead of the two used by the three-phase, it would not be considered at all. Against the advantage of the single wire, there must be placed the lower installation cost, smaller weights of motor-cars or locomotives, greater security of service and less cost of maintenance on the side of the three-phase. In time these advantages will cause the present prejudice to be overcome.

◆

Electricity vs. Compressed Air in Mining.

In commenting upon the assumed advantages of compressed air in comparison with electricity as a means for transmitting power in mines, Mr. W. R. Hulbert brings forward the following facts in a recent issue of *Mines and Minerals*. One of the most important advantages claimed for compressed air is that the exhaust air may be used for ventilation. It is to be noted, however, that while compressed air rock drills undoubtedly ventilate the mine with their exhaust air, analysis shows that the carbonic oxide gas formed in the cylinders is apt to have an exceedingly bad effect on the health of the workmen. The modern compressed air rock drill cannot use air expansively on account of the trouble due to the freezing up of the exhaust ports, and hence a large amount of power is thrown away. A small electric blower, requiring less than one-thirtieth the power necessary to operate a 3-in. rock drill, will effect all of the ventilation which would be accomplished by the exhaust from the drill. In general it might be said that a 3¼-in. electric drill will consume only from 2½ to 3 hp against 15 hp for an air drill of the same size. Taking into consideration also the fact that electric power is more economical in production and transmission, it would seem as though there ought to be a large field for its use in the mining industry in the future.

A Central Station Campaign at Niagara Falls.

The business of the Buffalo & Niagara Falls Electric Light & Power Company has very materially increased during the past three years. The organization of the working force is very efficient at all points, and the company finds that promptness, courteous attention and good service are material factors in making and retaining business. An example of the business getting methods of the comyany is shown in the system of following up new business, as outlined below. Immediately after the meeting of the Board of Public Works the company's contract agent secured from the office of the city clerk copies of all the permits issued for new buildings, and even before the owner of the proposed building has obtained his permit from the city, the solicitor calls on him and sets forth the advantages of electricity for lighting and heating purposes. The property owner having been shown that the company is interested in seeing that he has the most economical and most efficient system of lighting installed, he is informed that it will be glad to assist him in having the various wiring contractors submit bids for necessary wiring. This agreed to, notice is then sent by the company to all contractors in the city, stating that Mr. Blank will be ready to receive bids on the job by a certain date.

The company does no wiring and shows no partiality between contractors, and for this reason the contractors are retained as friends, and are ever ready to assist the company in popularizing the use of electricity. The company uses its influence to have all wiring bids reasonable, and in the interest of the owner they follow up the job, seeing that wiring is done properly, and in accordance with the Underwriters' rules. The solicitor impresses on the house owner the advisability of connecting up to the company's lines immediately on the completion of the building, also having lamps installed throughout. The company also arranges to install a meter, agreeing to charge only for the actual consumption until the house is occupied. This enables the owner to show his house in the evening, the only time convenient for many people to inspect it to good advantage. The installation of the lighting system has been found a material aid in the renting of buildings, and property owners are very ready to have this assistance in securing good tenants. The average man appreciates promptness and the lighting company endeavors to be prompt in all that it promises.

When the house is rented and the tenant moves in, the electric lighting service is there, ready to be used. The solicitor of the company calls and secures an application for lighting service from the tenant, at the same time taking the occasion to explain the advantages of the various small heating units, such as smoothing irons, chafing dishes, etc. After the contract is made the company is careful to follow up from time to time and see that the consumer is satisfied with the service. When a copy of the approved contract is returned to the consumer, circulars on cooking apparatus, etc., are enclosed, also a booklet instructing consumer how to read his meter. The introduction to this book reads as follows:

"Electricity is a commodity which is to-day as accurately measured as any other which is bought and sold, although to the person unacquainted with the subject it is enveloped in doubt and mystery. This should not be. We want you to know how the current we furnish you is measured in order that you may understand the invoices we render and may intelligently govern the consumption, and to that end we have given you, in the following pages, directions for reading the Westinghouse meter installed in your house or place of business, and a brief explanation of what it is and how it operates.

"We hope you will read this carefully and that you will occasionally consult your meter and note the rate and amount of consumption. It will give you a definite idea regarding the quantity of energy that is used and you will understand the accuracy and care we observe in rendering an account thereof."

This statement is impressive and inspires confidence in the consumer, who is assured that the company wants him to understand just how much current he is using and paying for. The effect has been to materially reduce the number of complaints as to the amount of bill rendered. With the copy of agreement is also sent a neatly printed card, which reads:

"We take pleasure in enclosing herewith approved copy of your agreement with this company.

"It is our constant aim to give our consumers perfect service, and we shall be glad to receive your suggestions on any subject pertaining to this end."

At the time of receiving the application, the solicitor impresses the prosjective customer with the advisability of installing low-candle-power lamps in the halls, basements and such places, where only a general illumination is required.

The company furnishes all incandescent lamps to consumers at cost. Where a house is being erected in a district not at present reached by the company's mains, the owner is advised to have his house wired, the company agreeing to supply him with current at the earliest possible date, when the business in the district warrants the extension; there are, however, few such cases, as the company has a line on practically all the streets in the city.

The company divides the city into contract districts, employing a solicitor in each district whose duty it is to follow up new business and see that all consumers are satisfied, etc. Small heating and cooking units are furnished by the company at cost.

A plan recently adopted for the extension of this business, and one which is giving eminent satisfaction, is an arrangement which the company has made with ladies of moderate circumstances and pleasing address, one residing in each contract district. These ladies are furnished with the heating and cooking apparatus at cost. In making afternoon calls they find it convenient to turn their conversation to electric irons, cooking utensile, etc., and to point out the excellent service given by them. They then mention that they are selling them, and will be glad to supply whatever is wanted. These women are not in the employ of the company, but are simply trying to make a little pin money in this way. They can, therefore, place apparatus where regular solicitors would not meet with success.

Another excellent plan is an arrangement with the various church and charitable societies of the city whereby the company agrees to furnish small cooking and heating apparatus at cost to them, and on all that are sold the societies make a profit.

It is found that to interest ladies in electrical apparatus designed for their use and convenience is to popularize electricity and cause conversational comment that is a help in selling appliances that consume current. Under this latter arrangement the company is also able to show its willingness to help the charitable organizations to profit by their labor. Not only are the ladies made customers, but also good friends of the company, and their good will is a valued asset.

The company is popularizing the use of small motors for all purposes. Many of the Niagara Falls barber shops have electric massage machines, butcher shops use electric meat choppers and grocery stores electric coffee grinders. In hotels electric carbonating apparatus is used, and many of the lemonade stands operate their shakers electrically.

Consumers who do not feel able to pay cash for motors at the time of purchase are given opportunity to pay for them on the installment basis.

All the Niagara Falls daily newspapers carry the company's advertisement, which is changed twice a week to keep it attractive.

The latest determination of the company to assure the customer that it is willing to be generous and reasonable in its charges is made clear by a step taken on November 1, when the following notice was attached to the bill of each consumer, with the head line:

"MINIMUM RATE REDUCED."

"The company has found that there is a growing demand for electric lamps for decorative purposes, etc.; and the installation of lamps in clothes closets, attics and such places has proved a great convenience. To enable our consumers to have these conveniences economically, we will, on Nov. 1, 1905, reduce the minimum monthly charge to $1.25 on all residence meter agreements, regardless of the number of candle power of lamps connected. Lamps cut out under former minimum rate will be reconnected free of charge."

The company keeps a supply of cards bearing the names and addresses of all reputable wiring contractors in the city, and on these cards appear the following notice:

"Note.—The contractor must furnish you with a certificate of inspection from the Underwriters' Association of New York State, certifying that all wiring has been done in accordance with their rules and regulations."

The up to date methods employed by the company in the getting of new business and taking proper care of their consumers, has resulted in a very satisfactory increase in their connected load, which is at present about three 16 cp equivalent per capita.

The Patent Law Situation.

By Ludwig Gutmann.

The comment of the London *Electrical Times*, reprinted in your issue of September 30, and referring to a letter over my signature, which appeared in the issue of August 26, entitled "The Patent Law Situation," shows that this subject can readily be misunderstood, and to correct some erroneous ideas, I beg leave to trespass upon your valuable space.

Few Americans, or American citizens, are dissatisfied with the way in which patents are granted by our Patent Office, or with the general organization, which is believed to be superior to that of other countries. An equally small number is dissatisfied with the patent laws of this country, and if patents after issue were to remain under the jurisdiction of the Patent Office, very little dissatisfaction would exist. The conclusions derived by your English contemporary are not quite fair, as the subject is general, and of too large scope to deal with individual interests. No laws can ever be framed that can be equally just to all, and that is well known and realized by everybody.

Great discontent has existed for some considerable time, and has caused some to abandon securing patents, others to direct their ingenuity into lines where secret processes of manufacture gave them greater security than patents ever have done; others again, discouraged by the expense incurred in defending the fruits of their labor, have abandoned the field of original work entirely. The existing defects are mostly outside of the patent law proper, and are due mainly to the fact that a patent after issue has neither the protection nor the guardianship of the Patent Office; but, like a ship that is launched from a shipyard, it goes out on the high seas of commerce, to be tossed about, and to fight its own battles.

It may be of interest to enumerate a few cases of hardships caused by "existing conditions" (not to be confounded with patent laws).

An inventor has made a desirable invention and obtains his patent. After a year or so he notices that one or another manufacturer uses his invention. He calls their attention to his patent and the result is, as experience has shown, a small firm is willing to recognize a patent and to compensate for its use. A large firm, on the other hand, rejects the offer, saying the patent is not good unless it has been upheld by the courts, or, in other words: "We will use your invention until you have beaten us in the court." The "court" does not mean "Patent Court," however, but an institution where a man sits in judgment permeated with "law" and honest intentions to be just, but who is for some cause or other not permitted to say that he is incapable of judging on a subject matter foreign to his experience and training.

Manufacturers frequently will not buy the patents, because they can use the invention for a long while before the fact becomes known to the inventor, and if such company is willing to buy it will offer a very modest sum. The actions of the officials show that they are not afraid of litigation, as they have attorneys by the year and with the present judges and courts, the chances are in their favor.

Another hardship results to small manufacturers from the endless number of patents granted on "modifications" of constructions, which any mechanic would arrive at in the course of his work. These should not be classed as inventions. At present they are so considered and are convenient means for harassing small makers by instituting suits for infringement.

Next may be mentioned the interpretation of claims. How these matters operate may be illustrated as follows:

Suppose a large firm has acquired the rights of some process of manufacture which is well covered by patents. After a few years some modifications are attempted by a competitor, which he regards to be outside the claims of the broad patent, when in fact they were actually infringements. A few years later a similar invention appears that is actually outside the scope of the broad patent, and the large firm begins to be anxious. It adopts a vigorous policy and its attorneys institute numerous suits. In a systematic way they attack first those makers whose cases of infringement can readily be proven; the latter, however, are prepared to fight, and both sides lose time and money; generally it takes several years before a final decision is reached. Sometimes the defendant sells its business to the complainant during such a fight, but the suit is not dropped. The absorbed firm is asked to put up a weak defense and loses the case. The court rules according to the evidence presented, and is, of course, unaware that the former opponents have now a common interest.

Assume that the company has three or four decisions in its favor. Now it becomes courageous, and studies the case of the manufacturer who is not infringing. The attorneys and experts for this company plan the case and work out a "line of analysis" to suit their purpose, "to explain to the court the nature," having as an excuse, of course, the well-known fact *that the court does not understand the theory.* The juggling done is amazing, and the court grasps the improvised "science." To help him out further his particular attention is called to the decision of former infringement suits with other makers, whose devices and purposes may have been entirely different from the present case. The court, after receiving the voluminous case, studies and compares both sides, and the more he tries to get hold of the theory and differences of the contesting parties the more mystified he becomes, and he argues somewhat as follows:

"Here is Judge X who upheld the patent in New York and Judge Y in Indiana gave a favorable decision. Can I put myself up to be more capable than these able and learned judges?"

Courts judge and are influenced by precedents. The decision of a court under such conditions can hardly be wondered at.

Let us now take the concrete case mentioned by the *Electrical Times.* Suppose a court is sitting in judgment and both sides send in their evidence. Now let it be provided by an act of Congress that all technical matters must be sent to Washington to a lower patent office court, which may be made up of former commissioners, examiners, etc., etc., permanently or temporarily connected with such a court. Would it be difficult for two or three of the examiners of the present Patent Office force, who have had polyphase patents to examine for three or four years, to know in any particular case submitted to them who is infringing, what the claims really cover, and whether the scope of the claims is not stretched by the complainant? It seems to me a logical conclusion that those who can grant patents must be able to judge, especially as they make it their daily business.

If the present system is in part to be continued the judge would make his ruling so far as he is competent; but would it not be well to have all technical matters turned over to a Patent Office Court, or a department of officials who do not require to be educated by primary methods for the occasion? In order to judge wisely the subject matter should have been understood for a considerable period, which cannot be expected in the brief time of the trial. On this point a well-known St. Louis jurist expressed himself as follows:

"In order to have sound judgment in any domain of reasoning the matter considered should have been previously assimilated and transfused into the mind that reasons thereon, so that every element thereof should be valued in due proportion with all other considerations bearing thereon."

This statement is to the point; in all matters in which courts are *versed,* they show sound judgment, but in matters that take years of training it can hardly be expected that a court can have "sound judgment" or absorb "science" by reading or studying for three or four weeks a subject unfamiliar to it. The opposing parties to a suit could employ experts if they choose, or do without them. If the case is certified by the trial court to the "technical court" or department in Washington, this latter court should try, consider and determine the precise points submitted to it, and counsel should be notified, to have an opportunity to submit oral and printed arguments.

This technical department or court is not to decide questions of law, but questions of fact. The Patent Office library is at its disposal, and so far as knowing the state of the art is concerned, no one has ampler resources. For this reason it is much less influenced by opinions on either side, and will not accept an unfair interpretation of a claim nor allow an enlargement of the scope of the patent, abuses which are fostered by the existing system.

Under such a system, where examiners versed in their specific departments as just outlined are employed, the necessity of "experts" dwindles down considerably. The selection of the judges in a patent court might be made without public notice, should there be any fear that they might be subjected to undue influences, and justice may be expected under such conditions more speedily than under the present state.

Suppose the owners of the polyphase patents mentioned by the *Electrical Times* could have the infringement suits tried before a court consisting of the examiners that granted the claims, they might have had decisions thereon in their favor within a year or two instead of five or ten years' litigation. The complications arising in England and Germany are unfortunate and should be avoided in any system that is to take the place of the present system here. Two ways occur to the writer at present, and no doubt others better qualified may be able to find better ways or suggest more suitable means.

Suppose that a department, or advisory board, were created in the Patent Office for the purpose of rendering assistance when called upon by the courts. This department receives the cases of the opposing parties from the courts, studies them and gives a summary to the courts, which summary will guide the judges in their decisions. Those conclusions of the Patent Office Advisory Board could be or should be incorporated in the decision rendered. This advisory board of the Patent Office may be presided over by the Commissioner of Patents, or some official duly appointed, while two men are given the task to study the case on both sides. They may discuss and weigh the merits of the different points brought forward by both parties, and if their views are the same they make a report to the Commissioner of Patents, or superior official, after a hearing is given to both sides, and draft the reply to the court seeking the information. If the two investigators have different opinions, they bring these points before the superior officer, who becomes a member, and the decision of the greater number is reported to the court. There is something in favor of a secret Patent Office Board, whose examiners may be changed for each case, and whose names do not appear. Not only would any undesirable influence be avoided, but the examiners would act more independently.

The second is a lower patent office court, to whom all technical suits must be reported, and which decides the technical side of infringements, rights or wrongs, and at this stage turns the subject over to the proper court for the civil actions resulting from the finding. Here again the examiners, who are supposed to be technical men, should be persons who know the subject they are dealing with, and if they do the selection of experts for presenting the cases (which question seems to be the all-important one of the *Electrical Times*) drops out entirely. For the party that is not infringing, although accused of such act, can generally show this without great effort, and any attempt made by capable lawyers and experts to deceive will avail them nothing. It would be wrong to draw conclusions from the statements of results observed in England or Germany. Those conditions do not fit the American case. The English patent is granted without great search and strictness to any applicant; the class spirit of German professors does not find fertile ground on the American continent, while all the desirable qualities enumerated in the *Electrical Times* for an expert are found in the officials that would form such advisory board or Patent Office Court.

The questions raised are of interest to many and many should contribute their views freely. We are singularly fortunate in having an administration like the present, which makes the solution of such questions as these its duty, if they are shown to be weighty and of importance. This very point, however, can only be shown by a hearty and vigorous response and co-operation. The opinion of others is invited.

Resistance of Submerged Wires.

In a recent issue of *Comptes Rendus*, E. Rogouski reports the results of tests which showed that when thin bare silver wires are immersed in flowing water kept at a uniform temperature, and the current through them is gradually increased, the resistance decreases at first and then increases again. He gives a satisfactory explanation, based upon the presence of a molecular layer of water adhering to the wire. This layer prevents the temperature of the wire from becoming that of the surrounding water. It allows it to rise above it, and the resistance measured is not that of the wire at the temperature of the flowing water, but the resistance at a temperature a few degrees higher than that, and therefore greater than the value sought. When the current becomes stronger, the difference of temperature on both sides of the molecular layer increases, and when it becomes about 4° the layer breaks up and allows the water to flow in immediate contact with the wire. The resistance of the wire is then the true resistance at the temperature of the water.

Electric Towing.

Of the 120 papers which were read at the tenth International Congress of Navigation, held at Milan, Italy, in September, one of the most interesting was that of Mr. Leon Gerard and Mr. St. Johns Clarke, which dealt with electric haulage on canals. The paper described the experimental work which has been done on the Erie Canal. A description of the early experiments with electric towing near Schenectady, N. Y., was given in these columns November 14, 1903.

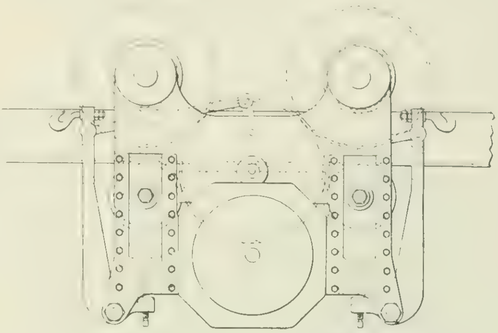


FIG. 1.—ELEVATION OF "PROPORTIONAL ADHERENCE TRACTOR."

In the earlier experiments it was found that the weight of the electric tractor could not economically be made great enough to afford sufficient tractive force to give the proper speed to the barges. An improvement was found in the use of powerful springs, which were caused to give a gripping effect on the under rail. A difficulty encountered with this method resided in the low efficiency with high traction strains, which would fall to 45 per cent with strains of 220 pounds.

Within the past year there has been employed on a special track at Schenectady a new type of tractor called a "proportional adherence tractor," which is represented in Fig. 1. The driving wheels, which are 12 in. in diameter, work on the top part of the guide girder. The main portion of the tractive effort at the moment of starting is supplied by wheels which run under the guide girder. These wheels are accurately fitted into place. The pressure exerted by them comes into play only when the traction strain is applied by the tow rope. The two springs, seen under the pressing wheels

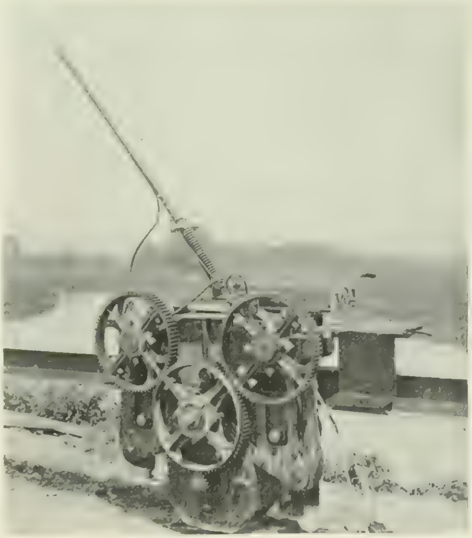


FIG. 2. IMPROVED TOWING DEVICE WITH GEAR COVER REMOVED.

in Fig. 1, are so adjusted as to obtain a contact with the guide girder without undue pressure.

A view of the completed contractor with gear cover removed is shown in Fig. 2. Although this apparatus weighs only three tons, it is capable of exerting a pull of one ton at a speed of 4½ miles per hour, under which condition the overall efficiency is 86 per cent. The tractor is equipped with a 45 hp motor of the mine type, and forms a compact iron clad and enclosed construction, the center of gravity of which rests under the guide girder.

The track consists of girders held in place by vertical posts of lattice construction to which they are fastened through brackets, as shown in Fig. 3. A single track weighs 60 tons per kilometer, and a double track weighs 105 tons per kilometer. The track proper is formed of 10-in. girders with large flanges, and weighs 80 pounds per yard. It presents a projecting guide on the top and bottom flanges. A track of this construction lends itself most favorably to electric traction for canals, the haulage path of which is narrow, and it is well adapted to overcoming the difficulties due to crossings and bridges, and those found in tunnels of reduced sections.

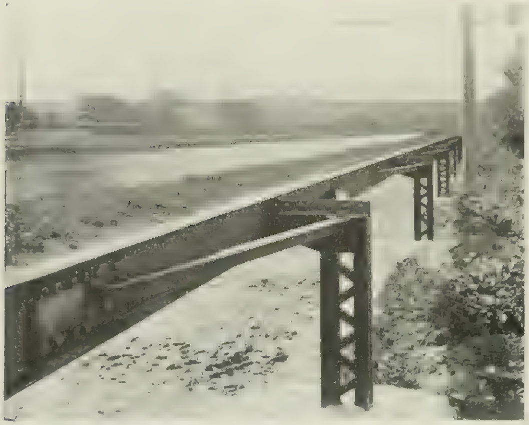


FIG. 3.—TRACK OF IMPROVED TOWING DEVICE.

With no load and at the greatest speed the apparatus does not exert on the track any pressure other than that due to its weight of 64,000 pounds. At a speed of 8 miles per hour without load the tractor motor absorbs 7 kw.

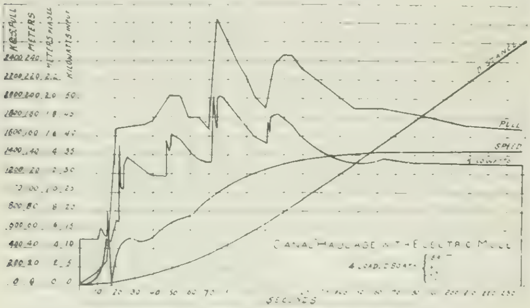


FIG. 4.—STARTING DIAGRAM WITH FOUR BARGES.

Fig. 4 shows the performance of the tractor when hauling four barges weighing complete 839 tons, of which 579 tons represent useful weight. The six peaks on the kilowatts input curve indicate the corresponding number of points on the controller. At the 70th second the pull at the hook reached 6,300 pounds, and it decreased to the normal running value of 3,800 pounds in about 200 seconds, when the speed reaches 3 miles per hour. It is estimated that the net efficiency is 84.5 per cent. It is believed that the "proportional adherence tractor" can improve the efficiency of electric canal haulage, increase its speed and render it thoroughly practicable.

New York City Destructor Plant for Lighting.

An interesting municipal plant in which the electric power derived is looked upon as a welcome by-product is found in the incinerator recently erected at Tompkins and Delancey Streets, in New York by the Street Cleaning Department for the purpose of destroying the combustible part of the city's rubbish and supplying illumination to the Williamsburg Bridge, which it adjoins.

Only a selected portion of the material collected by the street cleaners is brought to the incinerator, all vegetable matter and ashes being otherwise disposed of. The major part of the seven cubic yards, which form a department load, consists of wood from old furniture, boxes and barrels and paper and rags from all sources. Each load is carefully picked over by parties who pay for the privilege of obtaining the rags and similar material, so that the remaining rubbish consists largely of paper and wood. Previous to the construction of the present plant and a smaller incinerator on Forty-seventh Street, this material had been disposed of by dumping it into the sea or placing it as filler on low land. It is estimated that the disposal in this manner has cost 30 cents per cubic yard, and that the incinerator, treated simply as a means of destroying the rubbish will effect a saving of $10,000 per year.

FIG. 1.—VIEW OF REFUSE CONVEYOR, SHOWING FUEL.

FIG. 2.—VIEW SHOWING METHOD OF FEEDING FURNACE AND FUEL USED.

The feature of particular interest in connection with this novel plant resides naturally in the construction and operation of the furnace, and in the means employed in handling the unusual fuel. Fig. 1 shows the fuel conveyor which serves to elevate the rubbish from the dumping place of the street cleaners to the stoke holes of the furnaces. The conveyor consists of an engine-driven linked iron belt which allows the rags, paper and wood in all forms to be passed slowly in front of a gang of pickers who remove all rags and similar refuse. The remaining material, largely of a combustible nature, then passes to a small sorting space where the non-combustible matter such as cans, bottles, wire springs, etc., is removed. The final sorting space is immediately adjacent to the furnace doors through which the combustible material is passed at a regular rate, independent of the demands for steam by the electric lighting plant.

The method of feeding the furnaces is indicated in Fig. 2. There are two furnaces, each of which is equipped with top, side and end doors. One of the furnaces is constructed with a single combustion chamber and an ash pit, while the other, which was designed by Mr. Fred L. Stearns, of the Street Cleaning Department, is of the two-story type, being supplied with two sets of grates, one above the other, and a lower ash pit, as shown in Fig. 5. The lower set of grates has been installed so as to obtain, as nearly as may be, the full heating value of the fuel before it passes to the ash pit, and to overcome the difficulty of making a single set of grate bars of a compromise size to serve for the heterogeneous mass of fuel. The side doors have been provided for the purpose of removing any non-combustible material that might pass unnoticed into the furnace through the top doors. Bulky rubbish, such as furniture, etc., is fed through the end doors.

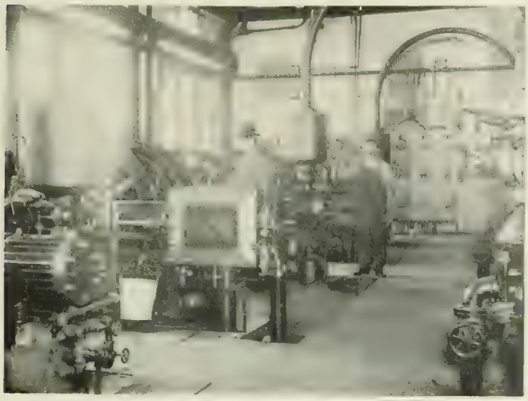


FIG. 3.—INTERIOR OF DYNAMO ROOM.

Each furnace is operated entirely distinct from the other, although the gases from the two pass finally to the same chimney, a 200-ft. brick stack, the top of which rises 75 ft. above the bridge, and carries the smoke to a height sufficient to eliminate any objectionable odor. A separate boiler is provided for each furnace, and between each boiler and the corresponding furnace there is placed a set of dampers which are so arranged that the gases may either pass under the boiler and then to the stack or may go directly to the stack. An idea of the temperature which the fuel affords may be gained from the fact that a cast-iron damper 3½ in. thick was melted out after a service of one week. Fire brick has been substituted for cast iron as a material for the dampers, and no additional trouble is expected from this source.

It may be of interest in this connection to note the results of tests made at the Forty-seventh Street incinerator upon a lot of rubbish similar to that used at the Williamsburg Bridge plant, tests at the latter place not having as yet been made. During a certain run of ten hours, during which a total weight of 102,531 pounds of rubbish was used, the average horse-power observed was 232.7. An analysis of the rubbish used showed that 43.8 per cent was combustible matter, 7.4 per cent was ash, and that 48.8 per cent was taken by the rag pickers or discarded as non-combustible. It is worthy of note that the ashes are disposed of to the American Tobacco Company for use upon its lands.

Under each boiler, entirely distinct from the main incinerator furnace, is placed an auxiliary furnace in which may be burned bulky furniture and other wood fuel, or coal may be used if emergency should require. Thus when the proper dampers are closed the boilers may be fired in the ordinary manner. The room in which the incinerator and the boiler plant are placed is entirely separated from the engine and dynamo room. The former room is devoted exclusively to the destruction of rubbish and the production of steam, and is in charge of the Street Cleaning Department. In the latter room are placed all of the apparatus for using the steam, and the steam auxiliaries, and this room is in charge of the Department of Bridges.

A view of the engine and dynamo room is given in Fig. 3. The electrical generating equipment consists of one 50-kw and two 100-kw Burke generators direct-connected to Ideal engines of the cross-compound type. The two larger engines have 12-in. strokes, with 20-in. and 12-in. cylinders, and are designed for a speed of 250 r.p.m. The small engine operates at 300 r.p.m., and is equipped with 16 by 9-in. and 9 by 9-in. cylinders. Each engine is connected to the armature of the corresponding generator through flange couplings which are keyed on to the respective shafts. The engines are operated condensing, each engine being provided with a Blake jet condenser. An enlarged section of pipe between the high-pressure and low-pressure cylinders of each engine serves as an intermediate receiver. Each receiver is supplied with a pressure gauge graduated from —30 pounds to +50 pounds, while a vacuum gauge graduated from 0 to —30 pounds is provided for each condenser. By means of these six gauges and an initial recording pressure gauge, the engineer in charge is enabled to judge of the performance of each engine. In the engine room are located a Blake 7½ by 5 by 6-in. feed-water pump and a 400-hp Cochrane feed-water heater of the open type. The supervision of these auxiliaries being exclusively under the control of the electric power department, the incinerator department is relieved of all responsibility with reference to the steam equipment, with the exception of that due to the single task of maintaining the desired steam pressure of 125 pounds.

The generators are of the direct-current type and are designed to operate directly on a three-wire system at 2 × 115 volts. The method of obtaining a neutral lead immediately from the machine itself is the feature providing most interest in connection with this type of generator. A so-called choke coil, an auto-transformer, is connected between certain points on the armature windings separated by 180 electrical degrees. It is evident that the central point of this coil will remain at all times at a potential midway between that at the two terminal points, and hence it will retain a mean potential between the positive and negative terminals of the machine. The choke coil is mounted directly on the revolving armature, while the connection to the central point is made to a slip ring, so that for the positive, negative and neutral leads for the three-wire system there are required only the ordinary direct-current commutator and a single additional slip ring. The seeming simplicity of this device for three-wire operation is slightly modified by the additional requirements imposed by the equalizer circuits which are necessary when compound-wound generators are to be operated in parallel. In order that the machine may maintain the proper voltage with unbalanced loads on the three-wire circuits, it is necessary that the series coils be connected in both the positive and the negative circuits. For this reason one-half of the series field turns is joined in circuit with the negative lead and the other half is connected with the positive lead. For the purpose of allowing the several sections of the series coils of the individual generators to be properly joined in parallel, it has been found necessary to connect five main cables from each generator to the switchboard

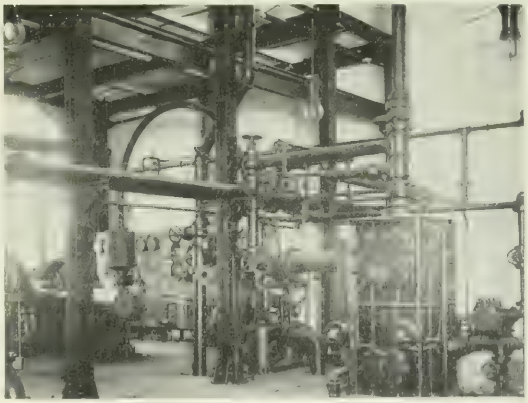


FIG. 4.—VIEW OF SWITCHBOARD AND STEAM AUXILIARIES.

The switchboard, which is indicated in Figs. 3 and 4, consists of three generator panels, one totalizing panel and four feeder panels. Each generator panel is equipped with a four-pole knife switch, provided with four "Noarc" fuses, a field rheostat and two Weston ammeters. The totalizing panel carries a 300-volt Weston voltmeter, a 1,500-amp. Weston ammeter, a Thompson three-wire watt-hour meter and a single-pole knife switch for the neutral wire. Each feeder panel is provided with a Weston ammeter, an "ITE" double-pole circuit-breaker and a three-pole knife switch. Three of the feeder panels serve for supplying power to the lamps on the Williamsburg Bridge, which are placed on three circuits, designated as the Brooklyn end, the south side and the north side, respectively. The fourth panel is used at present for the lamps around the incinerator and the generating plant. It is expected that the plant will later supply power for lighting several school houses in the neighborhood.

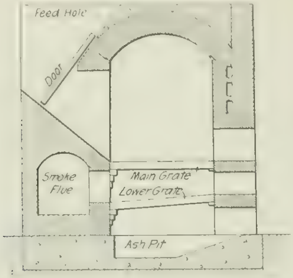


FIG. 5.—CROSS-SECTION OF TWO-STORY FURNACE.

This plant was designed by Mr. H. de B. Parsons, consulting engineer for the Street Cleaning and Bridge Departments of the City of New York. It was constructed by the Ralph J. F. Gerstle Company, at a cost of $34,000 for the incinerator and $49,400 for the boilers and electrical generating plant. The incinerator is operated by Mr. Fred L. Stearns, for the Street Cleaning Department, while the electrical generating equipment is under the charge of Mr. K. L. Martin, of the Department of Bridges.

New Telephone Patents.

ADJUSTABLE HARMONIC SELECTIVE SYSTEM.

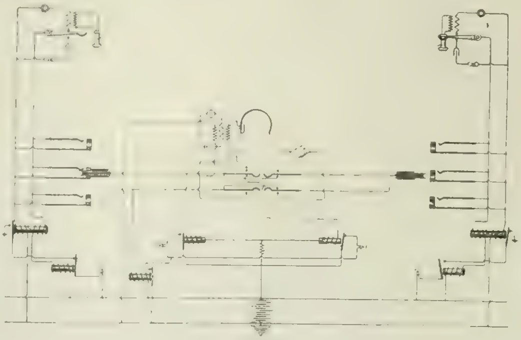
Several selective ringing systems have been produced wherein the selection depends upon the use of alternating currents of different frequencies for the different stations. With such systems the ringers must be designed so that the natural period of vibration of its moving system approaches that of the ringing current. Therefore, the ringer for each frequency of current must be distinctive. To overcome this necessity of using as many kinds of ringer as there are stations on a line, Mr. E. A. Reynolds, of New York City, has invented a ringer which is so adjustable that it may be made to respond to any desired frequency. The clapper rod is flexible for a short distance near its point of attachment to the armature. Its rigid portion is clasped between a pair of rigid guides. These guides may be placed near the flexible portion or near the hammer or at any intermediate point, the guides always acting as a pivot.

DESK STAND SET.

Mr. W. Kaisling has patented an improved desk stand set in which none of the exposed parts are included in the electrical circuit, and therefore all chance of shock is precluded. The hook switch springs are within the tubular stem and the switch lever actuates them through the agency of a hard rubber plunger. The transmitter is provided with two insulated terminals, and two insulated conductors pass through apertures in the hinged joint at the lug and are entirely concealed. The Stromberg-Carlson Company has been assigned the patent for this apparatus.

SWITCHBOARD CIRCUIT SYSTEM.

The cut shows a circuit system for a switchboard, worked out upon the two-wire plan. The key to the situation is the cut-off relay, which is permanently connected to the line, and which is differentially connected. When no plug is in a jack the line relay current, of course, passes through both coils of the cut-off relay and thus it is not affected. As soon as the shunting effects of the cord circuit are introduced at the jack, the cut-off relay operates. This circuit is the invention of H. G. Webster, who has assigned his patent to the Stromberg-Carlson Company.



WEBSTER EXCHANGE SYSTEM.

APPARATUS FOR THE DEAF.

The telephone is now considerably used as an apparatus to assist the deaf in hearing. Of course, for such service the parts must be of special design. The transmitter must pick up all sorts of extraneous sounds in its neighborhood, and with the receiver must greatly augment these.

Mr. H. G. Pope, of New York City, has recently patented a special form of head receiver adapted to this service. The magnet is of the iron clad tubular sort, and is adjustable with reference to the diaphragm. The ear piece is also special, being serated radially.

Mr. Pope has also patented a loud speaker which is virtually the same sort of receiver provided with a self-adjusting stand and a trumpet mouthpiece.

LOCK FOR AUTOMATIC SWITCHES.

With automatic exchange systems a fire alarm or other special feature may be provided, which when used legitimately is of considerable service. On the other hand the ability of any one to send in a false alarm and cover his tracks by immediately restoring his switch to normal is objectionable. In order to prevent this, J. Erickson, of Chicago, has invented a locking device which so locks a switch calling an alarm number that it cannot be restored until opportunity is given to note the number.

LETTER TO THE EDITORS.

Measuring the Power of Induction Motors.

To the Editors of Electrical World and Engineer:

SIRS:—Many articles on the slip method of measuring output of induction motors have come to my notice. In nearly all of these, the synchronous revolutions are determined by means of a frequency indicator or by going back to the generator speed in some more or less complicated fashion. In no case has there been given the simple and obvious method outlined below.

The instruments required are the apparatus by means of which to observe the slip, say a stroboscopic disc, and a simple revolution or so-called speed counter. If the voltage at the motor terminals is different from that at which the motor is rated, a voltmeter is necessary in addition to the above, because the slip which is given by the manufacturer refers to the motor with the rated voltage applied to its terminals. In case of variations in voltage the usual correction must be applied.

A convenient number of apparent revolutions of the disc is counted, and during this time the total revolutions of the motor are determined by the revolution counter. Obviously then, the revolutions slipped plus the revolutions of the motor equal the synchronous revolutions in the observed period. For example, a disc was observed to make 10 apparent revolutions. During the same time the revolution counter showed that the motor made 265 revolutions. The synchronous revolutions then were

275. The full-load slip of the motor as given by the manufacturer, when corrected for the voltage at the motor terminals at the time of the test, was 3.97 per cent. If the motor had been under full load, it would have slipped .0397 × 275 revolutions, or 10.92 revolutions. It was running, therefore, at 91.6 per cent of full load, assuming that the slip is directly proportional to the load.

The chief advantages of the method are that it is not necessary to estimate fractions of revolutions of the disc; it is independent of variations in generator speed, and it averages the fluctuations in load during the test period, precisely as does any other integration measuring process.

San Francisco, Cal. Allen H. Babcock.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Induction Motors.—Churton.—A paper read before the Leeds Section of the British Institution of Electrical Engineers. The author compares the performance and characteristics of motors of the induction type when provided with short-circuited, and with wound rotors, respectively, and outlines their performance on single-phase and polyphase circuits. The curves shown in Fig. 1 are from tests taken upon two motors, one having a short-circuited rotor and the other a wound rotor, but in other respects identical machines. It will be noticed that both the efficiency and power factor are higher in the case of the machine with the short-circuited rotor. Each machine was constructed to give 5 hp at about 1,420 revolutions on single-phase, 200-volt, 50-cycle circuit. For the purpose of speed regulation the wound rotor motor is the more satisfactory, though for some purposes, such as operating cranes, the short-circuited rotor with conductors of relatively high resistance combined with graduated transformers for varying the voltages on the stator windings, is sometimes preferred for polyphase motors. The performance of motors with regard to starting torque and current on single and two-phase circuits of 50 cycles, 200 volts and with short-circuited and wound rotors, respectively, is given as follows, the figures referring to the normal full-load values:

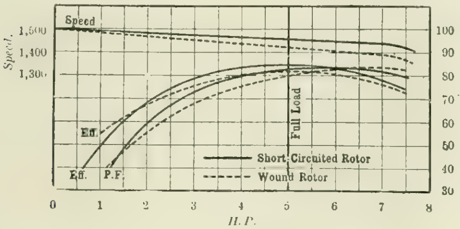


FIG. 1.—CURVES OF INDUCTION MOTORS.

	Single Phase.		Polyphase.	
	Starting current.	Starting torque.	Starting current.	Starting torque.
Short-circuited rotor	1.25	0.45	1.25	0.75
Wound rotor	1.0	0.75	1.0	1.0

The superiority of the polyphase motor is clearly shown. There are several means by which the starting torque of the single-phase motor may be somewhat improved, but which involve lower efficiency under load. The author finally discusses the influence of frequency. High-frequency is not only prejudicial to efficiency, power factor and torque, but is particularly detrimental to good starting performance. High frequency to the motor use implies higher cost of motors and higher cost of working, and to the electricity supply undertaking it means lower day load (because of the less inducements to power users to adopt the supply), and greater proportional loss on mains on account of the lower power factor of the motors. The author suggests that a frequency of 50 cycles should be adopted whenever possible.—Lond. *Elec.*, October 27.

Armature.—In notes on the recent Olympia Electrical Exposition in London a motor armature of a new pattern, made by Vickers Sons & Maxim, is described. The motor exhibited is rated at 150 hp and was built to the order of the Admiralty. Its special feature is that the core body is not keyed to the shaft in the ordinary manner. As shown in Fig. 2 a considerable portion of the shaft is of triangular section, the altitude of the equilateral triangle being greatly in excess of the diameter of the shaft proper. It should be understood that the entire shaft consists of a single forging. Each apex of the triangle is rounded off and forms a key which fits into a groove cut in the stampings. Thus the moment of the couple tending to shear the key, when the motor has to start against a heavy load, is considerably less than when the keyway is cut in the surface of an ordinary circular shaft. For this reason the motor is peculiarly suitable for driving rolling mills and other purposes where a large starting torque is met with.—Lond. *Elec.*, October 27.

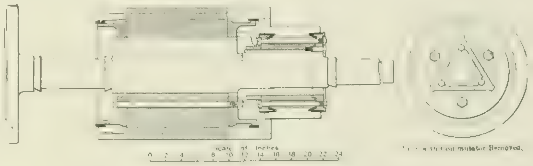


FIG. 2.—SECTIONAL VIEWS OF ARMATURE.

Double-Field Alternators.—A fully illustrated French translation of the recent German article by Ziehl on "double-field alternators" for single-phase and polyphase currents, which was abstracted in the Digest some time ago.—*L'Industrie Elec.*, October 10.

Alternators.—Rushmore.—An illustrated paper describing the origin, development and present status of alternating-current generators.—*Jour. Franklin Inst.*, October.

Lights and Lighting.

Street Lighting in London.—An account of photometric tests made by Bailey on old and new street lamps in the City of London. From these tests he deduces the following comparative figures, the cost of gas lighting being taken from the *Journal of Gas Lighting:*

	Average total cost per cp. per annum.
Gas.—Double burner, ordinary low pressure incandescent (mean of six tests)	22.2 cts.
Single burner, high-pressure gas	1.8
Double burner, high pressure gas	2.3
Arc Lamp.—Old lantern	16.
Flame arc	10.

It must be noted, however, that whereas the cost of the electric arc is quoted, including all charges of maintenance and interest and redemption of capital, in the case of the gas lamp the cost is solely for maintenance charges; that is to say, the supply of gas and mantles only, and it does not include any portion of the capital cost of providing posts, mains or fittings; and further, the hours per year for the use of electric arcs are fixed at 4,473, but the hours of burning adopted for the gas lighting "have been observed to be less." The tests were made on a clear night under normal conditions. "The candle-power measurements were in each case taken at a horizontal distance from the light equal to twice the height from the ground level, thus enabling positions to be taken, whereby the lamp measured was the only light in line with the photometer screen." From these tests of candle-power Bailey estimates the illumination at a distance of 100 ft. from the source as follows:

	Candle-feet.		Ratio.
Double ordinary incandescent gas lamp illumination	0.013	=	1.0
Single high pressure incandescent gas lamp illumination	0.016	=	1.24
Double high pressure incandescent gas lamp illumination	0.027	=	2.10
Ordinary arc lamp	0.061	=	4.50
Flame arc lamp	0.120	=	9.0

Some criticisms are added of statements of the gas people.—Lond. *Elec.*, October 27.

Arc Lamps.—In notes on the recent Olympia Exposition in London, the Regina and Reginula arc lamps are referred to. In the Regina arc lamp both the arc and regulation gear are enclosed in one air-tight space. A syphon and safety valve are put in action should the pressure on the globe become too high. A length of 1¼ in. to 1⅓ in. of the carbons glow with a white light. One consequence of the air-tight arrangement is the long life of carbons, which is claimed to be between 300 and 400 hours. After that time it is necessary to replace only the upper carbon, as the remaining part of the upper carbon is used as the lower carbon. The overall length of the lamp is 2 ft. 2 in., its weight, complete, being 19 pounds. The inner globe is protected by a wire net and this arrangement makes a dirt-catching wire net on the outer globe unnecessary. The carbon-catch consists of two cheeks, which pinch the carbon, lifting it up when the magnet is lifted by the coil, an arc between the carbons resulting thereby. These two cheeks are fixed to a hollow plunger, which is sucked up or let down in the regulating solenoid. The carbon slides in the hollow plunger. When the carbon is so far consumed that the cheeks touch a ring, it is released and drops down easily. The resistance in the arc diminishes, the magnetic field grows stronger and the carbon is again lifted by the magnet. If there is no current on the mains, the top carbon rests on the lower carbon. The Regina lamp is made for voltages and currents ranging from 100 to 250 volts and 2.5 to 8 amp., respectively, the available pressure across the arc being, it is stated, from 68 to 72 per cent. When used for alternating current a choking coil (with $cos\ \phi = 0.9$) is used. Alternating-current lamps are made for 40 to 60 periods per second and for voltages between 110 and 220 volts, the voltage across the arc being as high as 85 to 90 per cent. The continuous-current type will burn in series of two, three, four or five lamps. It is claimed that the light given off by a 200-volt lamp is quite white with no bluish tints. The Reginula lamps are similar in construction to the Regina lamps, but are smaller in size and designed for currents from 1 amp. upwards and for 110 to 220 volts. It is stated that a Reginula lamp with 5-mm. carbons will burn for 40 hours when fed with continuous current, and from 15 to 20 hours when supplied with alternating current.—Lond. *Elec.*, October 27.

Window Lighting.—Roberts.—A short article on the advantages accruing to central stations by the addition of window-lighting loads which come on after business hours. The author points out the need of co-operation between the central station manager and the customer in order to obtain the best results. The advantages of the various types of lamps for window illuminating purposes are given.—*Am. Elec.*, November.

POWER.

Electricity in Mines.—Ravenshaw.—The first of a series of Cantor lectures on the use of electricity in mines. The following table shows the various classes of machinery that are in general use, with the type of load and the range of sizes that are usually met with:

	Usual sizes hp.	Type of load
Winding	50 to 2,000	Intermittent with frequent short stops.
Single rope haulage	5 to 200	Intermittent with long stops.
Continuous haulage	15 to 500	Steady load
Main and tail haulage	15 to 150	Intermittent with fairly long stops.
Locomotives	15 to 100	Intermittent with variable stops.
Creepers	10 to 30	Continuous variable load.
Coal cutters	20 to 50	
Pumping	5 to 500	Steady load.
Air compressors	10 to 100	Intermittent.
Fans	20 to 200	Steady.
Screens	20 to 50	Steady load.
Coal washing	20 to 100	Fairly steady.
Stamps	15 to 100	Steady.
Crushers	20 to 100	Very variable.

The author first discusses winding and says that steam engines are at present almost universally used for winding, many of them being of large size and capable of raising heavy loads at a high speed. Since the load fluctuates enormously, the application of electric driving without the result of sudden fluctuations on the supply network necessitate some method for storing up energy during the period of no load. For small plants it is probable that a motor having the speed regulated between, say, a third and full speed by means of shunt resistance, would give a simple solution, in conjunction with a motor carrying a heavy fly-wheel running free and connected across the mains. For large plants a more elaborate system has in some cases been adopted. The author refers to the well-known Ilgner system which has been repeatedly described in the Digest. He then discusses underground haulage. He says that electric locomotives are very little used in England, while they are much used in the United States, where the underground roads are more level. With respect to pumping he says that electric driving is particularly applicable to centrifugal pumps. He then refers to coal cutting and the equipment of the generating station. He remarks that in many cases a remarkably low cost per kw hour generated is obtained when there is a steady load extending over long hours. Owing to the fact that comparatively large powers are required at a considerable distance from the source of supply, and that in fiery mines a pressure of more than 500 volts is not allowable, the conductors must be of large section, and in many cases, in order to avoid an excessive drop of pressure, the density does not exceed 300 to 400 amp. per square inch.—Lond. *Elec.*, October 27.

Tar Burning in Gas and Electric Plants.—Field.—A paper on the use of tar as fuel in gas and electric plants. The author describes suitable tar strainers and tar burners and gives some results from actual practice. "Tar used weighed 9¼ pounds per gallon, and the average evaporation was 12.82 pounds of water per pound of tar. This low value was due largely to an unfavorable load factor during several hours of the day, as full-load tests indicated an evaporation of nearly 14 pounds of water per pound of tar. The tar is pumped without any strainers whatever, direct from the tar well to the burners by a small Marsh steam pump working under a pressure of from 125 to 170 pounds per inch. The tar pressure must be higher than the steam pressure used, and in our case this varies from 100 pounds during light loads to 150 pounds at the peak. The flame is directed downward by bending the nozzle so that it will strike the grate bars about 3½ ft. back from the furnace doors, where it is received on a bed of about 8 in. of ash, clinker, coal or breeze. The ash-pit doors are left open and ash-pits are filled with water to prevent warping the grates, but as there is very little draft through the mass of material on the grates the principal air supply is an over draft admitted through shutters in the firing doors. The burners rarely clog, and they require a minimum of attention. The flame is a single whirl of intense white, and there is no smoke. The entire installation can be made for $5 per boiler, exclusive of pump, which in our case cost about $31, and is large enough to supply two boilers to their greatest capacity. In figuring the fuel value of tar against any fixed price per gallon, it must be remembered that the price received is never net, since an allowance must be made to cover pumping, barreling and carting the product. In burning tar these costs, with the possible exception of the pumping, can be entirely eliminated and even the pumping may be done away with in firing benches, as the tar can readily be taken direct from the hydraulic main to the burner by the installation of a simple tank separator provided with suitable overflow connected back into the main leading to the tar well." In the discussion various speakers described their experience with tar burning.—*Progressive Age*, November 1.

Water Turbine Plants.—Baashuus.—An article giving advice to electrical engineers concerning the making of a first approximate calculation of a water turbine plant. The author is engineer of Escher, Wyss & Co. He points out that such approximate calculations can easily be made and do not require consultation with turbine specialists. When one has the data on the quantity of water to be utilized and the available fall, the next questions are what type of turbine to choose, their efficiency and their number of revolutions and especially the space required by them and by the building. When these questions are answered properly one has an approximate first basis for economical calculations so that it is not necessary to consult the turbine engineer. The author gives formulas for answering these questions on the basis of actual experience.—*Elek. Zeit.*, October 19.

Water Power Plant in the West.—Allen.—An illustrated description of the Washoe Power & Development Company's plant on the Truckee River. The plant contains two main generating sets each of 750 kw. These are three-phase generators of the revolving-field type, the voltage generated being 2,300. For transmission the voltage is raised to 20,000. There are two sub-stations at Sparks and Reno where the voltage is reduced to 2,500 for distribution.—*Jour. of Electricity*, November.

Niagara Falls.—The first part of a long illustrated description of the Niagara power plant of the Electrical Development Company of Ontario.—*Engineering News*, November 9.

Electric Driving of Rolling Mills.—Bayer.—A mathematical paper discussing the case in which a three-phase motor with fly-wheel is used for driving a rolling mill and receives the current directly from the central station.—*Zeit. f. Berg. u Hüttenwesen*, September 23.

Elevator.—Chignaterie.—An illustrated description of the electric lift to the top of the Burgenstock mountain in Switzerland.—*Le Genie Civil*, October 21.

Corrosion of Condenser Tubes.—Sexton.—An illustrated article discussing the reasons for the corrosion of condenser tubes, and means for preventing it.—*Eng'ing Mag.*, November.

TRACTION.

Three-Wire System for Traction.—An illustrated description of the electric road between Tabor and Bechyne installed by the firm of Krizik. The length is 15 miles. The three-wire direct-current system is used with the rails as neutral conductor. The total voltage is 1,400; that is, 700 volts between each overhead conductor and the rails. The power house contains two railway generators, each of 80 kw and 2x700 volts. The motor cars have four axles and contain four motors, each of 30 hp at 650 volts, 40 amperes, the number of revolutions being 550. The ratio of gearing is 15 to 75. At starting all motors are connected in series, then they are connected in groups of two in parallel. The connections for running and breaking are shown is Fig. 3. The controller has three steps with the motors in series and three steps with groups of two motors in parallel. For increasing the speed there are provided two further steps with resistances in parallel with the field windings. In the field coils the current always has the same direction. For the regulation of speed and for breaking, the connections of the exciting windings are changed. There are six steps for short-circuit breaking. The fundamental idea of the installation is said to have been to make the first cost as low as possible and to use in operation as small trains as possible..—*Elek. Bahnen*, October 4, 14, 24.

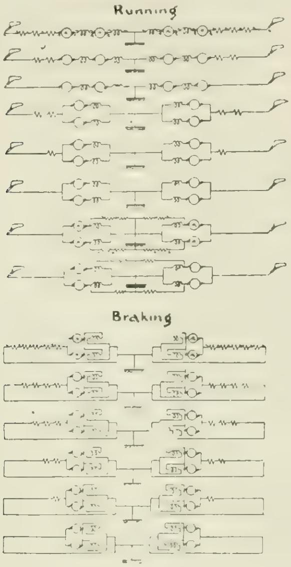


FIG. 3.—DIAGRAM OF CONNECTIONS.

Proposed Regenerative Control in the New York Subway.—Some editorial notes with respect to the suggestion of Dr. Soper that instead of stopping the trains with the present brakes, the motors might be used as generators to restore current to the line, thus reducing the draft on the power station and the consequent amount of heat liberated in the subway. It is thought that practically nothing is to be hoped for in this direction for sanitary improvement of the Subway atmosphere. Two objections are raised against the regenerative system of controlling the speed of electric trains. The first is the heating effect on the motors when used as generators, and it is said that larger and heavier motors would be required. As a second reason against any and all forms of electric braking is quoted the matter of safety.—*Eng'ing News*, November 9.

Electric Railway Signals.—An illustrated article on electric signaling on the Great Northern & City Railway. This railway uses two conductor rails, the running rails not being employed for conveying traction current. The track rails are, therefore, now employed for signaling purposes. The general idea of the signaling system is to actuate the signal lamps by the train itself in such a manner that the signals, which consist of electric lamps in the tunnels and semaphores in the open, are constantly set at "danger" behind a train but cleared again after the train has proceeded a certain distance beyond. Signals in the previous sections cannot be cleared until the signal immediately behind the train has gone to danger.—Lond. *Elec.*, October 27.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Reverse Power Relay.—In a very fully illustrated article on new Ferranti switch gear exhibited at the Olympia exposition in London a reverse power relay is described. It depends mainly of the movement of a Ferranti alternating-current meter placed on end, and it is arranged so that with power flowing in the right direction in the controlled circuit the rotating part of the relay impinges against one side of a pivoted weight. With power flowing in the right direction, the movable disc of the relay is stopped from rotating and presses against that side of the pivoted weight which prevents it falling over. It is thus seen that it is impossible for external vibration to cause the pivoted weight to fall over and complete the tripping circuit. On a reversal of power in the main circuit, to a predetermined extent (controlled by the hanging weight), the disc will begin to move in the opposite direction to that in which it is urged by a normal flow of power. Just before the disc has made one complete revolution, it impinges, with a smart knock, on the other side of the pivoted weight, throwing it over, and thus causing the main circuit-breaker to be automatically opened. The speed at which the disc makes this one revolution is determined, firstly, by the extent of the reversal of power, and, secondly, by the retarding action of a permanent magnet between the poles of which it travels. The longest time taken by the relay to close the tripping contactor after the occurrence of the reverse current is generally about 20 seconds, when the reverse power just exceeds that for which the relay is set.—Lond. *Elec.*, October 20.

Electrical Equipment of Railway Shop.—An illustrated article describing the Keyser Valley shops of the Lackawanna Railroad. Electricity for power and light is supplied by one 100-kw and two 300-kw three-phase, 60-cycle, 480-volt generators. Power is transmitted from the power house to the various shops by lead-covered cables which are placed in underground terra-cotta ducts. The various motor drives installed at the shops are tabulated. Four hundred and forty-volt induction motors are used exclusively. With one exception, the individual drives are all belt-connected, and the group drives are similarly connected. There are over two hundred arc lamps used for indoor lighting, and these are all fitted with concentric diffusers. Series arc lamps are used for all-night lighting of the buildings and grounds. The distribution of arc and incandescent lamps is said to make the Keyser Valley shops one of the best-lighted railroad repair shops in the country.—*Am. Elec.*, November.

Hamburg.—RUPPRECHT.—A well illustrated paper on the electric distribution network of Hamburg. There are four central stations and eight sub-stations, furnishing direct current for tramways and lighting. Three-phase currents are used for transmission between certain stations and sub stations.—*Zeit. d. Ver. Deutsch Ing.*, August, September, October; abstracted with various illustrations in *Le Genie Civil*, October 21.

High-Tension Circuit-Breaking Devices.—FERNANDEZ.—An illustrated article containing some practical information on the operation of various types of high-tension circuit-breakers.—*Amer. Elec.*, November.

WIRES, WIRING AND CONDUITS.

The Most Favorable Conditions for the Transmission of Energy.—SARRAT.—A paper presented before the International Society of Electricians in Paris. The author criticises a former paper of Swingedauw and claims that it is incorrect to consider in a general way the current density which Swingedauw calls the most profitable one as analogous to that which results from the rule of Lord Kelvin and that under practical conditions the former quantity should be used only in exceptional cases. The paper is chiefly mathematical. *Bull. de la Soc. Internat. des Elec.*, July.

Reinforced Concrete Poles.—A short article on the use of reinforced concrete poles on some of the Canadian transmission lines. —*Amer. Elec.*, November.

ELECTROPHYSICS AND MAGNETISM.

Velocity of Roentgen Rays.—MARX.—An abstract of a paper read before the Society of German Naturalists and Physicians. To measure the speed of Roentgen rays, the author has used a method which enables one to measure directly periods of time, smaller than the time in which light passes through a distance of 10 centimeters (that is, smaller than one-third of one-thousandth of one-millionth second.) The radiation to be tested is produced periodically by short electric waves. In synchronism with the rays, an electrode oscillates in a special tube, so that this electrode is as many times per second positive and negative as the cathode of the Roentgen tube. If the Roentgen rays reach this electrode while it is negative, it sends out cathode rays; when it is positive, it does not do so. If the distance of the Roentgen tube is changed, it is possible to reach with short electric waves a certain point at which the Roentgen rays just reach the electrode in the positive state so that no cathode rays are emitted. If now a wire of 10 centimeter length is inserted into the wire leading to the electrode, cathode rays are again emitted, and a displacement of the tube is necessary to avoid again the emission of cathode rays from the electrode. Since this necessary displacement is found to be identical with the 10-centimer of inserted length of wire, the equality of the velocity of the Roentgen rays and of the velocity of light is proven. The author remarks that by means of a similar method the fundamental question as to the influence of the motion of the earth on the speed of light could be decided.—*Zeit. f. Elek* (Vienna), October 22.

ELECTROCHEMISTRY AND BATTERIES.

Electric Furnaces.—FitzGerald.—A continuation of his illustrated serial on electric furnace construction. In the present installment the Ruthenburg and Acheson furnaces are discussed. The object of the Ruthenburg furnace is to agglomerate finely divided magnetic iron ore by passing an electric current through it. The author shows that no great amount of power is required in order to reach the fusing temperature at the points of contact of the ore grains. The theory of the Acheson graphite process is that graphitization is brought about by the formation and subsequent decomposition of carbides, hence a carbonaceous material, such as anthracite coal, is chosen, because it contains a certain quantity of carbide-forming material distributed throughout it. On the other hand, when a very pure carbon, such as petroleum coke, is employed, the carbide-forming substance is mixed with the charge. Data are given on the construction of a furnace for making graphite from petroleum coke. The author then discusses the Acheson furnace for making graphite electrodes, detailed figures being given of the construction of such a furnace. The current passes alternately through sections of the furnace filled with granular carbon or electrodes, and as the resistivity of a mass of the granular carbon is very much greater than that of the electrode the chief generation of heat takes place in the former. Herein lies the chief feature of the invention, for by this ingenious arrangement the use of currents of very low voltage and enormous ampereage is avoided. For an actual furnace the author calculates the distribution of power in the granular carbon and in the electrodes as follows:

	Granular carbon. Kws.	Electrodes. Kws.
Initial	203.82	0.18
At end of five hours	750.05	5.95
Final	700.56	19.44

The article is illustrated.—*Electrochem. and Met. Ind.*, November.

Copper.—A discussion of copper smelting as a process for recovering gold and silver. Reference is made to the complex treatment of copper ores, consisting in furnace treatment to a 50 per cent matte, blowing this matte into blister copper, and finally electrolytic refining. In this last state the copper is turned out chemically pure and 98 to 99 per cent of actual values of gold and silver are recovered. With the great increase in the consumption of copper, due to general expansion in the electrical industries, the capacities of the electrolytic copper refineries near New York have greatly increased and are now about double what they were only six years ago. Some figures are given for the different refineries.—*Electrochem. and Met. Ind.*, November.

Analysis of Copper Slag.—Smith.—The first part of a report on a co-operative analysis of copper slag. Samples were sent out by the author to a great many chemists and complete analyses were received from fifteen different parties with statements of the methods used, etc. These are critically discussed. In the present installment the determination of copper, silica and alumina is dealt with.—*Electrochem. and Met. Ind.*, November.

Rotating Cathode.—Flora.—An account of experiments on the use of the rotating cathode for the estimation of cadmium taken as the chloride.—*Am. Jour of Science*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Meters.—An official paper of the German Reichsanstalt describing some new types of meters of Aron for direct current, single-phase and polyphase currents. The special details in which the new types differ from the well-known older type of Aron meters and which comprise an auxiliary coil and auxiliary springs are described and illustrated.—*Elek. Zeit.*, October 19.

Meters.—Gerhardi.—A continuation of his long illustrated serial. In the present installment he describes stands for testing meters, racks for storing meters, etc.—Lond. *Elec.*, October 27.

Measuring Instruments.—Reyval.—An illustrated description of various voltmeters, ammeters and wattmeters exhibited at the Exposition at Liege.—*L'Eclairage Elec.*, September 30.

Condenser for Jump-Spark Coil.—An illustrated article giving complete instructions for the construction of a condenser for operation in conjunction with a jump-spark coil for gas engine ignition purposes.—*Amer. Elec.*, November.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Transmission of Hand Writing.—English.—An illustrated article on the invention and development of the Gray telautograph and a description of the instrument of Tiffany in its present form. At the transmitter a pencil is attached by rods to two lever-arms which carry contact rollers at their ends. These rollers bear against the surface of two current-carrying rheostats, connected to a constant-pressure source of direct current. The writing currents pass from the rheostats to the rollers and from them to the line wires. When the pencil is moved, as in writing, currents of varying strength go out upon the line wires. At the receiver these currents pass through two vertically movable coils, suspended by springs in magnetic fields, and the coils move up or down according to the strength of the line currents. The motions of the coils are communicated to levers similar to those at the transmitter, and on these levers is mounted the receiver pen, which, by the motion of the coils, is caused to duplicate the motions of the sending pencil.—*Jour. Franklin Institute,* October.

Meter-Testing Equipment.—Ellis.—An illustrated description of a board designed for testing various kinds of meters. The author gives a diagram of connections for testing 500-volt, 220-volt and 110-volt direct-current meters; 220-volt and 110-volt alternating-current meters; 220-volt, three-wire, direct-current meters, and 220-volt, three-wire, alternating-current meters.—*Am. Elec.*, November.

Telephone Switchboard.—An illustrated description of a new multiple switchboard which has recently been taken into use at the Guernsey telephone exchange in England.—Lond. *Elec.*, October 20.

MISCELLANEOUS.

Rare Atmospheric Gases.—Valentiner and Schmidt.—Dewar has shown that charcoal at the temperature of liquid air possesses an extraordinarily high absorbing power for atmospheric gases, and has used this property for discovering hydrogen, helium and neon in comparatively small quantities of air. The present authors have employed this same property for manufacturing neon, krypton and xenon for spectrum tubes. To obtain the neon, they collected a quantity of argon, which contains neon, and led it over cocoanut charcoal kept at the temperature of liquid air. In this manner they liberated the neon, and avoided any admixture of nitrogen. The pressure had to be low, not exceeding a few millimetres. To free the neon from traces of helium, they occluded it in pure charcoal at a somewhat higher pressure and drove it out again. They thus obtained spectroscopically pure neon. To obtain krypton and xenon, they used charcoal at —120° C., which absorbs krypton and xenon completely, but only a little argon. They again eliminated the argon by connecting with a tube of charcoal in liquid air. Heating to —80° C. liberated pure krypton. A similar differential method enabled the authors to eliminate the krypton and to obtain spectroscopically pure xenon at —15°.—Lond. *Elec.*, October 27; from *Ann. der Phys.*, No. 11.

Liquid Air.—Pictet.—A paper read before the recent meeting of the Society of German Naturalists and Physicians. The author gives a review of the history and theory of liquefaction of air, and discusses the production and uses of commercial oxygen. After air has been liquefied, it is possible to keep it in liquid form at a pressure of two atmospheres. Nitrogen gas passes off first, afterwards oxygen which may be obtained in any desired purity. With a mixture of oxygen and illuminating gas it is easy to produce a temperature of 3,300 to 3,400° C. Incandescent bodies in such a flame give, of course, a much brighter light than in a flame of a temperature of 1,500° C. The author demonstrated such a flame. The ordinary Welsbach mantles could not stand such a temperature, but the author says he has succeeded in producing suitable mantles. According to his statements oxygen made from liquid air costs 0.25 cent per cubic meter (the pressure not being stated).—*Zeit. f. Elek.* (Vienna), October 22.

Thawing Dynamite.—Kelly.—An illustrated article on thawing dynamite electrically in an underground magazine. The method is used in a mine in Michigan. The apparatus employed is described and illustrated.—*Mines and Minerals,* November.

Estimating on Contract Work.—Auerbacher.—An illustrated article treating of the general subject of estimating from the viewpoint of the electrical contractor. Various expedients necessary to successful estimating are pointed out.—*Amer. Elec.*, November.

Swiss Electrical Society.—Herzog.—A report on the recent general meeting of the Swiss Electrical Society in Freiburg. The presidential address urged very strongly a systematic study of the problem of electrifying railroads. The work of a committee appointed for this purpose is progressing rapidly, and it is suggested that the government should interest itself somewhat more in the subject. The society adopted a resolution protesting strongly against the municipal ownership of water powers. It is considered that monopolization of water powers by the government would be very detrimental to the electrical industries. Mosciciki read a paper on high-tension condensers and on disturbances in network due to electric discharges of high frequency and voltage. This paper will be dealt with in a separate abstract.—*Zeit. f. Elek.* (Vienna), October 15.

"Graft" In An Electrical Manufacturing Concern.

A recent litigation at Sandusky, Ohio, brought to light an extraordinary state of affairs in connection with the financial status and management of the Warren Electrical Manufacturing Company, of that city. The suit was started by Maria C. Warren, widow of the late C. C. Warren, and D. J. Mackey, as executors of the will of C. C. Warren. It was declared in the petition that the manager, Mr. L. G. Read, had endorsed paper aggregating $35.000 and that the company was mismanaged and so heavily in debt that it would become insolvent. The petitioners asked for the appointment of a receiver to protect their interest. The court had appointed H. W. Parsons receiver, and the defendants immediately filed a motion for a dissolution of the receivership. Mr. H. B. Warren, son of the dead president of the company, told of the contract by which machines were delivered to agents at a net price, all above this realized being the agent's commission. On one contract known as the Montpelier contract, the price paid was $22,700, while the company secured only $14,062. The remainder was the agent's commission. The sale was made by L. G. Read, who is manager of the company, as there was credited to him, as commission, $6,750, of which $3,250 was paid in cash, although the machine was not yet completed.

When Mr. Read took the witness stand he told of a sale of a turbo-generator to an Eastern light and power company for $21,750. The Warren Company got a little over $15,000 for the machine, but Mr. Read, as agent, did not get the rest. He said that he dickered a long time with the president of the power company, naming both the company and the president, and the president finally agreed to let the contract to him if the sale was made on a basis of $19,500 as actual cost, to be billed in to the company for $21,750 and the president to get the difference as a "rake off." It was so ordered and the president was sent a present of a Warren Electric Company's check for $2,250.

As to the manner of getting loans, Mr. H. B. Warren testified that for $2,500 borrowed from the Euclid Avenue Trust Company, of Cleveland, the trust company charged the market rate of interest, took $1.50 in bonds as collateral for every dollar borrowed and in addition charged 10 per cent for making the loan.

As the result of the hearing Receiver W. H. Parsons was removed and James Flynn, R. E. Schuck and John Whitworth, three bankers, were put in charge of the plant to operate it under the court's order. The resignation of L. G. Read as manager was at once demanded.

Judge Reed, who tried the case, said that he had no doubt that under the management of the late C. C. Warren the business grew and the concern prospered. He designated it as "poor business" when L. G. Read was made manager following Mr. Warren's death. Mr. Read was, prior to that time, a selling agent and only a short time prior to Mr. Warren's death made a long-time contract for the entire output of the Warren Company's plant. His subsequent election as manager of the plant made it so that he fixed the price at which the company's products were sold to him.

In regard to the $2,250 Manager Read admitted on the stand he had allowed the president of a purchasing corporation, Judge Reed remarked: "I was shocked at the statement of Mr. Read that he deliberately paid the president of this company $2,250 as an inducement to buy. It may be the usual thing in business, but I give very little credit to the word of a man who admits he bribed an officer of another corporation. He does not come into court with very clean hands and is entitled to very little consideration at my hands."

An effort was made by Mr. Read not to have his testimony in regard to the bribe go on record. He asked the court to have it stricken out. "Mr. Read," was the court's reply, "I will have you understand that everything in this court is open and above board and there will be no whitewashing here. The record will stand."

The court commented unfavorably on the fact that the company had found it necessary to pay a bonus of 10 per cent in addition to the customary interest in order to float a loan. "It certainly shows that the company's credit was exhausted or there was very poor management," said the court, "if it was necessary to give a bonus of $2,800 in order to secure a loan of $28,000, as has been testified to."

In conclusion the court said he thought the company should be a paying institution. He remarked that it seemed queer, to say the least, that small bills for two or three dollars would be refused payment when the manager was paid $4,000 as a commission for a sale and the president of a buying company a bribe of $2,500. "The management of Mr. Read has been detrimental," said the court, "for the benefit of a few individuals getting a rake-off."

New Flaming Arc Lamp.

The rapidly extending use in Europe of the flaming arc lamp, and the favorable attention which the relatively few installations thus far made in this country have attracted, indicate that this type of lamp must now be considered a live factor in the electric lighting field. The American Beck Arc Light Company, 1591 Broadway, New York, has been formed to take over the American rights and will manufacture one of the most popular of European flaming arc lamps, and is now about ready to place the lamp on the market. This lamp is the invention of Heinrich Beck, of Meiningen, Germany, and is remarkable for its simple construction, which will be described farther on.

Composite carbons are used and therefore any color within the practicable range of lighting, running all the way from white through yellow to red, may be obtained at will. The lamp burns with a long arc, but owing to the flaming arc the voltage at the terminals is about the same as for the ordinary open arc, ranging from 42 to 46 volts. The current is from 6 to 12 amp. for both direct and alternating current, the candle power corresponding to the latter current being 3,800 cp, all of which is distributed below the horizontal for reasons that will be seen later. For the 9 amp. lamp the diameter of the positive carbon is about 1/3 in. (8 mm.), and that of the negative carbon is slightly smaller (7.5 mm.). The length of the carbon is about 12 in. (330 mm.) for the smallest type of lamp, which gives a carbon life of eight hours. The lamps, however, are built for carbon lengths up to 26 in. (550 mm.). Prof. Wedding, the German authority on illumination, has tested a direct current lamp for 9.1 amp. at 42.2 volts, which gave, without globe, 2,464 hemispherical candle-power, corresponding to a consumption of 0.163 watt per candle—an economy almost four times as great as that of the ordinary open arc lamp, which latter is at least twice as efficient as the best enclosed arc lamp.

The construction of the lamp is shown diagrammatically by Fig. 1. The carbons are arranged side by side in a slightly inclined position. One carbon is fixed, with respect to its longitudinal direction, the other being adjusted in position by means of the lever shown at the top. This lever is operated by means of an electromagnet, shown in the center at the top of the lamp. When no current flows the two carbons touch each other at their terminals at the bottom. When the circuit is closed the right-hand carbon is deviated sideways and the arc is started. The deviation of the right-hand carbon is limited so that a constant distance between the two carbons is maintained. The electromagnet contains only a few windings through which the main current flows.

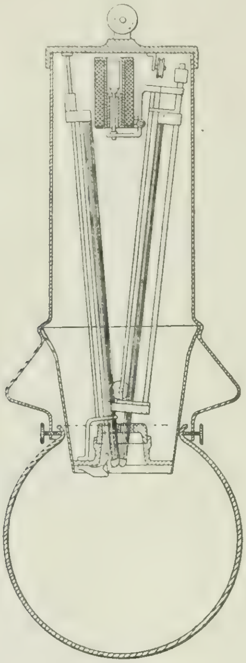


FIG. I.—FLAMING ARC LAMP.

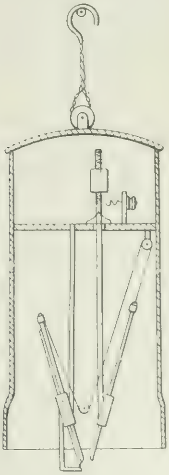


FIG. 2.—FLAMING ARC LAMP.

The lower terminals of the carbons are surrounded by a cast-iron reflector, the inside of which is of white enamel. The left carbon (for direct current usually the positive carbon) has not an exactly circular cross-section, but is provided with a rib, which is shown at the left, and by means of which it rests on a support mounted at the bottom of the reflector. Above the lower supporting surface there is provided a small chamber surrounding the carbon rib and protecting it from the air. The purpose is to let the carbon burn off in such a way that a fine point always remains at the end of the rib, and on this point the left carbon rests. It burns off very uniformly and slowly, so that the carbon electrode is fed downward very gradually and uniformly. The support on which the fine terminal point of the carbon rib rests remains relatively cold. The right-hand carbon, which has a completely circular cross-section, is fed downward simultaneously with the left-hand carbon by means of the mechanism shown in Fig. 2.

◆

Automatic Switchless Telephone.

The mechanism of the complete automatic switchless telephone, shown in Fig. 1, is composed of a built-up frame of heavy sawed brass, with a sliding plate in the center. The push buttons are made of hard-drawn cone-shaped brass, with a hard-steel pin on one end and a hard-rubber button on the other. There are no spiral springs used on this mechanism. The buttons are held and worked by a heavy hard-drawn bronze spring, bent on one end for the line terminal. Pressing the button all the way in will give the ringing circuit; on its return the button makes two self-cleaning, talking contacts. When the conversation is completed, the placing of the receiver on the hook causes the button to be released. The self-cleaning contacts are stated to eliminate the trouble due to acid, dust and corrosive fumes.

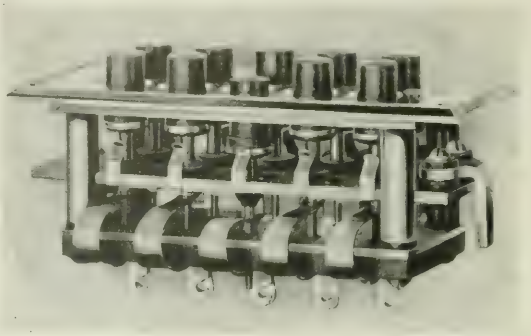


FIG. I.—AUTOMATIC TELEPHONE PUSH BUTTONS.

The self-cleaning contact spring is of hard-drawn bronze. It is fastened to the talking plate by rivets and so bent up that every time a button is pressed, the spring makes two or more scraping contacts before it comes to rest. The cone-shaped push button on the sliding plate is also equipped with a scraping contact. Either of these contacts will cut through any foreign matter.

Fig. 2 shows the mechanical details of the push buttons. The circuits indicated in Fig. 2 are intended for a six-station system, for which 10 wires are required, when there is used a separate bank of batteries for ringing and talking. The same general scheme can be employed for systems having any number of stations not ex-

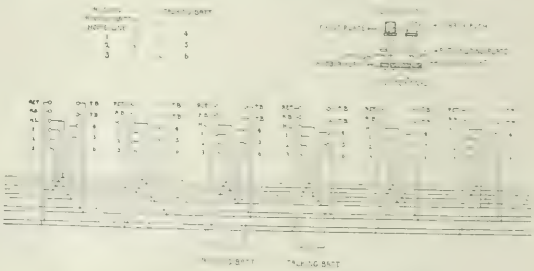


FIG. 2.—DIAGRAM OF TELEPHONE CONNECTIONS.

ceeding 50, by using in each case four more wires than there are telephones. The manufacturer of the automatic switchless telephone is the De Veau Telephone Manufacturing Company, New York.

Portable Moving Coil Galvanometer.

The portable moving-coil galvanometer illustrated in Fig. 1 is equipped with a novel form of moving system and filament suspension which is claimed to avoid the initial friction to be overcome when jewel bearings are adopted as a means of suspension and to permit high sensibility. The suspension consists of upper and lower filaments, and in this particular it differs from the pivot-and-jewel suspension as ordinarily used in instruments of the portable type.

The magnetic field is produced by a U-shaped cast-iron permanent magnet, Figs. 2 and 3, having inwardly directed poles at one end so as to have north polarity only on one side of the air gap, separating the poles, and south polarity only on the other side of the air gap. The magnet is slotted so as to accommodate the moving system, as shown. The air gap between the poles being very short, the field is uniform and intense.

The moving system consists of four flat coils of very fine wire, wound alternately in opposite directions, so as to produce alternate north and south poles when viewed from one side. These coils are held between two aluminum discs, and suspended in such a manner that normally only a portion of each coil extends into the air-gap between the magnet poles, though at all times only about one-half of the coil surface is between the pole faces. It is evident, therefore, that when current is passed through the coils, two of the coils of a certain polarity will tend to swing around to inclose the greatest number of lines of force, while the other two coils of opposite polarity will be repelled. The aluminum discs also serve the purpose of damping the system and rendering it dead-beat. The galvanometer can be given a high, medium or low resistance by connecting the coils in series, series-parallel, or parallel.

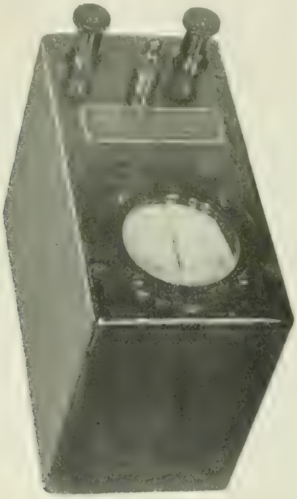
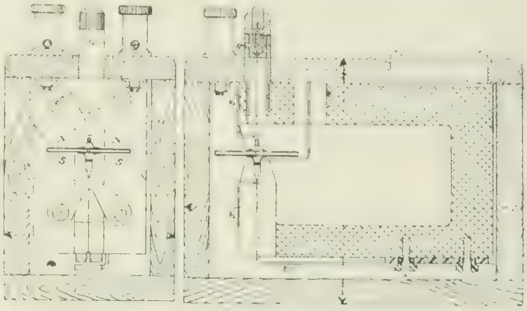


FIG. 1.—PORTABLE MOVING-COIL GALVANOMETER.

The suspensions consist of three-wire filaments of a high tensile strength, which are non-corrosive. To give the entire system resiliency in the event of sudden jars, the upper suspension terminates in a spiral spring, and the lower suspension is attached to a long flat phosphor bronze spring. An additional protection against excessive strains on the moving system is provided by means of two guards, which have clearance holes to provide for the rotation of the system around its axis of suspension and to limit the sidewise play of the system, thereby arresting the movement of the coil due to any sudden shock. The movement of the system vertically is limited by the pole-faces of the magnet, which also prevents breaking of the wire filaments.

A torsion head provides a delicate zero adjustment, and by means of a screw operating in an annular groove, it engages the end of the groove and thus acts as a stop to limit the extent to which the torsion head may be turned, and, therefore, prevents the suspension filament from being twisted off by turning the adjusting head too far.



FIGS. 2 AND 3.—SECTIONAL VIEWS OF GALVANOMETER.

The magnet with its complete moving system and scale is mounted in a highly polished mahogany case, as shown in Fig. 1. A circular opening in the top protected by a glass window provides for the visibility of the scale. This instrument is being placed on the market by the Leeds & Northrup Company, 259 N. Broad St., Philadelphia.

A Safety Line Disconnector.

A device for automatically disconnecting and rendering harmless all broken ends of wires hanging down from poles is being made by the G. & W. Electric Specialty Company, of Chicago, after having been perfected on the lines of the Commonwealth Electric Company, of that city. Fig. 1 shows these automatic line disconnecters as they will appear placed in a high-tension line at a crossing with telephone lines. The object of the device is to provide something safer and more satisfactory than guard wire net works under high-tension lines. The recommendations of the underwriters for such crossings are for extra high poles set close together at crossings, so that if the wire breaks the broken ends will not be long enough to reach down to the telephone wires below. It is not always possible thus to locate poles.

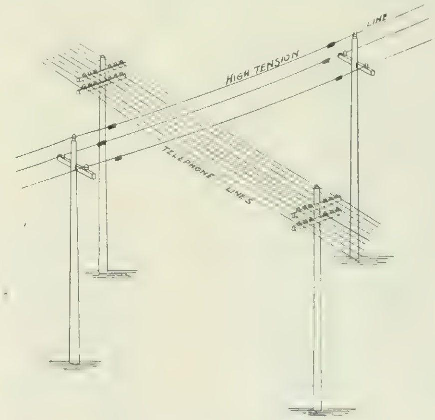


FIG. 1.—APPLICATION OF LINE DISCONNECTOR.

This line connector is so constructed that, as soon as the tension on the line is removed, a powerful spring will disengage the device and disconnect the broken section. This spring acts so quickly as to prevent even a momentary contact between the high-tension wire and the wires crossing below it. The disengaging spring and hook are protected from the weather by a hood, which also prevents sleet from interfering with the operation of the device. Referring to Fig. 2, the parts *G*, *D*, *E* and *F* have been removed from the hood

(to show their construction more clearly. The piece *D* is held in the hood by the screw shown on the side of the hood directly above it. The spring *G* is held in the hood by the screw directly above it. The hook *I* has a slot in the middle to receive the spring. When placing the device in a line the hook is placed against the spring and pressed up until it rests against the cross piece *D*. The tension is then placed on the line, which holds the hook in place until the tension is released by the breaking of the wire, when the spring throws the hook out and disconnects the line. Two sizes are made, one for use on high voltage wires and the other for telephone and telegraph wires where they must cross above high-tension lines. The type illustrated is the one made for telephone wires. In the device as made for high tension wires, terminals are provided which permit of soldered connections giving a current-carrying capacity equal to that of the wire. The connections on the telephone wire disconnector are also soldered. This soldering is done in manufacture, and the device is furnished with wire terminals attached. To provide against the possibility of a moving contact interfering with good service on the telephone line, the hook contact of the device is bridged by a wire, *E*, Fig. 2, one end of which is soldered to the inside of the hood. The other passes into a hole in the hook of about ⅛ in. diameter and ½ in. tip, which forms a mercury well. The top of the mercury well is soldered with paraffine wax while the hook is being put in position to prevent the mercury being spilled.

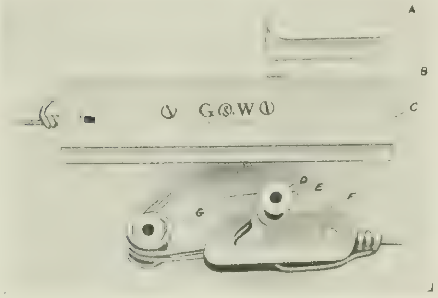


FIG. 2.—DETAILS OF LINE DISCONNECTOR.

◆

Split Porcelain Insulator.

The accompanying illustrations show an insulator which has been designed to eliminate the objectionable tie wire. Each insulator is made in two parts. The slot in each part is given a certain oval curvature. The oval shape enables the hole for the screw to be placed in the center, while the wire is held securely in place on account of the curve between the two parts which are forced against the wire. Fig. 1 shows the insulator complete while Fig. 2 shows the general construction of the insulator. This insulator is manufactured by the Star Porcelain Company, Trenton, N. J.

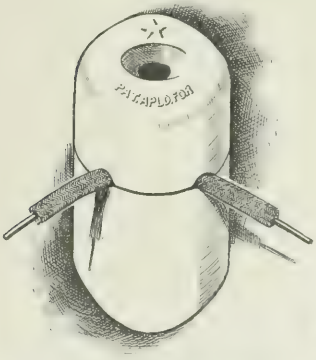


FIG. 1.—INSULATOR COMPLETE.

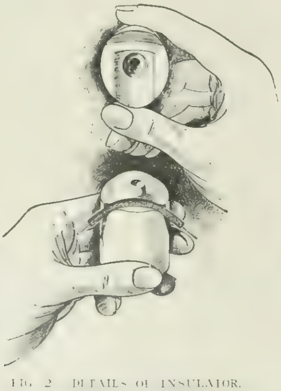
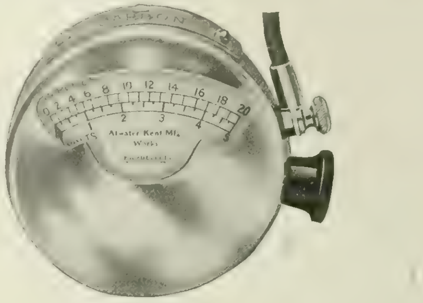


FIG. 2.—DETAILS OF INSULATOR.

Volt-Ammeter for Battery Circuits.

The volt-ammeter shown in the illustration herewith has been designed especially for use with primary batteries. The scale of each meter is graduated by hand when it is calibrated by comparison with standardized apparatus. An advantageous feature which has recently been introduced in these instruments resides in the "dead-beat" needle which, on account of its quickness in coming to rest, assures a quick and accurate reading. These instruments are manufactured by the Atwater Kent Manufacturing Works, 112 North Sixth Street, Philadelphia.



VOLT-AMMETER.

◆

A Pocket Live Wire Indicator.

The Minerallac Company, of Chicago, has received notification that it has just been awarded a prize of 500 francs and given honorable mention by the Association des Industriels de France for its small device known as the "Electroscope," which is for use by linemen and all working where there may be live conductors, to indicate the presence of dangerous potentials on conductors. This French institution opened a competition something over a year ago for an indicating instrument which could be used by those working around high-tension conductors, to determine whether conductors about to be handled had been cut out or were still alive. The electroscope is an extremely simple device, as shown in Figs. 1, 2 and 3. It is merely a glass tube on one end of which is secured a metal cap, which carries a strip of metal projecting some distance into the tube. On this strip of metal is mounted the indicating leaf of the electroscope. The metal cap is hermetically sealed, in addition to being screwed on to the end of the tube so as to prevent moisture from getting into the tube. When the tip of the electroscope is held near a dead conductor, there is no indication and the indicating silver leaf lies flat in the bottom of the tube, as in Fig. 1. When the tip of the electroscope is held near a live conductor, the indicating leaf rises, as in Fig. 2. The pocket size of this instrument is kept in a light aluminum case, while the station size, which is that shown, is in a heavier wooden case, so that it can be kept in tool boxes. As ordinarily made, this electroscope will indicate positively on voltages

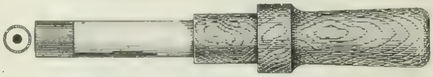


FIG. 1.—LIVE WIRE INDICATOR.

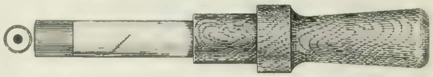


FIG. 2.—LIVE WIRE INDICATOR.

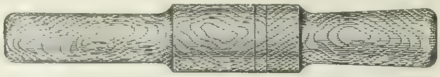


FIG. 3.—CASE FOR INDICATOR.

as low as 500 volts. It could be made to indicate on lower voltages, but in such case the indicating leaf would be so light as to tear itself to pieces when held near high-tension conductors. It goes without saying that some positive, quick method of testing for live conductors is very desirable when men are working around oil switches or on lines, as there is always a chance for a mistake or misinformation as to which high-tension lines have been cut out at the switchboard. By trying it on each side of a primary fuse box, indications will show if the fuse is blown. Those accustomed to using the device can also learn to judge approximately the potential a line is carrying by the distance from the conductor that the instrument must be placed to indicate. It is of course not useful for indicating potential on lead-covered cables before the lead sheath is removed.

Blower for Hot Gases.

Experience has shown that in handling hot gases with a fan, as in a plant producing induced draft for boilers, it is impossible to give the fan shaft a suitable bearing at the inlet side. A bearing here would necessarily be situated in the inlet area and would be constantly surrounded by hot flue gases. Much better results have been obtained by the use of an overhung wheel, having, in addition to the two engine bearings, a bearing on the engine side of the fan, but none on the inlet side. The usual form of construction, which requires a third bearing separate from the engine, has, however, given trouble from the fact that this bearing cannot readily be lined up with the two engine bearings.

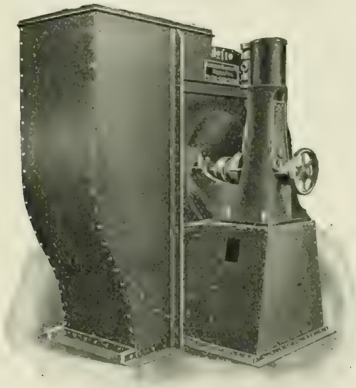


FIG. 1.—BLOWER FOR HOT GASES.

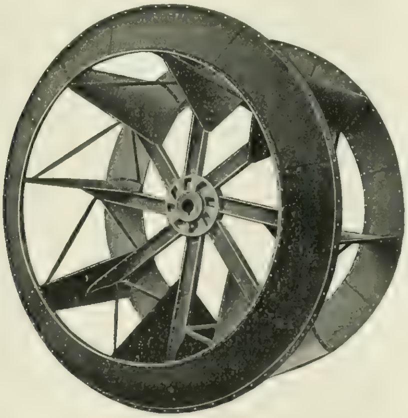


FIG. 2.—DESIGN OF SINGLE-SPIDER WHEEL.

In Fig. 1 is shown a new method of construction which has been designed to overcome this trouble. All of the journal boxes are cast in the engine frame and can be bored with the same boring bar. Thus it is impossible for them to be out of line. The fan bearing is water-cooled and ring-oiled. From the fact that all bearings are bored at once, a self-aligning bearing, such as would otherwise be necessary, is not required here, so that the arrangement is still further simplified. In addition to these points, it will be noticed that the bearing is supported by the engine bed and not by the housing of the fan as would otherwise be the case. This disposal simplifies the construction by doing away with the additional bracing usually found on fan housings.

The wheel, shown in Fig. 2, is varied somewhat from the ordinary construction. In place of the usual three spiders, is substituted one heavier one, built of I-beams cast into the hub. The blades are braced upon each other, as shown in the cut. The wheel constructed in this manner has been shown to be fully as strong and rigid as the ordinary three-spider form.

The engine is of the enclosed type, oiled by a recently devised pump which distributes copious streams of oil all over all of the reciprocating and revolving parts, even lubricating the eccentric outside of the frame. Tests in actual practice have proven that it will run several months without oiling or adjustment. This outfit is manufactured by the American Blower Company of Detroit, Michigan.

Battery Fan Motors.

The usefulness of the fan motor has long been appreciated by consumers of central station and isolated plant current, and each year records more extended applications of improved designs in portable and stationary fans. Although the vast majority of fan motors in commercial service are operated upon lighting or power circuits, the field of usefulness of fans run by battery current is constantly expanding. The storage battery is a most convenient source of power for small fan motor work, in installations where the dynamo equipment is supplemented in this way, for the energy consumed by a modern fan motor of first class design does not exceed that required by a 16-cp incandescent lamp, and consequently a considerable number of fan motors can be operated at any convenient voltage from a power house or sub-station battery without noticeable interference with its discharge capacity.

There has arisen of late a commercial demand for a fan motor capable of being operated upon a primary battery circuit in locations where central station or isolated plant power is not available. This requirement has been met by the manufacturers in the design of motors capable of performing good service with a remarkably low operating expense considering the unfavorable aspects of economical current generation by chemical means. An illustration occurs in the case of a 9-in. fan battery motor now on the market which operates 150 hours on a single battery charge at a cost of about 3.5 cents per hour. The first cost of the entire outfit, including a spring suspension bracket, four cells of battery, a containing box, flexible cord, fan and guard is but $25, and the motor alone may be purchased for about $13. Equipped with ball bearings, which greatly decrease the friction losses, such a motor is adapted to high-speed operation and is in no sense a toy, despite its being designed for less than 3 volts full potential. The battery occupies less than 2 cu. ft. of space and the motor with its fan an area of only 120 sq. in. Another battery motor, equipped with a 7-in. fan, will operate 150 hours at an expense of about 2.5 cents per hour, drawing its current from three cells of battery giving a total e.m.f. of but 2.1 volts. Such an outfit costs in the beginning but $18, of which about $8.50 may be charged to the motor and fan.

Perhaps the most useful application of these motors is found in the sick room, where good ventilation is imperative. There are still many homes which are out of the reach of central station circuits, but which none the less are in need of the service which the fan motor can supply. It is certainly quite worth while, in a well-to-do rural community, to employ the battery fan motor in hot weather to alleviate the discomforts of sultry days, and in the winter season the part which such an equipment plays in the freshening up of a sick room may well become an important factor in the patient's recovery. Noiselessness is a prime essential, however, and it is important to avoid turning the air current directly upon a patient—a proceeding which has at times been followed by serious results, including the discrediting of the fan motor itself.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—There is no reason for complaint over the trade and industrial conditions, since excellent reports are made from nearly all lines. Free movement of freight is hampered, however, by car congestion in widely separated sections, which plight affects prices and collections. Trade continues to receive stimulus from the cold weather, and sales compare well with those of a year ago. Jobbers and wholesalers report some change of activity from staple lines to holiday specialties, and manufacturers of such goods are working full time. Intense activity characterizes industry, the past month being a record-breaker in all lines of iron and steel. Touching upon this subject the *Iron Age* says the monthly statistics show that there were produced by the anthracite and coke furnaces of the United States, 2,053,127 tons of pig iron, which compares with the previous achievement of 1,963,717 tons in May. Both figures do not include the output of charcoal pig, which may be estimated at about 30,000 tons a month. The steel companies produced 1,370,960 tons in October, as compared with 1,287,438 tons in May. Of this October product the United States Steel Corporation had 950,752 tons. How enormous the output of the steel works is, is proved by the record of the plants of the United States Steel Corporation, which, in October, produced 1,172,951 gross tons of ingots. The pressure for deliveries in the structural trade is enormous. The New York & New Jersey Railroad Company, which is building the so-called McAdoo tunnel, has awarded the second contract to the Bethlehem Steel Company, for steel and iron castings for use in the tunnel. The company will require about 73,000 tons before the work is completed, and another contract will probably be let before the end of the year. Prices of staples show marked strength, and, in a majority of cases, are higher. Money is in active request in the country, and the demand on account of crop movement is unabated. The strength of demand and of prices in many industries is perhaps the most marked feature of the present season's unprecedented trade. Iron and steel, lumber, all other building materials, cotton and cotton goods, and hides, leather and shoes show strength never heretofore surpassed. The recent advance in the price of cotton has caused more sales at the South, with good results upon trade and collections. Labor is scarce, however, and complaint is made that the crop cannot be picked promptly. There is a less foreign demand for cereals, but foreigners display a tendency to come into the market at lower prices. At home the reactionary tone of last week continues. Railway tonnage is very heavy, only a paucity of transportation facilities preventing further expansion. The gross earnings for October will probably show an increase of 6 per cent over the same month last year. In the metal market, copper was very dull, consumers being apparently well supplied for present needs. Lake and electrolytic sold at 16½c., and casting stock is held at 16¼c. *Bradstreet's* reports 166 business failures in the week ending Nov. 9, compared with 160 the week previous, and 184 in the corresponding week last year.

THE AMERICAN WOOLEN COMPANY, of Boston, Mass., through its president, William M. Wood, has just signed a contract with the Otis Elevator Company, of New York, for four escalators to be installed in the new "Wood" worsted mill which is being built at Lawrence. This is the first factory installation of the escalator on record, and, in fact, one of the first instances where provision has been made in a factory equipment for mechanical means of elevating employees from the surface level to the various floors. The "Wood" worsted mill will be one of the largest single factory buildings in the world, contemplating an ultimate capacity of 5,000 hands. The escalators are to be installed in a special building situated between the wings of the factory proper and adjoining and connected with the factory entrance, which is at the second floor. Two escalators will run in parallel from the second to the fourth floor, it being contemplated that employees shall either walk from the fourth to the third floor or ascend by ordinary stairs from the second to the third floor. One escalator will run from the fourth to the fifth floor and one from the fourth to the sixth floor. Although this escalator installation involves an investment of approximately $100,000, it is calculated by the management of the American Woolen Company that the enhanced efficiency of the employees will more than offset the interest on the investment, most of the employees being women, and the injurious effects of stair-climbing upon women being recognized as more serious than the mere consumption of muscular effort. It is estimated that 100 ordinary elevators would be required to furnish an equivalent service.

MAGNETO-ELECTRIC COMPANY.—The property of the Magneto-Electric Company, of Amsterdam, N. Y., has been sold in that city to satisfy a judgment foreclosure action brought by the United States Mortgage & Trust Company. Contractor Fred Conrad made the first bid, which was $15,000. This was raised to $20,000 by Attorney Dodd, representing the bondholders, and as there were no other bids it was accordingly struck down to him. Steps will now be immediately taken to effect the organization of the new electric company, which will have the present building, and then it is expected the plant will be started. The New Electric Manufacturing Company, of Amsterdam, capital $250,000, has been incorporated to take over the property, with Roy W. Brown, George I. Herrick, John E. Larrabee, Richard Murphy and Waldimer C. Schaufler, of Amsterdam, and Eugene Moore and Frank D. Oliver, of Johnstown, as directors.

LIGHTING IN CONNECTICUT.—Mr. Burdett Loomis, of Hartford, representing a syndicate of Philadelphia capitalists, has acquired a controlling interest in the capital stock of the Windsor Locks Electric Lighting Company. The price paid for the control was $200 a share. The company has a capital stock of $20,000, and it also has outstanding a $30,000 issue of 4½ per cent bonds, which mature in 1922. The company pays a regular dividend of 6 per cent, and it recently declared an extra of 4 per cent. It is expected that the new owners will expand the plant and operate it for power and light, both night and day. A gas plant will probably be added to the equipment at an early date.

KOERTING GAS ENGINES.—It is reported that the De La Vergne Machine Company, of New York, which has recently completed its contract for 40,000 hp of Koerting two-cycle double-acting gas engines, of which 32,000 hp is employed for driving blowing engines, and 8,000 horse-power for driving direct current, and polyphase alternating current generators, have recently been given a contract for three 500 hp Koerting gas engines to be direct connected to 325 kw, 550-volt direct-current Crocker-Wheeler generators for the Boston Elevated Company. These engines will be put in operation about Jan. 1, 1906.

CATALOGUES FOR BELIZE, B. H.—Mr. Joseph Lewis, proprietor of the Belize Ice & Distilled Waterworks, etc., Belize, British Honduras, S. A., has closed a contract with the colony government to furnish light and power for a period of 30 years, and wishes to get catalogues, with lowest cash prices, for electrical machinery, fixtures and supplies. He does not state the terms or nature of the contract. He also wishes quotations on batteries for automobiles and launches.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has been awarded the contract for the construction of a complete subway system at Chattanooga, Tenn., for the East Tennessee Bell Telephone Company. Active work on construction of this contract was commenced last week and is to be rushed to a speedy conclusion. This is the first conduit work installed in the city of Chattanooga and the system will be a large one.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Friendly, W. Va.; Sistersville, W. Va.; New Matamoras, Ohio; Laclede, Mo.; Long Lake, Minn.; Eureka, Utah; Payson, Utah; Richmond, Utah; Tooele, Utah; Preston, Idaho; Lowville, N. Y.; Louisville, Ky.; Attica, Ind., and Rochester, N. Y.

PLANT FOR HOOPESTON, ILL.—The city council of Hoopeston, Ill., has granted a fifty years franchise to Mr. Charles J. Wakeman for a gas and an electric lighting plant. It is proposed to rebuild the electric plant and to put in gas works. Mr. Wakeman is the president and manager of the present Hoopeston Electric Lighting & Heating Co., which has Westinghouse and Fort Wayne apparatus for lighting and a day power circuit.

FACTORY FOR SUPPLIES.—It is stated by the Middletown, Conn., *Press* that Mr. Farley Osgood, general manager of the New Milford Power Company, has bought the Wannopee pottery buildings, which will be used for the manufacture of electrical supplies.

RAILROAD SIGNAL EQUIPMENT.—The New York Central has closed a contract with the Hall Signal Company for the equipment of the West Shore Railroad from West Cornwall to Haverstraw with normal danger automatic block signals.

JAPANESE ELECTRIC ORDERS.—Takata & Co., engineering department reports the following recent orders from Japan for Westinghouse machinery, etc.: Takata & Co., Tokio—Ten 1-kw, type "N" transformers, 7,200 alternations; twenty 2-kw type "N" transformers, 7,200 alternations; twenty 3-kw type "N" transformers, 7,200 alternations; twenty 4-kw type "N" transformers, 7,200 alternations; twenty-five 5-kw type "N" transformers, 7,200 alternations; ten 7½-kw type "N" transformers, 7,200 alternations. Osaka Arsenal—One portable wattmeter, single-phase, 7,200 alternations; one portable voltmeter, direct current and alternating current; one portable ammeter, alternating current. Nagoya Industrial School—Two 10-hp, shunt-wound, type "S" motors, 110 volts; two type "K," direct-current, 120-amp. ammeters. Osaka Arsenal—Two type 8-A, 250-volt, three-phase, feeder panels, an extension to a previous Westinghouse installation. Ashio Mine—Three 150-hp, 2,000-volt, 6,000-alternations, three-phase, type "C," alternating-current induction motors; two 25-hp, 500-volt, 6,000-alternations, three-phase, type "C" induction motors; one 15-hp, 500-volt, 6,000-alternations, three-phase, type "C" induction motors; one 15-hp, 500-volt, 6,000-alternations, three-phase, type "C" induction motor, arranged for gear connection to a countershaft, complete with Laminar fibre motor pinions, gear wheel, etc.; six 75-kw, 2,000-520-volt, 6,000-alternation transformers; three 50-kw, 2,000-520-volt, 6,000-alternation transformers. Takata & Co., Tokio—Ten direct-current, enclosed arc lamps, series potential, 200-220 volts, 16 series resistances. Hokkaido Tanko Railway Company—One 75-kw, single-phase, alternating-current, revolving-armature generator, 7,200 alternations, 2,200 volts, 720 r.p.m., driven by a Westinghouse standard engine, 13½ by 12; one 2-kw, 125-volt exciter for the above generator; one marble switchboard consisting of one exciter panel, one generator panel, one feeder panel, for the control of the generator and the exciter mentioned above, together with three feeders; ten 5-kw, type "B" transformers; five 3-kw, type "B" transformers.

ELECTRIC BARK GRINDING.—The Public Service Corporation's bulletin, *Light and Power,* for October, says: "Early every spring in Virginia, Mississippi, Missouri and other Southern States, men, carrying what they call a 'spud' go far into the lumber regions to strip the bark from the trees, while the sap is running. Large quantities of this bark, in about 4-ft. lengths, is shipped to the mills of H. Stacey Smith. Two of these are located in Virginia, while the other is at 565 Ferry Street, Newark. The bark, shipped to the Newark mill, is largely chestnut-oak and hemlock, these two being especially adapted to the tanning of patent leather for which Newark is celebrated, about 75 per cent of that product used in the United States being made in that city. In preparing the bark for this trade rock oak, found only north of the Mason and Dixon line, is also used. When the bark, received by the car load, is thoroughly dry, it must be ground or shredded to be of use in leather tanning. H. Stacey Smith has the only mill for this work in Newark. He has installed for his process a 35-hp electric motor to operate a patent crushing machine, which instead of grinding, tears the bark apart. There are many by-products for which the dust of the bark may be used so that no waste is allowed. In the large yard back of the mill is 3,000 or 4,000 tons of bark. These are emergency piles, used only when there is a delay in the regular shipments. The United Electric Company installed the motor now in use there."

WIRELESS AND STOWAWAYS.—The Atlantic De Forest Wireless Company sends us the following report from the De Forest operator on the steamship *Coamo,* from San Juan. The steamship *Ponce* and *Coamo* are equipped with the De Forest system: "On last Wednesday, November 8, when the steamship *Coamo,* of the New York & Porto Rico Steamship Company Line, was about 300 miles from San Juan on her return trip to New York, the captain discovered two boys, stowaways, aboard. The steamship *Ponce,* of the same line, was about 100 miles away when Captain Sargent sent a wireless message to Captain Dalton, of the *Ponce,* giving his position and asking if he would take the boys back to San Juan. The captain of the *Ponce* replied, agreeing to do so, also giving his latitude and longitude. The *Coamo's* course was then changed and when the two vessels hove in sight, four hours later, they were end on coming within a few hundred yards of each other. A boat was manned and the stowaways were transferred with a delay of less than ten minutes actual time, a feat which would have been absolutely impossible without the use of wireless telegraphy."

TELEPHONY AT GRAND RAPIDS.—Mr. E. B. Fisher, secretary of the Grand Rapids, (Mich.) Citizens' Telephone Company, writes to the Automatic Telephone Company, of Chicago, as follows: "We have had a net gain of 829 telephones in the Grand Rapids Exchange since January 1 last, which is a more rapid rate of growth than we enjoyed last year. Also we have a net gain of 83 telephones so far this month, and still they come, and this without solicitation on our part. The exchange this morning had 6,784 telephones in service, and we shall undoubtedly pass the 7,000 mark before the holidays, for we have between 60 and 70 orders on the books to fill. We began service with the Automatic apparatus on January 9, 1904, displacing a manual telephone exchange with 5,094 telephones. Soon after the change to Automatic equipment we made a general increase in our rates amounting to $6 per telephone for business telephones and $4 per telephone for residence service per annum. Notwithstanding the increased price of service the list of subscribers has shown a net gain of 1,020 in approximately 20 months."

POWER IN WASHINGTON STATE.—Secretary S. Deas Sinkler, of the Northwestern Gas & Electric Company has issued notices that there will be a meeting of stockholders at Walla Walla, Dec. 21, for the purpose of voting on the proposition of increasing the capital stock of the company from $650,000 to $1,000,000 by the issuance of $350,000 8 per cent cumulative preferred stock, entitled to priority, both as to dividends and in the distribution of the assets upon dissolution of the company. This has given rise to new rumors that another electric plant is to be erected on the Walla Walla river on what is known as the Roberts ranch, five miles above the big power house erected by the company two years ago, and which now supplies Walla Walla, Athena, Weston and Pendleton with power. Increasing demand for power and the fact that the street car line to be installed in Walla Walla by a branch company of the Northwestern company will need several hundred horsepower is said to be responsible for increasing the facilities. Local representatives of the company say the increased capital stock will be used for improvements.

LIGHTING APPARATUS WANTED.—The Springfield (Ky). Water & Electric Light Company (Incorporated), contemplates enlarging its lighting plant. They now have two 100 hp boilers, one Chandler & Taylor automatic engine, and one 60 kw Wiley generator belt connected. For the new plant they want a 125 to 150 hp tubular boiler, a 100 to 125 kw direct connected generator, and a 125 to 150 hp direct connected engine of good make. It is proposed to reinforce all the main lines and to build a new one in the city. They have now from the station four No. 0 wires to the central part of the city. Other small changes are contemplated. Mr. H. B. McElroy is the superintendent and manager of the company.

BIDS FOR NAVY SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, until Nov. 28, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., arc lamps, wire, conduit, panel boards, electrical supplies, etc. H. T. B. Harris, Paymaster-General, U. S. N.

THE BROOKLYN HEIGHTS RAILWAY COMPANY has recently placed an order with the Westinghouse Electric & Manufacturing Company for a substantial addition to its present equipment, consisting of 300 No. 101-B Westinghouse direct current railway motors and 150 sets of controllers. The order for motors is in addition to one placed some months ago for 600 motors of the same type.

B. F. STURTEVANT COMPANY, Boston, Mass., reports sales of a new horizontal generating set to David Rogers Company, Paterson, N. J., and economizers to Singer Manufacturing Company, Elizabethport, N. J.; Springville Manufacturing Company, Rockville, Conn.; Nashua Manufacturing Company, Nashua, N. H., and American Woolen Company, Lawrence, Mass., etc.

O. C. WHITE FIXTURES.—The O. C. White Co., of Worcester, Mass., were visited by fire on October 25, and their whole factory was in danger for a time. Their stock suffered from smoke, etc., but all their machinery and tools were saved. They are now in a position to make shipments again of their well-known adjustable fixtures for incandescent lamps.

HEATING AND VENTILATING APPARATUS is being supplied by B. F. Sturtevant Company, Boston, Mass., for a large number of school buildings; also for the Hotel St. Regis, New York; Bantleon Bros., Rochester; Ætna Cotton Mills, Mixon, S. C.; Pennsylvania Railroad shops; H. S. Kerbaugh, Altoona, Pa.

ORDER FOR SIGNALS.—The Philadelphia & Reading Railroad Company has given an order for the equipment of about fifty miles of double track with the Hall normal danger automatic block signal system.

THE NATIONAL ELECTRIC COMPANY, of Milwaukee, has recently closed a contract with the Arbuckle-Ryan Company, of Toledo, O., for two 250-kw engine-type, alternating-current generators, for installation at Canton, O.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was renewed reaction in the stock market as a result of higher rates for loans, although there was some support at the declines. At the close of the week the tone was steadier. The market was also unfavorably affected by the election in New York City, local franchise stocks showing some weakness as a result of the apparent strength of the municipal ownership vote. There was a break in Metropolitan Street Railway and an accompanying weakness in Brooklyn Rapid Transit and Consolidated Gas. The decline in Metropolitan was checked, however, by covering on the part of the large short interest which has been outstanding in that security for some time past. The United States Steel stocks sold off with the rest of the list, and this was also the case with the standard railroad stocks as a class. The electric securities, in common with the rest of the stocks, were down. Metropolitan Street Railway was the heaviest loser among the tractions for the reasons already stated. There was heavy selling of this stock at prices ranging between 125½ and 116, the closing quotation being 116⅛, representing a net loss of 5½ points. The sales aggregated 109,700 shares. This number was exceeded, however, by Brooklyn Rapid Transit, of which securities 198,500 shares were reported sold, but the price of this stock did not yield to the pressure to so great an extent. The closing quotation was 74¾, which is a net decline of 1¼ points. Interborough Rapid Transit (on the curb) dropped 1⅛ points, closing at 208⅞. Manhattan Elevated lost 2½ points, closing at 163½, a narrow business being recorded. Of the electrics the two issues of Allis-Chalmers, closed with fractional declines, common, ⅜ point, and preferred, ¾, the last quotations being 19 and 61¼, respectively. General Electric, on sales aggregating 3,600 shares, lost 1 point, closing at 185, and Westinghouse declined 4 points, the last quotation being 170. New York & New Jersey Telephone rights sold at prices between 13⅛ and 12⅞, closing at the lowest figure. Western Union is down as a fraction, the last quotation being 93, and American District Telegraph dropped 6 points, losing about all of its recent gains, the closing quotation being 37. The curb market showed evidence of a good deal of liquidation during the week, following the lead of the Stock Exchange list. Following are the closing quotations of Nov. 14:

NEW YORK

	Nov. 8	Nov. 14		Nov. 8	Nov. 14
Allis-Chalmers Co	19½	20	General Electric...........	183	182
Allis-Chalmers Co. pfd....	61	62¾	Hudson River Tel..........	..	..
American Dist. Tel.........	40	37	Interborough Rap. Tran...	210	207
American Locomotive.... .	68⅝	67¾	Mackay Cos.......	48⅝	48½
American Locomotive pfd..	114	114	Mackay Cos. pfd......... .	73	72
American Tel. & Cable....	92	93	Marconi Tel.................	..	..
American Tel. & Tel... ...	136	133	Metropolitan St. Ry........	121	117½
Brooklyn Rapid Transit....	75⅜	76¼	N. Y. & N. J. Tel..........	..	..
Electric Boat.........	32	32	Western Union Tel.........	93	92⅞
Electric Boat pfd...........	70	70	Westinghouse com..........	171	175
Electric Vehicle............	15	15	Westinghouse pfd..........	..	.
Electric Vehicle pfd........	20	20			

BOSTON

	Nov. 8	Nov. 14		Nov. 8	Nov. 14
American Tel. & Tel	138¼	134	Mass. Elec. Ry. pfd........	55½	56
Cumberland Telephone . .	122¾	122½	Mexican Telephone.........	1½	1⅛
Edison Elec. Illum....	246	245	New England Telephone...	*136	134
General Electric.......... .	182	182	Western Tel. & Tel.........	13	13
Mass. Elec. Ry....	13	13¼	Western Tel. & Tel. pfd...	89½	89

PHILADELPHIA

	Nov. 8	Nov. 14		Nov. 8	Nov. 14
American Railways...	52	53	Phila. Electric.........	8⅜	8⅛
Elec. Co. of America.. . .	11⅛	11⅝	Phila. Rapid Trans....	27¾	26¼
Elec. Storage Battery .. .	80	78	Phila. Traction..............	..	..
Elec. Storage Battery pfd...	.	..			

CHICAGO

	Nov. 8	Nov. 14		Nov. 8	Nov. 14
Chicago City Ry	200	200	National Carbon....	64	60
Chicago Edison.	.	..	National Carbon pfd	114	115
Chicago Subway	.		Union Traction.....	.	.
Chicago Tel. Co			Union Traction pfd........	..	..
Metropolitan Elev. com. ..	28	28⅛			

* Asked.

TRANSFER OF PITTSBURG SYSTEMS.—It is stated that the United Gas Improvement Company has at last bought the Philadelphia Company. Incorporated as the Empire Contract Company in 1871, the Philadelphia Company was organized under its present name in 1884. The original purpose was to supply fuel gas, but operations long ago expanded into illuminating gas, electric light and electric surface transportation, and the company furnishes fuel and illuminating gas and electric light almost exclusively to a population of 700,000, including the cities of Pittsburg and Allegheny. The company has over 469 miles of street railway through ten street railway properties owned or controlled by it, these properties being operated by the Pittsburg Railway Company, whose stock is entirely owned by the Philadelphia Company. Six electric and gas illuminating companies are owned or controlled by lease by the Philadelphia Company, and it furnishes electric light, heat and power almost exclusively to the cities of Pittsburg and Allegheny and vicinity, while it controls the exclusive right to manufacture illuminating gas in these two cities. The company has almost a monopoly of the supply of natural gas in the same territories in which it operates its electric light and illuminating gas by its ownership and control of a number of gas companies. About 319,764 acres of gas territory in Pennsylvania and West Virginia are controlled by lease, which are reported to be good for from twenty-five to thirty years.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company has been showing very good earnings. In fact, the yellow fever epidemic has not been an adverse factor at all, for the reason that when people cannot travel they telephone. During the first nine months of the current fiscal year gross earnings have increased $449,683 and net have increased $112,110. The heavy increase in expenses for the first nine months of the current year was due to the fact that quite large sums have been spent on works of improvement because the Cumberland has in the past maintained its equipment on a pretty fair level. The expense item has increased so far this year to the extent of $337,573 and has eaten up about 62 per cent of gross. The surplus for the nine months after the payment of charges stands at $1,089,589, which is considerably in excess of the dividend requirements for the whole year. The dividend disbursements this year will be somewhat larger than that for 1904, because a new issue of stock to the amount of $1,745,300 was made in February of this year, bringing the total outstanding stock up to $13,449,650.

THE STANISLAUS ELECTRIC POWER COMPANY. has been organized at San Francisco, Cal., with a capital of $10,000,000. The financiers of the new corporation are Tucker, Anthony & Company, of Boston, and the Knickerbocker Trust Company, of New York. Beach Thompson, of San Francisco, was the organizer of the company, and Leopold Wallach, of New York, interested Eastern capital in the enterprise. Both Leopold Wallach and Leopold Michels, president of the San Francisco Coke & Gas Association of this city, are heavily interested in the new power company. The company has been organized to furnish the city with electric power, and probably will be closely allied with the San Francisco Coke & Gas Company. It is understood work has already been commenced on the middle fork of the Stanislaus River. The plans of the company call for 30,000 e.h.p., and, in addition to that, water power equivalent to 20,000 hp.

MASSACHUSETTS ELECTRIC GOLD NOTES.—A syndicate, headed by the Old Colony Trust Company, has purchased a block of $3,500,000 4½ per cent five-year gold notes of the Massachusetts Electric Companies. These notes were authorized at the annual meeting last July, and replace a like amount of notes, of which $2,700,000 were outstanding. Of the new issue, $2,700,000 will be used to retire the $2,700,000 of notes now out and which mature Jan. 1, and the remaining $800,000 notes will be issued and the money invested in the notes of the controlled corporations. These notes are secured by shares of the Boston & Northern and Old Colony Street Railway companies. It is stated that these notes were syndicated at 96½ and are being offered to the public at 98.

JERSEY FINANCIAL LITIGATION.—By consent of all counsel, Chancellor Magie in the Court of Chancery dismissed the suit brought by Adam H. Groel, of Newark, against the United Electric Company of New Jersey and the United Gas Improvement Company of Philadelphia for the return of $20,000,000 par value of the stock of the United Electric Company, or of its value, alleged to be at least $6,000,000, and claimed to have been appropriated without consideration by the United Gas Improvement Company at the time it promoted and caused the formation of the United Electric Company, now absorbed by the Public Service Corporation.

BONUS TO THE PUBLIC.—In connection with the recent statement of Milwaukee Electric earnings, General Manager John I. Beggs writes us: "Our receipts have been reduced about $1.100 per day (which must all come out of net), owing to the fact that on Jan. 1 last we began honoring commutation tickets—25 for $1 and 6 for 25 cents—all day long; whereas for five years before that date tickets had only been good during two hours in the morning and 1½ hours in the evening. The increased use of tickets has averaged from 110,000 to 120,000 daily, about 80 per cent of our riding now being on tickets."

DIVIDENDS.—The American Railway directors have declared the regular quarterly dividend of 1½ per cent, payable December 15, to stock of record, November 29. The regular quarterly dividend of the American Telegraph & Cable Company of 1¼ per cent is payable on December 1. The directors of the Columbus Railway Company have declared the regular 1¼ per cent. quarterly dividend on the common stock, payable December 1.

CINCINNATI TROLLEY BONDS.—The capital stock of the Cincinnati, Milford & Loveland Traction Company will shortly be increased $650,000, the new stock to be 5 per cent cumulative preferred. The new stock will be issued to take up a bond issue of the same amount and bearing the same rate of interest.

General News of the Week

The Telephone.

SAN DIEGO, CAL.—The Sunset Telephone Company is preparing to put up about 145 miles of new extensions. The direct line from here to Oceanside is one of the important links.

STAMFORD, CONN.—The Southern New England Telephone Company has purchased a lot of land in this city, on which it will erect a new building for its exchange. A new switchboard with a capacity of 3,000 lines will be installed.

COLQUITT, GA.—The Colquitt Telephone Company has been organized. Messrs. C. C. Bush, N. L. Stapleton, W. I. Geer, W. C. Dancer, J. S. Bush, E. D. Bush, Joe Tole, J M. Shingler, M. D. Roberts, J. L. Tabb and W. J. Ballard compose the local company.

BOISE, IDAHO.—Articles of incorporation have been filed for the Star Independent Telephone Company, with a capital stock of $10,000. The incorporators are: H. D. Anderson, J. S. Clark, L. B. Wehr, A. S. Bixby, S. S. Foote, A. W. Hall.

QUINCY, ILL.—The Quincy Automatic Telephone Company proposes to increase its capital stock from $15,000 to $1,000,000.

CHICAGO, ILL.—The Chicago Numerical Telephone Index Company has been formed with a capital of $50,000, by J. W. Arnet and E. C. Mapledoram.

SOPHERVILLE, ILL.—The Sopherville & Log City Telephone Company has been formed with a capital of $625, by James Pendergast and Charles J. Maxwell.

ELKHART, IND.—The Dunlap Telephone Company has been organized. Capital, $20,000. Incorporated by William D. Kauffman and Marion I. Pancake.

INDIANAPOLIS, IND.—Checks for the payment of the November dividend were mailed during the week by the Indianapolis Telephone Company to holders of stock in the New Telephone Company, lessee.

DES MOINES, IA.—The Brighton Mutual Telephone Company has been formed with a capital of $25,000.

EARLVILLE, IA.—The Interstate and the Delaware County Telephone Companies have consolidated their lines in this county, and hereafter the same central office will be used for both lines.

COUNCIL BLUFFS, IA.—Wickham Bros. and P. H. Wind have secured the contract to erect the new exchange building for the Independent Telephone Company. The cost will be $14,000.

MANCHESTER, IA.—The toll lines of the Interstate Telephone Company, extending from Dyersville to Hopkinton, Delhi, Delaware and Manchester, have been taken over by the Delaware County Telephone Company, of Manchester.

PADUCAH, KY.—The Independent Telephone Company has closed a deal for the acquirement of the independent lines at Benton and in Marshall county.

LANSING, MICH.—The Council has directed the Michigan State Telephone Company to place the wires under ground.

EMMETT, MICH.—The Michigan Telephone Company has awarded to ex-Representative Dunn the contract to build a telephone line from this city to Goodells.

GRAND RAPIDS, MICH.—The Common Council has passed a resolution which voids an old franchise granted some years ago to the American Telephone & Telegraph Company. This action was undoubtedly taken to forestall any of of the present companies from securing the old grant. It is claimed that the franchises of the companies now doing business in this city have expired and the Common Council has declared its intention of forcing them to secure new grants.

ISHPEMING, MICH.—Articles of incorporation of the Home Telephone Company, a new independent concern, have been filed with the secretary of state. The promoters are identified with the new United States Independent Telephone Company. The new company proposes to build an exchange at Detroit as soon as it is practicable to do so, the system there costing perhaps $5,000,000, and it also plans to build trunk lines in other portions of the State, including the upper peninsula.

ERSKINE, MINN.—A. F. Cronquist has purchased the Erskine telephone system and will extend and improve it.

EAST GRAND FORKS, MINN.—The election resulted in favor of granting a franchise to the Tri-State Telephone Company.

BIGELOW, MINN.—Wm. Widman and others are interested in the proposed construction of a telephone exchange at this place.

MINNEAPOLIS, MINN.—The Minnesota Central Telephone Company will at once commence the construction of an additional copper line from Minneapolis to Granite Falls, the one built last fall being found inadequate for the amount of business now handled from and through this exchange.

CARTHAGE, MO.—The Missouri & Kansas Telephone Company has purchased the property and business of the Southwest Telephone Company, known as the Peel lines. The purchased lines includes extensive toll lines over parts of Barry, McDonald, Newton, Jasper and Greene counties and over all parts of Lawrence county. It also includes the telephone exchanges at Peirce City, Monett, Aurora, Stotts City, Bowers Mills, etc., and means the accession of a large amount of business to the company making the purchase.

GOLDFIELD, NEV.—The Southern Nevada Consolidated Telegraph & Telephone Company, it is stated, will immediately construct a new building here, which is to be the headquarters of the company. An office building will also be built.

HORNELLSVILLE, N. Y.—The New York & Pennsylvania Telephone & Telegram Company will soon commence the erection of a new building in this city.

WALTON, N. Y.—The Pine Telephone Company of Walton has been incorporated with a capital stock of $15,000. The directors are I. L. Brayman, Vernie Francisco and C. W. Murray.

WEATHERFORD, OKLA.—The Farmers' Mutual Telephone Company has been formed with a capital of $2,500, by R. X. Ward and J. T. Bradley.

MULHALL, OKLA.—The Mulhall Rural Telephone Company has been formed. Capital, $5,000. Incorporated by C. E. Hudropete and W. M. Peters.

WATONGA, OKLA.—The Watonga Telephone Company has been organized with a capital stock of $25,000. Incorporated by George Massey and George A. McArthur.

CADIZ, OHIO.—The Harrison County Telephone Company certifies to an increase of capital stock from $50,000 to $100,000.

COSHOCTON, OHIO.—James S. Brailey, jr., of Toledo, has purchased the controlling stock in the Tuscarawas County Telephone Company.

BOWLING GREEN, OHIO.—The Wood County Telephone Company by a deal completed a few days ago has absorbed the Home Telephone Company at North Baltimore. The North Baltimore plant will be continued under the same name, The Home Telephone Company, but will be owned and controlled by the Wood County Telephone Company.

NEW WILMINGTON, PA.—The New Wilmington Telephone Company has been organized by J. M. Houston and Wm. A. Thompson and others, and they are finishing the erection of a local telephone system at New Wilmington. They have signed a 3-year contract to connect with the Union Telephone Company's long-distance lines, and will have connections with local systems in Lawrence County, Pa.

BONESTEEL, S. D.—The Nebraska Interstate Telephone Company and the Gregory Home Telephone Company have been merged and will make extensive improvements and additions.

SHAMROCK, TEX.—The Walker Telephone Company has been formed; capital, $10,000.

CAMERON, TEX.—The Southwestern Telephone Company will improve its system and service in this place.

BEAUMONT, TEX.—C. C. Conroy, president of the Beaumont Northwestern Telephone Company, says that he will institute proceedings in court to recover possession of the property of that company from Receiver J. W. Mackey. The Beaumont Northwestern Telephone Company's property consists of 16 exchanges in East Texas and more than 500 miles of wire. It was under lease to the Lone Star Telephone Company at the time it was placed in the hands of a receiver. Mr. Conroy says that if he recovers possession of the property important improvements and extensions of the system will be made.

DALLAS, TEX.—At a meeting of the members of the Texas Independent Telephone Association, held at Dallas on Nov. 7 and 8, steps were taken to establish a clearing house for the purpose of handling all of the business of the independent telephone companies in the State and to provide for toll charges to apply to all messages on the independent toll lines. The following officers of the clearing house were elected: President, Cecil L. Simpson, of Dallas; vice-president, E. P. Butler, of Gainesville; secretary and treasurer, E. W. Dunaway, of Paris. It was decided to hold the next meeting at Waco at such time as the executive committee shall decide to call it.

RICHMOND, VA.—The Petersburg Telephone Company has awarded the contract for a new building in this city, to cost about $10,000.

CATHLAMET, WASH.—The North Shore Telephone Company will construct a line to connect with the Sunset cable at McGowan and extend east to Cathlamet, Gray's River, Deep River, Skamokawa, Knappton, Frankfort and intervening points touched by the system. Brix Bros. are interested in the project.

PRENTICE, WIS.—A local company is projected to install an automatic telephone exchange.

EDGAR, WIS.—The Edgar-Cassel-Emmett Telephone Company has been organized. The capital is $1,500. Incorporated by E. C. Barrett and Otto Fehlhaber.

RANDOM LAKE, WIS.—The Random Lake Telephone Company, of Sheboygan county, has been formed; capital stock, $5,000. The incorporators are T. E. Malloy, T. D. Schmidler and W. B. Krause.

KENOSHA, WIS.—The business of the two telephone exchanges in Kenosha has been merged, but no changes were made in the management of either. By the merger the Wisconsin company retires from the Kenosha field and the entire telephone business is turned over to an independent company.

RAWLINS, WYO.—The Bell Telephone Company for Wyoming announces that it will reconstruct the telephone systems in Cheyenne, Laramie, Rawlins and Sheridan.

VANCOUVER, B. C.—The Western Union Telegraph & Cable Company has decided to lay another cable from the mainland to Victoria, at a cost of $25,000.

CITY OF MEXICO, MEX.—The Mexican Telephone & Telegraph Company has resumed the work of laying its underground telephone system, under the direction of W. B. Hale, its new general manager. When the underground system is further advanced the work will be commenced of taking down the overhead wires within the portions of the city for which the company holds a concession to put down its conduit system. The company expects to have the work of improvement completed by the middle of next May. The new switchboard has been ordered from Chicago.

Electric Light and Power.

ABBEVILLE, ALA.—The citizens are discussing the question of constructing an electric light plant.

FORT PAYNE, ALA.—The Alabama Cooperage Company, of Fort Payne, has petitioned Council for a franchise to construct an electric light plant to furnish light for the streets, residences and business houses.

LOMPOC, CAL.—J. M. Stamp has petitioned for a franchise for an electric light plant.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company has secured the contract for lighting the city for 3 years. The total amount of the contract is about $500,000.

OROVILLE, CAL.—The Oro Water, Light & Power Company, of Oroville, has completed the contracts for the equipment of its electric transmission plant at Pentz by ordering two "double overhung" Pelton impulse wheel units. A 1,000-hp. wheel is placed at each end of a shaft, with a 1,000-kw. General Electric 3-phase railway-type generator in the middle. There are two of these units to be operated under a head of 465 ft., transmitting power 16 miles to Oroville, where city lighting and power for operating gold dredges will be supplied. There is an ample water supply from the Feather River Canyon.

PALO ALTO, CAL.—Measures will be taken by the Board of Town Trustees of Palo Alto to prevent the Redwood City Electric Light & Power Company from operating there without a franchise. Since electric light and power was first supplied to Palo Alto the Redwood City concern had no opposition until the municipal plant was installed. The question then arose whether a franchise was necessary for the private corporation. Threats of rate-cutting have had no effect on the trustees. At a conference the proposition to purchase the works and plant by the trustees for Palo Alto was rejected. Of the several plans suggested none was accepted as favorable to the municipality. The officials of the Redwood company refused to turn over the Palo Alto branch of their plant, asserting that a franchise is no more necessary now than it was when they first entered this territory.

SAN FRANCISCO, CAL.—The Santa Cruz Portland Cement Company has closed a contract with the Westinghouse Electric & Manufacturing Company for 28 induction motors for the new cement mill in course of construction at Davenport, Santa Cruz county, Cal. The largest motor will be of 850 horse-power and there will be ten 200-hp. motors. The combined capacity of all the motors is 5,600 horse-power. The same owners have two 800-hp. Westinghouse induction motors operating the cement mill at Napa Junction giving satisfaction, but it was thought advisable to subdivide the power units more for the new plant, which is larger, having a daily capacity of about 5,000 barrels of cement. A 40-mile pole line is being constructed to the works by the California Gas & Electric Corporation, which has a contract to supply the electric power. The Allis-Chalmers Company has the contract for all of the cement machinery, amounting to 50 car loads, and shipments have commenced.

STONINGTON, CONN.—Fort Mansfield at Napatree point is to have electric lights and electrical connections for other purposes. Connections will be made with the Westerly Company's wires from which power will be taken until the government establishes a plant at the reservation.

RIDGEFIELD, CONN.—The plans for the plant of the Ridgefield Electric Light Company have been approved and contracts will soon be let for the work.

JACKSONVILLE, FLA.—The Allis-Chalmers Company, of Milwaukee, Wis., has secured the contract for two 500-kw. turbo generators with necessary equipment for $36,135.

ASHBURN, GA.—The question of constructing an electric light plant and water works is under consideration here. J. B. McCrary, of Senoia, is engineer.

ATLANTA, GA.—An interesting fight has ben started in Atlanta by the Southern Power & Lighting Company to gain a footing in this city. The first move was made at a recent meeting of the Council when the Atlanta Telephone Company applied for a franchise to lay conduits in the streets. A representative of the telephone interests stated that it was desired to have the right to place any kind of electric wires in the conduits and that the Southern Company could make terms with Council when occasion might arise.

ATLANTA, GA.—According to a quoted statement of Forest Adair, vice-president of the Atlanta Water & Electric Power Company, there can be no reopening of the question of the franchise of the company with the State, Mr. Adair claiming that the matter has been settled by arbitrators and that the proposed reopening of the matter by submission to another board is without precedent, as far as he knows. The state comptroller will however insist upon the collection of taxes on a valuation of nearly half a million dollars.

MONMOUTH, ILL.—The Monmouth Gas & Electric Company has completed plans for an electric light plant.

STREATOR, ILL.—The People's Light & Railway Company and the Streator Gas & Light Company have combined, the light and railway company being the purchaser. The latter corporation is capitalized at $400,000.

PERU, KAN.—W. R. Murrow, proprietor of the electric light and power plant, has gone to Cherryvale to make preparations to install a plant there. He has a franchise from the city.

LA HARPE, KAN.—S. A. Gard, of Iola, Kan., has made a proposition here to the City Council to light the town. Wm. Turner, of this place, has also made a similar proposal. The plan of the latter is to operate the light plant in conjunction with the ice plant.

PADUCAH, KY.—The Paducah Light & Power Company has been incorporated, with a capital of $450,000.

WINCHESTER, MASS.—The Edison Electric Illuminating Company has lately taken over the business of lighting the streets and houses of Winchester, which service was formerly performed by the Woburn Light, Heat & Power Company.

PALMER, MASS.—The town of Wilbraham is now supplied with electric light from the plant in this city. The Palmer plant is now furnishing a lighting service to the towns of Palmer, Warren, West Warren, Monson and Wilbraham.

PALMER, MASS.—The Central Massachusetts Electric Company has decided to extend its business to Bondsville for commercial use in that village. It will be necessary to run four miles of wire and the work will start in a short time. It is expected to have it completed by Jan. 1.

BALTIMORE, MD.—Bids will be received until Nov. 22 by the Board of Awards for furnishing for the use of the Electrical Commission about 1,000,000 duct-ft. of conduit material, and $100,000 ft. of special duct pipe. For further information apply to Chas. E. Phelps, jr., chief engineer electrical commission.

ELK RAPIDS, MICH.—The Elk Rapids Light & Power Company has been incorporated with a capital stock of $25,000.

JACKSON, MICH.—Electric search lights have been placed on the walls and top of the main building of the State's prison, located here.

IRON RIVER, MICH.—The citizens have voted to issue $30,000 bonds for constructing an electric light plant and for the rebuilding of the water works.

MORRICE, MICH.—The electric lighting plant owned by Sutton & McKay has been sold to John Hubert, of Lansing, and Edward Hubert, of Farmington.

WOODMERE, MICH.—The Edison Lighting Company, of Delray, is preparing to construct a plant in Woodmere, to supply the village with electric light.

LANSING, MICH.—The receipts of the municipal lighting plant are showing a gain of more than $1,000 a month, compared with the figures for corresponding periods last year.

JACKSON, MICH.—The factory building of Withington & Cooley, which was destroyed by fire, has been rebuilt and nine electric motors will replace the 350-hp. engine which formerly furnished the power.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Electric Water Power Company expects to deliver power in this city and Muskegon by Feb. 1. The contract for a concrete sub-station in this city has been let.

LANSING, MICH.—W. L. Haag, of Haag Bros., is seeking a franchise to furnish power and heat within the city. The firm generates electric power at its mill at the head of the North Lansing mill race. The heating privilege is asked for in anticipation of the perfection of electrical heating apparatus.

CANNON FALLS, MINN.—The Cannon River Electric Power Company has purchased the plant of the Northfield Light, Heat & Power Company. Power for the plant at Northfield, and also the local plant will eventually be transmitted from the dam to be built across Cannon River, one mile west of the falls.

SEDALIA, MO.—In accordance with a resolution recently passed by the Sedalia City Council, suits were filed, Nov. 7, against the Sedalia Water and Light Company, and the Sedalia Light and Power Company, to forfeit their charters. The petitions allege that both companies have failed to comply with the conditions, and have failed to furnish light and power for city and commercial purposes. A similar suit was recently filed against the Sedalia Gas Company.

BUFFALO, N. Y.—At the election Nov. 7 the citizens voted in favor of a municipal lighting plant.

WATERFORD, N. Y.—The village trustees directed the Light Committee, president, attorney and engineer, to ascertain the cost of constructing and operating an electric light plant.

LOCKPORT, N. Y.—Electric power from the Ontario Power Company's plant at Niagara Falls is now being received in this city. The gas and electric light company is utilizing the power, which is transmitted at 12,000 volts.

OSWEGO, N. Y.—The Citizens' Lighting Company has been incorporated with a capital stock of $75,000 by J. C. Knight, Thomas Moore and C. A. Bentley, of Oswego.

NEW YORK, N. Y.—Bids will be received until Nov. 20 by Maj. G. S. Bingham, Q. M., U. S. A., 39 Whitehall Street, for furnishing and delivering f. o. b. factory about 55,000 incandescent electric lamps.

LENOIR, N. C.—The Citizens Light & Power Company, of Lenoir, has been incorporated with a capital of $25,000. The incorporators are H. F. Newland and W. B. Ivey.

YADKIN COLLEGE, N. C.—The Yadkin Development Company has been formed by Dock Hartley, of Yadkin College; Prof. J. M. Bandy, of Greensboro, and others, to develop water power for electrical purposes in Davidson county. It is proposed to construct a canal 11 miles in length from a point on Yadkin River, at Yadkin College, to a point near Linwood.

NEWPORT, N. H.—The Sunapee Electric Light & Power Company, which is now owned by the Newport Electric Light Company, has just completed the work of rebuilding its lines. A 24-hour service will now be given.

NEW MARKET, N. H.—W. H. C. Follensby, of Exeter, has been appointed receiver of the Newmarket Electric Light, Heating & Power Company by Judge Stone. The appointment was in answer to the petition of the minority stockholders of the company, which alleged that the affairs of the company were being mismanged by President J. W. Burnham, of Durham, who was the majority stockholder, and that the company was insolvent. Further, that $15,000 of the bonds of the company had been fraudulently issued by the president, and asking that W. E. Barrett, of Boston, president of the Union Trust Company, be asked to explain how he had come into possession of the bonds, which the latter did. Mr. Follensby has furnished $5,000 bonds.

FOREST, OHIO.—The Town Council has decided to construct an electric light plant.

HAINES, ORE.—J. F. O'Bryant has secured a franchise to construct an electric light plant.

LA GRANDE, ORE.—The Grand Ronde Light & Power Company has completed its connections with Morgan Lake and the new plant is now in operation.

EUGENE, ORE.—W. T. Campbell, of Eugene, and associates are said to be considering the construction of a power plant on McKenzie River in the vicinity of Walterville, for the purpose of generating power for electrical purposes.

EUGENE, ORE.—The City Council has employed Engineer Kelsey, of Salt Lake City, Utah, to make surveys, plans and estimates, for the proposed municipal electric light plant and water works, for which the citizens have voted to issue $200,000 bonds. The site for the power plant is reported to have been selected on McKenzie River, about 30 miles east of Eugene.

OREGON CITY, ORE.—H. W. Hageman, of Stone City, Ore., has completed financial arrangements for the construction of an electric light and power plant on Clackamas river, about 7 miles above Oregon City. He will build a 35-ft. dam and construct a large power plant. It is proposed to furnish light and power to Park Place, Gladstone, Clackamas Heights, Oregon City and Portland.

PORTLAND, ORE.—Machinery costing $165,000 for the Oregon Water Power & Railway Company is being delivered. The company is constructing a dam in the Clackamas River, at Cazadero, 37 miles from Portland, and will install a plant to develop 20,000 horse-power. President, W. H. Hurlburt officially announces that the plant will be completed and in operation before the end of next summer. The total cost will be $225,000. The Bullock Company, of Cincinnati, has the order for generators. The Stanley Company, of Pittsfield, Mass., is manufacturing the transformers. The water wheels come from the Pratt Iron Works, Dayton, Ohio. The power to be generated will be used in operating 100 miles of electric railway between Portland and Cazadero and branch lines in and about this city, also the electrically lighted pleasure park, "The Oaks." There will be a large surplus of power, and this will be delivered under a contract to the Portland General Electric, to be used in commercial lighting and power in this city.

GEARY, O. T.—The Geary Electric Light & Power Company has been incorporated with $5,000 capital stock by Charles F. Dyer and I. J. and J. M. Romm.

BENTON, PA.—Definite steps have at last been taken towards bringing the Benton electric light plant into reality. The company has engaged W. O. De Witt of this town as consulting engineer, and he will at once prepare plans and specifications for the erection of the power house.

LAWRENCEBURG, TENN.—Jas. Dunn, city secretary-treasurer, writes that it is proposed to construct water works and an electric light plant, at a cost of about $25,000. No engineer has been employed as yet.

CHATTANOOGA, TENN.—A 20-year exclusive franchise is for sale for a water and an electric light and power system, including rights of way, etc. For further information address I. L. Faucett, Chamberlain Building, Chattanooga.

MEMPHIS, TENN.—The Boardman Electric Company has filed an application for an amendment to its charter in order to change the name of the company to the Bluff City Electric Company. The incorporators are: H. H. Carson, R. M. Ellet, G. B. Thornton, jr., and H. B. Hart.

VAN BUREN, TEX.—A deed has been filed here transferring the Van Buren electric light and power plant to the Fort Smith-Van Buren Bridge & Traction Company.

DUBLIN, TEX.—The Dublin Gas & Electric Company has been incorporated with a capital stock of $50,000 by J. F. Strickland, Oscar Godwin, of Dallas; M. B. Templeton, of Waxahachie; R. B. Sticher, of Sherman, and J. R. St. Clair, of Dublin.

SALT LAKE CITY, UTAH.—Francis M. Lyman, jr., has filed an application with the county commissioners for a franchise to erect poles and string wires along the county highways. He owns water rights on Mill Creek and proposes to construct a power plant.

HEBER, UTAH.—In addition to establishing an irrigation system to supply the settlers of Blue Bench on the Uintah reservation, the Blue Bench Co-Operative Water Company also proposes furnishing electric light and power, and has filed application with the state engineer at Salt Lake City for 200 second-feet of water from Rock Creek, in Wasatch county, which it proposes to develop. The diverting canal will be 36,500 ft. long.

OAKESDALE, WASH.—Mr. Shields, of Moscow, Idaho, is interested in the construction of an electric light plant at this place.

PORT ANGELES, WASH.—Mr. W. S. Hoskins, of Seattle, has made a proposition to take over the present electric light plant here, upon a 20-year lease, for the purpose of superseding the city in the lighting business.

FRESNILLO, MEX.—Regaciano Felguenes, a wealthy haciendado of the State of Zacatecas, is at the head of the company which is installing a new electric light and power plant at Fresnillo.

ZACATLAN, MEX.—Luis Gomez Daza and Joaquin Pita will install an electric power plant in the Zacatlan district. They have obtained a concession from the federal government for the purpose.

VERA CRUZ, MEX.—La Electrica is the name of a company which has been organized at Vera Cruz for the purpose of providing light and power for private consumers, factories and other industries. The company will install a large electric light and power plant.

GALEANA, MEX.—The federal government has granted a concession to Canuto Reyes, or any company he may organize, to install an electric power plant on the Atoyac River, near Galeana. The electrical energy will be transmitted to towns and mining camps of that section.

BATOPILAS, MEX.—It is stated that the Batopilas Mining Company will install an electric power plant near Batopilas. The company has obtained a concession from the federal government to use the waters of the Santa Gertrudes arroyo for the purpose of operating the plant.

CITY OF MEXICO, MEX.—La Compania de las Fabricas de Papel de San Rafael y Anexas, which recently increased its capital stock from $5,000,000 to $[illegible], will make a large addition to its electric power plant on the Ixtechuatl River, near the City of Mexico. A dam will be built for the purpose of storing the water for power purposes.

PARRAL, MEX.—It is announced that the American company, of which Eugene Davis is at the head, has made all necessary financial arrangements for the construction of a large electrical power plant which is intended to supply the Parral mining district with power and electric lights. The initial power plant which is to be installed at Zona will consist of 3,000 horse-power in six units of 500 horse-power each.

ZACATECAS, MEX.—It is announced that the Compania Electrica de Zacatecas, which was organized for the purpose of installing an electric light and power plant in the city of Zacatecas, has awarded the contract for the entire installation to the Schoendube & Neugebauer Company, of the City of Mexico. The electrical machinery and equipment will be manufactured by the Allgemeine Electrical Company, of Berlin, Germany. The plant will be equipped with gas engines of about 200 horse-power each, to be built by the Koerting Works, of Hanover. The power house will be located about a mile from the center of the city.

EL DUERO, MEX.—The Guanajuato Electric Light & Power Company is installing additional machinery and motors at its hydro-electric plant at El Duero. The capacity of the plant will be doubled when the installation of the new equipment is completed. The plant now has a capacity of 10,000 horse-power. The company is supplying current to the cities of Leon, Irapuato, Guanajuato and La Barca, as well as to the mining camps throughout the district. Practically all of the 10,000 additional horse-power has been contracted for by mines and mills in the Guanajuato district. The cheap power is causing great activity in mining operations.

HALIFAX, N. S.—The question of constructing a municipal electric light plant is now being investigated. L. Fred. Monaghan is city clerk.

The Electric Railway.

MONTGOMERY, ALA.—The Alabama Railroad Commission has set a precedent by citing the Birmingham Railway, Light & Power Company to appear before that tribunal and show cause why it should not submit tariffs for approval.

LOS ANGELES, CAL.—The San Bernardino Valley Traction Company announces its intention of building a double track, connecting San Bernardino with Riverside. A. C. Denman, Jr., is now general manager of the company, in place of J. H. Fisher, Jr., resigned.

SAN FRANCISCO, CAL.—The California Midland Railway Company, which has been incorporated, with San Francisco as the principal place of business, will construct the projected electric railway system connecting Grass Valley, Auburn and Marysville. The capital stock of the new company is $3,000,000, of which $70,000 has been subscribed by John Martin, Eugene J. de Sabla, Leo H. Sussman, John W. Pryor and Walter J. McLean.

KOKOMO, IND.—By the acquisition of the interurban line now building from Zanesville to New Philadelphia, the Randall Morgan syndicate will control an interurban route from this city to Cleveland.

JEFFERSONVILLE, IND.—The Louisville & Indianapolis Traction Company, which proposes to build from Jeffersonville to Seymour, to unite with the Indianapolis & Columbus into Indianapolis, has obtained franchises through Clark and Scott counties.

MARION, IND.—The Marion, Hartford City & Eastern Traction Company, which proposes to build from Marion to Hartford City, has elected directors as follows: J. L. Thompson, R. A. Brasher, Oscar Thompson, W. B. Dodds and F. R. Chandler. Mr. Thompson was elected president; Mr. Dodds, vice-president, and Mr. Brasher, secretary.

SIOUX CITY, IA.—An announcement has been made that the Sioux City & Ireton Interurban Railway Company will build its line from Sioux City to Ireton. It is proposed to issue $400,000 of 5½ per cent 20-year bonds. The plan is to eventually continue the line to Spirit Lake. Surveyors are now at work laying out the route.

WORCESTER, MASS.—Directors of the Worcester Consolidated Street Railway Company have approved plans for a substation at West Boylston. It is to cost $35,000 and will be equipped with machinery to cost $20,000.

BAY CITY, MICH.—The Detroit & Bay City Traction Company will be built from Bay City to Caro this year. The remainder of the road to Detroit will be completed before Oct. 1 of next year.

ST. JOSEPH, MICH.—Vice-President Smith of the Indiana Railway Company has announced that the right of way for the proposed extension of that line from South Bend, Ind., to this city, has been secured. This extension, when constructed, will complete an interurban line between Chicago and Pittsburg.

ALLEGAN, MICH.—Allegan County supervisors have asked that W. H. Patterson build and equip the proposed electric line between Kalamazoo and Grand Rapids, with branches to Allegan and Douglas, before they grant his application for rights to dam the Kalamazoo river below Allegan village. The supervisors ask that the line from Allegan to Douglas by way of Fennville be built, giving that city an outlet to the lake shore.

CARTHAGE, MO.—The sum of $200,000 has been raised for the purpose of building an electric railway between this city and points to the northwest. At the meeting it developed that the action is necessitated by the advent of a new electric railway fostered by the Southwest Missouri Electric Company, connecting Webb City and Joplin with three smaller towns which have heretofore been tributary to Carthage.

LYONS, N. Y.—An electric railway is projected from Lyons to Sodus Bay. Among those interested are Charles H. Betts, Edson W. Hamn and James D. Bashford.

NEW YORK, N. Y.—Electric service has begun on the Grand and Desbrosses Street line from Desbrosses Street to Broadway. The line will soon be in operation to Grand Street Ferry and the Williamsburg Bridge.

ALBANY, N. Y.—The Catskill Mountain & Mohawk Valley Railway Company has been incorporated, with a capital stock of $2,000,000, by Edward C. White, New York; George C. Kendall, Stamford; Herbert S. Lounsberry, Port Chester, and E. E. Billings, Gilboa. It proposes to build a line of railway from Cairo to Onconta, with spurs to Stamford.

WINSTON, N. C.—The High Point & Winston Electric Interurban Railway has been granted a franchise. Its capital is $450,000. Officers have been elected as follows: J. H. Mills, of High Point, president; C. C. Yetter, of Bloomsburg, Pa., vice-president; Frank A. Chaplin, of Philadelphia, secretary and treasurer.

SALEM, ORE.—The Citizens Electric Light & Power Company, of this city, has an agent in the field arranging for the right of way for the proposed electric railway between this city and Portland.

UNIONTOWN, PA.—The Uniontown and Waynesburg Street Railway Company has been formed. Capital, $120,000. Incorporated by J. V. Thompson and Geo. L. Hibs.

HOUSTON, TEX.—The Houston Electric Company has perfected plans for important extensions of its electric railway lines in Houston, and for other improvements. This system is owned by Messrs. Stone & Webster, of Boston, Mass.

GAINESVILLE, TEX.—John C. King, of Gainesville, vice-president of the Gainesville-Whitesboro-Sherman Interurban Electric Railway, announces that the contract has been let for the construction of the road. The power house will be located at Gainesville.

WAXAHACHIE, TEX.—The City Council of Waxahachie has granted a 35-year franchise over the streets of the city to J. S. Daugherty and associates for the proposed interurban electric railway that is to run from Dallas to Waxahachie. The road will be about 35 miles long.

BUCKHANNON, W. VA.—W. E. Hildebrand, of Clarksburg, is interested in a plan to build an electric railway from this place to Clarksburg. Mr. Hildebrand says the intention is to build a trolley system from Pittsburg through West Virginia.

PARA, BRAZIL.—An extensive American electric traction and lighting system is about to be constructed in the city of Para, Brazil, the commercial center of the Amazon Valley.

NEW WESTMINSTER, B. C.—The British Columbia Electric Company will probably build a branch line from this city to the Fraser River saw mills, at an estimated cost of $35,000.

WINNIPEG, MAN. — A by-law is being prepared to enable the Winnipeg Electric Company to run Sunday cars. In return for the concession the company will do away with the double fare after 11 o'clock nights and will sell 8 tickets for 25 cents on Sundays, the regular day rate now being 6 tickets for 25 cents.

New Industrial Companies.

THE GENERAL COLLECTION COMPANY, of New York, has been incorporated with a capital stock of $10,000, by G. A. Howard, George Learned and P. W. Brown, New York.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, with a capital stock of $60,000, has been granted permission to do business in Texas. Dallas is the Texas headquarters of the company.

THE AUTOMATIC FIRE PROTECTION COMPANY, of New York, has been incorporated with a capital stock of $5,000. The directors are R. L. McElroy, J. E. Shepard and A. F. Hatch, Chicago.

THE CARPENTER ELECTRIC BATTERY & LAMP COMPANY, of New York, has been incorporated with a capital stock of $10,000. The directors are E. S. Thomson, C. B. Waite and Lillias H. Waite, of New York.

THE TONOPAH ELECTROLYTIC GOLD AND SILVER REDUCTION COMPANY has been incorporated at Camden, N. J., with a capital stock of $100,000, by H. Gilbert Coyle, J. Shoch Summers and Wilfred B. Wolcott.

FAIRBANKS, MORSE & COMPANY, of New York, have been incorporated with a capital stock of $50,000, by E. M. Boughey, Chicago, G. H. Baker and Emil Ebann, New York, to conduct an electrical equipment business.

THE ACME ELECTRIC COMPANY has been organized in Knoxville, Tenn. The officers are: Henry M. Moses, president and general manager; Frank S. Mead, vice-president; R. K. Gibson, secretary; Lewis P. Self, treasurer; Hugh J. Henry, superintendent. The capital stock is $5,000.

MACOMB CONSTRUCTION COMPANY.—The Macomb Electric Construction Company has been formed at Macomb, Ill., to act as consulting and contracting engineers for electric light stations and plants, telephone exchanges, power systems, etc. It will also handle electric light and telephone supplies. The capital stock is $10,000. Mr. C. M. Erwin is president; Mr. D. P. Pennywitt, vice-president; Mr. W. I. Savidge, secretary and constructing manager, and Mr. S. E. Parlum, treasurer.

◆

Legal.

WIRELESS LITIGATION.—An order granting a perpetual injunction against the De Forest Wireless Telegraph Company, the American De Forest Wireless Telegraph Company, Abraham White and Lee De Forest, in favor of the National Electric Signaling Company, has been signed by Judge Wheeler in the United States Circuit Court. The injunction has to do with three claims based upon the Signaling company's patent and restrains the De Forest Company from making, using or vending the barretter device technically described as "an improvement in receivers for electro-magnetic waves." The decision was quoted recently in these pages. The De Forest people say that the matter is of slight importance, as it relates to an old form of apparatus discarded by them some time since.

Obituary.

MR. BEAUCHAMP H. SMITH, second vice-president of the S. Morgan Smith Company, of York, Pa., died at his home in Los Angeles, on Nov. 1, at the age of 36 years. Mr. Smith went to Los Angeles about five years ago for the benefit of his health, since which time he has resided there, and hopes for a complete recovery were entertained.

MR. F. H. BETTS.—Mr. Frederic Henry Betts, one of the legal advisers of J. P. Morgan & Co., died in New York City on November 11. Mr. Betts was an authority on patent law and was counsel in famous patent cases for the Western Union Telegraph Company, American Bell Telephone Company and the Edison Electric Light Company. In 1872, and for sevral years thereafter, he was counsel for the State Insurance Department. He was born in Newburg in 1843 and was graduated from Yale in 1864. Two years later he was admitted to the bar from the Columbia Law School. From 1880 to 1885 he was a member of the Republican County Committee, and was prominent in various reform movements in this city. In 1882 he was a member of the Committee of Fifty, and in the following year was a member of the Citizens' Committee of One Hundred. In 1890 and 1891 he was a member of the People's Municipal League. Mr. Betts was always closely associated with Yale University, in which for several years he was a lecturer on patent law. He founded the Betts Prize in the Yale Law School, and was a vice-president of the Yale Alumni Society. He was a member of the Century, Metropolitan, Grolier, City and Tuxedo clubs, and was a vestryman in St. George's Church in this city. Mr. Betts married in 1869 Miss Louise Holbrook, a daughter of John F. Holbrook. His wife and three children—Louis F. H. Betts, Wyllys R. Betts and Mrs. Russell H. Hoadley—survive him.

◆

Personal.

MR. ROBERT McF. DOBLE, consulting engineer of San Francisco, has severed his connection with the Abner Doble Company, in order to resume his individual practice, which requires all his time.

MR LOUIS J. MAGEE, the representing director in America of the Allgemeine Elektricitaats Gesellschaft, has just returned to New York from a long trip to Europe, a large part of the time being spent on the Continent.

MR. ROBERT J. CROUSE, JR., of the National Lamp Company, of Cleveland, has been visiting New York City and the Eastern States this week in connection with his ingenious propaganda for general electrical advertising.

MR. CLOYD MARSHALL has resigned his position as engineer in the power department of the Union Electric Light & Power Company, of St. Louis, and become connected with the American De Forest Wireless Telegraph Company at St. Louis.

MR. FRANK J. SPRAGUE is to contribute to *Scribners Magazine* an article on the future of electric power applied to great railroads. This will be one of a general series of articles on modern railway enterprises and the problems associated with them.

MR. W. H. PATCHELL, engineer in chief of the Charing Cross, West End & City Electricity Supply Company, London, sailed for home this week on the White Star liner "Baltic." He made a very thorough study of central station and power transmission practice in this country and Canada, visiting Chicago, Detroit, Niagara Falls, Montreal, Boston, etc.

MR. T. C. MARTIN has been appointed by President Blood as editor of Progress, to report to the 29th convention of the National Electric Light Association, next May or June. Mr. Martin has for the past three years made to the association comprehensive reports on the progress during each year in the various branches of the art in this country and abroad.

MR. DUDLEY FARRAND, head of the electric lighting department of the Public Service Corporation of New Jersey, has sustained an irreparable loss in the death of his little daughter, an only child, to whom father and mother were devotedly attached. In this terrible bereavement the warm sympathy of a host of friends will go out to one who has always been himself so kind and thoughtful for all his associates.

◆

Trade Publications.

L. B. ALLEN COMPANY, INC., sole patentee and manufacturer of the Allen soldering paste, soldering stick, soldering salts, Liquiflux, etc., has issued a large series of attractive blotters. They are available to such of our readers as may wish to secure them and care to make an application.

ELECTRIC WATER PURIFIER.—The Electric Water Purifying & Filter Company, 25 Broad Street, New York, has issued a descriptive booklet dealing with a new electrolytic process for the purification of water applicable to the treatment of supplies for municipalities, commercial and industrial establishments, hotels, apartments, homes and all domestic uses.

LIGHTING SPECIALTIES.—The General Electric Company, Schenectady, N. Y., has recently issued flyer No. 2166, devoted to porcelain receptacles for moulding wiring. All live parts of each receptacle are covered by a one-piece porcelain cap held in place by two screws which serve to attach the receptacle to the moulding.

MECHANICAL MACHINISTS TOOLS.—Catalogue No. 107 of the Brown & Sharpe Manufacturing Company, Providence, R. I., is a 164-page publication illustrating, describing and giving complete price-lists of machinists' tools. It is stated that the tools described in this catalogue are made with the intention that they shall be the best in their respective classes.

MINING MACHINERY—Catalogue No. 127 of the Allis-Chalmers Company, Milwaukee, Wis., treats at great length of ore sampling machinery. Bulletin No. 1405 of the same company deals with portable rock crushing plants. Bulletin No. 1406 is devoted to forged steel balls for ball mills, while bulletin No. 1407 describes the Bennett's pouring spoon for use in copper converters.

INSTRUMENTS FOR ELECTRO-THERAPY.—E. B. Meyrowitz, 104 East Twenty-Third Street., New York, has issued a well-illustrated, 73-page catalogue devoted to dry cells, galvanic and faradic batteries, milammeters, volt limit selectors and current controllers employed in connection with constant and alternating currents for galvanism, faradism, cataphoresis and galvano cautery.

A RED CIRCULAR, in neat narrow form, issued by the Stromberg Carlson Telephone Mfg. Company, of Rochester, N. Y., has a view of their handsome private branch switchboard for 60 lamp-signal lines and 10 trunks, and shows a variety of sub-station apparatus for use in connection therewith. Several testimonials are quoted.

GASOLINE ENGINES FOR SMALL POWER.—Bulletin No. 1 of the Olds Gasoline Engine Works, Lansing, Mich., deals with the constructional features and operating characteristics of type "A" gasoline engines for small power. A complete description is given of every detail of the engines. These engines are constructed in sizes from 2 to 7 horse-power, and are suitable for all kinds of work where small power is required.

TRANSFORMERS FOR THAWING WATER PIPES.—The Pittsburg Transformer Company, Pittsburg, Pa., has issued a special publication to show the practicability of thawing frozen pipes by means of electricity, to show that it is exceedingly profitable to do so, and also to call attention to its 1906 thawing outfit. Twenty-one testimonial letters are offered as evidence that the thawing outfits which have been used have given entire satisfaction.

MACHINE TOOLS.—The November issue of the *Progress Reporter* of the Niles-Bement-Pond Company, 111 Broadway, New York, describes numerous special machine tools, and illustrates several methods of mounting electric motors for direct driving. An interesting feature of a plate planer, which is shown, resides in the use of pneumatic clutches, which are stated to have proved very satisfactory for this work. Several views are given of Niles electric hoists and traveling cranes.

NEW YORK EDISON COMPANY has recently adopted some very neat and attractive stationery for its canvassing and follow up literature in different branches. The headings are printed in color and exemplify electric heating, cooking, motor service, printing, etc. The letter and sheet on signs has a neat vignette pasted picture in the upper left hand corner. A new head has Father Knickerbocker looking through a microscope at a small bill for current, rendered under the new reduced scale.

THE AMERICAN ARC LAMP COMPANY, of Kalamazoo, Mich., has issued a little folder talking about the use of enclosed arc lamps in department stores, offices, etc. It shows two illustrations, one of the brass and the other of the copper cover with which the lamp is provided when desired. The lamp is of the direct-current type for either 110 or 220 volts enclosed arc, with long life. One of the illustrations shows the immediate accessibility of the parts of the lamp opening completely without the use of tools.

DIRECT-CURRENT MEASURING INSTRUMENTS.—The Simplex Company, 60 Nassau Street, Newark, N. J., has just issued an illustrated catalogue dealing with direct-current measuring instruments. The moving system of these instruments consists of a flat rectangular coil wound on a damping frame, supported above and below by straight conducting bands. The magnetic system involves a horse-shoe permanent magnet having four flat, soft-iron pole pieces and a flat disc soft-iron core. Switchboard instruments are assembled in cast-iron cases, while the portable instruments are mounted in finely finished carrying cases.

"PROFITABLE ADVERTISING," always a valuable medium and monitor for the advertiser and the advertising public, has just issued an unusually valuable number. It is called the "international edition," and its hundreds of handsomely printed pages are full of most interesting data as to the personnel, history, circulation, influence and range of the famous newspapers and journals of Europe. Facsimile pages, portraits, sample "ads," etc., abound, and the issue is a mine of real information. Miss Kate Griswold, the publisher of this admirable Boston periodical, is to be heartily congratulated on the success of this "European trip."

News of the Trade.

THE SCOTT ELECTRIC LIGHT COMPANY will build a large plant in New Brunswick, N. J., to manufacture an improved electric arc lamp.

CASON & BARRETT, the consulting engineers, have removed their offices in Kansas City, Mo., to Suite 608-9-10, Heist Building, in that city, where they have secured much larger quarters for their electrical and mechanical engineering business.

LAMP GUARD FACTORY.—The Attleboro Electric Manufacturing Company, Attleboro, Mass., has opened a new shop for the manufacture of incandescent lamp guards. The firm has purchased the business and plant of the Greenwood & Daggett Company, of Boston. This firm manufactured guards until last July.

THE BAINBRIDGE-DURBIN ELECTRIC COMPANY has succeeded Burke & Whittle in the electrical construction business, which the latter concern has carried on at 26 N. 7th Street, Philadelphia. The new company will continue business at the same place. Mr. A. E. Bainbridge of the new company will continue manufacturing telephones as in the past.

FAN MOTORS.—The Westinghouse Electric & Manufacturing Company will have a new line of ceiling and floor column fan motors on the market the coming season, both direct and alternating current. These fans will have four blades and ball bearings, and be finished in black enamel and oxidized copper. The alternating current fans will be of the induction type and the direct current fans will be furnished with three-point switches. The regular line of alternating and direct-current desk and wall bracket fans will be as complete as requirements demand, and the current consumption the lowest ever known for fans of these types.

DE LA VERGNE MACHINE COMPANY.—Owing to the rapidly increasing Southern business of the past year the De La Vergne Machine Company, of New York, has established a branch agency at Atlanta, Ga. This agency is to cover the States of North Carolina, South Carolina, Alabama, Florida and Georgia, and will handle business connected with the three lines of machinery manufactured by the De La Vergne Machine Company, viz., refrigerating and ice making machinery, "Hornsby-Akroyd" oil engines and Koerting gas engines. Their representative will be Mr. W. M. Hargreaves, and the office will be located at 510 Chandler Building.

ELECTRIC TESTING LABORATORIES.—In response to the demands of its clients the Electrical Testing Laboratories, Eightieth Street and East End Avenue, New York, has installed a machine for testing some of the mechanical properties of conductors. The rated capacity of this machine, in the measurement of tensile strength, is 15,000 pounds, which is sufficient to break a No. 0000 hard drawn copper wire. By this addition to its equipment the company now has excellent facilities for all such tests of wires and cable as are ordinarily required in electrical practice. These comprise measurements of conductivity, insulation resistance, dielectric strength, electrostatic capacity, tensile strength, elongation, elastic limit, etc.

JOSEPH M. ROMAN & CO., of New York City, engaged in the design and construction of electric and power properties, announce that they have opened offices in Atlanta, Ga., in order to follow more closely their work in the South. Mr. R. W. Hutchinson, Jr., a native Southener, and a close student of and author of several books on power development, transmission and application, enters the firm. The firm has a broad experience in this line of work, holds contracts for several plants now in course of construction, has just completed some electrical transmission work for the U. S. Government, and anticipate a busy future, based on the prosperous condition and bright future of the South. The firm will be glad to receive catalogues and price-lists for the files of its Southern office.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY continue to have an enormous demand for its alternating-current motors of the "CCL" type. The favor with which these motors have been received has surpassed the expectations of the company, and it is a matter of extreme gratification to note the entirely successful operation of the motors, even under the most severe conditions. A large marble plant has recently been equipped, and, although the motors have been operating under overloads and under conditions which require the strongest mechanical construction, their operation has left nothing to be desired. Increase in production and decrease in operating costs, as well as absence of the multiplicity of belts, are among the principal features noted in connection with this installation.

RENDERING PITTSBURG POSSIBLE.—In the office building of the H. K. Porter Company, at Pittsburg, Pa., an apparatus has been installed in connection with the heating and ventilating system whereby the air is washed and all dust and soot removed before it is put in circulation. This device, installed by the B. F. Sturtevant Company, of Boston, Mass., consists of a metal supporting frame filled with coke over which water trickles. All air entering the building is drawn through this filter by means of a fan and delivered under pressure to the various rooms. It is stated that during the past summer the fan has been operated continuously with the windows closed, the air has been thoroughly cleansed, its temperature lowered, the health of the office force improved and their daily output increased.

TRAIN LIGHTING.—The Chicago & Northwestern Railway Company has a new fast train from Chicago to St. Paul and Minneapolis, of a special luxurious character, especially as to lighting and toilet arrangements. The electric lighting arrangements of the train are so complete that it is no less than a brilliantly lighted moving palace. In the buffet-smoking and library car lamps shed a softened flood of light through delicately tinted art glass. In the sleeping cars each berth, compartment and drawing-room is equipped with individual reading lamps, and in the chair cars and day coaches special attention has been given to the subject of lighting, with a row of incandescent lamps on either side of the car, in addition to the usual center lights. The color effect is particularly attractive in the dining cars, where electric candelabra shed a softened glow of light over snowy linen and sparkling crystal.

"LONG-ARM" DOORS.—The Bureau of Construction and Repair of the Navy Department, after severe tests, has approved the new Model C electrically-operated bulkhead door made by the "Long Arm" System Company, of Cleveland, Ohio. The ships for which this door was specifically approved are the the "Montana" and "North Carolina." The tests demonstrated that the door was fully capable of closing through coal, and its watertight qualities were demonstrated under high pressure. The nominal leakage of the doors under this pressure was so small as to give entire satisfaction to the representatives of the Bureau who witnessed the tests. In the course of the evolution of the "Long Arm" System power doors, some minor defects developed in the first models. These defects have been overcome in the Model C door, which is more direct in its operation, simpler in design, and, therefore, easier to keep in good condition than were the earlier models.

SIMPLEX ELECTRIC HEATING EXHIBIT.—Few of the exhibits at the Madison Square Electrical Show, to be held from Dec. 12 to 23, will have a more popular interest than that of the Simplex Electric Heating Company, of 39 Cortlandt Street. Among the displays in the booth of this company will be complete lines of electrical heating apparatus, including electric radiators, chafing dishes, waffle irons, ovens, tailors' irons, coffee urns, glue pots and incubators. These exhibits will be shown in actual operation. For this purpose a model electric kitchen will be furnished where a corps of cooks will practically demonstrate the uses of the products of this company by actually cooking some of the food, including roasts which will be served in the cafe. It is also planned to demonstrate the uses of electricity in baking biscuits and in making coffee, samples of which will be given to visitors. The Simplex Electric Heating exhibit will be in charge of Mr. Roger Williams.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 7, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

803,539. BLOCK SIGNAL SYSTEM. Charles E. Bennett, New York, N. Y. App. filed June 10, 1905. This patent and the one following relate to an unusual block signal system. (See below.)

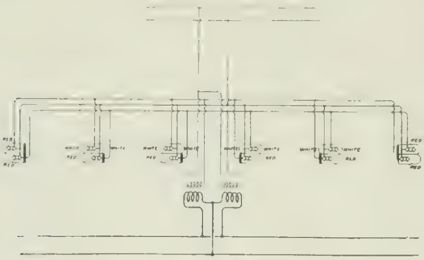
803,540. BLOCK SIGNAL SYSTEM. Charles E. Bennett, New York, N. Y. App filed July 11, 1905. The patentee secures an automatic overlap block signal system wholly without use of relays, contactors, tappets or circuit closers of any sort. The rails are charged with alternating-current low potential from step-down transformers, and the high potential primary current is utilized for transmitting the signals. The increased current in such primaries when the secondaries are short circuited by the axles of a passing train, is sufficient to actuate the home and distance signals.

803,543. ELECTROLYTIC PROCESS USING INSOLUBLE ANODES; Anson Gardner Betts, Troy, N. Y. App. filed Feby. 16, 1905.

803,544. APPARATUS FOR REFINING LEAD BY ELECTROLYSIS; Anson Gardner Betts, Troy, N. Y. App. filed March 18, 1904.

803,569. INDUCTION TRANSFORMER FOR WIRELESS TELEGRAPHY RECEIVING STATIONS; Eugene Ducretet, Paris, France. App. filed Mar. 2, 1904. The antenna circuit includes the primary of an induction coil of which the secondary is formed of two parallel windings, each having a free unconnected end. The other ends are bridged across a multiple circuit including the coherer and a local battery and sounder

803,676. TELEPHONY; Francis W. Dunbar, Chicago, Ill. App. filed Nov. 12, 1904.



803,539.—Block Signal System.

803,684. INSTRUMENT FOR CONVERTING ALTERNATING ELECTRIC CURRENTS INTO CONTINUOUS CURRENTS; John Ambrose Fleming, London, England. App. filed April 19, 1905. (See Current News and Notes.)

803,704. TELEGRAPHIC SOUNDER; Frank H. Miller, Washington, D. C. App. filed Feb. 18, 1905. A rectangular box is secured upon the usual contact posts of a telegraph sounder in order to constitute a resonator and improve and amplify the quality of the sound.

803,793. INSULATED RAIL JOINT; Reuben W. Smith, Bryn Mawr, Pa. App. filed May 26, 1905. A pair of metal fish plates are so formed as to each closely embrace one rail of the pair to be joined, each plate overlapping the other rail and being separated therefrom by an insulating section.

803,795. ELECTRIC HEATING DEVICE; George E. Stevens, Lynn, Mass. App. filed Feb. 15, 1904. A pair of resistance coils are suspended in a vertical position between a pair of sheet metal plates with which contact is made by specially formed clamping nuts.

803,803. BRUSH HOLDER; Norman C. Bassett, Lynn, Mass. App. filed Mar. 20, 1902. In order to avoid brushes becoming gummed to their holders when cold, and preventing good contact, the patentee makes use of two separate springs, one of which presses the brush holder and the other the brush within the holder.

803,806. TROLLEY WHEEL; Emile Brossy, West Hoboken, N. J. App. filed July 20, 1904. The trolley wheel is made spherical in form with an annular groove to engage the usual conductor. The purpose is to give a stronger construction, one less liable to heat, and in which angular or sharp edges are not presented to catch on guy wires, etc.

803,816. INSULATING MATERIAL; William L. R. Emmet, Schenectady, N. Y. App. filed Nov. 24, 1900. Embodies superposed sheets of asbestos with hard-baked layers of linseed oil and gum copal baked upon one surface of each sheet.

803,817. CIRCUIT BREAKER; Michael B. Field, Sevenoaks, England. App. filed Mar. 17, 1903. An apparatus for breaking the circuits of three-phase high-potential systems. After the main switches have been broken the current is carried by bridges across diverging rods upon a convenient place. The bridges are suddenly removed and the arc travels upward and outward and is finally broken by the divergence of the rods.

803,825. TRIP COIL FOR CIRCUIT BREAKERS; John D. Dilliard, jr., Schenectady, N. Y. App. filed Feb. 13, 1902. Relates to means for calibrating a circuit breaker to respond for different current intensities. Different magnetic cores may be inserted within the magnet coil having different restricted areas at a portion of their length.

803,827. RAILWAY SWITCH STAND CONTACT BOX; William J. Hughes, Levis, Canada. App. filed May 5, 1905. The box contains an insulating plate with a pair of contacts or terminals thereon which are engaged by a spring blade depressed into contact therewith by a movable plunger.

803,832. MOTOR OPERATED SWITCH; Wesley E. Laird, Pittsfield, Mass. App. filed Feb. 16, 1904. In the case of large motor operated switches a danger arises in the event the motor becomes disabled. This patent provides a gravity device which is always effective to throw the switch in case the electric motor is disabled.

803,834. CONTROL SYSTEM; Carl W. Larson, Schenectady, N. Y. App. filed Apr. 17, 1905. The controller arm has a plurality of latches thereon which prevent any movement until they have all been released by their respective electro-magnets. The electro-magnets are controlled by different stops and brake devices insuring the release of all of these before the motors can be started.

803,836. VAPOR ELECTRIC APPARATUS; Alexander D. Lunt. Schenectary, N. Y. App. filed May 12, 1904. (See Current News and Notes.)

803,853. BRUSH HOLDER; Henry G. Reist, Schenectady, N. Y. App. filed Mar. 20, 1904. The brush holders form links of a continuous chain which extends around the contact ring. Each brush holder has a supplemental spring by which its brush is individually pressed toward the commutator or ring

803,856. TELEPHONE SYSTEM; William A. Robinson, South Kortright, New York. App. filed Feby 18, 1904

803,872. SIGNALING ON RAILWAYS, TRAMWAYS, ETC.; John Brown, Dunmurry, Ireland. App. filed Oct. 4, 1901. Relates to a system for transferring passengers to express trains without stoppage of the latter by means of a local train running temporarily alongside. The trains have galvanometers to indicate their proper approach to one another.

803,881. SELF-SOLDERING THERMAL PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed March 26, 1904.

803,895. KNIFE SWITCH; Bird M. Graybill, Chicago, Ill. App. filed Mar. 11, 1905. The contact members of a knife blade switch have spring pressed plugs therein which engage the knife blades and make an improved contact therewith.

803,898. ELECTRIC SWITCH; Arthur E. Handy, Providence, R. I. App. filed Oct. 20, 1904. Details of an elevator controller in which the contacts are supported from an insulating block in the rear thereof, and the cylinder has segments which oscillate into engagement with one or another series of contacts.

803,936. ELECTRIC PUMP; John C. Stokes, Mansfield, La. App. filed Feb. 28, 1905. The pump is operated by a pair of opposed solenoid magnets which are alternately switched into circuit by a quick-acting knife switch actuated by tappets on the pump rod.

803,973. INSULATOR; George M. Bemis, Readsboro, Vt. App. filed June 11, 1904. The insulator comprises two hemispherical blocks which can be dovetailed together to produce a diametral passage therethrough for the wire. The insulator is supported by a fork shaped fixture.

803,976. AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS; Algernon H. Binyon, London, England. App. filed Apr. 26, 1905. Details of an overlap block signal system employing contactors and circuits in which the track rails are energized by continuous currents.

804,021. MEANS FOR PRODUCING OXIDES OF NITROGEN; Ernst Marquardt, Schoenberg, near Berlin, and Hermann Viertel, Charlottenburg, Germany. App. filed May 2, 1903.

804,045. ELECTRIC WELDING CLAMPING DEVICE; Adolph F. Rietzel, Lynn, Mass. App. filed Nov. 16, 1903. A pair of jaws are arranged to clamp the articles to be welded so as to be forced against one another. Each jaw is independently adjustable in all directions so that the articles may be brought into perfect alignment.

804,070. ELECTRICAL FUSE PLUG; George B. Thomas, Bridgeport, Conn. App. filed May 22, 1905. The fuse plug has two parts which can be brought together so as to enclose the fuse cartridge in a cylindrical cavity. The fuse circuit is independently completed at the same time by a pair of studs upon one of the members which engage sockets in the other.

804,077. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed May 7, 1903. (See page 868.)

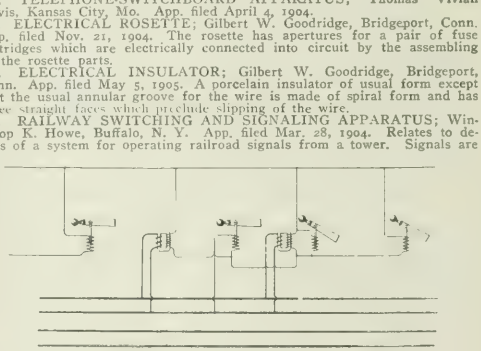
804,082. ELECTRIC CLOCK; Leopoldo Agostinelli, Terni, Italy. App. filed July 31, 1903. The clock train is driven by a weighted lever which is intermittently raised by a magnet periodically energized from a line current. The periodicity is controlled by the clock train.

804,103. TELEPHONE-SWITCHBOARD APPARATUS; Thomas Vivian Davis, Kansas City, Mo. App. filed April 4, 1904.

804,114. ELECTRICAL ROSETTE; Gilbert W. Goodridge, Bridgeport, Conn. App. filed Nov. 21, 1904. The rosette has apertures for a pair of fuse cartridges which are electrically connected into circuit by the assembling of the rosette parts.

804,115. ELECTRICAL INSULATOR; Gilbert W. Goodridge, Bridgeport, Conn. App. filed May 5, 1905. A porcelain insulator of usual form except that the usual annular groove for the wire is made of spiral form and has three straight faces which preclude slipping of the wire.

804,126. RAILWAY SWITCHING AND SIGNALING APPARATUS; Winthrop K. Howe, Buffalo, N. Y. App. filed Mar. 28, 1904. Relates to details of a system for operating railroad signals from a tower. Signals are mechanically worked by motors which have their circuits specially controlled.



803,540.—Block Signal System.

804,133. ELECTRICAL BINDING SCREW; William Kaisling, Chicago, Ill. App. filed May 22, 1903.

804,156. SYSTEM OF ELECTRIC MOTOR CONTROL; Charles A. Mudge, New York, N. Y. App. filed Mar. 2, 1905. A complete multiple unit system in which the operator works a pair of valves through electro-magnets which admit fluid pressure to the respective ends of a cylinder which turns the controller to its various positions for each car upon the train.

804,176. SYSTEM OF AUTOMATIC SIGNALING FOR ELECTRIC RAILWAYS; Fitzhugh Townsend, New York, N. Y. App. filed Aug. 1, 1905. The rails are charged with a low potential A. C. current and whenever a train passes it closes a separate circuit through a transformer which steps up the current to an amount sufficient for operating the signals.

804,180. SELF-RESTORING SIGNAL CONTROLLING DEVICE; Eugene W. Vogel, Chicago, Ill. App. filed July 23, 1901. In order to prevent waste of current in those cases where an alarm bell is rung during the time the train is on a block section a switch is provided by which such circuit can be opened when desired.

804,182. METALLIC CIRCUIT FOR OPERATING SIGNALING DEVICES; Albert Koch Andriano and Hermann Herbstritt, San Francisco, Cal. App. filed March 6, 1905.

804,189. APPARATUS FOR MEASURING THE LENGTH OF ELECTRIC WAVES; John A. Fleming, London, England. App. filed Feb. 8, 1905. The antenna circuit of a wireless system is connected to the end of a coil, the earth connection from the other end of which can be moved to variable positions thereon. When a position is found where the resonance agrees with the periodicity, the potential takes nodes and loops along the coil which can be investigated with a vacuum tube. The wave length can be determined from the active length of the coil.

804,190. INSTRUMENT FOR MAKING ELECTRICAL MEASUREMENTS; John A. Fleming, London, England. App. filed Feb. 8, 1905. Relates to details of construction of a wave length measuring coil of the character mentioned in the preceding patent.

12,406. DIRECT-CURRENT DYNAMO ELECTRIC GENERATOR; Benjamin G. Lamme, Pittsburg, Pa. App. filed May 2, 1905. Relates to means for overcoming defects of balance of the field forces by the employment of a balancing alternating-current connected to points of the armature circuits.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, NOVEMBER 25, 1905. No. 22.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE	1139 Monadnock Block
PHILADELPHIA OFFICE	929 Chestnut Street
CLEVELAND OFFICE	402 Cuyahoga Building
EUROPEAN OFFICE	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGraw Publishing Co.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

***The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue* 13,000 *copies are printed. Total circulation for* 1905 *to date,* 646,000.**

NEW YORK, SATURDAY, NOVEMBER 25, 1905.

CONTENTS.

Editorial 887
The Indiana Municipal League 890
Latest Municipal Lighting Statistics from Detroit 890
Meeting of the New York Magnetic Club 891
Graphitizing Filament Patents Expired. By Edward P. Thompson 892
United States vs. German Patent Office Practice 892
Investigation of Municipal Ownership 894
Building up Central Station Business at Kansas City 894
The Patent Law Situation 894
Milwaukee Street Lighting Contract 895
Electric-Steam Competition in England 895
Electrical Engineers of the Times. XXXVII. Mr. Peter Junkersfeld 895
Radioactive Water 896
Current News and Notes 896
Niagara Power in the Gorge.—II 899
The Efficiency of Electrical Power Generating Stations. By H. M. Hobart. 901
The New Lighting Campaign in Topeka, Kan 905
Reflectors, Shades and Globes.—I. By J. R. Cravath and V. R. Lansingh 907
Pennsylvania Independent Telephone Association 909
English Automobile Stage Lines 909
A Small Motor Testing Equipment. By Roy T. Wells 909
A Topical Classification for Electrical Engineering References. By George Parsons 910
A Method of Testing Wireless Receivers. By Greenleaf W. Pickard 912
Vertical-Shaft Direct-Current Generator 913
Homopolar Dynamo 913
LETTERS TO THE EDITORS:
  American Inventors and the German Patent Office. By Louis J. Magee. 913
  Approximations of the B. & S. Gauge. By Austin Burt 914
Digest of Current Electrical Literature 914
Annual Meeting of Westinghouse Managers 918
Signal Service Annual Report 919
Electrically Operated Capstan 919
Flexible Suspension for Grooved Trolley Wire 920
Expanded Metal Lockers 920
Industrial and Commercial News 921
General News of the Week 923

ONE FORM OF ELECTRICAL ACTIVITY.

This has been a fairly busy week in electrical meetings in New York City. It is a good sign of intellectual activity in an art, and of corresponding mental alertness on the part of the individual engineers and practitioners. In fact, it might be argued that the well-being of an art is in pretty close relation to the prosperity and activity of its representative societies. Last Wednesday the New York Electrical Society devoted its monthly meeting to an important paper on electric traction. The same evening at the Chemist's Club the subject of a municipal electric light plant was considered. On Thursday evening the American Electrochemical Society visited the Elestrical Testing Laboratories and heard addresses there. On Friday evening the American Institute of Electrical Engineers took up the important subject of the National Bureau of Standards. Any man taking in all this would have kept himself well up to date, though he might not have had much time left for social duties and pleasures, or for other technical meetings, of which there were also some of interest electrically.

◆

THE RATE OF RECOMBINATION OF IONS IN AIR.

We read so much about the production of ions in air and other gases, and we read so little about their disappearance after having been produced that we are apt to surmise that perhaps ions once produced never do disappear, but live happy ever after. When, for example, X-rays are caused to traverse air, we know that air particles or molecules in the normally neutral electric condition are split up into ions; that is, into electrified constituents, the sum of the positive charges being equal to the sum of the negative charges. It is, however, known that the ions, when left to their own devices, tend to recombine and disappear into neutral molecules, the original condition from which they started. It may well be imagined that a positively electrified particle, flying about in a gas, tends to attract any wandering negatively electrified particle that may chance to come within the sphere of influence. If the velocities of these two oppositely electrified particles be propitious to the procedure, the particles will approach until they unite in permanent and stable neutrality. It may readily happen that ions once brought into existence may tend to produce others, if an electric field be present. In the presence of an electric field of force, the electrified ions are impelled along the field, either upstream or downstream, according to the sign of their electrification, with a velocity depending upon the strength of the field and the time elapsing between collisions. In a powerful field and a low-pressure gas, the velocity acquired by the ions makes their collisions with innocent neutral particles very disturbing to the equilibrium of these neutrals, so that above this critical velocity the collision is followed by a rupture of the neutral into a positive and a negative ion.

Starting, say, with a single pair of ions, and a sufficiently powerful electric field, this pair can play such havoc with the peace of neighboring neutrals that in a brief interval of time an enormous number of ions may be brought into existence. It would seem, therefore, as though the ions in a gas were never quiet. They must either create new ions with frantic zeal, or they must unite with ions of opposite sign and disappear from active duty as independent electrified citizens. At any instant both actions may be going on simultaneously in a given region, new ions being born while old ions are disappearing. A steady state of ionizing activity is attained when the rate at which ions are produced is equal to the rate at which ions are reduced. In a recent number of the *Physical Review* there is an article by Mr. L. L. Hendren on an experimental determination of the rate at which ions in air recombine. For the purpose of this research, a radium salt was employed as the ionizing agent. Under any given conditions of pressure and temperature in an ionized gas, the rate of recombination is found to vary as the square of the number of free ions per unit of volume; so that if the number of free ions be doubled, keeping all other conditions the same, the rate of recombination of ions will be increased four times. The results detailed in the article go to show that as the pressure of the gas is reduced, or the mean free path of an ion increased, the rate of recombination, for a given number of ions per cubic centimeter, is reduced, so that recombination is favored by pressure in the air at least as far as ordinary atmospheric pressures.

THE INEFFICIENCY OF GENERATING STATIONS.

Mr. Hobart's study of the net annual efficiency of electric supply stations is illuminating, though not precisely cheering, and ought to be given more than a passing glance by central station managers. The tables are a grim commentary on current steam practice. It is not a pleasant thing to realize that, reckoning from the coal pile, which is the most practical basis since it is fuel bills that one has to pay, the ordinary large station of the better class abroad shows at the switchboard only six or seven per cent efficiency. If one wishes to follow the trail still further he finds that in electric lighting not more than three or four-tenths of one per cent of the total energy is delivered as useful light energy at the lamps. The rest is frittered away as worse than useless heat at various points in the long chain of transmutations. Of course, so far as possible improvements go the opportunity is not so great as the figures indicate. Taking this world as it is, and the only one in which our readers are likely to be in the electric lighting business, its natural limitations as regards temperature range are such that some 70 per cent of the total thermal energy is now utilizable in steam energy. Of the energy within the temperature conditions the waste is not terribly great, so that the most hopeful line of economy is to extend the working temperature range, as is being done with superheated steam and with gas engines. Electric generators are as transformers of energy already too efficient to permit of any considerable improvement, so that the practical chance for improvement lies in the boilers and furnaces of the engines and in the load factor applied to each.

Only the most determined efforts at improvements all along the line can give even a moderately satisfactory result judging from the criterion set by Mr. Hobart in the energy recovered from the mechanical equivalent of the heat of combustion of the fuel. Let us put the question with brutal frankness: The calorific value of the fuel is, say, 9,000 kw-hours per ton. How many kw-hours per ton are *you* getting? And why? Are the general parts of your equipment as good as they ought to be, and are they kept at anywhere near their best performance? Why do "practical" men so often speak contemptuously of what they are pleased to call "test conditions"? Is there anything mysterious about them save that the apparatus is put in good condition and used, as it was intended to be, intelligently? We know from repeated tests with superheated steam that a first-class direct-connected set with compound condensing engines can pass up the kw-hour on about 15 pounds of steam at its most economical load even now, and we also know from repeated boiler tests that this steam should be delivered from the boiler for the consumption of not far from 1.5 pound of coal. Yet the station man generally smiles a gloomy smile and mumbles something about "theory" and "test" conditions and goes on paying for 3 to 5 pounds of coal per kw-hour, even at a good load. That kind of "theory" and those "test" conditions are what he needs to pay dividends with. Now we are perfectly well aware that very few electric stations are operated under good load conditions on account of varying demand, but if the station is properly planned and is reasonably large there is no reason why the machines in active, operation should not be working under much better load factors than is now usual, and consequently at higher efficiency.

Bad firing, too, is responsible for very serious waste in many central stations. In these days of automatic stokers the cheap and shiftless fireman should have no place; unfortunately, trade unions would decree otherwise. It is probable that a really good fireman can beat the performance of an automatic stoker, but the latter can give results month in and month out far better than can be reached by the set of firemen too often found as the logical consequence of false economy. If one stops to think of the value of the coal daily handled by a fireman, and then realizes that a third of that value can be gained or lost according to the fireman's skill, there is found ample food for reflection. And following out the matter of economy still further, what becomes of the steam that is generated? Is the performance of the engines in the average large station known or merely guessed at? In the gross it is all very well to look at the coal burned and the kw-hours generated, but the distribution of the losses is all important in checking them and guesswork does not go. Of course, it is well known that most electric stations use a painfully large amount of coal per kw-hour, and in a sense Mr. Hobart's paper is merely confirmatory. The thermal value of the coal in kw-hours per ton is, however, a particularly striking starting point in the reckoning which brings the shortcomings of even good modern plants very vividly before one. Looking over some of the convenient data from American plants, we have the consolation of noting that they are as good as the best of the plants cited by Mr. Hobart; indeed, we judge some of them to be a shade better than any in Mr. Hobart's list, but even in the best of them there is plenty of room for improvement. The next few years will see considerably higher economy than now rules. The stimulus of competition between turbines, engines with high superheat and gas engines is rapidly making itself felt, and the day is coming in which we shall see stations put in with a guarantee of efficiency reckoned from the coal pile. Efficiency counted from the steam condensed is very well so far as it goes, but it is far from telling the whole story of thermal losses, which must all ultimately be paid for.

INDUCTION MOTORS FOR TRACTION.

In connection with the application of alternating currents to electric traction, much thought has been expended on schemes for eliminating the commutator type of machines, it being held as obvious that the squirrel-cage or coil-wound rotor of an induction motor has an advantage over an armature with a commutator. In regard to the two major difficulties inherent in the polyphase motor when used for traction, namely, its constant-speed characteristic and the necessity for the use of three conducting wires, the advocates of the induction motor system claim that the power recuperated during retardation compensates for the excess lost during acceleration, and that the difficulties due to the use of duplicate trolley wires are of minor importance. It is evident that in investigating the importance of these difficulties, experience is of more value than theoretical arguments. The article on page 860 of our last issue tends to show that in practical service the three-phase induction motors have operated in a manner entirely satisfactory to those responsible for their installation. A most encouraging feature of the alternating-current railway situation is that those who have installed polyphase systems have failed to detect any unsurmountable difficulties, and are loud in the praises of its advantages, while those who have employed single-phase commutator motors have been equally pleased with their operation.

In examining the characteristics of the induction motor one is forcibly impressed with the fact that, although means may be employed for causing the machine to exert its maximum torque at any speed from standstill to a few per cent below synchronism, in no case can the efficiency be as great as the speed in per cent of synchronism. The seeming increase in efficiency at fractional speeds with concatenated connection of the motors is due solely to the change in the synchronous speed, and the relation expressed above is not altered thereby. When one compares the limited speed range of the induction motors with the economical speed range of the motors possessing series characteristics, he is apt to conclude that the former machines are very much less efficient at low speeds than the latter machines. It is not proper, however, to neglect the fact at the moment of starting each type of motor has an efficiency of zero, and that under starting conditions the induction machine, on account of the lack of a commutator, is essentially at a great advantage. Experience shows that the mere fact of the induction motor possessing the characteristics of a shunt machine is not sufficient to preclude its adoption for railway work. In connection with the difficulty incident to the use of induction motors for traction, it is interesting to investigate the possibility of employing a single trolley wire by making use of the self-starting single-phase type of machine. As is well known, the magnetic field of a single-phase induction motor when the rotor is at full speed is of constant value and rotates uniformly, while at zero speed the magnetism is unidirectional in space and alternating in value. Since the torque produced by a certain secondary current depends upon the product of this current with the magnetism in space-quadrature and time-phase with it, it follows that the torque exerted by a simple single-phase motor at a certain speed is equal to the product of the rotor speed and the torque exerted by the corresponding polyphase motor, and hence is zero at standstill. In order that the motor may possess a torque at zero speed, it is necessary that it be supplied with magnetism in space-quadrature and time-phase with the secondary current, which result can conveniently be obtained by the use of suitably selected impedances properly disposed.

The Digest for this issue contains an account of an investigation by J. Dalemont on the use of condensers with single-phase motors during both the starting period and normal operation. If a motor with a three-phase delta-connected primary winding be supplied with normal electromotive force across two leads and the potential of the third lead be displaced relatively from a potential line joining the other two leads, the machine will exert a starting torque proportional to the product of the percentage displacement and the starting torque exerted by the normal three-phase machine. Thus, if the quadrature potential displacement is equal to $\sqrt{3/4}$ of the e.m.f. impressed between the two leads, the starting torque will be the same as that of the polyphase machine, and it may be made equal to the maximum torque of the equivalent three-phase motor by employing the proper secondary resistance. A displacement having the value indicated above may be obtained by the use of condensive impedance in series with inductive impedance, as indicated in the Digest. Under these conditions the motor operates as a three-phase machine, but possesses the added advantage over the usual three-phase motor of requiring a smaller current input, since the quadrature magnetism is supplied by the condenser current, and the power factor is correspondingly increased. The author shows that the performance of the motor may be considerably improved by relatively reversing the terminals of the main phase winding from the usual connection, in which event the magnetism due to the currents in the three separate phase windings operate to give torque in the same direction. It is seriously to be regretted that satisfactory condensers suitable for such work on a large scale have not as yet been produced. That a large demand would immediately follow the introduction of commercial condensers of large volt-ampere capacity occupying small space and light in weight, is beyond any doubt.

Magnetic Irreversibility of Certain Alloys.

A note on the subject of the magnetic irreversibility of Heusler alloys by Mr. B. V. Hill appears in the *Physical Review* for November. Certain compound steels are called irreversible, from a magnetic standpoint, because when heated to a certain critical temperature they become non-magnetic; but on reversing the process by cooling they do not regain their magnetic quality at the same critical temperature, but remain non-magnetic until a much lower temperature is reached. On the contrary, soft iron has a critical temperature at about 700° C. When heated above that point it becomes non-magnetic; but on cooling it regains its magnetic property at the same temperature. This means that iron is magnetically reversible. Selecting a bar of copper-manganese-aluminum alloy, the material was found to be magnetic at room temperatures. When it was heated to about 370° C. it gradually became non-magnetic. On cooling it reacquired nearly all its original magnetic properties. When, however, it was heated to 500° C., it remained almost non-magnetic after cooling. In other words, it was magnetically irreversible at the temperature of 500° C. When the same rod of alloy was heated to a temperature of about 850° C., it regained its magnetic property, and the property persisted during and after cooling. If this result is capable of being reduplicated, a curious relation presents itself. We have first an alloy that is magnetic at ordinary temperatures. Then it loses its magnetic properties when carried up to 500° C. in such a manner that they are lost and forgotten when the substance is cooled. But if the substance is carried to a bright red heat, not only is the lost magnetic power regained at this temperature, but it is retained on cooling.

Our present knowledge of magnetism gives no clue to the causes of the curious magnetic behavior above described. The only comfort is that the physical behavior of alloys is a maze of apparent inconsistencies that awaits the work of future researches to unravel. The mere fact that three non-magnetic substances like copper, manganese and aluminum when melted and cast together form a strongly magnetic alloy, makes sufficient mystery for the contentment of any single energetic investigator. It is suggested as a speculation, in the article referred to, that possibly manganese might be found to possess magnetic properties at a sufficiently high temperature. Much work will have to be done in the investigation of magnetic behavior of alloys before we can predict whether metals can be produced with a greater magnetic power than iron and steel. It is conceivable that an alloy might be produced which would have a greater permeability and carry a greater flux density than steel, so that a smaller cross-section and weight of the metal might serve for use in a dynamo. If such an alloy were discovered and it was fairly inexpensive to produce, it might come into extensive use in dynamo construction. But at the present time this is pure speculation, because no alloy has yet been discovered which approaches in magnetic properties to soft iron and steel. All that we can say with certainty is that the storehouses of nature are vast beyond our ken, and that at any time persistent endeavor may bring facts to light sufficient to upset our practical applications and commercial processes.

The Indiana Municipal League.

Municipal franchises and municipal ownership of public utilities were the principal subjects discussed at the 14th annual meeting of the Municipal League of Indiana November 15. The discussion was opened by an address on "Municipal Franchises" by Finley P. Mount, City Attorney of Crawfordsville. Mr. Mount said his experience was that the success or non success of municipal ownership of public utilities was largely a matter of bookkeeping. He said it was an easy matter to render reports or trial balances—one in favor of and one against municipal ownership. He said it was absolutely impossible to divorce their management from politics. "Every employee in a plant under municipal ownership," said Mr. Mount, "from a coal shoveler up, knows he owns his job through political preference. You cannot get municipal ownership separated from politics, no matter how hard you may try."

Mr. Mount gave a history of the trials and tribulations encountered by the electric light plant at Crawfordsville, owned by the city, saying that for 15 years it was operated at a loss, and while it is now being operated by a bi-partisan board in a paying and satisfactory manner, the experience had been a very expensive one to the city. He told of a long list of delinquents and of persons who were benefited by free service, many of whom were city officials who indignantly denied any intimation of graft. He then spoke of the water works in Crawfordsville operated by a private corporation. He said the city was enjoying excellent service and he attributed it to the strength of the contract with the water company. No reliance, he said, could be placed in a forfeiture clause in a franchise, especially in a water franchise. The strength of a water franchise lies in the financial penalties that may be assessed and withheld from the next quarterly payment. Penalties of this sort for failure to provide water of a specific degree of purity, and failure to keep the pressure up to a certain point and other penalizing safeguards should be in every franchise contract, he said. He closed his address by saying that for a period of twenty years or more he was confident a city would get better results from properly framed and well guarded franchises to private corporations, for public utilities than from municipal ownership and control.

Mr. Mount's address and points aroused quite a discussion, Mayor Becker, of Hammond, leading in an argument in favor of municipal ownership of public utilities excepting when the indebtedness of a city precluded in favor of a grant of franchise to a private corporation in order to get service. He described how the municipal water works plant of Hammond was saving the city $30,000 a year —practically paying for itself. He condemned the methods of the private corporations in issuing bonds on the earning capacity of a plant rather than its actual cost, thereby compelling the public to pay interest on bonds sold for 25 cents on the dollar. He said private corporations have been known to control city elections and in such case they are a menace to a municipality. He said "if we cannot govern a municipal plant, it is evident that we are not able to govern ourselves."

Mayor France, of Huntington, said that he favored municipal ownership; that private corporations were gaining a stronger and more arrogant hold on the government, and that it is time to crush this arrogant power. He insisted that party politics should not enter municipal affairs; that the day will come when it will have no place in municipal affairs and municipal elections.

Mr. William Fortune said that he favored municipal ownership of water plants, and that there is no more reason why a municipal government should be a failure in the management of public utilities than in the management of other affairs. He said the better plan would be to allow the people to vote on an important franchise before it was granted to a private corporation.

A paper was next read "On Municipal Ownership of Water and Light Plants," by H. C. Ayers, mayor of Portland. Mr. Ayers' paper covered much the same ground and reasoning assumed by Mr. Mount. The delegates participating in the discussion were about equally divided in favor of municipal and of private ownership and control of public utilities.

The following officers were elected for the ensuing year: President, Fred J. France, mayor of Huntington; vice-presidents, B. R. Russell, ex-mayor of Crawfordsville and George R. Carr, mayor of Greenfield; secretary, John F. Taggart, Clerk of Richmond. The next meeting will be held in Marion, June 15, 1906.

Latest Municipal Lighting Statistics from Detroit.

The tenth annual report of the Public Lighting Commission of the City of Detroit, covering the year July 1, 1904, to June 30, 1905, has just reached us in its pamphlet form. In July the commission gave some advance figures to the local newspapers and we reprinted some comments thereon by *The Michigan Investor.* (See Electrical World and Engineer, August 12, 1905.) The issue of the report in its final form calls for some comment at our hands. The tenth report gives as usual a careful analysis of the expenditures made on operating account by the Public Lighting Commission. The completeness of this statement has always been very creditable to the Detroit Commission, and it is also to the credit of the commission that every report has shown economical operation.

On page 22 there is a statement of charges made to Investment Accounts, also in good form. On page 23 there is the usual statement of Depreciation Account, entries for the year covered by this report being as follows:

By amount added to cost of lights for discarded lines, machinery and lamps, year ending June 30, 1905	$15,827.19
By amount added to cost of lights for depreciation for year ending June 30, 1905	.26,991.53

We have in the past pointed out that the depreciation account of the commission was utterly inadequate, and we have no occasion to take back what we have said; but it is fair to compliment the commission on the first of these two entries. It shows an awakened commercial conscience and gives hope that sooner or later these annual reports will recognize depreciation in an adequate way.

The commission still avoids—we may say evades—the true method of arriving at the value of its property. On page 10 of the report the statement is made that the present value after making deductions for all possible depreciations is $872,726. Reference to page 23 shows that this figure is the resultant of the sum of all the charges to investment, less the chronic 3 per cent per annum depreciation charge, which we have so often challenged; and less, in addition thereto, the charge of $15,827.19 on which we have just congratulated the commission, and two small charges of a similar character in previous years. The statement on page 10 is, therefore, merely a book value and not an inventory value. During the past year the commission was given an opportunity to have its property inventoried at the expense of private parties. A local electric light company deposited with the Common Council $1,000 to be used to pay the cost of an inventory of the Public Lighting property by the dean of the engineering faculty of the University of Michigan, or by engineers acting under his direction, the lighting company offering to add to the $1,000 whatever further amount might be necessary to pay for the inventory. The commission when invited by the Common Council to accept this offer refused to do so, presenting as its final excuse after much verbiage, the statement that it did not think the public interest would be served at this time by the making of such an inventory. We cannot conceive what interest, public or otherwise, can be served by the concealment of the value of a public property. If it were the act of office holders concealing graft or malfeasance, comprehension would be easy; but that men notably above suspicion should have reason for concealing the condition of a public property in their care is a thing passing all understanding.

In the introductory pages of the report the commission takes a new ground in its annual argument as to the value of the plant to the City of Detroit. Incidentally, we think that the commission has been in the habit of overdoing its argument. *"Qui s'excuse s'accuse."* The new exhibit is on pages 8 and 9. It shows the total appropriations by the Board of Estimates for the construction and operation of the Public Lighting plant from the beginning until June 30, 1905, $2,172,451.80. It divides this sum by the number of arc lights operated one year during the ten-year period and arrives at the conclusion that were all the property under the control of the Public Lighting Commission obliterated, including the land on which the plant stands, the total cost to the City of Detroit from June 30, 1895, to June 30, 1905, would have been $87.63 per arc light per year. Having arrived at this conclusion the commission proceeds to compare this total cost with the prices paid in other cities and the prices paid more than ten years ago for the lighting of Detroit streets by contract.

It is characteristic of the commission's position that it does not take the opportunity to make comparison with the cost of arc lights furnished by private companies during the ten-year period in the City of Detroit or in villages adjacent to the city. It does make comparison with a bid made for a Detroit ten-year contract more than twelve years ago, but omits to recall that the City of Detroit could not lawfully have accepted that bid, even had a corrupt council been willing to do so; and also omits to say that at any of the legal three-year contract periods since the beginning of the 12 years the city could have obtained contract lighting on much lower terms.

It is even more characteristic of the Detroit Public Lighting Commission's peculiar point of view that it forgets to include in its statement of total cost of the plant an item of $281,000 interest. It has been explained to the critic many times that the Public Lighting Commission does not pay this interest, but that the city treasurer does. That does not alter the fact that the interest is part of the total cost of the plant, and it does not warrant the Public Lighting Commission, over the signature of its president, in stating that the total cost of the plant was a certain amount when the true total cost has been $281,000 greater. We do not believe that any one of the gentlemen of the Public Lighting Commission of the City of Detroit would wilfully omit interest from a statement of his own business prepared for a commercial agency or for a bank, or from the annual report of a corporation of which he was a director. For that matter, we do not believe that any of the commissioners would operate his individual business for ten years without making inventory of his machinery and stock. We cannot comprehend why business men should cease to be business men when they become Public Lighting Commissioners, and we ask our readers to remember in contemplating this mystery that these Detroit gentlemen are not practical politicians, nor "grafters," but are unpaid commissioners working only for the credit and good of their city. How the credit and good of their city can be served by their forgetting essential truths in the preparation of their annual report is a mystery.

If we add the forgotten $281,000 to the commission's exhibit of cost it adds to their resultant figure of $87.63 per arc light per year, another $11.34, making the correct figure $98.97. If this be done the commission's exhibit must be accepted; but after all it is only a *tour de force* and the result is of no value to those of us who have occasion to study real costs. To make it of value it will be necessary to prepare that evaded inventory of the property and to deduct from the foregoing $98.97, a figure which would be the quotient of the inventory value using the total arc-lamp-years as a divisor. Seeing that guesses at the value of the Public Lighting property of Detroit are in order—for the book valuation by the commission is neither more nor less than a guess—we submit our guess as $581,817, and the resultant of this is an annual cost, calculated by the new method evolved by the Public Lighting Commission, of $65.50. To this we must now add the item of taxes lost by the city in that its municipally-owned plant is not taxable, while a similar plant owned by private parties would be taxed. It is to the credit of the commission that it makes some allowance for this in all its regular statements. It is our remembrance that in an earlier report the commission stated that its property had been assessed at its request by the tax assessors, but in later years the commission seems to have guessed at its own assessment. According to the commission's reckoning the item of lost taxes would be about $2.50 per lamp per year. It rather startles us to note that while the commission flatly states the present value of its property as $872,726 it estimates its assessible value as $500,000. After ourselves guessing the value we are not fairly permitted to challenge the commission's alternative guess. We feel rather disposed to think that in assessing the property at $500,000 the commission meant the public to conclude that the value lay somewhere between that and the preceding inflated statement. And the final of all this figuring is that arc lights for ten years past have cost Detroit $68 per year.

Besides this extraordinary exhibit the commission presents its customary calculation of cost. This calculation includes interest, lost taxes and the 3 per cent allowance for depreciation. This year it works out as $59.34 per lamp. We are not willing to accept the commission's depreciation estimate, but the additional allowance for discarded machinery during the present year entitles the commission's figures to more than customary credence. We trust that we shall be able, as a result of the commission's complete recognition of depreciation of its property, to give to the corresponding figure of the eleventh or twelfth annual report the entire credence to which the personal standing of the commission would then entitle it.

An amusing paragraph on page 11 deserves notice. It is the answer of the commission to *"unjust and uncalled-for attacks on the Public Lighting plant by private lighting interests here and elsewhere."* The commission says that the persons who were responsible for these attacks had been led to believe that the commissioners favored going into the business of private lighting, whereas the contrary is the fact. We do not at the moment remember personally any unjust or uncalled-for attacks on the commission during the past year, although we have seen criticisms which erred as far on one side of the line of exactitude as the commission's reports usually err on the other. The reports have usually provoked the criticism and it is eminently proper that in this case the criticism should provoke the report. But the commission does not come before the public with clean hands. It in this report repudiates any desire on the part of its members to go into the business of private lighting, but there are earlier reports in existence perchance prepared by earlier commissioners. In the seventh annual report, page 10, we have two paragraphs setting forth the great success elsewhere of municipal enterprises and ending as follows: "Were we allowed to do this work (i. e., private lighting) and charge the going price per kilowatt we could light the city for nothing and have a handsome balance in our treasury at the end of the year. If the citizens of Detroit were fully aware of the delights and comforts they have within their grasp from their Public Lighting plant I think they would insist that it be allowed to serve them."

The commission can hardly repudiate its seventh annual report unless it proposes to repudiate as individuals the former member or members who prepared that report. If we recall the tenor of the Detroit newspaper articles furnished by our press clipping bureau the commissioners were quoted within the past year as strong proponents of the performance of private lighting by the public plant. We conclude that this plea of "Not Guilty" is entered on behalf of the six members now forming the commission and represents a change of heart on the part of those who were included in the membership during the seventh year. On this we felicitate these gentlemen; and we congratulate the commission as a whole on its official recantation of its former error.

The foregoing criticism has been prepared with reference to the documents in the case, and without a simultaneous inspection of the property. From several sources there come to us tales to the effect that the lighting service given by the commission is worse now than ever before, and that the plant, particularly the pole line, has been positively neglected. From press clippings we gather that blame has been laid on the plant for a recent fatal accident because of the alleged dangerous condition of the overhead wires. These are matters which require before they are made the basis of any adverse comment, a more careful inspection and report than is at present time available for our use.

Meeting of the New York Magnetic Club.

The New York Magnetic Club held its fall dinner at the Hoffman House, New York, on the evening of November 15, over 200 members and guests being present. The handsome banquet hall was tastefully decorated with American flags, and this, together with the effective electric illumination of the room, presented an attractive scene.

Delegates to the meeting of the Telegraphers' Mutual Benefit Association, which was held in the afternoon, were guests of the club, and altogether a very enjoyable evening was spent. Col. A. B. Chandler, president of the club, presided, and at the table with him were several prominent officials of both the telegraph companies. Among others present were Prof. Samuel Sheldon, T. D. Lockwood, Stephen D. Field, Ralph W. Pope, Henry W. Pope, H. L. Shippy, F. W. Jones, A. G. Mills, Dr. A. S. McAllister and many others well known in the different branches of electrical activity.

An excellent dinner was served, this being accompanied by instrumental and vocal music. A quartette of Mexican troubadours, dressed in native costume, was a feature of the entertainment. After the dinner, speeches were interspersed with the musical and other parts. The presence of the "sacred three," which title has been applied to A. B. Chandler, D. H. Bates and C. A. Tinker, the three cipher telegraphers during the Civil War, was noted and commented on.

Graphitizing Filament Patents Expired.

By Edward P. Thompson.

To show that manufacturers of incandescent electric lamps are free to make graphitized or so-called metallized filaments without danger of infringing any patent, comparative quotations are submitted below and taken respectively from Mr. John W. Howell's Institute paper of last June, and from expired patents granted to me in 1887, Nos. 370,992 and 370,995, sold to the Westinghouse Electric & Manufacturing Company, in 1889.

From the Institute paper: "To produce the effects described in this paper, the heat is externally applied to treated filaments at atmospheric pressures." From one of my patents: "To raise them," the filaments, "to a sufficient temperature to cause them to break." Again, "Surround it," the filament, "with an atmosphere of hydrocarbon" at or below or above atmospheric pressures, "then subjecting it to heat by passing a current through it, and while thus heated, causing it to break at a predetermined point," thereby insuring a long filament to break at such a point by the high temperature, as to leave the filament still long enough for the lamp. The patents show also the heating to only approximately the point of rupture. To allow a long enough time for the permanent set or transformation to take place, which is doubtless a kind of cooking or chemical process, the approximate breaking temperature may be maintained a few minutes in an inert atmosphere or vacuum, instead of in hydrocarbon vapor. One of my patents reads: "Heating a filament to approximately its point of rupture during the latter part of the process of evacuation." This approximation was arrived at by noting on the ammeter the breaking current of several filaments successively, and then limiting the permanent set current to a little less than this maximum. Occasionally it was necessary to discard a filament which broke at this limit. In the Institute paper there is, therefore, no novelty in not letting the filament break; besides, in the electric furnace the heat of 3,700° would evacuate the porous space in the carbon powder around the filaments. The air is highly rarefied in such a furnace, or else the filaments would burn up instantly. By my process of heating by electric current, the inert atmosphere around the filament may be under high pressure if preferred, which is not possible in an electric resistance furnace.

From the Institute paper: "The temperature was usually between 3,000 and 3,700° C." From one of my patents: "And purposely causing them to break by reason of such temperature." The paper mentions no such intense heating as to cause the filament to melt into two parts. No higher temperature can be imagined than that which will actually rupture the filament in the absence of oxygen.

So much for the invention itself. Now for the effects:

From the paper: "Its changed nature is also indicated by its toughness and flexibility." From one of my patents: "The carbon thus treated is also found capable of being bent and strained with less liability to break."

From the paper: "Metallized filaments blacken the bulb very much less than ordinary filaments." From one of my patents: "It also throws off less carbon and thus prevents the interior of the globes from becoming so quickly blackened."

From the paper: "Metallized filaments, as thus described, are much more stable at high temperatures than ordinary carbon filaments." From one of my patents: "Having once been broken in this manner —subsequently, the filament will not be broken except by an application of an equal amount of heat," other things, of course, remaining the same. Also, "a filament which has thus been raised to a high heat, is capable of greater endurance than those which have been treated at a moderate temperature."

From the paper: "Its graphite coating looks as though it had been melted." From one of my patents: "The extreme temperature . . . . causes the carbon to pass through a viscous state." It was this feature that led me to the discovery. In experimenting on filaments at a high temperature, higher than what had been suggested at that early date, eighteen years and more ago, I found that a carbon filament would bend of its own weight, by becoming, of course, viscous. I then decided that to expose filaments purposely to high temperatures, would have the same effect upon them as to heat scraps of metal until all the small pieces fused into a solid mass.

From the paper: "Its specific gravity is also much higher than it was before heating." From one of my patents: "And when it cools, it is more dense."

From the paper: "They have been given the name 'metallized filaments.'" From one of my patents: "Producing a permanent set of the molecules in a filament," like steel, which as well known, may be given a permanent set.

From the paper: "The conclusion that the effect is produced by material being driven out." From one of my patents: "The extreme temperature to which the filament is subjected drives off every particle of gas from the carbon."

From the paper: "Curve No. 5, 200 per cent of normal pressure, or at 280 candles, for a 16-cp lamp. Curve No. 6, is the curve of a filament heated hotter than No. 5. The temperature was not measured by this method *for fear of breaking the lamp.*" From one of my patents: Purposely causing them to break by reason of such temperature. "Therefore the temperature in my experiments and in the treatment of actual carbons, was of course, very much higher, as a new treated carbon filament will not break as soon as an older filament."

From the paper: "This high temperature treatment of the base," meaning the bare carbon, "is, however, a beneficial step in the process here described." My patents show intense heating of either a bare carbon, a treated carbon, and also heating to softness a treated carbon in hydrocarbon, and then the same filament again, while exhausting, the break being so managed as not to spoil the filament."

The only difference consists in different kinds of electric furnaces being used. To change the source of heat is probably not patentable, and has not been patented to the time of writing. Dr. W. R. Whitney deserves credit for being the first on record to measure the increased efficiency of filaments exposed to extreme temperatures.

United States vs. German Patent Office Practice.

In the communication printed in these columns last week entitled "American Inventors in the German Patent Office," President Hauss referred to a report by Consul-General Frank H. Mason on United States vs. German Patent Office Practice, and urgently recommended the reading of this report by those who believe they have reason for complaint concerning the treatment of their German patent applications. The report of Consul-General Mason thus referred to is reported below:

It is a matter of common knowledge among inventors and others who are interested in patent law practice that, while the United States and Germany are by common consent the two countries in which inventions are most intelligently and thoroughly examined and in which, therefore, a patent once obtained is most valuable, there are certain radical differences in the methods of the patent offices at Washington and Berlin which, being often misunderstood, lead to disappointments, recriminations, and litigation whch more exact knowledge mght have averted.

It is not uncommon to hear American and other foreign inventors complain of a hostile and forbidding attitude on the part of the examiners at the German patent office, as though the duty of the latter were to assume that every invention presented for a patent is defective or plagiarized until the contrary is proven—in other words, to discourage rather than encourage the protection of meritorious inventions by patent. It requires but slight experience in such matters to show that in many, if not a majority, of the cases the troubles of American inventors at the German patent office are due to their failure to realize the difference in the two systems of application, by reason of which an application which would be correct at Washingtou would inevitably fail at Berlin for informalities which any clerk in a patent lawyer's office should recognize and be able to correct. It is beyond the scope of a consular report to enter exhaustively into this subject, but a few of the more obvious differences may be cited as illustrative examples.

In the first place, a foreign inventor may not deal directly with the imperial German patent office. He must be represented here by a patent attorney of recognized standing, by whom the application and specifications are presented, and through whom additional details or explanations may be asked for by the examiners. This does not mean, however, that the foreign inventor need necessarily send his application through a long international chain of offices, which may not infrequently involve needless delay and expenses. There is kept at the German patent office a list of recognized patent attorneys who are located in Berlin and throughout the Empire.

Secondly, specifications and claims for patents on American inventions are frequently presented in the form of translations made by persons who have only an acquired and superficial knowledge of German. Such translations, made with the aid of a dictionary, mechanically translate the words, and not the meaning, of important phrases, so that the specifications and clauses as filed are often incomprehensible. This entails additional correspondence, corrections, and frequently long delays which might have been obviated. Few persons, comparatively, are capable of translating a technical description so that it shall mean exactly the same in a foreign language as in the original, and it is this want of exact completeness that often loses a foreign patent or renders it, if gained, loose in its provisions and impaired in value.

Many inventors and even some attorneys in the United States seem not to understand that section 2 of the German patent law prescribes that an application for a patent in this country must be filed (1) before the invention has been disclosed in any generally accessible publication during the past hundred years and (2) before it has been so publicly used or exhibited in Germany that anybody skilled in the art to which it relates could carry out and utilize the invention.

This differs radically from the provision of section 4886 of the United States statute, as revised February 9, 1897, which allows the first inventor to obtain a patent on his invention even after it has been made known (except by previous patent, in which case the application must be filed within seven months after the date of the application for said previous patent), provided he files his application within two years from the time when the invention was first publicly disclosed. A want of exact knowledge concerning this variation between the practice of the two countries leads to the presentation of American claims in Germany which can not be granted, because the antecedent record of the invention in respect to publicity is in violation of the German law.

But the chief difficulty, upon which more hopes are wrecked than any other, is the radically different views taken by the American and German authorities as to what constitutes a single patentable invention. This difficulty is more especially obvious and serious in the case of a machine composed of a number of parts, on each of which priority of invention is claimed. Patents are granted in the United States for new constructions and combinations which in Germany would be required by section 20 of the imperial patent law to be divided and covered by several different patents. Consequently, applications are often received here which, being substantially translations of specifications prepared for use at Washington, have to be rewritten and divided into two or more individual applications before any examination can take place. This, of course, entails delay, expense, and introduces a new element of uncertainty into the case, since one or more of such separate claims, which are all covered by one American patent, may be rejected by the German examiners.

As an example of this fundamental variation in practice may be cited the sample specifications and claims on improvements in a meat-chopping machine which is given in the rules of practice published by the United States Patent Office. The preamble states as follows the three objects to be obtained by the invention, viz:

(1) To provide a continuously lubricated bearing for the chopping block;

(2) To afford facilities for the proper adjustment of the knives independently of each other in respect to the face of the block; and

(3) To reduce the friction of the reciprocating rod, which carries the knives.

Then follow the four claims setting forth the separate elements of the machine by which these three problems are solved, and protection is afforded for the elements in the combinations by which the desired results are reached. To facilitate the reference, the exact wording of the clause is herewith given:

(1) The combination, in a meat-chopping machine, of a rotary chopping block having an annular rib, with a table having an annular recess and a pocket communicating with the said recess, all substantially as set forth.

(2) In a meat-chopping machine, the combination of a rotary chopping block with a reciprocating crosshead carrying knives, each of which is vertically adjustable on the said crosshead independently of the other, substantially as described.

(3) The knife *d*, having two screw rods, *m m*, attached to its back, substantially as shown, for the purpose specified.

(4) The combination, in a meat-chopping machine, of the reciprocating rod, carrying the knives, the crosshead secured to the said rod, and having anti-friction rollers, with guides, adapted to the said rollers, all substantially as set forth.

Now, a German patent claim is what is known in American practice as "functional." It provides protection for the means employed in the solution of a problem, and characterizes the different elements by which the solution is obtained by their functions, instead of by their arrangement and combination. For instance, claim 1 of the foregoing series would need to be rewritten for the German examiners into a form substantially as follows, which would of course be expressed in clear, idiomatic German:

A meat-chopping machine, in which vertically reciprocating knives operate in conjunction with a rotating chopping block, characterized by the fact that a rib provided on the under side of the rotating chopping block moves in an annular groove provided in a table and connected with a depression or recess filled with oil, for the purpose of sufficiently lubricating the block.

If such a claim were accepted in Germany as the first or principal claim, all the other claims in the same application would have to fall within its scope—that is, assist in obtaining the same end as is obtained by the first claim. But it is inadmissible in Germany to introduce the solution of a new problem in the second or following claims, so that in the instance above recited from the rules of practice, the second claim, which covers the combination of elements for obtaining the second object stated in the preamble, could not be included in the same German application as the claim 1, above quoted, because it relates to a different problem, or, in other words, is based on another and independent inventive idea.

It is impracticable within present limits to follow the comparison through in all its details, but it will be sufficient to say that these claims and specifications, covering three independent improvements on a known machine, and which can legally be covered by a single patent in the United States, would require three separate patents in Germany.

Each claim in the United States must be complete in itself, which not only means that no reference may be made from one claim to another, but also that each claim must cover a combination quite separate from and independent of the other claims.

Quite the opposite is the case in Germany. Here, the first claim is a statement of the invention, and all other claims must fall within the same scope. In this country, any number of "modifications" may be introduced in the subsidiary claims, while in the United States "alternative constructions" are inadmissible, and subject-matters introduced as "modifications," in subsidiary claims in Germany can only be properly claimed in the United States as new combinations, quite separate from and independent of the other claims.

Still another source of error is the lettering of drawings which accompany applications for German patents on inventions which have already been patented in the United States. In most cases the preamble, specifications, and claims are translations of the English text, in which a lever, for instance, is designated by *L*, a crank by *C*, a pinion by *P*, and so on. As the German rule requires that the first reference letter alluded to in the text must be *A*, the second *B*, and so on throughout, it is plain that the English initial letters, when fitted into a German translation in which lever is rendered by "Hebel," a crank by "Kurbel," etc., would not only be misleading, but meaningless.

An American inventor, who has had long experience in securing foreign patents for his inventions, gives it as his opinion that—

Two-thirds of the first rejections of American applications for German patents and the failures of American inventors to secure prompt attention and early issue are justified by the loose, informal manner in which they are presented, and this often by international patent attorneys of large experience and high ability, but who are prevented by the great volume of their business from giving personal and expert attention to details which they know, or ought to know, to be prescribed by law and therefore of the first importance.

The subject is one of immediate and steadily growing interest. No foreign people apply for and obtain so many patents in the United States as Germans, and in no country is it more necessary and to the advantage of American inventors to protect their inventions by patents than in Germany. A clearer and more exact understanding of the many differences in practice and theory between the two countries, of which the foregoing are typical examples, would save not only time and money, but avert friction and litigation which might well be avoided.

Investigation of Municipal Ownership.

A call has been issued by Mr. Melville E. Ingalls, chairman of the committee of twenty-one appointed to investigate municipal ownership under the auspices of the Civic Federation, for a meeting of the committee in this city on November 27. .This committee was appointed by the Public Ownership Commission organized to investigate actual conditions of municipal ownership in this country and Europe. Mr. Ingalls is chairman of the board of directors of the Big Four Railroad of Cincinnati, and the members of the committee are heads of corporations, prominent college professors, journalists, publicists, and heads of unions in trades.

A sub-committee which has for some time been engaged in preparing a report on the scope and methods of the investigation has issued the following statement: "The report provides that a considerable number of plants of varying sizes, locations, and character be first visited in the United States and a careful investigation made by expert accountants and engineers into every detail of management. Not only will the public reports be considered, but the actual working of the plant in all its phases investigated by competent and impartial men. By these means the committee will be able to acquire accurate data regarding representative plants throughout the United States and the actual results of the various forms of management obtained both for public and private operation.

"This investigation having been completed and the detail work having been put well under way, the committee will visit Europe, proceeding first to England, and later to the Continent. Expert accountants and engineers will accompany the committee or be employed by it abroad, and the same careful, thorough, and comprehensive examination made into every phase of the subject. Special topics probably will be referred to sub-committees or single members of the commission, such as the French system of granting franchises, the leasing of municipally owned works to private management, as in vogue particularly in Italy and Germany; the English method of taxing both public and private plants, the Scottish methods of limiting charges of service to actual cost, the sale of public franchises at auction, popular control of grants through the initiative and referendum, methods of settling labor questions, etc.

"The purpose of the investigation will be to determine and record the facts; opinions are to be eliminated. Every essential point will be treated and ample time allowed for the collection of data, to the satisfaction of the committee. The report of the Committee on Plan and Scope, which outlines in detail the subjects to be considered and the questions to be answered, contains about 12,000 words.

"The important points and those likely to produce the most discussion are the effects of private and municipal ownership upon municipal politics, the appointment and removal of employees, the election of city officials, municipal corruption, wages, hours and conditions of labor, strikes, collective bargaining, organization of labor, character of service rendered, cost of service, method of assessing charges, economy of management, rapidity with which improvement in service and methods has been made, the financial results, and the effect upon the debt and taxation of the city.

"The history of the municipal ownership movement will also be written, and special attention paid to the methods of granting franchises to private corporations, the practical results of the various experiments that have been tried, and the methods by which private corporations and municipalities are controlled and supervised by Governmental authorities."

◆

Building Up Central Station Business at Kansas City.

A recent interview of a representative of the Electrical World and Engineer with Mr. R. E. Richardson, manager of the Kansas City Electric Light Company, brought out some interesting and valuable points in connection with the very rapid growth of the central station business in that city since Mr. Richardson took charge of that company in 1900. This growth has been partly on account of the rapid growth of the city itself and partly because of the active efforts of the present management to give first class service, make attractive rates on a basis profitable to the company, and to push the business. Mr. Richardson sums up the whole situation in the statement: "People had always looked upon electric light as a luxury; we have brought them to consider it a necessity."

Kansas City, Missouri, with its neighbor, Kansas City, Kansas, form a community the population of which is probably now close to 300,000. The company now has seven solicitors in Kansas City, Mo., and four in Kansas City, Kansas, the latter town growing rapidly and having much manufacturing in it. Mr. Richardson lays particular stress on his policy of seeing that the customers on the electric lighting service are getting good returns for the money expended. To this ends he gives much attention to the question of illumination. He tells customers that what he wants is to give them something from which they will get returns, for he knows that any man is better satisfied to spend $100 on electric light and get his money's worth, than spend $5 and get no returns. "Kickers" who complain of the size of bills and insufficient light have their installations promptly investigated by a representative of the company, who shows them why the results are poor and what can be done to make the service more satisfactory. The company does not advertise in the daily papers. Mr. Richardson does not consider the city large enough to make this kind of advertising as effective as personal solicitation, and if advertisements are carried in one daily paper, they must be carried in all to avoid hard feeling, which involves a heavy expense.

In connection with the question of illumination, Mr. Richardson has attempted to look after customers' interests by seeing that when window lighting is attempted, it is done properly. He points out to customers that the old plan of running a string of border lights around a show window is a fine thing for the electric light company, as it advertises electric lighting, but does not advertise the goods in the window because it is so hard to see the goods past these border lights. He points out to customers that if a display of goods rather than simply a display of light is the thing wanted, lights must be concealed in reflectors at the top and sides of the window.

◆

The Patent Law Situation.

We have received the following comments from a prominent patent attorney relating to the suggestions contained in a letter by Mr. Ludwig Gutmann on "The Patent Law Situation," which appeared in the issue of August 26:

1. I take no stock in any criticisms that are made as to the competency of our Federal judges to deal with the intricacies of patent litigation. In the course of a forty-year practice I have argued patent questions before some seventy-five or eighty judges, and in all parts of the United States east of the Missouri River. Among them I have found only two whom I considered incompetent—one because he was color-blind as to mechanics generally; he was made so and couldn't help it, and the other because he was incompetent to decide anything. One is now dead, and the other resigned.

Of course, judges sometimes make mistakes; but who does not? Taking it by and large I think that our Federal judges make as few mistakes in patent cases as in any other class of cases; that is, in proportion to the amount of litigation in each.

It is also probably true that mechanical experts make quite as many mistakes as any other class of men. Certainly they differ in their opinions and conclusions quite as frequently as any, and when they differ one side or the other must be mistaken.

The Patent Office already has a quasi sort of a court, a Board of Appeals, made, theoretically at least, of three of its best experts, for the hearing of appeals from the decisions of examiners. It is a not infrequent occurrence that two of these three experts decide one way, and the third the other way.

2. Nor do I take any stock in what is said as to the persecution through unjust patent litigation, of small manufacturers, by powerful corporations. That such things are done, I do not deny; but in my observation and experience the very large majority of the persecution is the other way. It is a not-infrequent occurrence that owners of fraudulent patents bring unjust suits expressly to extort money from wealthy defendants; and also that parties with little capital and no responsibility enter a field of business wherein, under patent protection, somebody else has made a great success; then being justly enjoined, a howl is raised about persecution.

3. I regard it as unfortunate that the final decision in patent causes in the United States is divided between nine courts, even though all are competent. But even this is better than the condition of things which previously existed, and is not as bad as I feared it would be. Still one court of final authority, properly constituted, would, in my opinion, be preferable. The "Patent Court of Appeals"

bill, recently pending in Congress, though not wholly free from objection, ought to be taken up and enacted into a law.

4. Much of the evil complained of in connection with patent litigation, would be corrected by the court itself, if we had judges enough to do the work as it ought to be done. We need about fifty per cent more judges, and their pay should be doubled.

5. Mr. Gutmann's suggestions 1, 2, 3 and 4 as to the judicial use of experts, while perhaps very good in theory, is utterly impracticable. Good experts cannot be got to do judicial work so long as private practice pays so much better. It is also a fact that the best experts are either privately retained or have private interests, and therefore are not available.

6. Mr. Gutmann's 5, if I understand it, proposes to carry patent litigation into the Patent Office. This is also impracticable. The Patent Office already has more work than it can manage, and do it as it ought to be done. In fact, Patent Office work should be lessened if it were possible to do so, instead of increased. A Patent Court for litigated cases administered by the Commissioner of Patents, would very soon become a public nuisance.

Also it has been the policy of our government from its organization to keep the judiciary department entirely separate from the executive. The Patent Office belongs to the executive, and exercises no judicial functions except such as are absolutely necessary to the performance of its executive work of issuing patents. The same rule prevails in all governmental departments. After a patent is issued all questions arising thereunder go to the judiciary, and to a judiciary which is wholly independent of departmental interference or control. Congress will never agree to make it otherwise, and it is a waste of time to talk about it.

7. The same considerations apply to Mr. Gutmann's 6.

8. The 7th is all right, omitting "By the heads of departments or."

9. These are only a partial statement of the objections to Mr. Gutmann's suggestions. This whole subject has been repeatedly threshed out by the parties who know most about it; and the "Court of Patent Appeals" bill is generally regarded as the best remedy now available.

Milwaukee Street Lighting Contract.

The city council of Milwaukee is in a state of turmoil over the renewal of the contract for street lighting with the Milwaukee Electric Railway & Light Company. The municipal ownership bee is buzzing in the bonnets of some of the city fathers, which complicates and hinders the settlement of the matter. The company's contract expires December 15, and John I. Beggs, president and general manager of the company, has indicated very positively his unwillingness to continue lighting the city after that time without some kind of a contract as the city officers would have no authority to pay for light furnished without a contract. As a result of this very reasonable and natural stand, some of the more rabid aldermen are ranting about Mr. Beggs' "threats" to put the city in darkness, and one is even quoted as favoring such a state of affairs to show the people what sort of a dreadful creature Mr. Beggs is. These things are wearisome to good citizens. The city has been made an offer to light the streets for a term of years by a new corporation called the Municipal Electric Lighting Company, which proposes to establish a plant for street and commercial lighting and turn it over to the city at cost at the end of fifteen years.

Electric-Steam Competition in England.

United States Consul Murat Halstead, of Birmingham, England, in a recent report, speaks of the steam-electric traction competition in that country. He notes that the chairman of the Great Eastern Railway, at its 86th half-yearly meeting, complained of the competition of electric railways. The Great Northern seemed to have suffered more than other companies by electric street car competition. They carried 350,000 fewer passengers in York, and though they carried 400,000 more in the London district they had received less money for doing so. Of the adverse influences from which the British railways have been suffering, increased taxation demands from local authorities, war abroad, and new forms of competition, the latter the *Times* considers the most serious because in order to correct it "a graduated transformation of existing methods of haulage seems inevitable. The future is with electricity as an agent of transportation, although at present its application to long-distance traffic has not become practical. In the meantime a beginning will probably have to be made with short-distance business by providing electrical power on sections of the various systems. Several companies have been trying more or less successful experiments with motor cars on short lengths of line, a measure which may be regarded as a half-way house to the use of electricity. It seems to us that in large cities served by more than one company whose directors are turning their minds to this problem it would be well, if possible, to work together, by erecting joint power houses, the cost of supplying current on a large scale being less than when it is produced in smaller quantities. No difficulty has been found in erecting joint stations in Nottingham and elsewhere with capital guaranteed by the companies concerned, and the principle could surely be applied to joint electrical works."

The chairman, at the half-yearly meeting of the Midland Railway Company, also explained that there had been fewer short-distance passengers in consequence of electric street railway competition, which is very keen.

Electrical Engineers of the Times—XXXVII.

MR. PETER JUNKERSFELD.

Peter Junkersfeld was born October 17, 1869, near Champaign, Ill., where his boyhood was passed on a farm. He attended common school until the age of 14 and then followed an inclination which led him to engage in various mechanical pursuits. During the winter months of 1888-89 and '90 he prepared for entrance to the University of Illinois, where he matriculated in 1891 and was graduated from the electrical engineering course in 1895.

Having had some miscellaneous experience in steam engineering, refrigeration and similar work, he concluded upon graduation to complete his mechanical knowledge by engaging for a further period in practical work. He accordingly entered the employ of the Chicago Edison Company in October, 1895, beginning as machinist's helper in the Harrison Street Power Station, where he remained for two years, securing in this time an excellent practical training for his future career. In December, 1897, he entered the engineering department of the same company, becoming a draughtsman, and the following year was promoted to chief draughtsman. In 1899 he became assistant mechanical engineer, and in 1903 assumed his present position of head of the engineering department of the Chicago Edison and Commonwealth Electric Companies.

MR. P. JUNKERSFELD.

As will be seen from the above, Mr. Junkersfeld in the past ten years has had opportunity to study the engineering and operating sides of central station work in every detail, and during the past eight years he has been closely identified with all the engineering and construction work of the Chicago central station system.

The Chicago Edison Company was one of the first central-station companies to install rotary converters, centralize its principal generating equipment and thus effect an economy which made possible its great increase of service in the business and central districts of the city, to which territory this company is limited. The outlying districts of Chicago were formerly supplied by a large number of small companies operating systems of several different voltages and frequencies. The amalgamation of these small companies resulted in the organization of the Commonwealth Electric Company, which in 1899 built the 56th Street Station and standardized the entire distribution for all of the outlying districts of the city and making the first extensive application of the four-wire three-phase, 60-cycle system of primary distribution.

The affiliation of the Edison and the Commonwealth companies led to the further concentration of the generation of electrical energy for lighting and general power purposes for the entire city of Chicago, and included the development of an extensive 25-cycle transmission system with many sub-stations for railway as well as for general work, and recently the erection of the well-known Fisk Street Turbine Station. In all of the engineering work connected with this development, Mr. Junkersfeld took a leading part.

As a result of this experience, Mr. Junkersfeld has made special reports on several central station problems, one of the most important being his connection with an investigation and report on the central-station systems of St. Louis. The recommendations then made are the basis of the extensive reconstruction work still under way in that city.

Mr. Junkersfeld is an associate member of the American Institue of Electrical Engineers and also a member of the Western Society of Engineers. He has presented papers before both of these societies and also before the Association of Edison Illuminating Companies.

◆

Radioactive Water.

At the recent annual meeting of the American Electrotherapeutic Association, Dr. W. J. Morton presented a paper giving the result of investigations having in view to render water radioactive. While pointing out that in a number of cases water has been found radioactive in a natural state, no success had been met with in imparting artificially this property to water. Dr. Morton, however, succeeded in doing so by immersing powdered pitchblende in water. The paper includes two tests made at Columbia University by Dr. George B. Pegram and Mr. L. D. Case, which showed that the water thus prepared by Dr. Morton possessed the radioactive properties of the three elements: radium, thorium and actinium. There was but a slight decrease in the activity of the water when the bottle containing it was tightly corked, but any left standing in open containers lost its activity after several hours. Water contained in a bottle also lost its activity upon boiling.

Among the conclusions drawn from the tests were that the activity of radioactive water, unlike that of radioactive solids, is independent of the weight, and that the activity increases with the amount of free surface exposed. In his paper Dr. Morton points out what curative properties may reside in radioactive water. In general it has an active tonic effect, produces a regular action of the bowels, and has a special action on cancer, external and internal. An account is given of a case of rodent ulcer on the right cheek which was rapidly cured by a doseage of radioactive water and quinine, 5 grains daily.

◆

CURRENT NEWS AND NOTES.

TOLEDO (OHIO) MUNICIPAL PLANT.—At Toledo, Ohio, during the recent election, the proposition to bond the city for $470,000 for a municipal lighting plant was lost by 195. There were 15,215 votes cast for it and 7,901 against, a total of 23,116. To carry a two-thirds vote, or 15,410, would have been necessary.

TELEPHONY IN PHILADELPHIA.—One of the cities gaining rapidly in telephonic facilities is Philadelphia. In spite of the fact that there is an active opposition independent company, the Bell system gained 5,378 instruments in October, has increased 31,582 since January, and has now connected 114,079. This is not far from the figures of Chicago.

WIRELESS TO PORTO RICO.—A dispatch from San Juan, Porto Rico, states that the De Forest wireless station there on November 18 received the first complete message from Key West. This, the dispatch adds, is a record distance for wireless transmission, and assures the success of the station established at Porto Rico by the Navy Department.

N. E. L. A.—President Blood of the National Electric Light Association has reappointed the committee on Rates and Costs which made report to the Denver convention. The committee consists of Messrs. Charles L. Edgar, chairman; Louis A. Ferguson, Samuel Scovil, Frank W. Frueauff, P. G. Gossler and R. S. Hale. Mr. Geo. W. Brine, who was a member of the committee last year, declines on account of illness to serve again this year.

CHICAGO A. I. E. E.—Mr. Kempster B. Miller gave a talk illustrated with stereopticon views before the Chicago Branch of the A. I. E. E. November 14, on "Fire Alarm Telegraph Systems in Great Cities," describing especially the fearful and wonderful condition of the fire alarm system of New York City, which he spent the greater part of the past summer investigating. An abstract of his report on this subject was published in the ELECTRICAL WORLD AND ENGINEER of October 14, 1905.

OUTPUT OF CURTIS TURBINES.—In a paper read last week before the annual meeting of the Society of Naval Architects and Marine Engineers on the "Marine Applications of the Curtis Steam Turbine," Mr. Charles G. Curtis stated that the total number of turbine units thus far shipped by the General Electric Company is about 290, and that 200 are now on order. The units vary in capacity from 15 kw to 8,000 kw, more than 60 per cent ranging from 500 to 8,000 kw.

TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION—The 39th annual meeting of the Telegraphers' Mutual Benefit Association was held in New York on the afternoon of November 15. The report of President Belvidere Brooks showed the association to be in a prosperous condition. The sum of $20,000 was carried to the reserve fund last year, the fund now amounting to $247,941.71. Mr. Brooks was re-elected president; W. H. Young, first vice-president; Charles P. Bruch, second vice-president; M. J. O'Leary, secretary; and A. R. Brewer, treasurer.

SEVEN HUNDRED MILES TRANSMISSION.—Mr. Ralph D. Mershon has been retained by the African Concessions Syndicate, Limited, of London, in connection with the proposed development of power at Victoria Falls on the Zambesi River, Rhodesia, South Africa, and its transmission to Johannesburg and the Witwatersrand, for use in connection with gold mining. The distance of transmission will be about 700 miles. Mr. Mershon has just returned from a flying trip to Europe, made for the purpose of consultation relative to this enterprise.

STIMULATING PLANT LIFE.—It is proposed by the U. S. Department of Agriculture to test the effect of electricity on plant life and growth. A laboratory is being equipped in the division of pathology to conduct experiments in the growing of plants by the aid of an electric appliance. The experiments will be based on the theory that the growth of vegetable matter, which ceases at sundown, will continue through the night if proper artificial light is supplied to stimulate the developing powers of plants. Experiments will be made largely on lettuce, which has been found peculiarly susceptible to electrical influences. The plants will be kept under a strong light during the night, with a view to having the electrical rays take the place of the sun. It will probably take a year or more before actual results are obtained from the experiments.

LECTURES AT THE UNIVERSITY OF MINNESOTA.—Mr. E. P. Burch is giving a course of four lectures on "Heavy Electric Railroad Work" before the Senior engineers at the University of Minnesota. The subjects of the several lectures are: "The Physical and Financial Advantages of Electric Traction for Heavy Railway Work"; "The Speed-torque Characteristics of Steam Locomotives"; "The Speed-torque Characteristics of Electric Locomotives," and "The Physical Data for the Electrical Equipment for Operating a Division of a Transcontinental Railway." These lectures, which supplement the regular class room course in electric railways, are based upon the investigations made by Mr. Burch for some of the Western railway companies which are considering the feasibility and desirability of electric traction upon certain divisions of their main lines.

LONDON POWER PLANT.—A cable dispatch from London of November 14 says: "The London County Council this evening decided to introduce a bill in Parliament under which the Council will construct a plant to supply all the electric energy for London and the suburbs. The cost is estimated at $40,000,000."

TELEGRAPH WIRES UNDERGROUND.—It is stated from Philadelphia that the Pennsylvania Railroad has drafted plans for placing its telegraph lines underground. The first conduit will be laid between that city and Lancaster. The next work will be on the trunk lines between Philadelphia and New York, where much trouble has been experienced from wind and snow every winter. The line between Philadelphia and Washington will be taken up as soon as the New York division is finished. Inasmuch as the Postal Telegraph Company parallels the Pennsylvania system east of Pittsburg and Erie, it will co-operate in the tests.

POOR'S MANUAL FOR 1905.—The thirty-eighth annual number has been issued, for 1905, of that valuable standard publication, *Poor's Manual*. It contains the statements of all the steam railroads in the United States and Canada and of the principal roads in Mexico, the statements of all the street railway and traction companies in the United States, the statements of the leading industrial corporations and organizations auxiliary to railroad interests, and statements showing the finances and resources of the United States, the several States, and the principal towns and cities in the country. For reference purposes this statistical compendium cannot be excelled. There are 1,620 pages.

NEW YORK STATE LIGHTING.—Reports received by the State Commission of Gas and Electricity show that municipal lighting plants are maintained in Herkimer, Hamilton, Skaneateles, Boonville, Westfield, Mohawk, Ilion, Holley, Dunkirk, Cape Vincent, Spencerport and Dryden. Green Island also has its own lighting plant and supplies the village of Waterford. The commission is making a canvas of the gas and electric light and power companies of the State, and each company, municipality and individual engaged in the business of furnishing gas or electricity for light or power is asked to give certain details of stock and bond issues, amount invested in the plant and capacity and price charged for public and private lighting and power purposes. About 150 reports have been received.

TELEPHONY IN DETROIT.—The City of Detroit has had a lively experience with rival telephone systems, and after successive consolidations the same old question of a new company is up again. There is considerable diversity of opinion locally on the subject. "In my opinion, the new system will never be built," said C. F. Bielman, president of the Board of Commerce. "Detroit does not need two telephones half as much as it needs two street railways or two water works plants. We are fond of municipal luxuries in Detroit, but we cannot stand too many of the unnecessary things. I do not believe that the administration nor the people of this city will permit any local or foreign corporation to impose a new telephone plant upon us, string wires, erect poles and tear up our streets. We can take care of ourselves against any local corporation."

HEATING A MAN-OF-WAR.—The night of the recent ball on the British cruiser *Drake* in the Hudson River was bitterly cold, and attempts were made to heat the ship with hot shot in cauldrons of sand. Nobody seems to have thought of putting electric heaters into circuit with the ship's plant, instead of some of the superabundant lights. Dr. Park Benjamin, in a letter to the newspapers, remarks: "What a pity it is that Rear Admiral Battenberg's ball should have been marred, as it was, by the cold, merely because his advisers here failed to discover that abundant electric heaters were available and that a branch from the nearest electric main, which the electric lighting company could have provided, would have given all the current needed to make the ship comfortable. It was found entirely practicable recently to heat temporarily in this way the wide piazza over 100 ft. in length of a residence located in the northern part of this State during extremely cold weather in mid-winter. No request appears to have been made of the electric lighting people to deal with the easily met conditions existing on the *Drake*, although it was known here long ago that this ball was contemplated, and cold snaps in November are certainly to be expected."

ALL TRUSTS BANNED.—At St. Louis on November 16, at the session of the Citizens' Industrial Association of America, resolutions were adopted expressing approval of the investigations and prosecutions by Federal and State authorities of certain great trusts of capital, and also expressing the belief that certain associations of organized labor, or labor trusts, also should be investigated, and, if found to be illegal, prosecuted also. The association reaffirmed these principles: (1) The open shop, demanding only good faith and fair dealing; it discriminates against neither union nor non-union labor. (2) The freedom of the apprentice and the right of the individual to have a trade and to follow it. (3) The right of private contract, with equal obligation upon employes and employe. (4) The right to work, limiting the hours of labor, whether of brains or of the hand, is a matter of mutual agreement, not a subject for arbitrary legislative enactment. (5) The enforcement of the law. The election of officers resulted as follows: President, C. W. Post, Battle Creek, Mich.; first vice-president, J. W. Van Cleave, St. Louis; second vice-president, F. C. Nunemacher, Louisville; third vice-president, A. C. Marshall, Dayton, Ohio; secretary and treasurer, Major A. C. Rosencranz, Evansville, Ind.

CARNEGIE TEACHERS' FOUNDATION.—A meeting was held last week of college presidents from fourteen States and the Dominion of Canada, at the house of Mr. Andrew Carnegie in New York, to determine conditions for the Carnegie Foundation of $10,000,000 for the support of superannuated, retired and disabled teachers of the universities, colleges and technical schools. The available income will be about $500,000. There are already hundreds of applicants. The trustees elected President Eliot, of Harvard, as chairman of the Board of Directors, and President Harper, of the University of Chicago, as vice-chairman. President Thwing, of the Western Reserve University, was chosen secretary. It was decided that the home office of the foundation corporation should be in New York City. It was determined by a unanimous vote to leave the active management of the fund to an executive committee, with the president of the Board of Trustees as ex-officio chairman. President Henry S. Pritchett, of the Massachusetts Institute of Technology, was elected as the chief executive, and the executive committee was named to consist of President Nicholas Murray Butler, of Columbia; President Woodrow Wilson, of Princeton; Provost Charles C. Harrison, of the University of Pennsylvania; President Alexander C. Humphreys, of Stevens Institute; Frank A. Vanderlip, vice-president of the City Bank, and Robert A. Franks, president of the Hudson Trust Company, of Hoboken, who is Mr. Carnegie's private banker. T. Morris Carnegie was named as treasurer.

MARCONI AND ITALY.—It is stated that owing to a recent agitation in some of the opposition papers of the Italian press against the contract between the Italian Government and Mr. Marconi, which grants an exclusive license to the Marconi wireless telegraph system for fourteen years, Mr. Marconi has written to the Italian Minister of Posts and Telegraphs offering to consider the agreement as cancelled, thus relieving the Italian Government of all obligations. A translation of the reply of Minister Morelli Gualtierotti is as follows: "The tenders for work at the Coltano Station will be invited at Pisa on October 18. The ministry, in thus putting into execution the bill twice approved by parliament, is also convinced of the value of the conditions entered into and also grateful to the illustrious Italian who generously conceded to his country the use, without compensation, of the extraordinary fruits of his genius. I beg you not to concern yourself about any discordant opinion, which certainly does not reflect either the feeling of the country or that of the government." This reply confirms the policy of the Italian Government in adopting wireless telegraphy and refusing to permit compulsory exchange of messages between it and other systems. As compulsory intercommunication was the main point raised during the preliminary wireless telegraph conference held in Berlin two years ago at the instigation of the Kaiser, the strong attitude persisted in by the Italian Government will have a most important effect on the deliberation of the next conference, which, it is rumored, will be held at Paris. The Italian government has had the largest practical experience with wireless telegraphy and its renewed decision in favor of a single system will, it is claimed, carry exceptional weight and may influence the attitude of our own and other governments.

JERSEY UNDERGROUND ROAD.—A new project is an underground electric railway to be constructed from Jersey City to Newark, 8½ miles long, and tunneling the Passaic River. The road, if built, will start in Jersey City on the Pennsylvania Railroad property, and pass through Kearney and Harrison.

ELECTRIC COOKING IN FLATS.—It is stated that in some new apartments, or flats, in London, to be built on the site of Gloucester House, the town residence of the late Duke of Cambridge, all the cooking and heating is to be done by means of electricity. Why does not some enterprising apartment builder in New York try this plan?

NEW SHANGHAI CABLE.—A cable has just been completed by the German Dutch Company between Guam, Yap and Shanghai, connecting at the first island with the Commercial Pacific cable system. The new cable obviates the use of the route via Manila for messages from this country to China points and affords direct communication with Shanghai.

HIPPODROME LIGHTING.—A new spectacular piece at the New York Hippodrome is to be called "A Society Circus." The climax will present a lake into which many fountains will play. Four hundred thousand candle-power of electric light will be used for illumination. Two dolphins with 20-ft. tails, conch shells, mermaids, griffins, and an 80-ft. serpent are among properties to be employed. Four searchlights will be used.

ITALIAN ELECTRIC RAILWAYS.—A new company under the name "Officine Elettro-Ferroviarie" has been organized in Milan, Italy, with 1,500,000 francs capital, which is to be increased to 4,000,000 francs. Its purpose is to manufacture cars for steam and electric railways, also electrical machinery. Dr. George Finzi, well known in the field of single-phase railways, has been elected general manager, and Messrs. Hugo and Emil Tallero are superintending engineers.

CANADIAN MUNICIPAL RAILWAY.—A Canadian correspondent says that the city council of Guelph, Ont., a couple of years ago, undertook to run the street railway as a municipal venture and, although it is a city of 13,000 in population, it claims to have made a success of the enterprise. Last year there was an apparent profit of $2,000. The street railway is managed by a commission of five members, consisting of the Mayor, one alderman and three private citizens. These serve without salary and are chosen annually. Under them is a general manager, who receives a salary of $1,000 per annum for his services.

WIRELESS TO DETECT ORES.—Articles of incorporation have been filed at the office of the Secretary of State of Colorado for the Syntonic Wireless Engineering and Mining Company. The company is capitalized at $50,000, and will have its headquarters in Boulder. The company will try a new system of finding precious metals. A machine, from which the company takes its name, has been invented by A. W. Hunter, of Boulder, who says that it will locate bodies of ore. "The machine is electrical, but does not depend upon wires, being like a wireless telegraph instrument." When taken into a mine, it is said, the indicator will show the location of ore, as well as measuring its distance.

SINGLE-PHASE WORK.—With regard to its single-phase electric railway work in Europe, the Allgemeine Elektricitäts Gesellschaft, of Berlin, furnishes the following list of work that it has carried out or has now in execution: "Spindlersfeld, 5 110-hp motors, total 550 hp; Swedish State Railways, 5 110-hp motors, total 550 hp; Hamburg City & Interurban Railway, 161 115-hp motors, total 18,515 hp; compressor motors for the foregoing installations, 57 3-hp motors, total 171; Stubaitalbahn, 20 40-hp motors, total 800 hp; Borinage, 40 40-hp motors, total 1,600; mining locomotives for the Menzel shaft, 3 40-hp motors, total 120 hp, making a total of 22,306 hp of single-phase motors." It was probably not suspected that anything like this record had already been attained.

POWER PLANT PHONETICS.—An electrical engineer inquiring by circular letter recently as to the facilities for charging electric automobiles in the country districts of Michigan, received a reply from the manager of a combined electric light plant and grist mill. It is given herewith *verb. et lit*: "Your lader datat Oct. 31st razivet. Yu wont to no abaut charging storage batteries for Automobile. I harv gat hiar 220 Volts Deract Cornt marchian I am nat fitad op yat to du dat. I dink it kan bi don by a wari lidle xpans to du dat I wold haf to harv the apratos to konact op and cot daun the Volts to 110 Volts the Plant is rannig 18tin Hours awri dai the rate is hiar 5c for a 1000 Watts for lighting bildings yusing Walter Power the yier raund. Plandy zurplas Power an the Dainamo and Watter Wiells."

THE GALERIE DES MACHINES, which has long been an important part of the great expositions in Paris, and has contained the electrical and mechanical exhibits, is likely to be brought to New York. The circus firm of Barnum & Bailey announce the purchase of the Galerie. This mammoth structure has been on the site of the exposition for 27 years. It is of steel, measures 1,800 ft. in length, with a uniform height of 110 ft. It is Mr. Bailey's plan to have the building taken apart, bring the steel to this country and erect a building somewhat larger than the original. He says it will be capable of seating 26,000 people. Options have been obtained on a tract of land on West One Hundred and Sixtieth Street. If these plans go through the projectors expect to have their building up and ready for occupancy by the fall of 1908. The estimated cost of removal, transportation and erection of the building is $5,000,000. The projectors intend to have the reconstructed Galerie des Machines appear without post or pillar. As it now stands it is constructed of immense steel arches supporting roof and sides, terminating at their base on granite foundations.

ENTERTAINMENT AT NEW ORLEANS.—On November 7 Sanderson & Porter, contracting engineers of New York, entertained their friends and engineers at a banquet at the St. Charles Hotel, New Orleans, followed by a theatre party at the Tulane Theatre. The firm are consulting engineers for the New Orleans Railway & Light Company and have been the constructing engineers and contractors for the company's numerous improvements and extensions. Several members of the firm were present, with officials of the New Orleans Railway & Light Company, including President Foster and Vice-president Joseph H. De Grange. Mr. Blossom represented Sanderson & Porter and acted as host and toastmaster. He stated in his address that the dinner was given in testimony of the loyalty and devotion of the employes of the firm in the accomplishment of the work on hand during the prevalence of yellow fever in New Orleans, as many of them were from other States and not immune. Speeches were made by Mr. Blossom, Colonel De Grange and Mr. Foster, who complimented the engineers on the successful issue of the work undertaken, the starting of the new underground lighting system of more than 2,700 new arc lamps, and putting into operation the new power station at Market Street.

ENGLISH MUNICIPAL TROLLEYS.—In a report on British tramways United States Consul Williams, of Cardiff, Wales, calls attention to the fact that a large part of the English people favor the municipal ownership of all important public utilities, but submits figures to show that it is far from being as successful as its friends would wish. He says: "The schemes cover a multitude of utilities, some almost purely social, but the largest items have been spent on power plants and electric trams. The rate payers do not find the last-named profitable in all cases. For instance, the Cardiff Corporation Tramways, representing a capital expenditure of $3,530,048, returned a net profit of only $101.60 for the year ending March 31, 1905. This poor showing may be attributed to two causes, excessive costs and low income. In the matter of costs, a good showing was made so far as working expenses were concerned, for although there is a payment of time and a half for Sunday work and double time for holidays, they amounted to only 5.948 pence per car mile. Perhaps the principal cause of the reduced income in 1904-5 was bad trade. This was an unexpected experience for the advocates of public ownership, and the lesson should be taken to heart by Americans. It appears that tramways are the first municipal utilities to feel the bad effects of hard times. Depression in trade has led to a reduction of wages in many industries, and the tramway receipts have registered these reductions like a barometer."

Niagara Power in the Gorge.—II.

PORT DAY, with its frontage of 800 ft. on the upper river, the basin 1,000 ft. long and 70 ft. wide on the brink of the Gorge below, and the canal 4,400 ft. long and 100 ft. wide between them, are the most important elements in the system of the Niagara Falls Hydraulic Power & Manufacturing Company.

Among hydraulic developments about Niagara Falls the one under consideration is unique. Of the six great electric plants at the Falls, five operate with tunnels or pipe lines, and only in the one of the Hydraulic Power Company is the water conveyed entirely by canals. This canal, by cutting across the business section of the city, follows the shortest possible course between the upper and the lower river on the New York side, apart from the State Reservation. Duplication of this canal would now be entirely impracticable because of the great value of the necessary real estate, and the canal owes its existence to the fact that Niagara Falls was only a small village when the right of way was obtained, in 1852.

At Port Day, on the upper river, the canal is about 400 ft. wide at its head, and it narrows to a width of 100 ft. in a distance of 500 ft. from the inlet. From the upstream bank of the canal, at its head, a breakwater runs diagonally down stream for some 375 ft., and from the outer end of this breakwater an ice boom is stretched to the down-stream side of the canal inlet. The combined breakwater and boom thus completely encircle the head of the canal, and this construction has an important bearing on the freedom of the canal from floating ice. As ice comes down the river it first strikes the breakwater, and is deflected out into the stream. Then any ice that tends to float into the canal at points down river from the outer end of the breakwater is stopped by the boom. Two openings in the breakwater are also closed by booms.

The depth of the canal at Port Day is 14 ft. below low water line, and excavation now in progress is intended to carry its entire length of 4,400 ft. down to a corresponding depth. Most of the canal bed lies in rock, so that this excavation is slow and expensive. On a large part of its course the canal has masonry walls, and it is crossed by numerous bridges. The width of 100 ft. is maintained over the entire length of the canal from Port Day to the hydraulic basin at the top of the cliff above the Gorge, and this basin is 70 ft. wide along about 680 ft. of its original length of 850 ft., the width of the remainder being about 30 ft. In direction this basin is nearly at right angles with the lower end of the canal, and parallel with the face of the cliff and with the river.

The capacity of this canal to deliver water in the basin at the top of the cliff is much greater than the maximum demand of the turbine wheels that operate the present electric station in the Gorge below, and the Niagara Falls Hydraulic Power & Manufacturing Co. has begun the construction of another station with a capacity of about 100,000 electric horse-power.

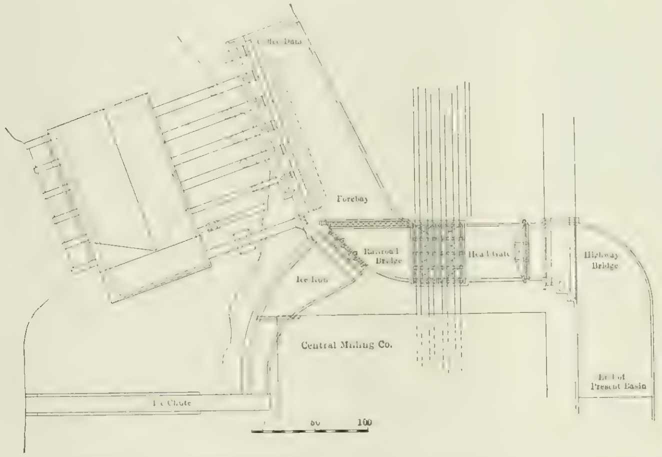


FIG. 1.—GENERAL PLAN OF NEW STATION OF NIAGARA FALLS HYDRAULIC POWER & MFG. CO.

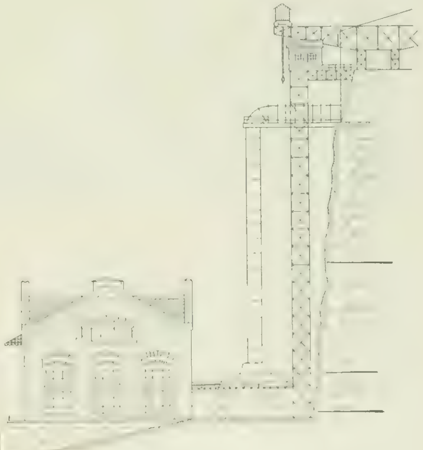


FIG. 2.—ELEVATION OF NEW STATION.

The new station will be located at the edge of Niagara River in the Gorge, a few hundred feet further down stream from the older station. In order to bring water from the canal to the top of the cliff above this new station, the basin has been extended about 150 ft., giving it a total length of 1,000 ft., and from the north end of this extension a forebay that will have an ultimate length of about 590 ft. is being excavated. Some 350 ft. of the length of this forebay will run along the top of the cliff parallel to its face, and from this part of the forebay the steel penstocks will drop down the face of the cliff to the electric station.

Just before the water reaches that part of the forebay where the heads of the penstocks are located, it passes an ice run whose head is 50 ft. wide, and any ice diverted into this run moves down the cliff into the river. Near the point where the forebay joins the canal basin, and where it has a width of 50 ft., a set of three head gates, each 15 ft. wide, is provided to shut off water from the forebay. This width of 50 ft. is uniform from the basin to the head wall of the forebay, but back of that wall the width starts at 67 ft. and gradually narrows.

FIG. 3.—ICE BOOM AT PORT DAY.

Both the excavation for the extension of the basin and for the forebay, as well as that for the power station in the Gorge below, is in limestone and shale, and such of the loosened rock as is not wanted for masonry construction is simply dumped into the river, in front of the station site. It is somewhat novel to see thousands of tons of excavated rock dumped into the tail race of a water-power plant, but the great depth of Niagara River, believed to be about 200 ft. at this point, is said to warrant such a course.

Between that part of the forebay where the penstocks enter and the outer portion, it is crossed by a bridge from which a solid steel boom drops to a line 10 ft. below the water level. Any floating ice will be deflected by this boom into the run above mentioned. Mean low water level at the rack in the inner forebay will stand at elevation 557 ft. above sea level, three ft. below Niagara River at Port Day, 22 ft. above the forebay floor, and 17 ft. above the centers of the steel penstocks. Over its natural foundation of limestone the forebay has a layer of concrete one foot thick, which joins the head wall of the same material. In height this wall measures 31 ft., its bottom width is 24 ft. 7½ in., at elevation 560, the top of the rack, the thickness is about 14 ft., and at the top, elevation 565, it is 9 ft. The toe of this wall is about 5 ft. back from the edge of the cliff, along a part of its length. On the forebay side of the head wall is the ice rack, rising 25 ft. from the bottom of the forebay and making an angle of about 33 deg. with the vertical. This ice rack will have a roof over it so that it may the more readily be kept clear of ice, and for raising the racks there will be an overhead hoist.

In the concrete front wall of the forebay the heads of 14 main penstocks, and of several smaller penstocks, will ultimately be fixed, and these penstocks will run down the face of the cliff to the turbine wheels in the Gorge below. With the section of the forebay and power station now under construction from penstocks for the wheels of the main generators, and one penstock for a pair of exciting dynamos, will be used.

Each of the main penstocks has a diameter of 8.5 ft., and the diameter of the small penstock is 5 ft. The head of each main penstock is imbedded in the forebay wall for a horizontal length of about 10 ft., and the penstock has a length of about 24 ft. beyond the outer face of the forebay wall before it turns at right angles and drops to the power station. A gradually contracting entry is formed in the concrete from the forebay side of its front wall to the head of each penstock, the length of this entry way being about 8 ft., and a circular iron gate operated from the top of the wall closes the mouth of each penstock. Beneath the head of each penstock there is a drain pipe, and connected on the power house side of its gates is a by-pass. From the front of the forebay wall to the cliff side of the power house the total horizontal run of the steel penstocks is 86 ft., and the vertical drop about 169 ft.

The design of the power house calls for a one-story building with walls of gray limestone and a slanting roof. In plan the complete power house will measure 350 ft. long, and 93 ft. wide. For the section of the power house now under construction the length is 168 ft. Between the base of the vertical cliff and the power house the distance is 50 to 80 ft., and the front of the house sets 22 ft. back from the edge of Niagara River. Access to the power house from the top of the cliff is to be had by means of a bridge over the ice run, and an elevator shaft down the face of the cliff. Under the generating station the masonry foundations are so designed that there is an arched tail race beneath each pair of main turbine wheels, and beneath the two pairs of turbines that drive two exciting dynamos. Each pair of turbines sets with its horizontal shaft at right angles to the longer sides of the station, so that water entering the station by way of the penstocks passes underneath that part of the floor where the electric generators are located on its way to the river.

FIG. 4.—HEAD OF CANAL AT PORT DAY.

To give the tail water a more constant level than the river has in front of the station, and to make sure that the lower ends of the draft tubes will be constantly under water, each tail race under the station discharges over a dam that is some 3 ft. above the normal river level. From the crest level of these tail race dams to the floor of the power station the vertical distance is about 21 ft., and to the centers of the main turbines about 24 ft.

Along its greater length the main floor of the station is divided into two parts by a masonry partition. That part of the station on its cliff side is 38.5 ft. wide and contains the horizontal turbine wheels, and that part of the station on its river side is 45.5 ft. wide and contain the electric generators and switchboard. Each penstock enters one end of its wheel case, and the two wheels in each case discharge into the tail race through a single draft tube. The case containing each pair of main turbines has a diameter of 13 ft., and the wheels are designed for 300 revolutions per minute under a net head of 210 ft.

From each pair of main turbines a horizontal shaft runs through the dividing wall of the station into the part on its river side, and there connects with the shaft of a 5,000-kw alternator. A short section of each shaft which passes through the dividing wall connects with both the turbine and the electric generator by means of flanged couplings. After passing into the station, the 5-ft. penstock divides into two branches, and each of these branches connects with a case containing a pair of turbines. Shafts from these two pairs of turbines go through the dividing wall, and are connected to exciting dynamos.

Each 5,000-kw alternator is rated at 11,000 volts, 25 cycles, three-phase, and will operate at 300 r.p.m. These alternators are of the internal revolving magnet type. The shaft of each is about 17 in. in diameter. It is said that the weight of the revolving magnet of each alternator will be about 50 tons, so that the pressure on each bearing will be about 50,000 pounds. The floor space for each machine is 14 ft. parallel with the shaft, and 20 ft. at right angles to it. It is the intention to install 14 of these alternators in the completed station, so that the ultimate capacity there will be 70,000 kw.

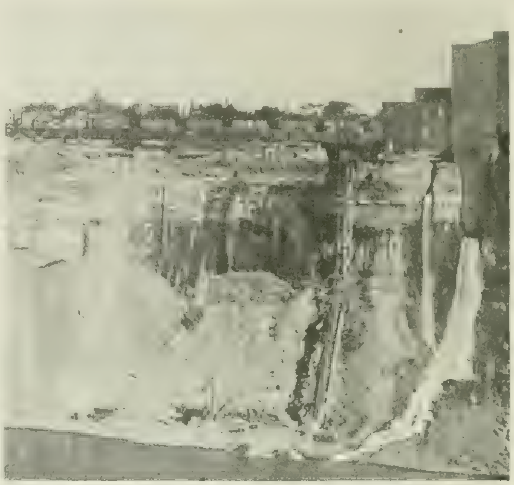


FIG. 5.—EXCAVATION FOR NEW POWER STATION OF NIAGARA FALLS HYDRAULIC POWER & MFG. CO.

It is the plan to locate the switchboard for this station on a gallery or raised plaform next to the river wall, and in full view of the electric generators. That part of the power station now under construction, with a capacity of 20,000 kw in main generators, is expected to be in operation before the end of 1907.

Of the Niagara Falls Hydraulic Power & Manufacturing Company, the owner of this new power plant, Arthur Schoellkopf, is general manager; John L. Harper, chief engineer; W. C. Johnson, consulting engineer; George R. Shepard, assistant engineer; Ross R. Coddington, construction superintendent, and Benjamin F. Lee, electrical superintendent.

Much of the work on the new plant is being done by day labor under the direction of the engineers of the Hydraulic Power Co.

◆

Physical Chemistry at Massachusetts Institute of Technology.

The staff of the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology has, according to *Science*, undergone several changes. Mr. Yogoro Kato, who has been engaged for the past two years in the investigation of the conductivity of aqueous solutions at high temperatures, has accepted a position in the technical high school of Tokio, where he will have charge of the work of electrochemistry. Prof. W. D. Coolidge has accepted a position in the technical research laboratory of the General Electric Company.

The Efficiency of Electrical Power Generating Stations.

By H. M. Hobart.

Stations commonly brought under the above designation should, of course, strictly speaking, be termed "transforming stations," since in such stations a small part of the energy of combustion of the coal or other fuel is transformed into electrical energy. At the same time there is transformed a far larger part of the energy of combustion of the coal into irrecoverable heat energy.

The writer has analyzed the results of a number of such generating stations with the object of determining the efficiency from the coal pile to the outgoing cables. This efficiency will be denoted as the annual overall efficiency of the generating station. Twenty-six of these stations are classified in three groups in Table I, page 902. In each group one-half represents British stations and one-half represents stations outside of Great Britain. None of the stations are situated in the United States, as the data studied did not comprise any such stations. Two considerations controlled the choice of stations for inclusion in the investigation. The first consideration was that the available data should include as many as possible of the facts affecting the annual overall efficiency. The second consideration was that the range of capacities and the average capacity of the British stations should be about equal to the range of capacities and the average capacity of the stations located outside of Great Britain. This selection was made without any reference whatever to the value of the resulting average efficiencies.

Table I on page 902 gives the output of the station for the period considered, in millions of kilowatt-hours per annum. The stations are arrranged in the order of their annual outputs. In this table are also compiled those particulars of each station which could be expected to have a bearing upon the overall efficiency, together with the data necessary for calculating this overall efficiency. The annual input of energy in the form of the energy of combustion of the coal, the annual output in millions of kilowatt-hours of electrical energy, and the annual overall efficiency are likewise recorded for each of the 26 stations.

Table II.

Class.	Great Britain (B) or abroad (A).	Average output from generating station during year in millions of kw-hours.	Average efficiency of generating station in per cent.
Between 0.9 and 3.3 millions of kw-hours. per year	B	2.0	2.8
	A	1.9	5.2
Between 6 and 13 millions of kw-hours per year	B	9.3	5.8
	A	9.9	6.6
Between 18 and 45 millions of kw-hours per year	B	28.8	7.2
	A	32.6	8.3

In Table II these results are averaged for the British stations and for the stations situated outside of Great Britain.

In Fig. 1 these average results are plotted in the form of curves showing the annual overall efficiency of the generating stations as a function of the millions of kilowatt-hours of annual output.

It is to be regretted that the published returns from generating stations are not more complete. Thus we naturally ask ourselves whether it might not be possible to trace a connection between the overall efficiency and the extent to which electrical storage batteries are employed, but we find that the incompleteness of our data makes this impossible. It is fair to assume that all these stations were operated condensing, although this fact is recorded only in the case of the British stations. In fact, non-condensing stations, when known to be such, were purposely excluded from the comparison. In no case, however, are there records of the average vacuum maintained, nor of the average amount of superheat employed. The comparison of the capital cost and the rate of depreciation would also have been impracticable, and hence one cannot assert conclusively that the one or the other set of generating stations represents the better engineering.

It is, however, quite evident that even the better of the two efficiency curves of Fig. 1 is very low. The efficiency of steam generating sets at full-load frequency exceeds 20 per cent in larger sizes, and the efficiency of a good boiler working at its rated capacity should not fall below 75 per cent. Taking the efficiency of the steam piping at 95 per cent, there is obtained a practicable full-load overall efficiency of the generating station of $0.20 \times 0.75 \times 0.95 = .14$.

The difference between this efficiency and that actually obtained in practice is due chiefly to the circumstances that the plant is run for a large part of the time at considerably less than full load; that fires must be kept under one or more spare boilers; that the boilers and engines are not maintained in this condition of highest efficiency; that the supply of air to the fires is not suitably regulated; that the coal is not uniformly of the calorific value of the samples tested, and to various other detail circumstances.

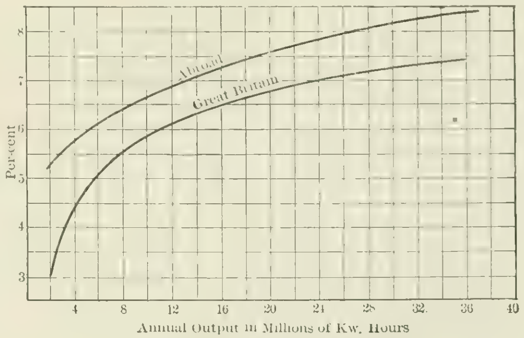


FIG. 1.—OBSERVED TOTAL EFFICIENCY OF GENERATING STATION FROM COAL PILE TO OUTGOING CABLES.

As shown in Table I, it is not unusual to find large stations with an annual overall efficiency of over 7 per cent.

CAPACITY OF SINGLE GENERATING STATIONS.

As illustrations of the size of modern generating stations, some rough leading data of a number of such stations have been brought together in Table III.

Table III.

Name of generating station.	Millions of kw.-hours delivered from generating station per year, during one year or half-year.	Period considered.	Total kilowatts rated capacity of generating sets, excluding exciters and sets for lighting and power in generating station.	Average load during total period considered (based on 24-hour day).	Maximum load during total period considered.	Load factor at out-going mains from generating Station.
Pinkston Station (Glasgow Corporation Tramways.)	23.0	Year ending May 31, 1905.	11,200	2,630	8,520	.31
Shepherd's Bush Station (Central London Railway).	18.1	Half-year ending June 30, 1905.	5,100	2,060	4,000	.52
Ringsend Station (Dublin United Tramways).	8.2	Half-year ending June 30, 1905.	3,600	936	....	..

In Table IV are given rough estimates of the ultimate capacities for which these stations would be suitable with a 50 per cent load factor. To the three stations in Table III there have been added. in Table IV the Neasden generating station of the Metropolitan Railway of London, and the Chelsea (Lots Road) power station of the Underground Electric Railways Company of London, Limited. The estimates in these last two cases are, of course, only of the roughest nature, as electrical power has only recently been delivered

Table IV.

Name of generating station.	Millions of kw.-hours of annual capacity of generating station, for a .5 load factor.	Total kilowatts rated capacity of generating sets excluding exciters and sets for lighting and power in generating station.	Average load based on a 24-hour day.	Maximum load (based on .5 load factor).
Dublin	13	3600	1480	2960
C.L.R.	19.5	5100	2220	4400
Glasgow	44	11200	5000	10000
Neasden	58	14000	6600	13200
Chelsea	200	44000	22800	45600

TABLE I.

Class.	Millions of kw-hours delivered from generating station per yr.	Condensing or non-condensing.	British station (B) or Abroad (A).	Accumulators employed or not in generating station.	Kw-hours delivered by accumulators during year.	Kw-hours by accumulators in per cent. of total kw.-hours.	Steam superheated or not.	Average amount of superheat in deg. Cent.	Quality of coal used.	Calorific value in kw-hours per ton.	No. of tons of coal burned per year.	Price in shillings per ton.	Use to which the electrical energy is put. Light, L; Traction, T; Power, P.	Average load factor of generating station per year.	Date of end of year for which data applies.	Year of working.	(C) Total kw-hours of calorific value of coal burned per year.	(D) Total output in kw-hours during year.	Efficiency of generating station in per cent. $\frac{100\,D}{C}$
Bet. 0.9 and 3.3 millions of kw hours per year.	0.95	Not stated	A	Accumulators Employed	177,600	18.7	Not stated	Not stated	German bituminous	8,600	2,080	21.4	L.P.T.	18.8	1904	6th	17,900,000	948,000	5.3
	0.97	Not stated	A	Accumulators Employed	148,880	15.4	Not stated	Not stated	German bituminous	8,500	2,730	9.6	L.P.T.	27.5	1903-1904	4th	23,200,000	965,000	4.16
	1.00	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	9,000	3,100	11.0	L.T.	15.4	March, 1904.	6th	27,900,000	1,000,000	3.58
	1.09	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	7,700	4,250	11.5	L.	16.0	March 25, 1904	7th	32,700,000	1,090,000	3.34
	1.18	Not stated	A	Accumulators Employed	200,300	17.0	Not stated	Not stated	Westphalian anthracite	8,150	3,458	18.0	L.P.T.	14.05	1903-1904	5th	28,200,000	1,177,000	4.2
	1.33	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	28°	Small peas	9,100	8,200	7.7	T.	13.8	March, 1903.	10th	74,500,000	1,330,000	1.79
	2.07	Not stated	A	Accumulators Employed	262,738	12.7	Not stated	Not stated	Westphalian bituminous	9,050	4,190	14.2	L.P.T.	43.6	1903-1904	5th	37,900,000	2,070,000	5.5
	2.25	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	Portion slightly superheated	Best Welsh Derby pea nuts	8,500	17,300	10.75	T.	11.6	March 31, 1904.	6th	147,000,000	2,250,000	1.52
	2.90	Condensing	B	Accumulators Employed	Not stated	Not stated	None	Not stated	Derby pea nuts	9,500	11,300	12.3	L.	12.1	March 31, 1903	10th	107,300,000	2,900,000	2.7
	3.02	Not stated	A	Accumulators Employed	211,000	7.0	Not stated	Not stated	Yorkshire steam	8,320	5,940	12.6	L.P.T.	20.5	1903-1904	12th	49,400,000	3,020,000	6.1
	3.12	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	Very little superheat	Not stated	7,100	10,800	8.2	T.	17.4	March 15, 1904	Not stated	76,600,000	3,120,000	4.06
	3.25	Not stated	A	Accumulators Employed	180,000	5.6	Not stated	Not stated	Fife small Scotch anthracite and German anthracite	7,100	7,500	16.3	L.P.T.	13.7	1903-1904	14th	53,200,000	3,250,000	6.1
Bet. 6 and 13 millions of kw hours per year.	6.3	Not stated	A	No accumulators employed	Not stated	Not stated	Not stated	Not stated	German lignite	5,600	22,580	10.1	L.P.	35.0	1904	11th	126,300,000	6,260,000	4.95
	8.2	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	8,020	16,500	9.75	T.	Not stated	....	Not stated	132,500,000	8,200,000	6.2
	9.0	Not stated	A	Accumulators Employed	Not stated	Not stated	Superheated	Not stated	German lignite	2,800	44,900	Not stated	T.	76.7	1904	9th	126,000,000	8,988,000	7.14
	9.4	Condensing	B	Not stated	Not stated	Not stated	Superheated	Part superheated to 238°	Smudge	7,060	26,100	5.0	L.P.	14.5	March 25, 1905	Not stated	184,000,000	9,400,000	5.1
	9.5	Condensing	B	Not stated	Not stated	Not stated	None	Not stated	Slack	7,700	20,300	8.2	T.	Not stated	March 25, 1904	11th	156,500,000	9,500,000	6.05
	10.1	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	28° to 56°	Slack	9,320	18,000	7.7	L.P.T.	28.6	March 31, 1905	Not stated	168,000,000	10,100,000	6.10
	11.9	Not stated	A	Accumulators Employed	Not stated	Not stated	Not stated	Not stated	Lignite briquettes and gas coke	8,350	20,800	13.0	L.P.T.	38.1	1904	13th	173,500,000	11,890,000	6.85
	12.5	Not stated	A	Accumulators Employed	Not stated	Not stated	Not stated	Not stated	Cardiff and Westphalian	8,750	19,800	Not stated	L.P.T.	40.1	1904	10th	173,000,000	12,480,000	7.21
Bet. 18 and 45 millions of kw-hours per year.	18.1	Condensing	B	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated	9,300	30,184	16.45	T.	Not stated	April, 1905.	Not stated	290,000,000	18,100,000	6.45
	23.0	Condensing	B	Accumulators Employed	Not stated	Not stated	Superheated	Superheated to 260°	Washed nuts	8,100	35,270	6.4	T.	30.8	May 31, 1905	5th	286,000,000	23,000,000	8.06
	26.7	Not stated	A	Accumulators Employed	2,491,000	9.4	Not stated	Not stated	Westphalian bituminous	8,750	40,800	17.1	L.P.T.	34.3	1903-1904	3rd-16th	357,000,000	26,650,000	7.46
	29.6	Not stated	A	Accumulators Employed	275,000	0.93	Not stated	Not stated	Cardiff	8,750	43,800	Not stated	L.P.T.	Not stated	1904	5th	383,000,000	29,600,000	7.75
	41.5	Not stated	A	Accumulators Employed	1,188,000	2.86	Not stated	Not stated	German lignite	7,750	56,000	Not stated	L.P.T.	35.2	1904	3d	433,000,000	41,500,000	9.61
	45.0	Both	B	Accumulators Employed	Not stated	Not stated	Superheated	Part superheated to 50°	Washed slack	8,940	75,000	10.0	L.P.T.	25.5	March 31, 1905	Not stated	670,000,000	45,000,000	6.72

TABLE VII.

Temperature of saturated steam.			—Consult These Columns to Obtain the Energy in Kilowatt Hours— Contained in One Ton of Steam.									—Consult These Columns to Obtain the Energy in Kilowatt Hours— Necessary to Raise One Ton of Steam at Constant Pressure.									Specific volume in cubic meters per kg.				Specific weight in kgs. per cubic meter.			
			(Component parts, i. e., Increase in Energy when Heating one Ton of)					(Total energy, i. e., Energy Contained in One Ton of)				(Component Parts, i. e., Heat Required to Raise One Ton of)					(Total Energy, i. e., Heat Required to Raise Steam from One Ton of Water at 0° C.)											
Absolute pressure in kgs. per sq. cm. Col. 1.	Temperature in centigrade scale (t) Col. 2.	Absolute temperature (= 273 + t). Col 3.	Water at 0° C. to water at t° C. (heat in liquid) Col. 4.	Water at t° C. to saturated steam at t° C. Col. 5.	Saturated steam to steam at 50° C. superheat. Col. 6.	Steam from 50° C. superheat to 100° C. superheat. Col. 7.	Steam from 100° C. superheat to 150° C. superheat. Col. 8.	Saturated steam. Col. 9	Steam at 50° C. superheat. Col. 10.	Steam at 100° C. superheat. Col. 11.	Steam at 150° C. superheat. Col. 12.	Water at 0° C. to water at t° C. (heat in liquid). Col. 13.	Water at t° C. to saturated steam at t° C. Col. 14.	Saturated steam to steam at 50° C. superheat. Col. 15.	Steam from 50° C. superheat to 100° C. superheat. Col. 16.	Steam from 100° C. superheat to 150° C. superheat. Col. 17.	Saturated steam. Col. 18.	Steam at 50° C. superheat. Col. 19.	Steam at 100° C. superheat. Col. 20.	Steam at 150° C. superheat. Col. 21.	Saturated steam. Col. 22.	Steam at 50° C. superheat. Col. 23	Steam at 100° C. superheat. Col. 24	Steam at 150° C. superheat. Col. 25.	Saturated steam. Col. 26.	Steam at 50° C. superheat. Col. 27.	Steam at 100° C. superheat. Col. 28	Steam at 150° C. superheat. Col. 29.
.05	32	305	37.2	639	21.2	21.2	21.2	677	698	719	740	37.2	680	27.6	27.6	27.6	717	745	774	801	28.0	33.4	38.2	42.8	.0357	.03	.0262	.0234
.06	36	309	41.9	636	21.2	21.2	21.2	678	699	720	741	41.9	677	27.6	27.6	27.6	718	746	775	803	24.1	28.1	32.1	36.2	.0415	.0356	.0312	.0277
.07	39	312	45.4	633	21.2	21.2	21.2	680	700	721	742	45.4	674	27.6	27.6	27.6	719	747	776	804	20.8	24.3	27.7	31.6	.048	.0412	.0362	.0317
.08	42	315	48.9	631	21.2	21.2	21.2	681	701	722	743	48.9	673	27.6	27.6	27.6	721	749	777	805	18.0	21.4	24.5	27.4	.055	.0468	.0409	.0365
.09	44	317	51.3	629	21.3	21.3	21.3	681	701	722	745	51.3	672	27.7	27.7	27.7	722	750	778	806	16.7	19.2	21.8	24.5	.060	.0521	.046	.0408
0.1	46	319	53.6	627	21.3	21.3	21.3	682	703	723	745	53.6	670	27.7	27.7	27.7	722	750	778	806	15.0	17.3	19.7	22.0	.066	.0576	.0508	.0455
0.12	49	322	57.0	626	21.4	21.3	21.3	683	704	725	746	57.0	668	27.9	27.7	27.7	723	751	779	807	12.3	14.6	16.5	18.5	.0813	.0686	.0606	.0542
0.14	52	325	60.5	623	21.4	21.3	21.3	683	704	725	746	60.5	664	27.9	27.7	27.7	725	752	780	808	10.8	12.6	14.3	15.9	.0925	.0795	.070	.063
0.16	55	328	64.0	619	21.5	21.4	21.4	684	705	726	747	64.0	661	28.0	27.9	27.9	726	753	781	810	9.5	11.1	12.6	14.0	.105	.0902	.0795	.0714
0.18	58	331	67.6	617	21.5	21.4	21.4	685	706	727	748	67.6	660	28.0	27.9	27.9	727	755	783	811	8.5	9.94	11.3	12.3	.117	.1008	.0885	.0814
0.20	60	333	69.8	615	21.7	21.5	21.5	685	707	728	749	69.8	659	28.1	28.0	28.0	727	755	783	811	7.78	8.97	10.2	11.3	.130	.1115	.0985	.0885
0.22	63	336	73.4	613	21.7	21.5	21.5	686	707	729	749	73.4	656	28.1	28.0	28.0	728	756	784	812	7.15	8.25	9.33	10.4	.140	.1215	.107	.096
0.24	65	338	75.6	610	21.8	21.7	21.5	686	708	730	750	75.6	654	28.2	28.1	28.0	728	756	784	812	6.63	7.60	8.58	9.58	.151	.131	.117	.105
0.26	66	339	76.8	609	21.9	21.7	21.7	686	708	731	751	76.8	652	28.3	28.1	28.1	729	757	785	813	6.10	7.02	7.94	8.86	.164	.1425	.126	.113
0.28	67	340	78.0	607	21.9	21.8	21.7	686	708	731	753	78.0	651	28.3	28.2	28.1	729	757	785	813	5.70	6.53	7.40	8.23	.176	.153	.135	.123
0.30	69	342	80.4	606	22.0	21.8	21.7	687	710	732	754	80.4	650	28.4	28.2	28.1	730	758	786	814	5.30	6.11	6.93	7.70	.187	.163	.1445	.130
0.35	72	345	83.8	604	22.0	21.9	21.8	689	711	733	755	83.8	648	28.4	28.3	28.2	731	760	787	815	4.60	5.28	5.96	6.64	.218	.1895	.168	.151
0.40	75	348	87.3	601	22.1	21.9	21.8	689	711	733	755	87.3	645	28.6	28.3	28.2	732	761	788	817	4.04	4.63	5.26	5.85	.246	.216	.190	.171
0.45	78	351	90.8	599	22.2	22.0	21.9	690	712	734	756	90.8	643	28.7	28.4	28.3	734	762	790	817	3.65	4.17	4.70	5.25	.274	.240	.213	.191
0.50	81	354	94.4	595	22.2	22.1	21.9	690	712	734	756	94.4	641	28.7	28.6	28.3	735	764	792	820	3.27	3.78	4.26	4.74	.306	.264	.235	.212
0.60	86	359	100.0	592	22.35	22.1	22.0	691	713	735	757	100.0	638	28.8	28.6	28.4	737	767	795	824	2.75	3.18	3.58	3.96	.364	.314	.279	.253
0.70	90	363	105.0	588	22.35	22.2	22.0	693	715	736	759	105.0	634	28.8	28.7	28.4	739	768	796	825	2.38	2.75	3.10	3.44	.420	.364	.322	.291
0.80	93	366	108.0	585	22.45	22.35	22.1	694	716	737	760	108.0	631	28.9	28.8	28.6	740	769	797	826	2.10	2.43	2.72	3.02	.476	.410	.367	.332
0.90	96	369	112.0	582	22.6	22.35	22.1	695	717	738	761	112.0	628	29.0	28.8	28.6	741	770	798	827	1.88	2.17	2.44	2.70	.532	.459	.409	.370
1.00	99	372	115.0	579	22.7	22.45	22.2	695	718	740	762	115.0	626	29.1	28.9	28.7	742	771	800	829	1.70	1.96	2.21	2.44	.587	.509	.453	.409
1.20	104	377	121.0	575	22.8	22.6	22.3	696	719	741	763	121.0	623	29.3	29.0	28.8	743	773	801	830	1.43	1.66	1.85	2.05	.697	.603	.538	.489
1.40	109	382	127.0	570	22.9	22.7	22.3	697	720	742	764	127.0	618	29.4	29.1	28.8	745	775	804	833	1.24	1.434	1.60	1.77	.806	.696	.625	.565
1.60	113	386	131.0	566	23.2	22.8	22.4	698	721	743	765	131.0	615	29.6	29.3	28.9	746	776	805	834	1.09	1.27	1.41	1.56	.916	.790	.708	.642
1.80	116	389	136.0	563	23.4	22.9	22.6	699	722	745	768	136.0	612	29.8	29.4	29.0	747	777	806	835	.978	1.13	1.26	1.40	1.02	.886	.795	.714
2.00	120	393	141.0	560	23.6	23.0	22.7	700	723	747	769	141.0	610	30.0	29.5	29.1	749	779	808	837	.886	1.02	1.14	1.26	1.13	.976	.875	.794
2.20	123	396	144.0	557	23.9	23.2	22.8	702	725	748	772	144.0	606	30.3	29.6	29.3	750	780	810	838	.810	.939	1.04	1.15	1.24	1.063	.956	.868
2.40	125	398	147.0	555	24.1	23.3	22.8	702	726	750	773	147.0	604	30.5	29.7	29.3	751	781	811	839	.746	.864	.962	1.06	1.34	1.155	1.04	.945
2.60	128	401	150.0	551	24.4	23.4	22.9	703	727	751	774	150.0	603	30.8	29.8	29.4	752	783	812	840	.692	.800	.890	.98	1.45	1.25	1.125	1.02
2.80	131	404	154.0	549	24.6	23.5	23.0	704	728	752	775	154.0	600	31.0	29.9	29.5	752	784	814	843	.645	.746	.830	.918	1.55	1.34	1.205	1.09
3.00	133	406	156.0	547	24.8	23.6	23.2	704	728	752	775	156.0	598	31.2	30.0	29.6	753	785	815	845	.605	.701	.780	.858	1.56	1.43	1.28	1.165
3.20	135	408	158.0	546	25.0	23.8	23.3	705	729	753	776	158.0	597	31.4	30.2	29.7	755	786	816	846	.569	.660	.732	.806	1.76	1.515	1.37	1.24
3.40	137	410	161.0	544	25.3	24.0	23.4	705	730	754	777	161.0	595	31.7	30.4	29.8	755	786	816	847	.538	.621	.692	.760	1.86	1.615	1.45	1.316
3.60	139	412	163.0	541	25.5	24.1	23.5	705	730	755	779	163.0	593	31.9	30.5	29.9	756	787	817	848	.510	.588	.664	.720	1.96	1.70	1.51	1.39
3.80	141	414	165.0	540	25.7	24.3	23.6	706	731	756	780	165.0	591	32.2	30.8	30.0	756	788	819	849	.484	.558	.620	.684	2.07	1.79	1.615	1.46
4.00	143	416	168.0	538	26.0	24.6	23.8	706	732	757	781	168.0	590	32.4	31.0	30.2	757	790	820	850	.461	.532	.593	.672	2.17	1.885	1.69	1.49
4.50	147	420	172.0	534	26.2	24.8	23.9	708	734	759	782	172.0	586	32.6	31.2	30.3	758	791	823	852	.431	.474	.528	.586	2.42	2.11	1.90	1.725
5.00	151	424	177.0	531	26.4	25.0	24.1	709	735	760	784	177.0	583	32.8	31.4	30.5	760	792	824	854	.374	.431	.474	.524	2.67	2.32	2.11	1.91
5.50	155	428	182.0	527	26.7	25.4	24.3	710	736	763	786	182.0	580	33.1	31.8	30.8	761	793	825	855	.342	.394	.437	.480	2.92	2.54	2.29	2.085
6.00	158	431	186.0	524	27.1	25.7	24.6	711	737	764	788	186.0	577	33.6	32.2	31.0	762	795	829	858	.315	.360	.401	.441	3.16	2.78	2.50	2.27
6.50	161	434	190.0	521	27.6	26.1	24.8	712	740	766	790	190.0	575	34.0	32.5	31.2	763	796	830	860	.292	.336	.370	.407	3.41	2.98	2.70	2.45
7.00	164	437	193.0	519	28.1	26.4	25.0	713	741	768	792	193.0	572	34.5	32.8	31.4	764	799	832	862	.273	.312	.345	.380	3.66	3.20	2.89	2.63
7.50	167	440	197.0	515	28.5	26.8	25.3	714	742	769	795	197.0	570	35.0	33.2	31.7	766	800	833	864	.255	.292	.323	.354	3.90	3.43	3.10	2.83
8.00	169	442	199.0	514	29.0	27.1	25.5	715	743	770	796	199.0	567	35.4	33.6	31.9	767	801	834	865	.240	.283	.303	.332	4.14	3.54	3.30	3.02
9.00	174	447	205.0	509	29.5	27.5	25.8	716	745	772	797	205.0	564	35.9	33.9	32.2	769	805	838	870	.215	.224	.270	.296	4.63	4.10	3.71	3.38
10.0	179	452	211.0	506	30.0	27.9	26.0	717	747	775	800	211.0	560	36.3	34.3	32.4	770	806	839	872	.195	.220	.243	.267	5.11	4.55	4.13	3.75
11.0	183	456	216.0	501	30.4	28.2	26.2	718	748	776	802	216.0	556	36.8	34.6	32.6	771	807	842	875	.178	.200	.222	.243	5.62	5.00	4.51	4.12
12.0	187	460	221.0	498	30.9	28.5	26.4	719	750	777	805	221.0	552	37.3	35.0	32.8	773	810	845	877	.164	.184	.204	.223	6.09	5.44	4.91	4.48
13.0	191	464	226.0	495	31.3	28.9	26.8	720	752	781	897	226.0	549	37.7	35.3	33.2	775	812	846	880	.153	.170	.188	.206	6.53	5.90	5.33	4.76
14.0	194	467	229.0	491	31.8	29.3	27.1	721	753	782	809	229.0	546	38.2	35.6	33.6	776	814	849	883	.142	.157	.175	.191	7.01	6.38	5.72	5.23
15.0	197	470	233.0	489	32.3	29.7	27.4	721	754	784	812	233.0	543	38.7	36.1	33.8	777	815	851	885	.133	.147	.163	.179	7.48	6.80	6.14	5.58
16.0	200	473	238.0	486	32.7	30.2	27.7	722	756	785	813	238.0	541	39.1	36.6	34.1	778	816	852	886	.125	.137	.152	.167	7.94	7.28	6.58	5.98
17.0	203	476	241.0	483	33.2	30.6	28.1	724	757	786	814	241.0	539	39.6	37.1	34.5	778	817	855	888	.118	.129	.142	.157	8.12	7.75	7.00	6.36
18.0	206	479	245.0	480	33.7	31.1	28.5	725	759	788	817	245.0	536	40.1	37.5	35.0	779	819	856	891	.112	.122	.135	.148	8.86	8.20	7.41	6.76

from these two stations, neither of which are as yet in full running order.

Single generating stations may thus deliver hundreds of millions of kilowatt-hours of electrical energy per annum. Let us roughly block out some preliminary figures for stations of capacities for delivering 10, 30, 90 and 270 millions of kw-hours per annum. By reference to Table IV it is seen that while for the smaller of these stations it will be necessary to install generating sets having 280 kw rated capacity per million kw-hours per annum, the largest station will require but 200 kw rated capacity per million kw-hours per annum. The total rated capacity of generating sets to be installed, the number of sets and the rated capacity per set, are indicated in Table V.

Table V.

Millions of kw hours per annum.	Rated capacity of generating sets per million kw hours per annum, for .5 load factor	Total rated capacity of generating sets to be installed	No. of generating sets to be installed.	Rated capacity of each generating set.
10	280	2800	4	700
30	240	7200	4	1800
90	210	18900	4	4700
270	200	54000	8	6800

With steam generating sets practically as low a rate of steam consumption has been obtained with 1,800-kw sets as with any of larger capacity. Hence, for all but the smallest station estimates can be based on the same average steam consumption. Taking an absolute admission pressure of 13 kg. per sq. cm. (185 lbs. per sq. in.), 50° C. (90° F.) of superheat, and a vacuum of 86.6 per cent (26 in.), a fair figure for the "all-day" steam consumption of the 700-kw sets will be 9.2 kg. (20.2 lbs.) per kw-hour, and for the larger sets 8.5 kg. (18.7 lbs.) per kw-hour.

The next steps in the estimate are set forth in Table VI.

Table VI.

Capacity in millions of kw hours per annum	Steam consumption in kgs. per kw hour.	Tons of steam consumed per annum.	Average tons of steam per hour during year.
10	9.2	92,000	10.5
30	8.5	255,000	29.2
90	8.5	765,000	87.5
270	8.5	2,300,000	262

The next step is to work back from the steam to the coal. Table VII, page 903, shows the properties of steam in terms used in electrical engineering. From this table it is seen that for the assumed standard conditions of pressure and superheat one ton of steam contains 812 kw-hours more energy than is contained in water at 0° C. (32° F.). The temperature of the feed water, however, may be taken as 50° C. (90° F.) since the condensation will be re-employed.

From column 4 of Table VII it is ascertained that 58.1 kw-hours are required to raise one ton of water from 0° C. to 50° C. Hence to obtain one ton of steam at the standard conditions of pressure and superheat, from feed water at 500° C., it will be necessary to impart to the steam 812 kw-hours — 58 kw-hours = 754 kw-hours.

Now the average boiler efficiency will be to a considerable extent dependent upon the size of the station, because the larger the station, the smaller the percentage of the boilers in operation at other than full-load conditions. Hence, for the four plants the average boiler efficiency for the year may be taken at 65, 68, 70 and 71 per cent, respectively. Taking 5 per cent loss in the steam piping for all cases the combined efficiency of boilers and steam piping will be 62, 65, 67 and 68 per cent, respectively.

Thus there must be burned under the boiler a fuel of such quality and amount as to provide during the year the energy of combustion shown in the last two columns of Table VIII.

Table VIII.

Capacity in millions of kw hours per annum.	Tons of steam consumed by generating sets per annum.	Energy to be given to each ton of steam in kw hours.	Total energy to be imparted to steam per year, in millions of kw hours.	Efficiency of boilers and steam piping, in per cent.	Total energy of combustion in millions of kw hours per annum.	Total energy of combustion per hour in kw hours during the year, hours
10	92,000	754	69.4	62	112	12,800
30	255,000	754	192	65	296	33,800
90	765,000	754	576	67	860	98,000
270	2,300,000	754	1730	68	2550	292,000

From the data in Table VIII may be obtained the annual overall efficiency of these generating stations, as shown in Table IX.

Table IX.

Capacity in millions of kw hours delivered from station per annum (S).	Total energy of combustion of coal burned in millions of kw-hours per annum (T).	Annual overall efficiency of generating station $\left(\frac{100\ S}{T}\right)$ in per cent.
10	112	8.9
30	296	10.1
90	860	10.5
270	2550	10.6

From the curves in Fig. 1 it is seen that the best annual overall efficiencies obtained in practice, on plants of 10 and 30 millions of kw-hours annual capacity, are 6.7 and 8.2 per cent, respectively, as against the above-estimated figures of 8.8 and 10.1 per cent.

As the assumptions in developing the estimates for these four stations have been very conservative, it may be said that it would be reasonable to attempt to improve best present practice as indicated by the upper curve in Fig. 1, by at least 33 per cent in stations of 10 million kw-hours annual output, and by some 23 per cent in stations of 30 millions of kw-hours of annual output, as seen from the following equations:

$$\frac{8.9}{6.7} = 1.33 \qquad \frac{10.1}{8.2} = 1.23$$

The results for the annual overall efficiency as arrived at in the last column of Table IX are plotted in Fig. 2.

Returning to the estimates, let us assume that there is used a quality of coal having a calorific value of 8,700 kw-hours per ton.

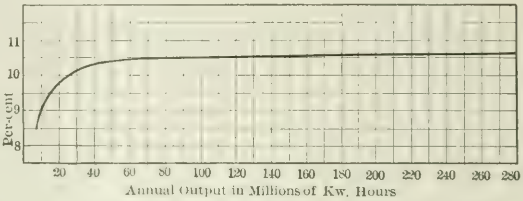


FIG. 2.—ESTIMATED TOTAL EFFICIENCY OF GENERATING STATIONS FROM COAL PILE TO OUTGOING CABLES.

From this figure there is obtained at once the number of tons of coal burned per year, as set forth in Table X.

Table X.

Capacity in millions of kw-hours per annum.	Total energy of combustion per annum in millions of kw hours.	Energy of combustion of one ton of coal.	Tons of coal consumed per year.	Tons of coal consumed per hour (average for year).
10	112	8700	12900	1.47
30	296	8700	34000	3.88
90	860	8700	99000	11.3
270	2550	8700	294000	33.6

In Table XI are derived results for the kilograms of coal burned (of a calorific value of 8,700 kw-hours per ton) per kw-hour of electrical energy delivered from the generating station per annum.

Table XI.

Capacity in millions of kw - hours delivered from generating station per annum.	Kg. of coal burned per annum.	Kg. of coal per kw-hours delivered.
10	12,900,000	1.29
30	34,000,000	1.13
90	99,000,000	1.10
270	294,000,000	1.09

Following these rough preliminary estimates of the quantities involved, the design and arrangement of coal bunkers, coal conveyors, boilers, superheaters, condensing plant, piping, generating sets, cables and switchboards, all require detailed consideration. Into these questions it is not proposed to enter, the purpose of the article having been to lay down a systematic plan of procedure in the design of plant of the type indicated, and to point out that it should be practicable to effect great improvement in the efficiency of most electrical generating stations.

The New Lighting Campaign in Topeka, Kan.

An active campaign for the increase of business has been begun by the Topeka Edison Company. For nine months previous to last July the work of extending this company's business was almost at a standstill on account of negotiations for a new franchise which were going on at that time. On July 14, 1905, the company was granted a franchise for 30 years. At this time new interests took hold, represented by L. E. Myers, of Chicago, and the name of the company was changed from the Edison Electric Illuminating Company to the Topeka Edison Company. The company had never extended its lines into some of the most important residence districts, so that as soon as the new franchise was granted an active campaign was begun not only to increase the business in the downtown districts of the Edison direct-current, three-wire network, but also to secure as much new business among residences on the alternating-current circuits as possible. Under the new franchise a reduction of 40 per cent from the old rate for residence lighting is made. This has been made the text of an active advertising campaign for new residence business.

One of the most effective means of advertising has been a form of portable electric sign, which is placed on one of the company's poles. These signs are changed in location every few days. They are usually placed in residence districts. The novelty of the electric sign in a neighborhood never fails to attract attention, and this is of course the first essential in advertising. These signs are made cylindrical in form to fit around a pole, being split and hinged in the middle so that they can be removed. The sign used at present has a row of lights at the top and bottom, with the reading matter on the face of the cylinder in between. The idea is rather to attract attention by the lights than to make the sign legible at any great distance.

Besides these portable signs a number of large electric signs have been placed on tops of buildings in the downtown district advertising the service. The wording of some of these signs is as follows: "Light up. The price is right." "A contract signed will increase your sales." "Your success depends on electric light." "Edison light means success. Use it." "Get ready. Xmas is coming. Edison light." "Put in Edison light for the holidays."

EDISON LIGHT
IS THE IDEAL HOME LIGHT
IT'S
The Convenient
The Economical
The Safe
The Clean
The Steady
The Odorless
The Matchless
The Cool
The Healthy
The Elegant
The Cheerful
The Brilliant
The Effective
The Decorative
The Flexible
The Summer
The Lawn Fete
The Sick Room
The Clothes Closet
The Library Drop
The Porch
The Conservatory
The Barn
The Coal Shed
The High and
The Low Light.
LIGHT
If not, Why not?
Telephones 369.
REDUCED 40 PER CENT.

FIG. 1.—POSTER.

These are for signs in the business district. The portable signs in the residence district of course have matter appealing more directly to the householder, such as "Edison light will not explode," and other points brought out on some of the circular matter reproduced herewith.

A very effective poster, 18 by 24 in., has been printed in two colors and is reproduced in Fig. 1. A cheap form of poster has frequently been placed on the pole under a portable electric sign and it has been found that people stop to get copies of these. Four pages of a circular sent to residences are reproduced in Fig. 2, and two pages of another residence circular in Fig. 3.

That
Labor-Saving,
Wholesome
Light
40% Less

EDISON
LIGHT
For the Home

NO PIPE

EDISON
LIGHT
A TONIC
Saves Strength
NO WORK
Saves Nerves
NO WORRY
Saves Health
NO ODOR
Saves Lungs
NO FUMES
Saves Eyes
NO FLICKERING

Saves Bills
NO DOCTORS
Saves Furniture
NO HEAT
Saves Curtains
NO SOOT
Saves Paper
NO MATCHES
Saves Money
NO MANTLES
Saves Life
NO DANGER
It's
What We Say
It Is

FIG. 2.—RESIDENCE CIRCULAR.

It will be seen from these that the Topeka management has the art of getting up very attractive advertising matter without great expense for costly designs. The advertising is very plain, direct and to the point. It is doubtless fully as effective as some upon which more money has been spent. The mistake has not been made of trying to crowd too much matter on a page. As gas competition has to be met, a "turn-down" incandescent lamp has been prominently advertised with circulars furnished by the manufacturer having the name of the Topeka Edison Company printed upon them. Another circular, the exact size of a cross-section of a 16-cp Edison lamp, is used, on one side of which is printed the outline of a lamp filament and base, the other side having matter worded somewhat like the poster in Fig. 1.

The new business campaign is being planned and carried out by Mr. C. R. Maunsell, general superintendent, and his brother, F. F. Maunsell, assistant general superintendent, the latter having direct charge of the work. Five solicitors are employed. Advertisements are placed in three of the principal Topeka newspapers, appearing three times each week in two papers and twice a week in one paper.

It has been the plan to concentrate attention in advertising and soliciting on one feature or class of business at one time and then take up another. The results of the first ten days' concentrated campaign in the business district resulted in the addition of 40 customers, which is certainly a remarkable record for a city the size of Topeka and shows what can be done by well planned effort.

Fig. 4 shows the front and back of a card which advertises the rates for residence lighting in a manner easily understood, the power consumption of each common size of lamp being reduced to the basis of cost per hour. In the advertising intended for residence business it will be seen that the point most prominently brought out is the recent reduction in rate. It is human nature to be seeking bargains and as a reduction in rates is in the nature of a bargain not before obtainable, it is a strong point to advertise. Under the company's new franchise the same rates are open to all. While this equity in rates is required by the ordinance, it goes without saying that it is a desirable thing for the company, as it does away with any suspicion on the part of the public that there may be discriminations in favor of some customers. Under the old plan of not publishing rates, even though the same rate might be open to every man, those whose power consumption was of such a nature or quantity as to call for the higher rates would feel that some one else was getting a better rate. A public schedule of rates is a good thing for a company because of the confidence it gives. The rates under the several forms of contracts are as follows:

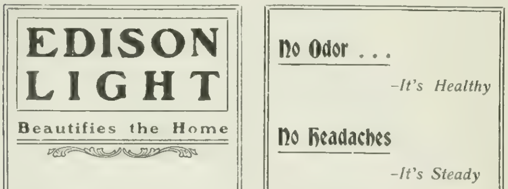
Residence lighting, 12 cents per kilowatt-hour. Commercial lighting, under a monthly contract, is 10 cents per kilowatt-hour, with a 10 per cent discount if the customer owns his arc lamps. The minimum bill for arc lighting is $2 per lamp per month. If the customer owns his arc lamps there is no such minimum.

Yearly contracts under the Wright demand system make a rate of 10 cents per kilowatt-hour for the first hour's use per day of the maximum demand; all in excess of that quantity is 6 cents per kilowatt-hour. Under this contract the minimum rates on arc lamps or equivalent connected load per month are as follows: First two arc lamps, $3 per month each; next three arc lamps, $2 per month each; all in excess of five arc lamps, 50 cents per month each. A 10 per cent discount is allowed if the customer owns all of the lamps and pays for all renewals.

Commercial lighting on the guarantee basis where the customer has ten or more incandescent lights or their equivalent is based on rates according to the following table, in which the first column indicates the guaranteed use per month:

Earnings.	Rates per 1,000 watt-hours.
25 cents.	8 cents.
30 "	7 "
45 "	6 "
60 "	5 "

The power rates are 8 cents per kilowatt-hour for electric elevators. For general motor work the rate is 6 cents per kilowatt-hour for the first 1,000 kw-hours; five cents per kilowatt-hour for the second 1,000 kw-hours, and four cents per kilowatt-hour for the third 1,000 kw-hours. The minimum bill is $1 per connected horse-power up to and including 20 hp. Power up to 3 hp inclusive, where lights and motors are connected on the same meter will be charged at lighting rates. The minimum bill from April 1 to October 1 is 75 cents per month and for the balance of the year $1.50 per month. The consumer has the option of selecting any one of these systems of rates.



EDISON LIGHT

Beautifies the Home

No Work –It's Clean

No Worry –Can't Explode

No Fumes –Just Light

No Soot –Can't Smoke

No Odor . . . –It's Healthy

No Headaches –It's Steady

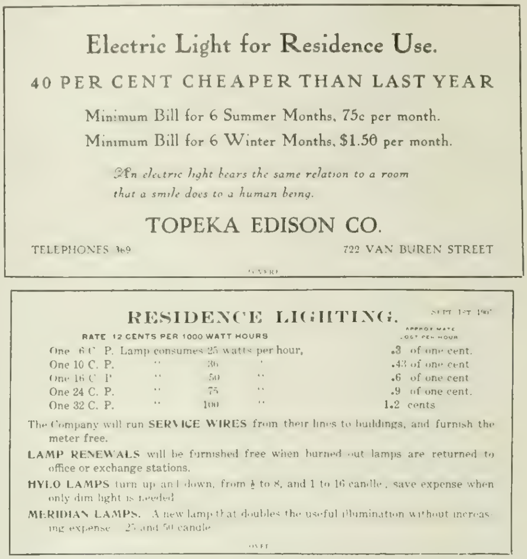
No Matches . –It's Handy

No Heat . . . . –It's Cool.

No Danger . . –It's Safe

FIG. 3.—RESIDENCE CIRCULAR.

The company furnishes steam heat in the business district of Topeka for a distance of three blocks from the station. It is making no effort to extend this business, however, because it is not desirable to increase the steam heat load beyond what can be supplied from the exhaust steam during the day, and more customers want service than can obtain it.



Electric Light for Residence Use.

40 PER CENT CHEAPER THAN LAST YEAR

Minimum Bill for 6 Summer Months, 75c per month.

Minimum Bill for 6 Winter Months, $1.50 per month.

An electric light bears the same relation to a room that a smile does to a human being.

TOPEKA EDISON CO.

TELEPHONES 369 722 VAN BUREN STREET

(OVER)

RESIDENCE LIGHTING. SEPT 1ST 1905

RATE 12 CENTS PER 1000 WATT HOURS

				APPROXIMATE COST PER HOUR
One 6 C. P.	Lamp consumes	25	watts per hour,	.3 of one cent.
One 10 C. P.	"	36	"	.43 of one cent
One 16 C. P.	"	50	"	.6 of one cent
One 24 C. P.	"	75	"	.9 of one cent.
One 32 C. P.	"	100	"	1.2 cents

The Company will run **SERVICE WIRES** from their lines to buildings, and furnish the meter free.

LAMP RENEWALS will be furnished free when burned out lamps are returned to office or exchange stations.

HYLO LAMPS turn up and down, from ½ to 8, and 1 to 16 candle, save expense when only dim light is needed

MERIDIAN LAMPS. A new lamp that doubles the useful illumination without increasing expense. 25 and 50 candle

OVER

FIG. 4.—CARD SHOWING RATES FOR RESIDENCE LIGHTING.

From what has been said about the recently begun campaign for new business in Topeka, it must not be thought that the management has been idle in times past, as it is evident on the downtown streets that the Edison Company has not been giving gas arcs much of a chance, and there is only one isolated plant in Topeka, which is that used for heating and lighting the State Capitol Building.

The company has connected about 1,700 hp in motors, 650 direct-current multiple arc lamps and the equivalent of 40,000 16-cp incandescent lamps. Topeka is now a city of probably about 40,000 inhabitants.

◆

Vaporization of Metals by High Frequency Discharges.

When an electric discharge from a battery of Leyden jars is sent through a wire placed between two glass plates an excessive amount of heat may be generated in the wire in an extremely short time, and this heat is often sufficient to vaporize the wire. The consequent increase in pressure blows the vapor out in all directions, and as it cools it is deposited in the form of finely divided metal with vacant spaces in between. The deposit near the path of the wire is so close that light is reflected from it as from a uniform surface, but a little further from the wire the deposit lies in lines at right angles to the direction of the wire with metal free spaces between. Some tests made under these conditions and recorded photographically are described by F. Braun in a recent issue of the *Annalen der Physik.* A battery of 20 Leyden jars giving a 6-mm. to 8-mm. spark was employed, and wires of tantalum, zinc, carbon, brass, platinum, silver, etc., were dealt with. In the case of an incandescent lamp filament, actual vaporization did not take place, but globules of melted carbon were readily distinguishable under the microscope. In the case of alloys, by suitably adjusting the strength of discharge the several component metals could be separated, the metal of lower melting point being deposited nearest to the path of the wire.

Reflectors, Shades and Globes.—I.

By J. R. Cravath and V. R. Lansingh.

In designing illumination it is usually important to consider not only the location of the lights but the candle-power given in various directions by each light. In other words, we must consider as a unit each source of light together with the reflector, globe or shade which accompanies it before arriving at any conclusions as to the illumination. In the majority of cases where the resultant efficiency is any object, it is desirable to have some means of directing the rays from the sources of light, so that the strongest light will fall where most wanted. Manifestly, it is of first importance in illuminating engineering to know what various types of reflectors, shades and globes will accomplish in this respect. There has heretofore been but little generally available information on the photometric performance of common types of these. The tests given in this and following articles will help supply this need.

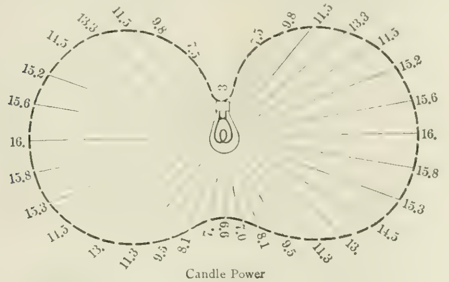


FIG. 1.—SHOWING DISTRIBUTION OF LIGHT ABOUT A BARE 16-CP INCANDESCENT LAMP WITH OVAL ANCHORED FILAMENT.

Reflectors, shades and globes are used for three purposes: (1) Softening and diffusing the light, (2) directing the rays of light in certain useful directions, (3) for ornament. A reflector, shade or globe may combine in one all these three characteristics or it may have only one of them. It is too often the case that the one chosen is not the right thing for the place or is chosen on its general appearance without any attempt to learn what it practically accomplishes in the way of altering the natural distribution of light from the lamp.

The reader can best be brought to realize the importance of a proper choice of reflectors and the great difference between reflectors, shades and globes by a study of tests made on lamps variously equipped showing the amount of light thrown in different directions above and below the lamp. All of the following diagrams were taken from photometric tests made by the Electrical Testing Laboratories of New York.

Fig. 1 shows the candle-power or intensity of the light thrown in different directions, in a vertical plane, from a bare 16-cp oval anchored filament incandescent lamp with a clear glass bulb suspended vertically, as indicated in the diagram, and without any reflector or globe. It is seen that the lamp gives about 16 cp in a horizontal direction. In other directions the light is less. Directly below the lamp, the candle-power is 6.6. It is evident that a bare lamp like this, hung in a room, will show more light in the directions of the walls than anywhere else. Much will also go toward the ceiling. There are certain locations where this is desirable, most notably in small stores, where the shelves and goods hung on the show racks must be lighted as well as the counters. The same is true in warehouses and storage rooms.

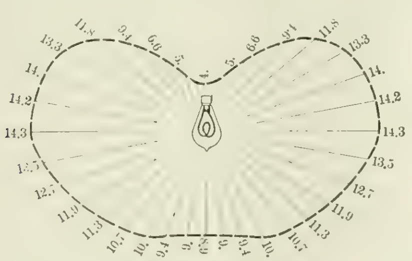


FIG. 2.—DISTRIBUTION OF LIGHT ABOUT A 16-CP INCANDESCENT LAMP FROSTED BY THE ACID ETCHING PROCESS.

Fig. 2 gives the light distribution about an incandescent lamp with a bulb, frosted by being etched with acid. This test was made after frosting the same lamp on which the test (Fig. 1) was made. By the term frosting is here meant the usual process of producing a rough surface in the glass itself by the use of acid, and not the coating or painting of the surface of the glass with white frosting. The latter process, known as dipping, is not satisfactory because unless a thick enough coat is applied to seriously cut down the light the glare from the bare filament is but imperfectly diffused. This test showed the absorption or loss of light due to frosting amounted to 11.5 per cent. Probably there is more loss than this in many cases. In Fig. 1 the mean spherical candle-power from the clear glass bulb incandescent lamp was 13.24. After frosting the bulb as in Fig. 2 the mean spherical candle-power was 11.71. The frosting of the bulb, it is seen, does not change the distribution of light about the lamp materially, but simply reduces the amount of light thrown in all directions except directly below the tip of the lamp, where the candle-power is increased from about 6.6 to 8.9. The loss of 11.5 per cent of the light by the frosting of the bulb is more than made up for in all locations where the lamps are placed within the line of ordinary vision; that is, when their rays fall directly in the eyes. The frosting of the glass diffuses the light so that it does not have the blinding effect that the bare incandescent filament has upon the eyes. Thus, although the actual amount of light may be reduced 11.5 per cent or more, one can really see better, and therefore the illumination is better with the frosted bulb lamps wherever the lamps are so located that the rays fall directly in the eye. For this reason it is desirable to use a frosted bulb in most locations where a bare incandescent lamp is to be used without reflectors or globes of any kind. Thus, in a small store where it is desired to light the shelves as well as the counters, a lot of clear bulb incandescent lamps would seriously interfere with vision because of the blinding effect which has previously been explained. By using frosted bulbs this will be partially overcome. It is much easier to see beyond a frosted bulb lamp which is nearly in the line of vision than to see beyond a lamp with clear glass bulb. In some places where it is desirable to use frosted bulbs, there is so much dirt that their use is inadvisable because a rough frosted glass when it is once dirty is difficult to clean.

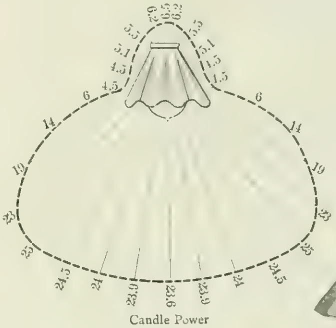


FIG. 3.—DISTRIBUTION OF LIGHT ABOUT A FLUTED OPAL CONE REFLECTOR.

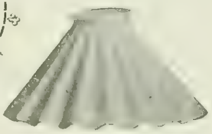


FIG. 3A.

A point open to argument is whether, if a diffusing covering is wanted, it is better to use a frosted bulb lamp rather than a surrounding globe of frosted, ground or sand-blasted glass. The loss by absorption in the surrounding globe is likely to be greater than in the frosting on the glass of the lamp bulb. Tests are now in progress on the relative life of frosted bulb lamps compared to clear bulb lamps enclosed in globes, which will help throw light on this matter.

One thing decidedly in favor of frosted as against clear glass bulbs is their artistic appearance. The light from them is much more pleasing than from the clear bulb, which exposes the filament.

Frosted or sand-blasted glass so diffuses the light as to overcome the streaks which are quite pronounced with the clear glass bulb. These streaks are very objectionable where reading, writing, draughting or any kind of close work is to be done. They cause a strain on the eyes which the user of the light is generally not aware of, and for that reason are specially to be avoided.

Where there is a mixture of daylight and artificial light, that from an incandescent lamp with a clear glass bulb lamp is likely to present a sickly, yellow appearance. This sickly appearance can be very much reduced, if not entirely eliminated, by the use of frosted or sand-blasted glass. This should be remembered in the lighting of stores, halls of hotels and office buildings, and all places where considerable light from incandescent lamps must be used during daylight hours in combination with daylight.

Fig. 3 gives the light distribution about a 16-cp incandescent lamp covered with what is commonly known to the trade as a fluted, opal cone reflector 6½ in. in diameter, the form of which is shown in Fig. 3A. This is one of the best and most efficient of the common, cheap types of reflector. It is useful wherever a large amount of light from the lamp is needed below the horizontal. It so changes the distribution of light about the incandescent lamp as to throw from 23 to 25 cp in all downward directions below 45° from the horizontal. The performance of opal reflectors of this kind depends somewhat upon the density of the opal glass used. The more dense the opal the greater the reflected light and the less that passing through the reflector. This particular reflector is fairly dense and hence lets comparatively little light escape above the horizontal. Enough, however, goes through the reflector to keep the walls and ceiling of a room from being in darkness. Such a reflector can properly be used in all cases where it is not objectionable from an artistic standpoint, and it is desirable to direct the light downward and at the same time allow a small amount of light to go to the walls and ceilings.

This opal cone reflector does not give anywhere near as great a maximum downward candle-power as some of the reflectors which will be shown later, but it illustrates very well what an enormous difference can be made in the amount of light thrown down from a lamp placed in a pendant position by the use of the proper reflector. Thus, for example, this reflector gives a candle-power directly below the lamp (that is, a tip candle-power) or 23.6, and at the angle of 40° from the vertical, a candle-power of 25. The bare lamp would give only 7 cp at the tip and less than 12 at the angle of 40° from the vertical. As lamps are so frequently placed high up in a room on chandeliers or pendants, or sometimes at the ceiling, the importance of directing the rays down so that they will be of use to the occupants of the room is apparent.

The ceilings and walls if light in color have considerable value as reflectors and diffusers. Where maximum efficiency is desired it must be remembered, however, that a reflector to be efficient must fit over a lamp and not be some distance from it, and that further much of the light is not reflected by walls and ceilings in the directions where it is desired, and must be reflected and re-reflected back and forth two or three times with much loss each time before it reaches the place that specially needs illumination.

In Fig. 4 is shown the light distribution about a 16-cp incandescent lamp equipped with a 5-in. opal bell reflector of the type shown in Fig. 4A. This is a very common type of reflector and, as seen from Fig. 4, is excellent for securing general distribution of light in all downward directions where it is not desired to concentrate a great amount of light at any one point. As the lamp bulb projects a considerable distance out of this reflector, it is frequently necessary to use it with a frosted bulb lamp on account of the large amount of exposed filament. If such a reflector is to be used on an ordinary height of chandelier in small rooms, chandeliers should preferably be equipped with sockets pointing straight down or nearly so in order that an unnecessary amount of light be not thrown upward. Such a reflector put on a chandelier with lamp sockets at an angle of 45° will evidently throw much more light upward than is necessary unless there happen to be pictures or other objects high in a room which are to be illuminated

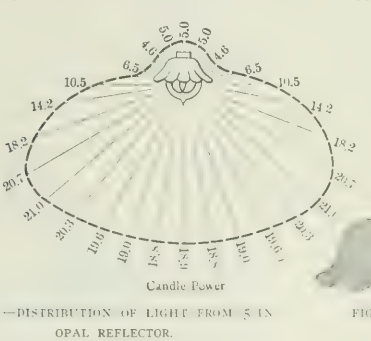


FIG. 4.—DISTRIBUTION OF LIGHT FROM 5-IN OPAL REFLECTOR.

FIG. 4A.

Fig. 5 gives the light distribution about a 16-cp incandescent lamp with an 8-in. metal reflector painted white inside, the form of which is shown in Fig. 5A. This is the kind of reflector so often seen in workshops, draughting-rooms and offices. It is designed to concentrate considerable light below the lamp, and succeeds fairly well in this, as can be seen. For a space 10° each side the vertical, it gives over 36 cp. Being of metal and entirely opaque, of course no light is thrown above the edges of the shade. The serious objection to such a shade as it stands is the extremely streaked light which it casts. In other words, it does not eliminate the streaks which are inherent in the incandescent lamp which is the source of light. Such a shade, if painted inside with aluminum paint, will give a well-diffused light practically free from streaks. Another way of getting over these streaks is to use a frosted bulb lamp. Although the authors have not secured tests on the relative efficiency of the reflector coated with white paint inside as against the reflector coated with aluminum paint, some rough, practical trials have convinced them that there is not enough difference between the white paint and the aluminum paint to be worth considering as far as the amount of light is concerned, while the quality of the light from the aluminum paint is vastly superior because of the freedom from streaks. These cheap metal reflectors are in very common use in draughting rooms and offices, where it is of greatest importance to the welfare of the users that they be not forced to strain their eyes with a streaked light of this kind. If the owners of such shades do not feel able to replace them with some of the more efficient types mentioned later, they can at least afford to have them coated inside with aluminum paint.

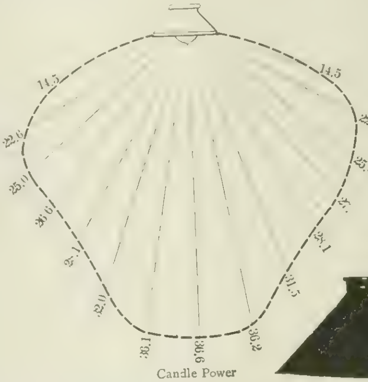


FIG. 5.—DISTRIBUTION OF LIGHT FROM AN 8-IN. METAL REFLECTOR.

FIG. 5A.

Further tests will be given in following articles.

Utilization of Victoria Falls.

The London *Times* announces that the question of utilizing the Victoria Falls for the generation of electrical power and its transmission to the Witwatersrand is receiving close attention at the hands of the African Concessions Syndicate. American and continental engineers are agreed that such a project could be made commercially successful, especially as the climate is most favorable to the scheme, being extremely dry, while there is no ice in the rivers to interfere with the working of the turbines, and no snow to break down the transmission lines. It is estimated that in the dryest season yet experienced 500,000 hp could have been developed. The available head of water is about 330 ft., but a head of 1,000 ft. could be obtained by engineering works of a comparatively light type. This head of water would produce 1,000,000 hp. At present $15,000,000 is spent annually on power on the Rand.

Pennsylvania Independent Telephone Association.

The second annual convention of the Pennsylvania Independent Telephone Association was held at the Monongahela House, Pittsburg, on November 9 and 10, over 200 delegates being in attendance from Pennsylvania, Ohio, Maryland and West Virginia.

At the first session a meeting of the executive committee was held at which various committees were appointed and the programme for the convention arranged. The afternoon session was called to order by second vice-president Charles Griffith, of Johnstown, who presided in the absence of President B. F. Meyers on account of illness. John A. Blair, assistant city solicitor, on behalf of the mayor, welcomed the delegates to Pittsburg and extended to them the courtesies of the city. The annual reports of officers were then submitted. In his report secretary Bradley stated that there are 50 organized operating independent telephone companies in Pennsylvania, all being allied with the association. There are in all 83 independent telephone companies in the State, but a considerable number of them are very small. The companies allied with the association operate 75,899 telephones, and 71,142 miles of toll circuits covering practically the entire State.

Mr. Charles West, of Allentown, general manager of the Consolidated Telephone Companies of Pennsylvania, spoke on the future of the independent telephone movement. He described how the independent movement started and suggested methods of strengthening the position of the independents. There was an interesting discussion at the conclusion of Mr. West's address. Several other addresses were also made during the afternoon session. The independent companies are taking an active part in the extension of lines among farmers. They encourage the farmers to build their own lines and then connect with some established company. By this method the farmer gets service for about $1.00 a month. Mr. West said that his companies send important news items to the farmers over the telephone. Four rings is the signal for everybody to get on the wire and the news is then transmitted to all the subscribers at the same time. The election returns were sent in this manner on the night of November 8.

Officers for the ensuing year were elected as follows: President, C. W. Kline, of Hazelton; first vice-president, Charles Griffith, of Johnstown; second vice-president, James Colins, of Philadelphia; secretary, H. E. Bradley, of Philadelphia; treasurer, C. E. Wilson. Executive committee: Edward Davis, of Philadelphia; Judge R. E. Umbel, of Uniontown; William B. Trask, of Erie; F. D. Houck, of Harrisburg; Charles West, of Allentown; E. D. Schade, of Johnstown; G. B. Ruby, of York, and J. G. Splane, of Pittsburg.

At the morning session of the second day resolutions of sympathy were adopted upon the death of W. D. Barnard, of Philadelphia, first vice-president of the Keystone Telephone Company, who died last September. A discussion dealing with the competition between the independent company and the Federal Telephone Company at Washington, Pa., was concluded, when Mr. C. E. Wilson offered a resolution, which was unanimously adopted, to the effect that the Federal Telephone Company is not an independent company, but is allied either directly or indirectly with the Bell Company.

A banquet was held in the evening, Senator J. S. Weller, vice-president and general counsel of the Pittsburg & Allegheny Telephone Company, acting as toastmaster. Speeches were made by a number of the officials of the various companies represented. The hall was neatly decorated for the occasion with palms, cut flowers and American flags, and covers were laid for 125 persons.

There was quite an extensive exhibit of telephone apparatus and materials which received the interested attention of the delegates. The Pittsburg & Allegheny Telephone Company entertained the delegates during the convention.

◆

English Automobile Stage Lines

Up to the present time few interurban electric roads have been introduced in England, and by some authorities it is now thought that they will encounter sharp rivalry from proposed automobile stage lines. The automobile has already proved its utility in the linking up of villages and small towns which are either not served at all or indifferently served by the railways. It is also being largely adopted in providing direct cross-country services. Along the coasts of England there are hundreds of towns, many of them flourishing seaside resorts, which, while they are connected with inland districts, have no direct railway communication with each other. The motor 'bus is being utilized to supply this want.

One of the largest schemes provides for a service twice a day of motor 'buses along a hundred miles of coast road in North Wales, linking up en route five railway termini, five other stations, seven market towns, seven large villages where cattle fairs are regularly held, 12 coast ports, as well as numerous isolated villages. It is calculated that the annual revenue needed to cover all working expenses of the proposed service, provide for up-keep and depreciation, and pay 10 per cent on the ordinary shares will be secured if the earnings are at the rate of only 50 cents per head a year of a population of 80,000 residents within two miles of the route, and two cents per mile from parcels and luggage.

A double-deck type of car, to hold 34 passengers, has been adopted in London with few exceptions. Experiments were made with the single-deck 'bus, but it was a failure from the commercial point of view, as its carrying capacity was too small to enable the earnings to cover expenses. The success of the larger car is still in doubt, but the results so far justify the continuance of the conversion policy. The average expenditure is estimated to be about one-fifth greater than in the case of the horse-drawn 'bus, but the earning capacity of the motor 'bus is, at least, one-third greater.

In this connection it will be of interest to refer to the illustrated article published in our issue of Oct. 28 last, describing an electric stage, or omnibus, in use on Fifth Avenue, New York City. This vehicle is entirely self-contained, carrying a generator which is driven by a gasoline engine.

◆

A Small Motor Testing Equipment.

By Roy T. Wells, Ph.D.

In much of the factory testing of small electric machines the test runs are short. Some are simply a loading of the machine to full load or overload for a few minutes, to observe the operating behavior as to sparking, etc.; others involve a heat run of a few hours loaded. These machines are frequently tested in the factory by fastening them to the floor and belting them to another machine, a driving motor or load generator according as the machine tested is to be operated as a generator or a motor. In a test of this sort a good deal of time is lost in placing the two machines so that the belt can be adjusted to run properly on the pulley. In a short test the time spent in placing the machines and in adjusting the belt may be a considerable fraction of the time used in the test.

In order to save much of the time lost in this way in a certain factory, the writer was called upon during the past summer to arrange the details of an equipment for the factory testing of small direct-current machines, whereby most of the work preliminary to the real test could be avoided. The general scheme of this equipment had already been decided upon.

Most of the machines to be tested are shunt motors, and these are usually of variable speed, the speed variation being obtained entirely by a variable resistance inserted in the field circuit. Seven sizes are provided for in the plan, the smallest being rated at one hp at a four-to-one speed variation, and at about 2½ hp at constant speed, the largest being rated at 15 hp at a four-to-one speed variation and at 40 hp at constant speed. There are also occasionally generators with the same frame sizes as the motors. The majority of the machines are wound for 110 or 220 volts, a few motors being built for 500 to 575 volts for operation from railway circuits, and also some generators of this higher voltage. The tests include the ordinary heat runs and efficiency tests, usually at the minimum speed, and in the case of variable speed motors, a short full load run at maximum speed to observe conditions as to sparking and balance, and to find the resistance needed in the controller for speed control. Other tests are occasionally called for by the designers, in addition to these.

In all, four testing units were built, two of each of two sizes. Each comprises a table and a switchboard, fitted with all necessary instruments and accessories.

Each table is seven feet long. The smaller for machine sizes one to four inclusive, are 30 in. wide and about 21 in. high; the larger, for machine sizes four to seven inclusive, are 40 in. wide and about 18 in. high. The widths were selected so that the machines will overhang the tables only a little if any, and the heights so that the machines will be at a convenient elevation from the floor for any adjustment, such as setting the brushes, etc., and for measuring speed, applying voltmeter terminals and the like. Both sizes of table are made to take size four machine, a 5-hp motor at a four-to-one speed variation, as this size is made in larger numbers than any other. The tables are framed of 3-in. by 4-in. timbers well braced, and the tops are of 3-in. planking. They are put together with bolts, all bolt heads at the top and on the outside being sunken below the level of the wood.

At each end of the table is a casting fitted to receive a bed movable along the length of the table, so that the beds may be brought together or separated by screws operating the two separately. Each bed has sixteen holes, in four sets of four each, drilled and tapped, each set being spaced to receive the holding down bolts of one of the standard sizes that goes on the table. The sets of holes are so arranged that the central planes of the standard pulleys of all sizes coincide. By this means any two machines of the proper sizes may be placed on the table, belted together, and when the belt is properly tightened it will run steadily, all shafts being parallel and all pulleys having the same central plane. It may be noted in this connection that in this line of machines the holes for the holding down bolts are drilled in jigs, instead of the cheaper but less accurate cored out construction sometimes used, and accordingly can be depended upon to be always in practically the same place in all frames, and to match those drilled to receive the bolts.

Any of the tests for which the outfit is arranged, except a motor run without load, involves the use of a motor and a generator, of which either or both may be actually under test. On this account the switchboard section to accompany any table has a motor and a generator panel, each with the instruments and apparatus for controlling its own machine, and for making the necessary measurements. As a source of power supply, the switchboard is connected to a 110-220-volt, three-wire circuit. When one of the comparatively few machines of higher voltage is to be tested, power is supplied from a factory motor-generator set.

To reduce the field of a motor to 25 per cent of full field, and thus bring the speed up to four times that with full field, requires a resistance of from five to six times that of the field coil, and in series with it. In the case of a 1-hp machine wound for 220 volts, the resistance needed may amount to perhaps 3,000 ohms, while in the case of a 15-hp, 110-volt motor, the resistance needed is small, but it must have a continuous current-carrying capacity of several amperes. This requires on the motor panel of the testing sets under consideration a collection of field rheostats of considerable variety, which are all connected in series, and as much as needed cut into the circuit. These rheostats are partly of high-resistance and partly of large current-carrying capacity. In the field circuit there is also an ammeter, a switch for closing the field circuit and a fuse. The armature circuit has a controller with reversing switch, fuses and two ammeters in series. The first ammeter is of 15 amperes capacity, and is for measuring the current of a motor running light and the load current of small motors, and is provided with a shunting switch, by means of which it can be made inactive when the current is beyond its range. The second ammeter is of a range large enough to carry the current for any motor to be operated from the board, and is left continuously in the circuit. On the motor panel also, before the separation of armature and field circuits, is a circuit-breaker and a double-throw switch for connecting to 110 or 220 volts. The generator panel has a field-circuit arrangement substantially like that of the motor panel, except that there is less resistance and a less variety of rheostats. The armature circuit includes an ammeter, a circuit-breaker, fuses, a set of cast-iron grid rheostats for loading the generator and a double-throw switch with which the generator load can be led to the rheostats or put back on the power line as desired. The load rheostats are placed on the ceiling, above the boards, and have terminal posts on the boards, by which they can be connected in series, multiple or series-multiple, according to the voltage and current of the generator.

Each pair of boards is supplied with a voltmeter having leads long enough so that contact can be made for voltage reading, insulation measurement, etc., at any part of the table. A shelf is placed across the front of the boards at a convenient height, for note-books, papers or any additional instruments, and an overhead crane can place machines at any part of the tables.

A Topical Classification for Electrical Engineering References.

By George Parsons.

Some years ago the writer felt the need of a system for filing notes, articles, catalogues and other references, in which such references could be readily located. The alphabetical system was given a thorough trial, but was found to be too cumbersome. A reference was apt to be lost unless thoroughly cross-indexed, since the wording of the title or subject was easily forgotten or might never have been representative of the essence of the subject matter. A topical or subject system was the only apparent alternative.

Careful inquiry showed no such topical classifications well developed. The Dewey decimal classification was of the right type, but was too meagre. Other unpublished systems in use by different individuals were studied, but were found to be too disconnected or too limited. Having given up hope of finding a system to adopt, the writer arranged the headings in the following order:

The fundamental basis of the arrangement is energy and its transformation, i. e., generation, transformation, transmission and utilization. A few of the sub-heads are much the same as in other systems.

Although this system has been in service for between one and two years the author has not experienced many difficulties with it, and it seems superior to all other systems he has found. It requires a minimum amount of cross-indexing, is fairly connected and logical, and may be made as completely comprehensive as desired. It may readily be adapted as the electrical engineering department of a general system for all subjects as the Dewey classification. It is capable of indefinite development in any part according to the needs of the user, e. g., if he be specially interested in one branch as electric railways, he may expand that part by adding sub-heads as desired.

The headings may be used best with card index and filing cabinets guide cards or tabs. In the appended list this importance is indicated by type and marginal indentation.

An example of the use and advantage of this system is here given: Suppose we wish to file a reference on the Cooper-Hewitt mercury vapor lamp. It is perfectly obvious that this falls under *utilization* of electric energy, and under *lighting* where it is naturally filed with Vapor Lighting. Suppose, also, we wish to classify an article on the Moore vacuum tube light. This, of course, goes in the same location and adjoins the above article on the Cooper-Hewitt lamp. Now, let us suppose that a later date the one who originally filed the references, or any other person who may be ignorant of the names of these vapor tube lights, turns to this place, he will find all articles concerning such illumination systems. A stranger could not find the articles if they were filed in an alphabetical system without a great deal of research. The great advantage over the alphabetical system is seen when we consider that under such an alphabetical arrangement one might file the Cooper Hewitt mercury vapor lamp under either C. H. M, V or L. Similar confusion would occur with the other article and the chances are that the articles would not be found together if one wished to study the general subject of vapor lamps.

The above shows some of the features of the system; the greatest satisfaction can come only by comparative trial of this and other systems. This is submitted in the hope that it may prove of aid to those who may be overwhelmed by the difficulties of preserving and locating notes and data.

GENERAL.

Statistics, Specifications, Design, Laws, Management, etc

GENERATION.

General.
Power plants (General). (Classified alphabetically or otherwise.) (See also "transformation" and "Transmission" for apparatus.)
" Equipment, Design, etc.
Batteries (Primary.) See also Physics. (For Storage or Secondary see "Transformation.")
Generators (Dynamo-Electric) (also "Motors" if a combined article or reference.)

- General.
- Dynamos (See also "Utilization," for Motors).
- Continuous-Current.
- Alternating-current.
- Pulsating-current.
- Double-current (See "Transformation," for Rotary Converter).

TRANSFORMATION.

- General.
- Transformers (Alternating to Alternating current).
  - General.
  - Constant-pressure.
  - Series.
  - Constant-current.
  - Induction Motor as Transformer.
  - " Coil.
  - " Regulator.
- Rotary Converter (Continuous and Alternating-Current)
- Rectifiers. (Alternating and Continuous-Current.)
  - Commutating.
  - Electrolytic.
- Secondary Batteries.
- Boosters.
- Regulators (See also "Transmission" and "Utilization").

TRANSMISSION.

- General.
- Systems.
  - Alternating-Current.
  - Continuous-Current.
  - Composite (Continuous and Alternating-Current).
- Lines.
  - General. Systems, etc.
  - Overhead.
    - General.
    - Conductors.
    - Messenger and Cable.
    - Insulation of.
    - Poles.
    - Cross Arms, etc.
    - Accessories.
  - Underground.
    - General.
    - Conductors.
    - Insulation.
    - Conduits.
      - Manholes, etc.
- Interior Wiring, etc.
  - General.
  - Systems.
  - Conductors.
  - Insulation of wires.
  - Appliances, etc.
  - Conduits.
  - Fuses.
  - Fixtures.
    - Switches and Accessories.
- Switchboards.
  - General. (Classification of, etc.).
  - Power and lighting.
    - General.
    - High-Tension.
      - General.
      - Switches.
      - Meters.
      - Ground Detectors and Auxiliaries.
      - Protective.
        - Fuses.
        - Circuit-Breakers.
        - Lightning Protection.
          - Choke Coils.
          - Arresters, etc.
    - Low-Tension (Regulation and control has heading under "Transmission.")
      - Continuous Current.
        - Switches.
        - Meters.
        - Protective.
          - Fuses.
          - Circuit-Breakers.
          - Lightning Arresters.
      - Alternating-Current.
        - General.
        - Switches.
        - Meters.
        - Ground Detectors, etc.
        - Synchronoscopes.
        - Auxiliary Apparatus.
        - Protective.
          - Fuses.
          - Circuit-Breakers.
          - Lightning Protection.
            - Choke Coils.
            - Arresters.
- Regulation and Control. (See also "Transformation" and Motor Control under "Utilization.")
  - General.
  - Measurement.
    - Systems.
    - Meters.
    - Maintenance.
    - Rheostats
    - Boosters.
    - Regulators.
    - Storage Batteries (See "Transformation").

UTILIZATION.

- General.
- Solenoids, Magnets, etc.
- Heating.
- Medicine.
- Lighting. (See also "Transmission" and "Wiring.")
  - Illumination.
    - General.
    - Systems.
      - Arc. Sub-classify "arc," etc., same as Incandescent.
        - Series, etc.
      - Vapor and Vacuum Tube.
      - Incandescent (See "Transmission" for wiring, etc.).
        - General.
        - Illumination.
        - Economy.
        - Photometry, etc.
        - Kinds of Lamps.
        - Apparatus. (See "Transmission," "Wiring").
- Intelligence and Signal Transmission.
  - Signals.
    - General.
    - Systems.
    - Call Bells, etc.
      - Wiring (See also "Transmission").
      - Appliances.
        - Bells.
        - Buttons and Switches.
  - Telegraphy.
    - General.
    - Systems.
    - Wire.
      - Land
      - Submarine.
    - Wireless.
  - Telephony
    - General.
    - Systems
    - Switchboards.
    - Lines.
    - Protective
    - Other apparatus
- Power.
  - General
  - Systems, etc.
  - Chemistry and direct products (Electrolytic, etc.).
  - Storage Batteries (See "Transformation").
  - Motors.
    - General.

- Systems (Alternating and Continuous Current.)
- Application.
  - General.
  - Shops.
  - Tools and Special Shop Machinery
  - General Machinery.
    - Hoisting, Conveying, etc.
  - Mining.
  - Fans
- Traction
  - General.
  - Systems
  - Canal Towage
  - Automobiles, Electric.
  - Railways
    - General
    - Systems.
      - Installations.
    - Power Plants (See also "Electric Generation").
      - Equipments.
      - Sub-Stations.
    - Transmission (See also "Electric Transmission" above).
      - General.
      - Feeder and Transmission
    - Track.
    - Cars, Trains and Locomotives.
      - General.
      - Equipment.
        - General.
        - Heat.
        - Light, etc
        - Motors and Motive Equipment
          - Motors of Car, etc.
          - Multiple Unit Equipment
          - Locomotives.
    - Stations, Depots, Terminals, etc.
      - Accommodations.
    - Business, Rates, Traffic, etc.
    - Construction, Repair and Test.

A Method of Testing Wireless Receivers.

By Greenleaf W. Pickard.

In the experimental investigation and development of oscillation detectors, it is frequently necessary to determine their sensitiveness to very feeble high-frequency oscillations when a commercial wireless telegraph station is not immediately available for this purpose. In such tests it has been the common practice among experimenters to set up miniature sending and receiving antennae placed a short distance apart, energizing the sending antenna, a simple ungrounded Hertzian oscillator, by means of a small induction coil. With this method the writer has had much unfavorable experience. Owing to the small dimensions of the oscillator, the oscillation frequency is many times that employed in commercial wireless telegraphy, and small changes in the adjustment of the spark-gap length or polish of the knobs greatly changes the amount of radiation. Further, the close proximity of the oscillator makes it difficult to eliminate the disturbing effects of electrostatic induction, which superimposes upon the high-frequency oscillations in the receiving antenna a relatively low-frequency current, often of considerable magnitude. Lastly, it is not possible to make more than the roughest guess at the e.m.f. impressed upon the terminals of the detector, so that quantitative measurements are entirely out of the question.

The method employed by the writer utilizes a closed oscillating circuit adjusted to the desired frequency, which is carefully shielded from the detector under test, but is connected thereto through a circuit of impedance so great that the resistance of the detector forms but a negligible part of the impedance. This is accomplished by inserting a variable air condenser of extremely low capacity in the circuit. Under these conditions the flow of current through the detector is governed solely by the value of the capacity, the impressed e.m.f., and the frequency. As the oscillating circuit, the air condenser, and the detector are separately shielded from each other and from external objects, the electrostatic capacities of these circuits are fixed quantities, with the exception of the air condenser, and movements of the observer are therefore without effect.

The diagram illustrates the arrangement of apparatus, circuits and shields. *M* is a shield of tin or sheet zinc, forming a rectangular box with three compartments, which are fitted with metallic covers or doors giving ready access to the compartments. The compartment on the right contains the battery, key, and induction coil, together with the oscillating circuit. The induction coil, *I*, the spark length of which is preferably one inch or less, charges the condenser, C_1, which discharges across the spark gap, *S*, through the inductance helix, L_1, thereby setting up oscillations of a frequency depending upon the values of the capacity and inductance. One terminal of the inductance helix is connected to the shield, while from an intermediate point along the helix a lead is taken through the detector to be tested, one terminal being connected to the plate, P_2, of the variable air condenser, C_2, in the middle compartment. The other plate of this condenser is made movable, being attached to a stout wire which slides easily in the glass tube leading to the left hand compartment. In this latter compartment is placed the detector to be tested, one terminal being connected to the plate, P_1, of the air condenser, and the other to the shield. The local circuit of the detector passes out of the shield to the telephone receiver or galvanometer, *T*, a suitable choke coil, L_2, being interposed on the air condenser side of the detector.

Although a practically unlimited range of oscillation frequencies may be obtained, it is well to select some one frequency for the tests. In commercial wireless telegraphy, the frequencies may range from five hundred thousand or less up to over a million periods per second, and for the purposes of detector testing, a million periods per second will be found an excellent standard. To obtain this frequency, a small Leyden jar or glass-plate condenser of one thousandth microfarad may be used in the oscillating circuit, discharging through an inductance of twenty-five microhenries. A simply constructed helix having this inductance may be built on a pasteboard mailing tube, two and a half inches in diameter, and eight inches long, by winding on a helix of thirty-six turns of No. 18 copper wire, so spacing the turns that the entire length of the tube is covered by the helix. After securing the ends of the winding, the tube and helix should be dipped in paraffine, both for insulation and to prevent the wire from slipping out of place.

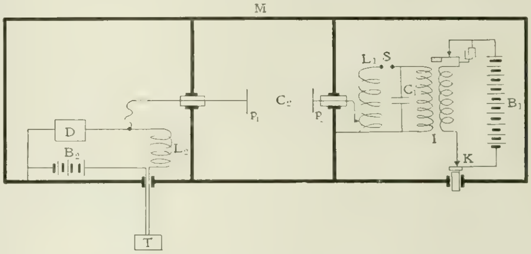


DIAGRAM OF TESTING CIRCUITS.

As shown in the diagram, one terminal of the helix is connected to the shield, while a tap is taken from an intermediate point along the helix to the air condenser. The position of this point determines the potential across the condenser, and in consequence the current through the detector, so that for purposes of rough adjustment several taps should be brought out along the helix. If, as should be the case, the spark-gap, *S*, is set at one millimeter, the potential across the terminals of the helix will be approximately 4,000 volts. Connecting the condenser tap to the first turn from the end connected to the shield, the potential impressed upon the air condenser will evidently be one-thirty-sixth of this, or about 110 volts. Knowing the capacity of the air condenser, the current through the detector may easily be calculated. The detector circuit includes one turn of the inductance helix, L_1, the air condenser, C_2, and the detector, *D*, being completed through the shield *M*. The current in this circuit will evidently be

$$I = \frac{110}{\sqrt{R^2 + \left(\omega L - \dfrac{I}{\omega C}\right)^2}}$$

and, as both R and L are very small relatively to $\frac{1}{\omega C}$, this reduces to

$$I = 110\omega C \text{ amperes.}$$

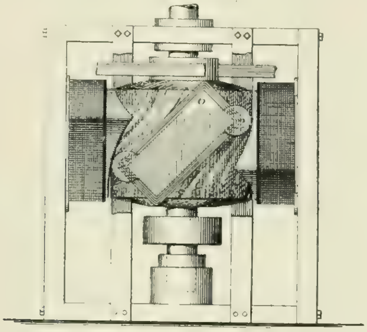
With the exceedingly sensitive detectors now used in wireless telegraphy, the current strength required to give an observable signal is very small. By making the plates, $p_1 p_2$, in the form of metal discs one centimeter in diameter, and separating them several centimeters, the capacity may be reduced to less than one-hundredth of a micro-microfarad, and the current to a fraction of a micro-ampere.

Not only may this method be used for testing oscillation detectors, but it affords a source of oscillatory current suitable for testing tuned receiving circuits, giving current values comparable with those obtained in commercial wireless telegraphy over long distances. As the damping in the oscillating circuit is comparatively small, the oscillations are persistent, corresponding to those used in high-power wireless stations.

◆

Vertical-Shaft Direct-Current Generator.

In a patent issued November 14, Mr. Morris Schwartz proposes to construct direct-current generators with rectangular pole pieces having their major axes inclined at an angle of substantially 45° with the vertical shaft of the machine. The armature conductors are disposed in helixes substantially parallel with the major transverse axis of the pole piece as they pass its face. The force between the armature conductor and the field magnetism is exerted at right angles to the direction of the conductor. The vertical component of this force, which does not represent power, is in a direction to oppose the action of gravity upon the armature, and the step bearing will be relieved of a portion of the weight of the armature, so that the principal frictional resistance is reduced. It is intimated in the specification of the patent that the whole force existing between the armature current and the field magnetism is effective in producing electrical power, while only the horizontal component of the force is represented in the torque which the prime-mover must supply. It would be interesting to learn what efficiency is expected from a machine of this construction.

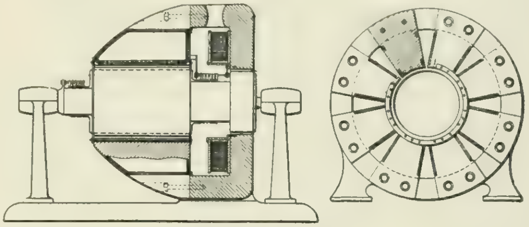


VERTICAL-SHAFT, DIRECT-CURRENT GENERATOR.

◆

Homopolar Dynamo.

A patent issued November 14 to Dr. C. P. Steinmetz relates to the construction of generators of the unipolar type, and deals with details tending to eliminate the armature reaction, which has rendered the regulation of such machine very poor. The armature winding consists of straight conductors, each of which is connected at each end to a collector ring, the circuit being completed through cross-connections between the collector rings external to the armature. The currents flowing in the armature are in the same direction in all of the conductors, and they tend to produce a circular flux, which is mechanically at right angles both to the conductors and to the normal field flux. This circular polarization results in an increased flux density in the field structure, a reduction of the total useful flux and a consequent decrease of the terminal voltage of the machine. The inventor increases the reluctance of the path of the circular flux by means of the polar construction shown in the illustration, wedge-shaped radial air-gaps interrupting the circumferential continuity of the field structure. An interesting feature of the invention resides in the use of shunt-connected field coils for the purpose of compounding the machine. In addition to the normal shunt-connected self-exciting field coil, the inventor uses other coils placed so as to produce at all times a circular polarization opposed in direction to that due to the armature current. These auxiliary shunt-connected field coils are placed so as to produce a constant circular polarization. When the armature is on open circuit this circular polarization will be unopposed, and an increased density will be produced in the field poles. Now, as the armature is loaded the tendency to circular polarization by the current in the armature will oppose the polarization due to the auxiliary field coils. Thus the circular polarization will be reduced, the density will be reduced and the total useful flux due to the exciting field coil will be increased and the terminal voltage of the machine will be raised.



HOMOPOLAR DYNAMO.

◆

LETTERS TO THE EDITORS.

American Inventors and the German Patent Office.

To the Editors of Electrical World and Engineer:

Sirs:—I notice on page 809 of your current volume an interesting letter from the President of the German Patent Office. I believe that we are treated absolutely as well as are the Germans themselves.

During a residence of thirteen years in Germany, I had frequent dealings regarding German patents taken out by foreigners. It was also a part of my routine duty as a managing director of an electric manufacturing company, to supervise the work of its Patent Department. In this connection I often felt that there were plenty of difficulties connected with German patents, and I heard many complaints on the shortcomings of the patent system. From time to time it has met with bitter criticism from well known technologists and patent lawyers. I remember such a criticism published by Dr. von Hefner-Alteneck, and another from Prof. Riedler. Most critics have referred to the lack of definiteness in the practice. There is certainly a feeling that one can never foretell what view of a case the patent office will take. The great divergence in decisions where analogous conditions have existed is bewildering. I have never heard any German deny the desirability of improving the system and more closely defining the rules of practice. I believe, however, that most of the *discontent among Americans, can be traced to the same troubles that Germans complain of.* I believe that the Germans are especially objective and are, as a rule, able to apply themselves impartially to the "materia," without being influenced by external circumstances. My experience with Germans, in general, and my acquaintance with some of those connected with the patent affairs, makes me confident that they do not discriminate against Americans or any other foreigners.

It will be remembered that after the German Patent Office has made its search and decided to grant a patent, the patent draft is laid out for public inspection. The sharpness of trade competition thus enters to increase the severity of the examination. A turbine builder, for instance, is immediately informed by his patent agent in Berlin for an improved turbine about to be patented and naturally makes every effort to find a prior reference. Thus the experts of a whole industry, and not the Patent Office itself, stand responsible for the ultimate refusal or narrowing down of a patent. I remember one case, for instance, where an Englishman doing a large business in his own country, was about to receive a German patent, but he was prevented therefrom by an American. In this way an American who is well informed on the previous state of the art is sometimes in a position to prevent a German from getting a patent.

Instead of sending simply the copy of an American application, it would usually improve the chances of obtaining a good patent if the inventor would send additional explanatory matter. One should select a good attorney in Germany and get into close contact with him directly or through one's American attorney. A good many applications are sent by the American attorneys to some large London office. There they are translated and sent on to German correspondents, thus that sense of direct personal contact is lost which is so valuable in all business. After getting a correspondent in Europe, whose capabilities are known to you, you must trust him to clothe the invention in such a form as to meet his conception of German practice. In translating *language* effectively we not only substitute words, but, at the same time, change from the spirit of one language to that of another. So, too, the essence of an *invention* must be clearly transferred to the European attorney, so that he will understand it and be able to fight for it. The German Patent Office is usually amenable to explanation and enlightenment.

It often happens that, for lack of novelty, the invention as originally proposed, is refused, and the patent, as granted, is narrowed down to details. These alterations, which sometimes are of eminent importance, take place in the course of the routine and frequently fail to come properly to the attention of the inventor or patent owner. The inadequacy of the claims to properly cover the article as put upon the market, frequently, therefore, appears some years later when the inventor attempts to sell his European rights. If all inventors would insist upon seeing the objections of the Patent Office and then assist their attorneys in preparing answers to these objections, the results would certainly be more satisfactory. This is especially true of patent applications on subjects regarding which technical practice is not very well established.

NEW YORK. LOUIS J. MAGEE.

Approximations of the B. & S. Gauge.

To the Editors of Electrical World and Engineer:

SIRS:—I read with much interest the letter of Mr. W. F. White in your issue of October 14, showing a simple slide-rule formula for determining the size of wire to use under the usual conditions. I find, however, that Mr. White's process can be simplified by the elimination of one step, and the result can be reached more directly than he has shown.

To ilustrate the step which is unnecessary let us take an example under Mr. White's rule, assuming the following conditions:

$V = 3.5$ = drop in volts,
$D = 74$ = distance in feet,
$I = 95$ = load in amperes.

From Mr. White's formula (8),

$$n = 36.99 - 10 \ log \frac{V}{D \ I} \qquad (1)$$

substituting,

$$n = 36.99 - 10 \ log \frac{3.5}{74 \times 95} \qquad (2)$$

$$= 36.99 - 10 \ log \ .000498 \qquad (3)$$

From the slide-rule it is seen that

$$log \ .000498 = -4.697 \qquad (4)$$

It is right here that the difficulty arises, because the figure —4.697 is not the *real* logarithm of .000498, and consequently it cannot be used in solving formula (3). This is owing to the fact that the characteristic (—4.) is negative and the mantissa (.697) is positive. The real *log*, therefore, and the one that must be used in the solution of the problem, is,

$$-4.000 + .697 = -3.303 \qquad (5)$$

Substituting this figure in (3) gives,

$$n = 36.99 - 33.03 \qquad (6)$$

$= 3.96$, or approximately No. 4 wire.

This unnecessary step can be eliminated as follows:
From (1),

$$n = 36.99 - 10 \ (log \ V - log \ D \ I). \qquad (7)$$

$$= 36.99 - 10 \ (-log \ V + log \ D \ I). \qquad (8)$$

$$= 36.99 - 10 \ log \frac{D \ I}{V} \qquad (9)$$

Taking the same conditions as before,

$$n = 36.99 - 10 \ log \frac{74 \times 95}{3.5} \qquad (10)$$

$$= 36.99 - 10 \ log \ 2010 \qquad (11)$$

The slide-rule gives directly,

$$log \ 2010 = 3.303 \text{ (see formula [5])} \qquad (12)$$

and substituting in (11),

$$n = 36.99 - 33.03$$

$= 3.96$, or approximately No. 4 wire.

WATERLOO, IOWA. AUSTIN BURT.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Three Phase Motors Operated from Single-Phase Mains. DALEMONT.—An article on the use of three-phase motors on single-phase systems (especially for traction) with the aid of an inductance and a capacity. In connection with his monocyclic starting system, Steinmetz has shown that by varying an inductance and a capacity it is possible to vary the torque of a three-phase motor. The present author discusses the operation of three-phase motors under such conditions, not during starting, but during the continuous running period. By means of Steinmetz's symbolic method he shows that a three-phase motor may be operated advantageously from single-phase mains if connected as shown in Fig. 1, where I, II, III are the three-phase windings of an ordinary three-phase motor, *C* a condenser, *R* an inductance and *A B* single-phase mains. He shows that the phase I is to be connected in a direction reversed to the ordinary one. He then gives the results of some experiments obtained with a small single-phase motor of a normal capacity of 1 hp at 1,500 r.p.m. This motor was first supplied from a three-phase circuit and the results of the tests are given in Fig. 2. Tests were then made with the same motor on single-phase mains, the connections being like those in Fig. 1, but phase I being connected in the ordinary way; that is, in a direct opposite to that in Fig. 1. Finally tests were made with the same motor connected exactly as shown in Fig. 1, the results being given in Fig. 3. Steinmetz has shown that it is possible to change the starting torque by means of this

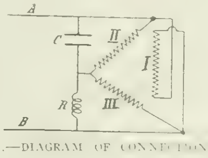


FIG. 1.—DIAGRAM OF CONNECTIONS.

arrangement, while the author says that his tests show that the motor may be operated advantageously in this way for continuous running. He calls attention to the high value of the power factor. He thinks it would be possible to use three-phase motors in this way for traction, only one overhead conductor being required. He remarks, however, that condensers have not yet been introduced to a great extent in engineering practice.—*Elek. Zeit.*, November 2.

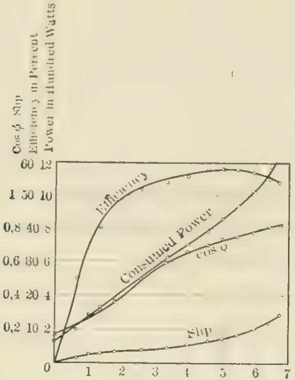


FIG. 2.—TEST CURVES.

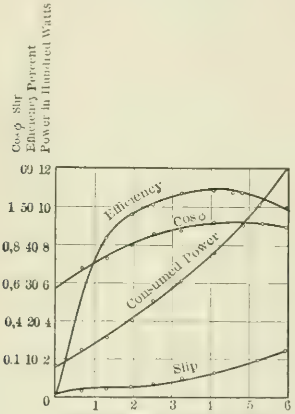


FIG. 3.—TEST CURVES.

Auxiliary Poles for Single-Phase Motors.—A note stating that the Siemens-Schuckert Co. has been granted a Swiss patent for a new method of preventing or reducing sparking in single-phase series motors. It is pointed out in the patent specification that the voltage induced in the coils undergoing commutation by the alternating-field flux lags 90° behind the main current. If the coils on the auxiliary poles were in series with the armature, the flux from the auxiliary poles would pass through zero value at the time the "transformer voltage" in the short-circuited coils is at its maximum. In order to bring the current more into phase with this voltage, the auxiliary coils, together with suitable resistances and choking coils, are connected in shunt across the armature.—Lond. *Elec.*, November 3.

Generators in Parallel.—Boucherot and Mongin.—Two papers presented before the International Society of Electricians in Paris. A brief paper by Mongin proves that the regulator of a prime-mover, acting by centrifugal force, operates like a damped pendulum system. The paper of Boucherot deals with the general problem of the influence of prime-mover regulators on the operation of electric generators in parallel. This problem is discussed mathematically from a very general point of view.—*Bull. de la Soc. Internat. des Elec.*, July.

Liege Exposition.—Reyval.—An illustrated description of a generating set exhibited at Liege. It consists of a 600-hp steam engine, driving a 400-kw direct-current dynamo of the Jasper Company, the voltage being 440 to 480 for a speed of 110 r.p.m. Drawings of the dynamo are given with detailed dimensions.—*L'Eclairage Elec.*, October 21.

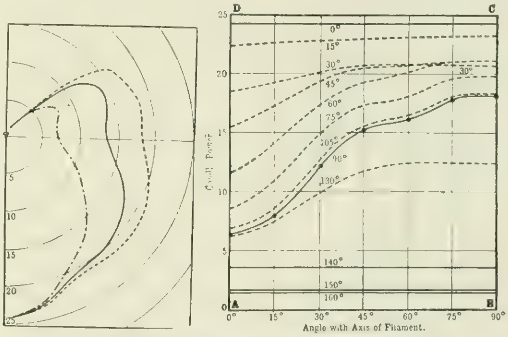
Compensated Repulsion Motor.—Bethenod.—A mathematical note on the theory of the Lehmann compensated repulsion motor, which was recently described in the Digest. The present author offers some criticisms.—*L'Eclairage Elec.*, October 21.

LIGHTS AND LIGHTING.

Absorption by Lamp Globes; Determining the Mean Spherical Candle-Power.—Solomon.—An account of some tests made with Nernst lamps to determine the absorption of light by globes. This was found to be much smaller than is generally assumed. But the author agrees that the Nernst lamp is not very well suited for just such an investigation. The results of tests of a Nernst lamp with 200 volts at 0.96 amp. made by the Allgem. Elek. Ges. is given in the following table:

	No. Globe.	Clear Globe.	Frosted Globe.	Holophane Class A	Holophane Class B
Mean horizontal candle-power	100.5	113.5	95.5	57	91.3
Candle power vertically downwards	20.0	13.5	44.5	177	91.5
Mean hemispherical c p. (upper)	77.0	78.0	74.5	50	41.0
Mean hemispherical c.p. (lower)	8[illegible].0	86.0	82.5	96	100.0
Mean spherical candle power	81.0	82.0	78.5	73	70.5

It will be seen that the mean spherical candle-power is larger for a clear globe than for no globe. This is due to the filament burning in a hot atmosphere if a globe is used, and not being subject to the cooling action of air currents. The author has devised a new method of determining the mean spherical candle-power which is applicable to all unsymmetrical light sources. It is as follows: The distribution of light in three planes was measured experimentally (*a*) the horizontal plane through the filament, (*b*) the vertical plane at right angles to the filament, and (*c*) the vertical plane through the filament. The distribution curves obtained in (*b*) and (*c*) are shown in Fig. 4. The curve consisting of dots and dashes gives the distribution in plane of glower; the curve consisting of dashes only gives the distribution perpendicular to the glower. As the Nernst filament is a straight rod the horizontal distribution curve may be divided into four similar quadrants, and it is necessary in what follows to consider only one such quadrant, the value of the candle-power at the various angles in this being taken as the mean of the values for the corresponding angles in all four quadrants. These values are plotted as a curve (90°, Fig. 5) to rectangular co-ordinates, the abscissæ representing angles made with the axis of the filament and the ordinates representing candle-powers. The mean height of this curve, which can be found by measuring its area with a planimeter, represents the mean horizontal candle-power. Consider now the distribution of light below the horizontal. If a sphere be described around the source of light and be divided into a number of horizontal zones the mean spherical candle-power can be obtained by Rousseau's method, the mean intensity of light on each zone being known. The problem, then, is to find the mean value of the candle-power for each zone, or, in other words, the mean candle-power along the surface of a cone having a given vertical angle, and to obtain this it is necessary to determine the distribution of light for this particular angle. The distribution for a cone having a vertical angle of 0°., i. e., in a direction vertically downward, is obviously a circle, and hence is represented on the curve sheet by a straight line (0°, Fig. 5). For this reason both



FIGS. 4 AND 5.—ABSORPTION BY LAMP GLOBES.

the curves 0° and 90° are drawn in full, as both may be considered as determined experimentally. When passing from the horizontal plane to the vertical, the curve of distribution must obviously change gradually in shape from that of curve 90° to that of curve 0°; but the starting and finishing points of all these curves are already known, since they have been determined in the measurements of vertical distribution in the two vertical planes at right angles. The values found in the plane of the filament are plotted on the ordinate, *A D*, and those found in the plane at right angles to the filament on the ordinate, *B C*. These points are then joined by a series of curves merging gradually from the shape of the curve 90° to that of curve 0°. These curves are shown in the diagram for angles of 15°, 30°, 45°, 60° and 75° with the vertical; they are shown dotted, as only the first and last points are actually observed values. By measuring the area of any one of these curves the value of the mean candle-power is obtained. In a similar way the mean candle-power for angles above the horizontal can be obtained (105° to 160°). If the mean values thus obtained be now plotted as a vertical distribution curve, the full-line curve in Fig. 4 is obtained, which represents the vertical distribution for an axially symmetrical source of light having the same mean spherical candle-power as the lamp, and from which the mean spherical candle-power can be obtained by the usual graphical construction.—Lond. *Elec.*, November 3.

POWER.

Electric Power and Fuel in San Francisco.—The extent to which fuel oil and electric power are entering into manufacturing and all other development and producing enterprises in California is shown by the reduction of coal imports at San Francisco. During the last four years these deliveries have been as follows: 1904, 1,051,072 tons; 1903, 1,215,554 tons; 1902, 1,445,598 tons; 1901, 1,834,785 tons. During the same years the oil production has been as follows: 1904, 29,850,000 barrels; 1903, 23,602,000 barrels; 1902, 13,692,514 barrels; 1901, 8,654,500 barrels. In steam-producing capacity, it requires four barrels of oil to equal one ton of coal. In the four years receipts of coal have decreased 783,713 tons. This would be compensated for by 3,134,852 barrels of oil, but the oil production has increased 21,095,500 barrels, or relatively nearly seven times the decrease of coal. This illustrates the growth in industrial and manufacturing development of California. The State has never in its history imported as much as 1,900,000 tons of coal in a year. In 1904 the coal imports and oil production combined equalled 8,513,517 tons of coal, or in 1904 there was considerably more than four times the available steam-producing power than in 1901. In 1904 there were 85,000 electrical hp in San Francisco, while in 1901 there were about 40,000 hp. Most of the electric power is transmitted from the Sierra Nevada Mountains.—*Jour. of Electricity*, November.

Electricity in Power Engineering.—Esson.—The conclusion of his presidential address to the Civil and Mechanical Engineers' Society on the influence of electricity on power engineering. He discusses the new phenomena introduced into transmission problems by the rise of voltage in recent years. He emphasizes how much electricity has done for the mining industry. "I am not thinking of its use for power distribution in and about coal mines, though on the continent this has now attained gigantic proportions, but of the reduction in operating costs effected by the utilization of distant water power through the medium of electricity, mines which under the old régime could not have been made to pay, have been opened up, while those that previously had just been clearing expenses have been enabled to pay dividends. It is estimated that the Sheba mine saved $50,000 per year by introducing electric transmission, owing to the ore being then crushed in the mine, instead of transported by aerial rope-way to a mill on the bank of a river 2¾ miles away." The paper is concluded by some remarks on turbine and gas engine construction.—Lond. *Elec.*, October 27.

Cranes.—Howlett.—A well-illustrated article on locomotive cranes as labor savers.—*Cassier's Mag.*, November.

Mechanical Stokers.—Bennis.—A paper discussing the advantages of mechanical stokers.—Lond. *Elec.*, October 27.

Peat as Fuel.—Stillings.—A discussion of the use of peat as fuel, with a description of machines for forming peat.—*Electrochem. and Met. Ind.*, November.

Peat as Fuel.—Collins.—An illustrated article on the present status of the peat fuel industry in the United States.—*Scient. Am. Sup.*, November 18.

TRACTION.

Berlin.—Two new projects for railways in the City of Berlin. It is pointed out that in traction facilities Berlin is behind Paris, New York, London, Chicago and Boston. The first project is that of the Grosse Berliner Strassenbahn for two subway roads. The current is supplied through a trolley wire on the upper wall of the tunnel. The second project is for a North-South line, and has been devised by the Continentale Gesellschaft für Elektrische Unternehmungen. This project is very remarkable since it contemplates a suspended railroad of 12 km. length. Along the line contemplated the construction of tunnels would offer considerable difficulties. On the other hand, a suspended road is believed to have distinct advantages over ordinary elevated roads; first, the width of its construction is smaller; it is thought to look better, and finally curves of 50 meters radius can be passed safely at the same speed as curves of 200 meters on ordinary elevated roads. This is the result of the experience with the suspended railway between Elberfeld and Barmen. The latter has been in operation since 1899, has carried 40,000,000 passengers and has fulfilled all expectations to such a degree that the suspended road in Berlin will be constructed on the same system. An idea of the construction may be gotten from Fig. 6.—*Elek. Zeit.*, October 26.

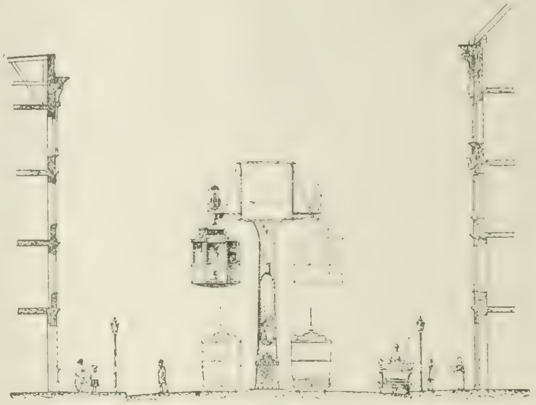


Fig. 6.—Berlin Suspended Railway.

Alternating-Current Locomotives on the New York and Stamford Division.—Sprague.—His reply to some of the criticisms which had been offered against his original criticism of the decision of the New Haven road to adopt alternating-current locomotives for operation on the New York and Stamford division. He maintains his original standpoint and believes that he is "a better friend of rational alternating-current development, applied in a rational way to railway operation, while maintaining that the limit of direct-current operation is by no means reached, than a majority of those who sing its praises on a single strident, but ofttimes unmusical note"—but he is unwilling to see its present injection into the densest section of the train movement of two great railway systems, "with almost inevitable adverse consequences."—*St. R'y Jour.*, November 11.

Tramway Station.—Reyval.—An illustrated description of the Sclessin Station, which supplies power for the electric tramway from Liege to Seraing. It contains two 2,700-hp steam turbines. Each turbine drives an alternator of 1,500 to 1,800 kw, a direct-current dynamo of 750 to 850 kw, giving traction current at 550 volts, and an exciter for both generators.—*L'Eclairage Elec.*, October 14.

Unit of Acceleration.—Mailloux.—A communication concerning some units used in American traction practice. He shows why the American short ton of 2,000 pounds is far more convenient than the English ton of 2,240, and that the only logical unit of acceleration for practical use is the "mile per hour per second."—Lond. *Elec.*, October 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electricity in Department Store.—Weil.—An illustrated article on the electric installation of the Oberpollinger department store in Munich. Comparative estimates showed that the operation of an isolated plant either with suction gas engines, Diesel engines or steam engines would have been less expensive than buying the electric power from the municipal supply network. For this reason a sub-station has been established in the basement of the store. It contains two three-phase, direct-current, 575-hp converters, and a storage battery. For lighting a department store arc lamps have so far been used almost exclusively in Germany. In this case the Nernst lamp has been introduced to some extent on account of its white light and of the artistic appearance of the lamps. Two floors are equipped with Nernst lamps and two with arc lamps, while the other floors are lighted either with arc lamps, Nernst lamps or ordinary incandescent lamps, according to the requirements of the case. There are six electric elevators and a complete telephone, fire alarm and electric clock installation.—*Elek. Zeit.*, October 26.

Electricity at a Modern Hotel.—An illustrated article describing the engineering features of the Gotham Hotel, New York City. Direct current at a potential of 250 volts is used for both lamps and motors. The various motor applications are described.—*Am. Elec.*, November.

ELECTROPHYSICS AND MAGNETISM.

Sodium Vapor.—Wood.—An account of an experimental investigation of the fluorescence of sodium vapor and the resonance radiation of electrons. The author has ascertained the very remarkable fact that the stimulation of the vapor with approximately monochromatic light furnished by a monochromatic illuminator (spectroscope), results in the emission of light, the spectrum of which consists of a number of more or less regularly spaced bright lines of different intensities. The slightest change in the wave length of the exciting light results in the disappearance of these lines, and the appearance of another set; the phenomenon indicating that the molecule contains a number of groups of electrons, the excitation of any one of which sets the entire group in vibration, without, however, disturbing the other groups. As the wave length of the exciting light is slowly changed, the fluorescent spectrum presents a most remarkable appearance. The lines appear in rapid motion, the luminous bands moving in a rippling manner, like moonlight on water. The motion is of course an illusion, due to the continual disappearance and reappearance of the bright lines, the phenomenon reminding one forcibly of the scintillations produced on a screen of zinc sulphide by the electron bombardment produced by radium. Concerning the bearing of his results on our molecular views, the author speaks as follows: "These experiments show in a striking manner the complexity of the piece of machinery which we will call the sodium molecule. Professor Rowland once said that a molecule is much more complicated than a piano. In most cases all that we have been able to do is to strike the entire keyboard at once, but in the case of sodium it seems possible to strike one key at a time. A study of the fluorescent spectra of other vapors will doubtless do much to clear up the mystery of the mechanism of molecular radiation."—*Phil. Mag.*, November.

Linear and Rotating Hysteresis.—Wecken.—There are two different methods by which the magnetization may be made to pass through a complete cyclic process. The first is a continuous change of the magnetizing force, while the direction of the core with reference to the coil remains always the same. The second is a continuous rotation of a magnetized body in a magnetic field of constant direction and constant intensity. In the first case the author speaks of linear hysteresis, in the second case of rotating hysteresis. He has carried out a set of measurements to find whether the hysteresis is the same in the two cases. For cast iron the results are given in the following table:

B max.	*Ar Ergs.*	*Al Ergs.*	$\frac{A_r}{A_l}$	
2,000	455	375	1.214	mean **1.171**
4,000	1.200	1.075	1.117	
6,000	2.160	1.930	1.119	
8,000	3.425	3.030	1.130	
10,000	5.120	4.350	1.176	
12,000	7.220	6.100	1.184	
14,000	10.175	8.530	1.194	
16,000	14.700	11.860	1.240	

B max represents the maximum magnetic induction, *Ar* the hysteresis loss for revolving hysteresis, *Al* the hysteresis loss for linear hysteresis, both these values being given in ergs per cubic centimeter. The last column gives the ratio of the revolving to the linear hysteresis loss. Similar tests were made with steel and cast iron and it was found that this ratio is almost the same in all three cases, the average value being 1.2. It is probable that for higher magnetic inductions this ratio will be larger. Under the supposition that Steinmetz's formula, $A = \eta\, Bmax^{1.6}$, is exact, the hysteresis coefficient η, was determined by the author and is given in curves in Fig. 7. It will be seen that this coefficient is not constant. Even for linear hysteresis, there are evident differences for wrought iron. With rotating hysteresis the formula cannot be applied to high values of the induction. For cast iron the error of the formula is inapplicable either for linear or for rotating hysteresis.—*Zeit. f. Elek.* (Vienna), November 5.

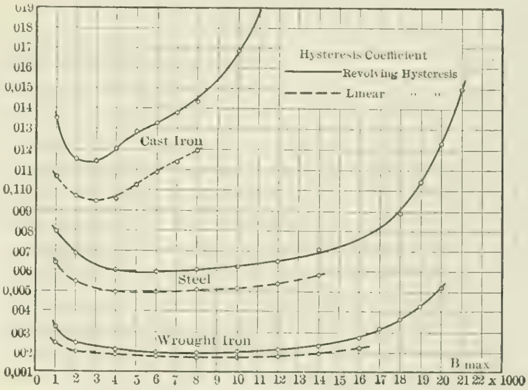


Fig. 7.—Hysteresis Curves.

Magnetic Alloys from Non-Magnetic Metals.—Hill.—An article on the irreversibility of the Hensler alloys. Experiments were made by him with an alloy containing about 60 per cent copper, 25 per cent manganese and 15 per cent aluminum. A rod formed of this alloy was tested at varying temperatures, the same being first increased and then again decreased. The results are shown in Fig. 8. Beginning at *A* with an intensity of *I* = 311 c.g.s., the curve falls till it reaches the axis at *B*. The temperature was carried 33° higher, bringing the curve to *C*. On cooling the line leaves the axis again at *B*, but does not return to *A*, but to a lower value at *D*, *I* = 267. With the second heating the curve lies above that for the first cooling, and does not come to the axis at *B*, but crosses the former heating curve at *E*, and when heated to 500° C. retains a slight susceptibility, *I* being equal to 7. After falling the second time to 17° C., the intensity was only 27; that is, the susceptibility was only 0.32. A reading was taken with the specimen in liquid air, giving *I* = 36. This remained unchanged when room temperature was again reached.—*Phys. Rev.*, November.

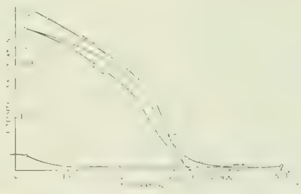


Fig. 8.—Curves Showing Results of Tests with Alloys.

ELECTROCHEMISTRY AND BATTERIES.

"Kupron" System.—In notes on the recent Olympia Exposition in London a large assortment of various articles manufactured by the "Kupron system" of a British company is mentioned. These articles varied in size from a small "flush" switch cover to an entire shop front. The process of manufacture is an exceedingly simple one, and it is only the development of it in this particular direction that is at all novel. First of all, the electric light fitting, or whatever it may be, is modeled in clay and the clay is then covered with a thin film of blacklead. By immersing the latter in a copper bath a layer of copper of any desired thickness is electrolytically deposited on the mould. The finish is bronze, silver, gold or any other style and the amount of labor entailed by the process is said to be very small. "The chief advantage of the process is the low cost of

the finished article, electric light fittings and other things of a similar kind costing not more than half what they would have cost if produced in the ordinary way." The process adapts itself to plating articles of very different shape.—Lond. *Elec.*, October 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing Earth Connections.—CORSEPIUS.—For safety purposes frames of electric machines, etc., are often earthed. The purpose of the earth connection is to make sure that any currents which may pass from the frame, etc., to earth will pass through the earth connection and not through a person who may be in contact with the frame. If such earth connections shall be effective, it is necessary to keep them in good order and to test them regularly. The author points out that tests made with small voltages, such as used with the testing bridge and the telephone, are not so reliable as tests made with higher voltages. In the case of an alternating-current installation the author recommends to use the supply current itself for testing, of course, through the intermediary of the transformer, while for direct-current testing a small storage battery is used. Two different connections are shown for testing, one for direct-current testing and the other for both direct and alternating-current testing. By his method he has found the following values: An earth connection consisting of a large 1 by 1.5 meter sheet iron plate with a copper cable, screwed and soldered to it at various places, had a resistance of about 7 ohms. Wire used as earth connections, as is often done with lightning rods, had a resistance of about 50 ohms. Lead pipes, of 20 mm. external diameter, 10 meters long and embedded in a trench 1.2 meters deep, showed resistances of about 6.5 to 8.5 ohms, and are considered by the author as quite advantageous. Underground pipes which belong to a large network, such as water pipes and gas pipes, have a very low resistance.—*Elek. Zeit.*, October 19.

Anti-Vibration Suspension.—JULIUS.—The author who is the inventor of the anti-vibration suspension named after him, points out that its principles are not yet sufficiently grasped by manufacturers. It must fulfil five conditions to be effective. The three wires of the suspension must be of equal length, equally loaded and perceptibly stretched. The center of gravity of the whole suspended body must be in the horizontal plane containing the bearing ends of the wires. Those parts of the apparatus whose freedom from disturbance is most important must be near the center of gravity. Vertical shocks must be eliminated by introducing a short length of spiral spring into each wire. And, lastly, the proper vibrations of the suspended body must be damped by liquid immersion or cotton wool, mounted in the plane containing the center of gravity. If the apparatus on the suspension must be frequently handled it is best to have a clamping device. This consists of a triangular frame mounted on a table and surrounding the triangular plate of the suspension on all sides within 1 cm. A screw projects through each side of the frame, and when one of the screws is driven home it urges the suspension against the two others. The three screws then hold it until the manipulation is completed.—Lond. *Elec.*, October 27; from *Ann. der Phys.*, No. 11.

MISCELLANEOUS.

Death by Electric Shock.—KRATTER AND JELLINEK.—Abstracts of two papers presented before the recent meeting of the German Naturalists in Meran. Kratter finds that death by electric shock is due to a kind of internal suffocation. The passage of 100 milliamperes through a human body is dangerous and often causes death. The seriousness of an accident depends on the resistance of the human body, which may vary between several hundred thousand ohms and a few thousand ohms. This variation of the resistance explains why men have been killed by little more than 100 volts, while others were not killed by several thousand volts. Jellinek described experiments which he had made with animals, and pointed out that an electric shock causes disturbances of vital functions which may be again revived. For this reason it seems probable that in many cases death by electric shock is only an apparent death. The importance of exact statistics of accidents due to electric shock was pointed out in the discussion.—*Elek. Zeit.*, November 2.

Annual Meeting of Westinghouse Managers.

The annual convention of the district managers of the Westinghouse Electric & Manufacturing Company was held November 13-16, at the general offices of the company at East Pittsburg. Mr. R. L. Warner, New England manager of the company, acted as chairman of the meetings, which were attended by the following representatives of the company: C. S. Powell, general agent, New York City; W. F. Zimmerman, representative, New York City; Maurice Coster, manager export department, New York City; W. C. Webster, assistant to second vice-president, New York City; F. H. Shepard, New York City; G. Pantaleoni, general southwestern manager, St. Louis, Mo.; J. R. Gordon, manager, Atlanta; H. H. Seabrook, manager, Baltimore; D. E. Manson, manager, Boston; C. W. Underwood, manager, Buffalo; T. P. Gaylord, manager, Chicago; C. W. Regester, manager, Cincinnati; G. B. Dusinberre, manager, Cleveland; J. E. Johnson, manager, Dallas; L. M. Cargo, manager, Denver; C. F. Medbury, manager, Detroit; T. J. McGill, manager, Minneapolis; C. A. Bragg, manager, Philadelphia; W. F. Fowler, manager, Pittsburg; D. E. Webster, manager, St. Louis;

GROUP PORTRAIT OF WESTINGHOUSE DISTRICT MANAGERS

W. W. Briggs, manager, San Francisco; M. P. Randolph, manager, Seattle; Paul T. Brady, manager, Syracuse.

At the opening session, which was held Monday morning, addresses were delivered by Mr. E. M. Herr, first vice-president of the company; by Mr. Frank H. Taylor, second vice-president, and by other officials. During the four days of the convention papers on topics of general interest were read by many of the officials and managers and by representatives of allied companies. On Wednesday evening the delegates and representatives of the local Westinghouse companies were entertained at the Hotel Schenley by Mr. Herr.

At no time in the history of the company have the managers spoken with more enthusiasm of the business conditions in their respective territories. Among these opinions expressed were the following: "I have it from the lips of a representative of one of the largest commercial interests in South America that the people in those countries would rather buy American machinery than buy European goods." This statement was made by the manager of the export department. Speaking further on the prospects for export business, Mr. Coster said: "The outlook for foreign trade has never been brighter in this country than at present. The superiority of American machinery as compared with European manufacture is being demonstrated every day, and in these markets where the Germans and English have heretofore enjoyed a monopoly, America is now gradually obtaining the lion's share of the business. As far as the Westinghouse Companies are concerned, we are enjoying the particular advantage that the name of Westinghouse is well known the world over: that our goods are used in every country on the globe, and hence we have no difficulty to obtain business for our companies."

Mr. F. H. Taylor, second vice-president, said: "I feel that this is a subject of congratulation, not only to ourselves, but also to the entire business interests of Pittsburg, that the prospects for prosperity in our works never will be brighter than at present. While we are already in possession of the facts which prove that the year of 1905 has been the banner business year in the history of the factory, we have every reason to believe from the assurances given us by our district managers from all over the country, who have now been in session here, that the industrial advancement throughout this country promises an unprecedented activity, and that our company will reap the benefit of this activity in a measure perfectly satisfactory to the company. I look for the business of 1906 to be materially larger than that of 1905."

Signal Service Annual Report.

Gen. A. W. Greely, chief signal officer of the army, in his annual report, advance copies of which have just been issued, says the Signal Corps can furnish all equipment necessary for 10,000 miles of communication. Studies of war in South Africa and Manchuria have shown deficiencies in the American army only in connection with the fire control of field artillery. Direct telegraphic communication is now established with five military posts in Alaska. The commercial business has netted $100,000 during the past year and, it is estimated, will be increased to $200,000 annually. The submarine cables of southeastern Alaska are 2,300 miles long.

Gen. Greely says the gradients of ocean depths were found most abrupt instead of gradual, as was indicated by existent soundings. Speaking of the wireless work in Alaska between Nome and St. Michael, Gen. Greely says: "This is the only wireless telegraph system in the world, it is believed, that is regularly operated as a part of a telegraph system handling commercial business. On August 6, 1904, it completed a year of uninterrupted service over its course of 107 miles. It has handled daily and uninterruptedly the entire telegraphic business of Nome and Seward Peninsula, which, together with the official business, averages several thousand words daily. More than a million words were sent during the year, many thousand being commercial code words in which no error has ever been traced to this section. In a single hour there have been transmitted over this section 2,000 words without error or repetition. Capt. Wildman was retained at Nome throughout an arctic winter to insure continuity of operation and the successful training of the enlisted force."

During the year there were 134,630 messages besides considerable free official business. Gen. Greely says: "It was deemed proper to relieve the isolation of Alaskan life by furnishing daily the approved news bulletin to each military post and station and by granting a strictly limited use of the line in intercommunication on social subjects between the different military stations."

Gen. Greely does not speak encouragingly of the detail system which he says he has loyally endeavored to carry out for the past three years. "As volunteers have failed conscription was necessary in the case of the sixteen officers already detailed (in the Signal Corps) of whom fully one-fourth have endeavored to evade service through personal or political influence," says Gen. Greely, and adds:

"It is suggested that the entire commissioned force of the army, excluding the permanent technical corps, be arranged in one lineal list below the grade of brigadier general. Through a system of annual retirement a suitable flow of promotion and elimination by retirement, as is done in the navy, of officers, incompetent, either morally or professionally, would then be practicable, and thus materially improve the service. Distinguished services could then be rewarded, without marked discrimination against equally competent officers who have not had opportunities, through advancement by files, the recipient being an extra number confirmed by the Senate."

Electrically Operated Capstan.

Among the interesting exhibits representing the Belgian industry at the Liege World's Fair may be mentioned the electrically-operated capstan shown by the Compagnie Internationale d'Electricite as indicated in the accompanying illustrations. Fig. 1 gives a general view of the exhibit, the foreground being occupied by the capstan and its magnetic controller. The capstan is separately shown in Fig. 2, from which it may be seen that the motor and gear transmission are properly balanced on an iron plate which is conveniently pivoted so that the lower part can be brought outside, and the machinery can be reached when necessary or desirable.

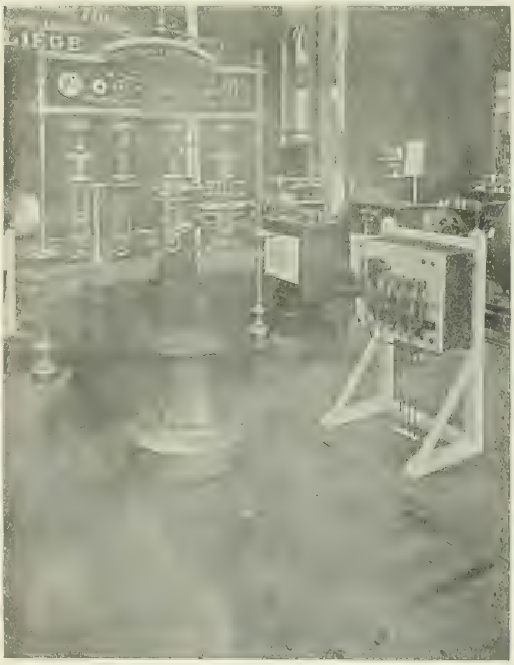


FIG. 1.—VIEW OF CAPSTAN AND CONTROLLER.

The controller, which is illustrated in Fig. 3, works automatically when the projecting rod shown in the floor plate, Fig. 1, is depressed by the foot of the operator. The five magnetic switches close successively; the left-hand one closes the circuit through the controlling resistances which are then gradually short-circuited by the section switches which follow from left to right. An oil dash-pot serves for securing a proper speeding up of the capstan. A spring brings back the rod when the foot pressure is released. The stopping of the motor is greatly assisted by an electric braking effect, obtained by disconnecting the motor from the line and converting it into a generator which sends current through resistances so regulated that one-fifth of a turn is sufficient for stopping the capstan. The motor is provided with compound windings, for avoiding an excessive speed.

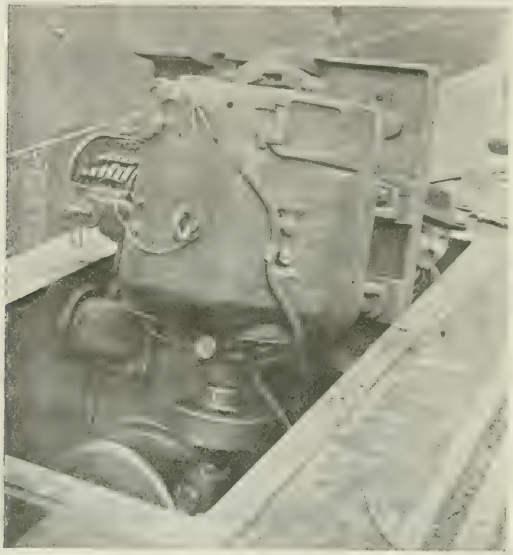


FIG. 2.—VIEW OF MOTOR FOR DRIVING THE CAPSTAN.

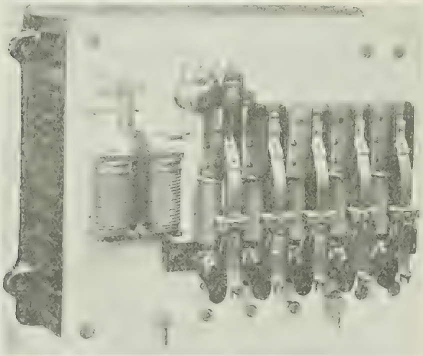


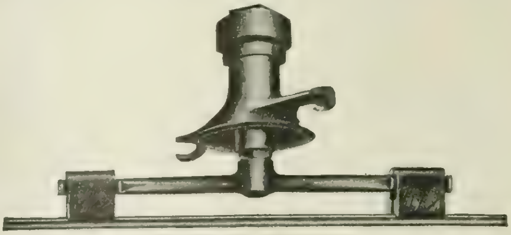
FIG. 3.—AUTOMATIC CONTROLLER FOR CAPSTAN MOTOR.

◆

Flexible Suspension for Grooved Trolley Wire.

When trolley wires are rigidly suspended there is a tendency to break near the ends of the ear, owing to the continual and abrupt flexure of the wire at such points, caused by vibration of the free spans. This tendency is aggravated with soldered ears on account of the effect of the heat in impairing the mechanical strength of the wire locally. A device to overcome this trouble has recently been brought out in England by the British Thomson-Houston Company, and is known as the B. T.-H. patent flexible suspension ear.

The wire is held in mechanical clamps, so supported as to allow practically free movement in any direction without producing unnatural curves or abrupt bends, while preserving an even path for the trolley wheel and firmly supporting the wire in position. The upward movement of the wire and clamps, caused by the trolley wheel in passing under the ear, is practically parallel, and since the clamps are capable of a limited longitudinal displacement on the supporting bar, the wire takes up a natural curve without abnormal stresses in any part of its section. This form of suspension also obviates the objectionable hammer blow which takes place when the trolley wheel passes on to a suspension ear of the ordinary rigid type. These flexible ears are supplied either with a mild steel drop-forged body, with drop-forged clamps, or with a mild steel drop-forged galvanized body, with gun metal clamps.

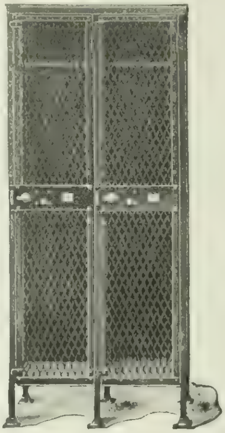


TROLLEY WIRE SUSPENSION.

◆

Expanded Metal Lockers.

Although much thought has been devoted to rendering office buildings secure from exterior fires, little attention had been given to the possibility of fires starting within. The so-called fire-proof building is poorly made if filled with combustible wooden furnishings. It is in this connection that the great value and utility of steel equipment is shown. In order to meet the demand for fire-proof furnishings for office buildings, telephone exchanges and central stations the Edward Darby & Sons Company, of Philadelphia, has designed the Pen-Dar system of interior equipment, consisting of metal lockers, shelving, partitions, tables, etc., which are not only absolutely fire-proof, but are sanitary, and add materially to the cleanliness, neatness and appearance of any building in which they may be placed.



EXPANDED METAL LOCKER.

The Pen-Dar expanded metal locker, shown in the accompanying illustration, is especially worthy of notice. The locker is built up of sheets of steel plate, which are cut, expanded and then rolled in such a manner that they present smooth surfaces, entirely free from rough edges or corners. This style of locker allows a free circulation of air, and, therefore, is thoroughly ventilated. Each locker is equipped with one shelf, three nickel-plated coat hooks, individual brass number plates, and special three-point locking device, which securely fastens the door at the top, center and bottom with a single turn of the locking lever.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The industrial and commercial situation continues very satisfactory. Reports indicate a further increase on the volume of business, and orders are being received for distant delivery, while buyers experience much difficulty in making purchases for prompt shipment. The approaching holiday trade, coupled with the colder weather, has caused heavy distribution in practically every section of the country except in the Northwest, where unseasonably high temperatures prevail and where the railway congestion prevents fullest development of trade. Railway earnings are very heavy, but the widespread blockades are assuming a serious phase and tend to curtail production in some industrial lines. The earnings for the first week in November were 4.9 per cent larger than they were in the corresponding period last year. All manufacturing lines keep up their high record of activity, the only discordant note being scarcity of labor in a few instances. The consumption of iron and steel goes on at a high rate with every indication of its continuance, and outdoor construction is being conducted on an extraordinary scale. Collections on the whole are classed as good, and the demand for money is generally increasing. Some raw materials, cotton and some grades of wool have lost strength, but this does not detract from the activity in nearly all manufacturing lines. Cotton is being held at the South for higher prices, and in that section the financial and industrial conditions are more satisfactory than they have been for years. In the great basic industries a further hardening of pig iron is noticeable. Plate mills are full of business and premiums for early delivery are the rule. Contracts for over 100,000 tons of steel rails were awarded during the week. Railway car builders are active, and lumber, hardware and builders' materials are in heavy demand. Copper has advanced in price. Lake closed at 16 3/16c., electrolytic 6¾c. and casting stock 6½. *Bradstreet's* reports 198 failures in the United States for the week, against 166 the previous week, and 190 for the corresponding week of 1904. The Middle States had 72, New England 33, Southern 30, Western 32, Northwestern 13, Pacific 10 and Territories 8. About 90 per cent of the total number of concerns failing had capital of $5,000 or less and 6 per cent had between $5,000 and $20,000 capital.

POWER FOR LOS ANGELES, CAL.—Mr. A. K. Detwiler, former Toledo capitalist, but now a resident of California, is interested in a corporation being formed for the purpose of erecting a power plant ninety miles from Los Angeles. Mr. Detwiler is heavily interested in telephone and electric properties in the Golden State, and is now giving his whole time to their development. The Express of Los Angeles says: "Besides entering the field as a producer of electricity the proposed company will also build dams and lay pipes for the distribution of 7,500 in. of water to certain points. Mojave River Valley will be the chief scene of the new corporation's operations. A. E. Poole, of Los Angeles, who has been at work quietly upon the project for many months, has secured the agreement of Philadelphia and Ohio capitalists to an organization for the purposes named, and incorporation papers will be filed within a short time. Mr. Poole says that his company already has secured all riparian rights to cover a watershed in the San Bernardino range and connecting lands amounting to 400 square miles. In order to develop the water and latent power a huge dam is to be constructed at Victor Narrows, which forms an immense natural reservoir. At that place will be constructed a plant which will develop 15,000 hp in electricity. It will cost in the neighborhood of $800,000 and will be completed within two years." The cost is estimated at a total of $6,000,000.

AN INDUSTRIAL ENGINEERING DEPARTMENT.—The Crocker-Wheeler Co. announces the establishment of an industrial engineering department, in which is concentrated all its work in the line of industrial engineering as applied to railway shops, machine shops, and industrial plants of every description. The company were among the first manufacturers to recognize that even high-class electric motors and generators should be accompanied in every case with sound engineering advice to the purchaser. Each sale of a motor has meant with it that a motor-drive problem has been successfully solved by a group of engineering experts. The company is not only "manufacturer" but "electrical engineer." Among those who have availed themselves of the services of Crocker-Wheeler Co. in this line are the Lake Shore & Michigan Southern Rd., John Simmons Co., Bucyrus Co., Ansonia Brass & Copper Co., American Bridge Co., Pittsburg & Lake Erie R. R., Joseph Dixon Crucible Co., Ingersoll-Sergeant Drill Co., etc. Mr. J. K. Warner Davenport, E. E., formerly a consulting engineer making a specialty of industrial work, has become associated with the company in order that its growing activities along these lines may be handled in as thorough and satisfactory manner as heretofore. Mr. Davenport and his staff of assistants are at the present time giving personal attention to several important industrial propositions.

PORTLAND GENERAL ELECTRIC.—H. W. Goode, president of the Portland General Electric Company, has left for New York and various Eastern manufacturing centers to arrange for the purchase and shipment of a complete new lighting apparatus, which is to be installed in Portland without delay. Mr. Goode says that the Portland General Electric Company will have work on the new system under way by January 1 and should have it completed by July 1. Under the new system Portland will have metropolitan street lights throughout the city. Every one of the 1,200 carbon arc lights will be replaced by magnetite arc lights. The cost of installing the new system, Mr. Goode stated, would be about $100,000. It will necessitate new apparatus in the sub-station at Seventh and Alder Streets, and require the rearrangement of the company's entire system.

BELL TELEPHONE OUTFIT.—The following is the Bell telephone instrument statement for October:

	1905.	1904.	1903.	1902.
Gross output	193,272	113,760	111,740	92,601
Returned	60,073	50,772	49,885	37,155
Net output	133,199	62,988	61,864	55,446
Since December 31:				
Gross output	1,494,330	990,369	923,978	900,935
Returned	517,478	425,697	408,716	383,844
Net output	976,852	564,672	515,262	517,091
Total outstanding	5,457,416	4,344,189	3,665,582	3,042,697

This would indicate 2,728,708 sets outstanding, or, roughly, 2,500,000 subscribers. The October gain is the largest in the year, and the increase during the year to October 31 is no less than 1,113,227 instruments.

MONARCH ELECTRICAL & MANUFACTURING COMPANY.—Messrs. K. E. Pew, of Warren, and J. F. Bonnell, of Youngstown, have, according to local prints, purchased 100 of the 130 shares of stock in the Monarch Electrical & Manufacturing Company, of Warren, O., and will continue the business of the company under the same name, and at the same location. The capital stock of the company will not be increased, but the company expects to enlarge its business and manufacture the old line of Monarch lamps, but will give its attention principally to the Monarch burst cluster. Employment will be given to a number of hands. The company will reorganize immediately and Mr. K. E. Pew will be elected as general manager.

ENGINEERING IN MEXICO.—The Federal Engineering & Construction Co., of Mexico City, has become the Federal Engineering Company. The capital is $25,000, gold, and the new concern will handle the construction work on all kinds of large engineering enterprises. It will also do general consulting work, giving special attention to hydro-electric development. The company has already been awarded several contracts, one being for $75,000 of material for the new aqueduct which is to supply water to Mexico City. The officers are Epes Randolph, president; A. H. McKay, vice-president; Milton T. Thompson, general manager, and Andres Horcasitas, secretary. The address is San Juan de Letran, No. 3.

CHICAGO ELEVATED ROADS.—The Chicago Northwestern Elevated is in the market for 8,000 tons of structural steel for its Ravenswood extension. Northwestern Elevated traffic this month will show an increase of 8 to 10 per cent. Since the first of November the Chicago Metropolitan Elevated has carried on an average of about 135,000 passengers as compared with 115,000 daily during November, 1904. The Beach Amusement Park, when opened, will add from 10,000 to 15,000 fares daily.

OCTOBER TRADE.—The Bureau of Statistics reports the foreign trade for October, showing exports of $154,398,872 and imports of $107,518,065, or an excess of exports of $46,880,806. The exports are the largest for this year, and the imports are the heaviest on record, except those of last March. The total exports for ten months are $1,256,950,246, and the total imports $979,987,820. The exports are slightly below those of October, 1904 and 1903.

HIGHER PRICE FOR BELTING.—An increase of 10 per cent in the price of leather belting has been decided upon by the National Leather Belt Association, which is composed of the leading belting manufacturers of the country. Since the introduction of automobiles, the demand for leather has greatly increased. In addition to this, it is said the raw material costs more now than ever before.

STANLEY FACTORIES.—It is stated from Pittsfield, Mass., that the Stanley Electric Manufacturing Company has secured options on several pieces of property in the vicinity of the Beaver Street shops. It is probable that the company will fill up all their land with saw tooth buildings or possibly with one or more big shops.

NAVAL ARCHITECTS AT SCHENECTADY.—Following the general convention of the Society of Naval Architects and Marine Engineers, held in New York Thursday and Friday of last week, guests to the number of 135 boarded a special train at the Grand Central Station early Saturday morning for Schenectady. The special train on arrival at Schenectady was switched into the yards of the General Electric Company where breakfast was served on the train. The visitors were then escorted in groups through the works in charge of representatives of the company. For the information of the visitors, a pamphlet was distributed which illustrated the marine section of the company's products and works, including a diagram of the route of inspection. The morning was spent in inspecting the various shops, including those devoted to the manufacture and test of the Curtis steam turbines which were of special interest to the visitors, as were the searchlight projectors and other applications of electricity to marine service. The society members of the General Electric Company were in charge of the trip and the entire matter was handled by Mr. J. W. Kellogg, head of the Marine Department of the company. After the morning spent in the works, the train was again delivered to the New York Central and the guests returned to New York City in the afternoon.

Financial Intelligence.

THE WEEK IN WALL STREET.—With the decline of money rates the prices of stocks recovered, although there was considerable depression and liquidation in the early part of the week. Bullish manipulation of both industrial and railroad specialties had the effect of causing a rally in prices. The United States Steel stocks sold off with the general list at first, and, although they recovered later on, were not especially prominent. The local traction issues continued heavy on the uncertainty of the political situation in New York City, but were not the objects of any particular pressure. The electric securities with the rest of the market showed more firmness and scored advances. Allis-Chalmers common made a net gain of 1⅜ and preferred ⅞, the closing quotations being 20⅜ and 62⅛, respectively. On aggregate sales of 5,200 shares General Electric advanced from 181½ to 186, and closed at 185½, which is a net gain of ½ point, Westinghouse common closed at the highest figure of the week—172—this being an advance of 2 points; preferred, however, lost 7 points, closing at 190. American Locomotive common ranged between 64 and 60¼, and closed at 67¾, which is a net gain of 1½ points, while preferred lost ½ point, closing at 114. Among the traction list Brooklyn Rapid Transit gained 7 points, closing at the highest figure—81¾. The sales of this stock aggregated 346,800 shares. Metropolitan Street Railway touched 118⅛ during the week, but receded and closed at 116⅛. Interborough Rapid Transit made a net gain of 3⅛ points, closing at 212. Western Union closed at 92⅞, a decline of ⅛-point. The curb market developed considerable strength in sympathy with the Stock Exchange list. The features were Chicago Subway, Interborough and the Copper shares. The closing quotations on the Stock Exchange November 21 are as given herewith

NEW YORK

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
Allis-Chalmers Co	20	20¾	General Electric	182	187¾
Allis-Chalmers Co. pfd	62⅜	62¾	Hudson River Tel		..
American Dist. Tel	37	37	Interborough Rap. Tran	207	212
American Locomotive	67⅜	69¼	Mackay Cos.	48½	50¾
American Locomotive pfd	114	117¾	Mackay Cos. pfd	72	72¼
American Tel. & Cable	93	91	Marconi Tel.	.	
American Tel. & Tel.	133	134	Metropolitan St. Ry	117½	115¾
Brooklyn Rapid Transit	76¼	87⅛	N. Y. & N. J. Tel.	.	
Electric Boat	32	32	Western Union Tel	92⅞	92¾
Electric Boat pfd	70	70	Westinghouse com.	175	169
Electric Vehicle	15	14	Westinghouse pfd		..
Electric Vehicle pfd	20	20			

BOSTON

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
American Tel. & Tel	134	135½	Mass. Elec. Ry. pfd	56	56
Cumberland Telephone	122½	122⅝	Mexican Telephone	1⅛	1½
Edison Elec. Illum.	245	*246	New England Telephone	134	134½
General Electric	182	186	Western Tel. & Tel.	13	13
Mass. Elec. Ry.	13¼	13	Western Tel. & Tel. pfd	89	90¼

PHILADELPHIA

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
American Railways.	53	53	Phila. Electric.	8⅝	8⅞
Elec. Co. of America.	11⅝	11½	Phila. Rapid Trans.	26¾	31¼
Elec. Storage Battery	78	81	Phila. Traction.		.
Elec. Storage Battery pfd.					

CHICAGO

	Nov. 14	Nov. 21		Nov. 14	Nov. 21
Chicago City Ry	200	200	National Carbon	60	69
Chicago Edison		..	National Carbon pfd	115	114
Chicago Subway.	.		Union Traction.		.
Chicago Tel. Co.			Union Traction pfd	..	.
Metropolitan Elev. com	28½	27			

* Asked.

ANNUAL REPORT OF BOSTON & WORCESTER.—The annual report of the Boston & Worcester Street Railway Company for the year ended September 30, 1905, showed that the company earned 6 per cent upon its capital stock after allowing liberal charges for taking care of its track, roadway and equipment. The company is planning to complete the double-tracking of its line through Framingham Center in the spring at a cost of approximately $150,000, and then the road will be double-tracked the entire distance between Boston and Worcester. The management of the Boston & Worcester Company anticipates, that, with the completion of the double-tracking, the gross earnings for the first full year after such completion will reach $600,000 without taking into consideration any earnings from the express and parcel business. For the fiscal year ended September 30, 1905, the company's lines carried 9,110,000 passengers, as compared with 8,000,000 the previous year, and its cars ran 1,820,575 car miles, as compared with 1,793,163 car miles the previous year.

ALBANY TROLLEY PURCHASE.—It is stated from Albany that the United Traction Company, controlling the street car system of Albany, Troy, Rensselaer and Cohoes, is to be sold to a purchaser, who, it is understood, represents the Delaware & Hudson interests. The sale was announced after a protracted meeting of the directors of the United Traction Company, as the result of two years' negotiations, in which Anthony N. Brady represented the stockholders of the company. A circular issued to the stockholders announces that the sale is to be made at $150 a share, available for all stockholders who shall deposit their stock before November 28 with the National Commercial Bank of Albany and that it is conditional upon the surrender of at least 51 per cent of the entire outstanding capital stock before that date. Rumors have been current for months that the New York Central interests were after this system, but is is stated on high authority that the Central is not concerned in this purchase. A price of $150 a share represents a total purchase of $7,500,000 for the stock.

DIVIDENDS.—The directors of the Washington Railway & Electric Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable December 1. The directors of the Philadelphia Electric Company have declared the regular semi-annual dividend of 2½ per cent, payable December 15. The regular quarterly dividend of 2 per cent has been declared on the stock of the Kings County Electric Light & Power Company, payable December 1. The directors of the American Graphophone Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable December 14. Directors of the Rochester (N. Y.) Railway & Light Company have declared a dividend of 1 per cent on the preferred stock payable December 3. Directors of the Kansas City Railway & Light Company have declared the regular quarterly preferred dividend of 1¼ per cent, payable December 1. The Philadelphia Electric Company has declared a regular semi-annual dividend of 2½ per cent., payable December 15.

THE PHILADELPHIA CO.—It is said that a new holding company will be formed to purchase control of the Philadelphia Company. For each $50 share of common stock of the Philadelphia Company the new company will offer $37.50 in collateral trust bonds secured on Philadelphia Company stock, and $20 in common stock of the new company. The new company will also guarantee to pay after three years $90 per share for the new stock, making $18 per share for the amount of new stock received by each share of the Philadelphia Company common. The Philadelphia bonds and capital stock aggregate about $55,000,000.

NEW YORK SUBWAY.—The quarterly report of the Interborough Rapid Transit Company shows a deficit of $117,741 for the elevated roads for the three months ended September 30. The surplus for the Subway was $227,560, so that the quarter's surplus from the operation of both divisions amounted to $109,820. This compares with a surplus of $411,310 on September 30, 1904, nearly two months before the Subway was opened. Gross earnings of the Interborough Company for the quarter were $3,905,097, an increase of $672,148 over the corresponding period last year. Operating expenses increased $598,352.

PITTSBURGH TELEPHONE.—The Central Dispatch & Printing Telegraph Company announces that 10,000 shares of treasury stock, with a par value of $1,000,000, is offered to stockholders at par (100). The company is capitalized at $15,000,000, and $10,000,000 is outstanding. Stockholders of record November 29 will have a right to subscribe for the new stock on a basis of one share of new stock for every ten shares of the old held. The right to subscribe expires January 18, 1906, and payment must be made on or before January 31, 1906.

General News of the Week

The Telephone.

SEARCHLIGHT, CAL.—A. M. Joy is here for the purpose of installing a local telephone exchange, reaching all the mines in the vicinity of Searchlight, and a long-distance line between this place and Nippeno.

SAN FRANCISCO, CAL.—The Standard Electrical Construction Company, of this city, has contracted to install a complete central energy telephone system for the Del Monte Hotel at Monterey, Cal., and to re-wire the main hotel building for about 5,000 lights. It has been decided to abandon the plans for installing an isolated electric power plant, and power will be purchased from the local electric lighting and street railway company. About 400 telephones will be installed about the hotel and grounds. The central energy switchboard, telephones, etc., with flash signals, will be supplied by the De Veau Telephone Manufacturing Company, of New York.

NORWICH, CONN.—The Southern New England Telephone Company is having plans made by L. W. Robinson, of New Haven, for a new building to be erected in Norwich.

MERIDEN, CONN.—The Southern New England Telephone Company is making extensive improvements in its service throughout Connecticut. New switchboards are being installed in New London, Stamford and South Norwalk. Many private branch exchanges are also being installed in the principal hotels throughout the State.

HARTFORD, CONN.—Application has been made for a charter for the Citizens' Telephone Company of this city. This is an independent company and will have a capitalization of $1,000,000, with the privilege of increasing this to $10,000,000 as necessary. Mr. D. A. Reynolds of the State Line Telephone Company, of New York City, is one of the leading promoters in the enterprise.

WEST PALM BEACH, FLA.—Dr. Liddy, of this city, and associates will apply for a franchise to construct and operate a telephone system.

BURLINGTON, IA.—The city council has voted to allow the Iowa Telephone Company to place its wires underground.

VIENNA, ILL.—The capital stock of the Interior Telephone Company of Vienna has been increased from $300 to $50,000.

SPRING VALLEY, ILL.—The Spring Valley Telephone Company has been incorporated with a capital stock of $10,000, by E. M. Bayscar, S. H. Brakel and Charles W. Knapp.

MULBERRY GROVE, ILL.—The Mutual Telephone System has been organized here with a capital stock of $2,500. The incorporators are: D. W. Brunson, J. S. Jones and L. Bosberne.

MONTICELLO, IND.—The Monticello Telephone Company has made a deal with the Bell Telephone Company for toll connections. All Bell telephone lines will come in over the local company's switch, and all Bell telephone booths in the town will be removed and long-distance transmitters and receivers will be installed when desired.

INDIANAPOLIS, IND.—At a meeting of the directors of the New Long Distance and the Indianapolis Telephone companies, both of which have recently changed hands, it was decided to expend all the money necessary to better the local switchboard facilities and provide for furnishing telephones immediately to those who apply for them. The local service has been handicapped in this particular, and it is the intention of the new management to see that everything necessary is done to make the service all that could be asked.

AUGUSTA, MICH.—The Citizens' Telephone Company has opened an exchange at Augusta, using the automatic system.

SAULT STE. MARIE, MICH.—Local business men have started a movement to organize an independent telephone company to fight the Michigan State Telephone Company. A raise of rates from $18 to $24 by the Michigan company is the cause.

CADILLAC, MICH.—The organization of the Wexford County Independent Telephone Company has been completed. The company is capitalized at $1,000 and expects to increase the capitalization to $5,000. The officers are: President, G. A. Lake; vice-president, A. B. Southick; secretary, D. L. Rose; treasurer, R. D. Fredrick.

DETROIT, MICH.—The executive committee of the Municipal League has passed a resolution to the ffect that in its opinion a second telephone system is not needed in this city; that one company with the highest grade service and reasonable rates is the ideal; that to establish a second telephone service as a protective measure against possible future bad service and extortionate charges of the one company is at this time unnecessary; that such a company can be established when the necessity arises and it is found that such second company will be the only remedy.

PORTLAND, ME.—The South Porto Rico Telephone Company has been formed here with a capital stock of $30,000. The officers are H. L. Cram, president; A. F. Pine, treasurer, and C. D. Booth, clerk, all of Portland.

STARBUCK, MINN.—The White Bear Lake Telephone Company will establish an exchange in this place.

COLOGNE, MINN.—The Norwood Young America Telephone Company has installed an exchange here.

PINE CITY, MINN.—The Northwestern Telephone Exchange Company has been granted a franchise for a local exchange.

GLENWOOD, MINN.—The Glenwood Telephone Company, with a capital of $12,000, has been incorporated by H. A. Wollan, C. T. Wollan, P. Peterson, C. C. Wollan and H. D. Peterson.

ST. JAMES, MINN.—The officers and directors of the St. James Telephone Company have purchased the local exchange from the Southwestern Minnesota Telephone Company, the price paid being $6,000.

BROWNING, MO.—The Browning Telephone Company has been incorporated and the following named officers elected: President, H. C. Taggart, Linneus; vice-president, J. C. Green, Browning; secretary, A. C. Hutchinson, Purdin; treasurer, H. F. Young, Purdin.

TRENTON, N. J.—A committee of directors of the Interstate Telephone Company has been appointed to readjust the affairs of the corporation because of the default of interest on the company's bonds last July. The committee was empowered as a voting trust to secure an adjustment of the company's affairs on an 80 per cent. basis.

BATH, N. Y.—The Bradford Telephone Company has been incorporated with a capital stock of $2,000. The directors are: Theodore W. Chase, of Bath; F. G. Ovenshire, of Urbana, and Edgar Sanford, of Bradford.

SYRACUSE, N. Y.—The franchise offered by the Inter-Oceanic Telephone Company of Buffalo, asking permission to construct a conduit system and plant poles, in connection with the establishment of an exchange in this city, has been rejected by the common council.

ROXBORO, N. C.—The Morris Telephone Company of this city has been incorporated, with a capital stock of $100,000.

CARRINGTON, N. D.—The North Dakota Telephone Company, with a capital of $50,000, has been incorporated.

ELK CITY, OKLA.—The United Telephone & Telegraph Company, of Elk City, has been incorporated with a capital stock of $100,000. The following named gentlemen are directors: C. T. Patterson, M. T. Spurlock, M. Scannell, W. T. Patterson and E. M. Scannell.

NEW BEDFORD, PA.—Residents of New Bedford have held a meeting for the purpose of organizing an independent telephone company to affiliate with what is known as the Citizens' Company, doing business in Sharon, New Castle and other Pennsylvania cities.

PITTSBURG, PA.—The Central District & Printing Telegraph Company has secured control of the Farmers' Telephone Exchange, of Lowell, O., and the franchise of the Murraysville Telephone Company at Export, Pa. The deals will give Pittsburg connection with new territory. The Lowell Company covers five townships in Washington County, O., and has 180 subscribers on its list. The Murraysville Telephone Company is located in Westmoreland County and the line is now being built. The company has 140 subscribers, most of whom are farmers.

PHILADELPHIA, PA.—The Bell Telephone Company, of this city, and the American Telegraph & Telephone Company, of New York, are placing 75,000 miles of wire underground between Wilmington and New York. The cost is estimated at $2,500,000, and more than 1,500 men are at work. It is proposed to have 50,000 miles of wire in operation before the end of the year. Eight ducts, carrying a large cable, are to be placed underground between this city and New Brunswick. A similar number are being laid to Wilmington. It has been planned to have two trunk lines between this city and New York as soon as possible.

SPRINGFIELD, TENN.—This place is now in the throes of a very hot telephone war. The Cumberland people and the Home or independent, are both circulating petitions, the former asking the people to say that one telephone was all that was wanted, and that two would be a nuisance, while the latter is asking the people to sign it because it would be far-reaching and give better service and lower rates. The Home wants to come here and put in an exchange and will put up its own building, and proposes to spend thousands of dollars in Springfield and this county and nearly all the business people here signed their petition. There is now no doubt that Springfield will in the next few weeks have the two systems in operation.

BLOOMING GROVE, TEX.—The Blooming Grove Telephone Company has been incorporated with $5,000 capital stock, by J. H. Jones and others.

BRONTE, TEX.—The Dixie Telephone Company, of Bronte, Cooke county, has been formed; capital stock $10,000. The incorporators are: B. H. Rand, Bascom Lynn and D. A. Lynn.

SPOKANE, WASH.—The Commercial Club at Lewiston and Clarkston favors the proposal made by the Pacific States Telephone Company to improve its service, and the independent company, which had 1,000 subscribers pledged, will retire from the field.

PULLMAN, W. VA.—The Washburn Telephone Company has been incorporated with a capital stock of $20,000 by J. O. Nay, Pullman; J. H. Lininger, W. R. Heservie, Okey E. Butter and A. J. Wilson, Harrisville, W. Va.

GREEN BAY, WIS.—The Brown County Telephone Company has been formed with a capital of $10,000. The incorporators are: Henry F. Hagemeister, C. A. Straubel and Frank J. B. Duchateau.

KENOSHA, WIS.—The Kenosha Home Telephone Company, with capital of $175,000, has been incorporated by Alonzo Burt, Milwaukee; Jas. Cavanaugh, Frank Slosson, Kenosha. The new company is to take over the plants of the Wisconsin and Citizens' Telephone Company and will unite the two.

MILWAUKEE, WIS.—The Milwaukee Retail Druggists Association has voted against the proposal of the Wisconsin Telephone Company to make a contract for its entire membership, giving the Wisconsin Telephone Company the exclusive right to install telephones in their places of business for five years.

Electric Light and Power.

PRESCOTT, ARIZ.—The McCabe Water, Light and Power Company has been incorporated with a capital of $50,000. The incorporators are H. A. Suttle and Hiram F. Todd, of Peoria, Ill. Place of business, Prescott.

JACKSON, CAL.—Geo. C. Bruce and F. H. Harding have located 20,000 miners' inches of water on the north fork of the Bokelumne River for electric power purposes.

RIO VISTA, CAL.—J. S. McDonald, representing the Rio Vista Electric Light and Power Company has been granted the privilege of erecting poles on the streets and a lease on certain town property on which he wishes to build a power plant.

SAN DIEGO, CAL.—For the purpose of developing electric power the Fletcher-Salmons Investment Company has filed upon 25,000 miner's inches of water near the head of the San Luis Rey river, and upon 20,000 inches near the head of Pauma Creek. Deeds to the same company convey 1,300 to 1,400 acres of land at South Oceanside and Carlsbad.

SAN BERNARDINO, CAL.—The Lytle Creek Power Company has been awarded the contract for lighting this city for the next five years. The company will immediately commence the erection of a power plant in Lytle Creek Canyon, and the building of a pole line to this city will commence at once. A franchise has already been secured.

SAN FRANCISCO, CAL.—The Redwood Manufacturers' Company, which is doubling the capacity of the electric power house supplying power for operating its factories at Black Diamond, Cal., has closed a contract with the National Electric Company for a 250-kw, 3-phase, 500-volt generator. A Hamilton-Corliss engine, supplied through Chas. C. Moore & Co., will be direct-connected to generator.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation has made a great deal of progress on the gas-engine reserve plant at the corner of Walbridge and Schwerin Streets, but will not have the electric generating units ready for operation before February, owing to a delay in the completion of some parts of the engines. The frequency changers will be installed in time so that electric power can be furnished for the operation of the United Railroads cars in the city under the contract beginning Jan. 1, 1906. One of the three units will be kept in operation all the time, and in case of any interruption of the current on the water-power transmission lines which furnish the main supply of power, the other gas engines will be started up. The new plant can also be depended upon to "boost up" the transmission lines when there is a shortage of power from lack of water or other causes. Wharves and other improvements have been put in on the Bay shore, opposite the plant, to facilitate the handling of supplies and materials. The gas works power house and equipment will cost about $1,000,000.

YALESVILLE, CONN.—A committee has been appointed to act on the proposed electric lighting of the village.

THOMASTON, CONN.—It is reported that the railroad company has bought the Thomaston plant on Electric Ave., or at least has secured a controlling interest. The company intends to use it in connection with the trolley road.

ENFIELD, CONN.—The Enfield Gas Company has purchased the plant of the Windsor Locks Electric Light Company. It is stated to be the purpose of the company to use the present water power for the generation of electric power and install gas engines for furnishing such additional electric power as is wanted.

COLUMBUS, GA.—The lighting committee of the Council will investigate the cost of a municipal lighting plant.

ATLANTA, GA.—The Southern Light & Power Company has petitioned Council for a franchise. It will get its power from the plant of the North Georgia Electric Company, at Gainesville, and transmit it to Atlanta.

GALESBURG, ILL.—The People's Electric Power Company has been incorporated with a capital stock of $2,500. The incorporators are Charles S. Harris, Addison P. Higgins and Frank W. Harris.

BLOOMINGTON, ILL.—The Union Gas & Electric Company of Bloomington has increased its capital stock from $400,000 to $750,000.

STREATOR, ILL.—The People's Light & Railway Company and the Streator Gas & Light Company, two large local corporations, have been combined, the recently incorporated Illinois Light & Traction Company being the purchaser. The latter corporation is capitalized at $400,000, and, in addition to extending the local lines will build an interurban road connecting Streator and Ottawa. Negotiations are pending for the purchase of the street railway plants and the lighting plant at Ottawa.

TERRE HAUTE, IND.—The result of the recent municipal election has prompted the city authorities to take steps to build a new municipal electric light plant. Alvin M. Higgins is president of the Board of Public Works.

FORT WAYNE, IND.—The Fort Wayne Electric Works have recently shipped a 100-light generator to the California Polytechnical School at San Luis Obispo, Cal., and two 60-light generators to Pittsfield, Mass.

ZIONSVILLE, IND.—Zionsville Water & Electric Light Company will construct an electric light plant and will be in the market for the entire equipment excepting for power.

LINDSAY, I. T.—A series of falls in the Washita River have been examined by experts who pronounce them of sufficient capacity for the development of electric power. The matter will be taken up at the next meeting of the city council.

AFTON, IA.—The citizens have voted to issue bonds for the construction of an electric light plant.

LINCOLN CENTER, KAN.—It is proposed to construct an electric light plant and water works at a cost of $34,500. No engineer has been selected as yet. Address, the Water Works Committee, Lincoln, Kan.

PORTLAND, ME.—The Portland Lighting & Power Company is making an important addition to its plant at Deering.

WINCHESTER, MASS.—The Edison Electric Illuminating Company has lately taken over the business of lighting the streets and houses of Winchester, which service was formerly performed by the Woburn Light, Heat & Power Company.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has petitioned the State Board of Electric Light & Gas Commissioners for permission to increase its capital stock from $50,000 to $80,000, for the purpose of making extensive repairs at the plant in this place.

LENOX, MASS.—It is stated that the State gas and electric light commission is to be asked to investigate the Lenox Electric Light Company's charges for light and power. For several years complaint has been heard against the rates made by the company to consumers.

NEW BEDFORD, MASS.—A petition, circulated by the Board of Trade among the largest local consumers of gas and electricity, asking the gas and electric light commission to investigate the affairs of the New Bedford Gas & Electric Light Company, with a view to securing a reduction in rates, has been presented to the commission. The board has granted a hearing, which will be held in this city.

FAIRVIEW, MICH.—Village Trustee Matt Kramer is interested in the construction of an electric light plant.

HOUGHTON, MICH.—The Superior Construction Company, of Houghton, has been awarded the contract for the construction of the municipal lighting and power plant at L'Anse.

MARSHALL, MICH.—The Gas & Electric Development Company, of Philadelphia and New York, reports the sale of the plant at Marshall, Mich., to Mr. Carroll Collins, who has already assumed control.

ANN ARBOR, MICH.—The Detroit Edison Company has purchased three dam sites on the Huron river for $130,000. An immense dam will be built at Geddy's for the generation of electric power for use in the valley and in Detroit.

LANSING, MICH.—The Commonwealth Power Company, of Jackson, has purchased a site for a sub-station in the city. The company will furnish power for the Lansing-Jackson electric railway, the Lansing-St. Johns railway and the Lansing-Haslett Park line.

TRAVERSE CITY, MICH.—The City Council has closed a contract with the Boardman River Electric Light and Power Company for lighting the city for another year on an all-night schedule except for shut-downs after midnight for repairs, at a cost to the city of $60 per light. The contract runs for five years and provides for 100 lamps.

BELLE PLAINE, MINN.—Bids are wanted until Nov. 27 for an electric light plant on which a 20-year franchise will be given; bids to state price of 16 street arc lights of 1,600 to 2,000 candle-power per month, and cost of each additional light; also cost of incandescent lights for commercial use. J. E. Townsend is borough clerk.

NEW ALBANY, MISS.—The Board of Aldermen of this city will probably issue $12,000 of town bonds, the proceeds of which will be expended in enlarging the city electric light plant and in other municipal work.

BOWLING GREEN, MO.—The Pike County Light & Power Company has been incorporated, with a capital of $7,000 by H. Ladford and I. Dempsey.

INDEPENDENCE, MO.—The City Council has granted a franchise to the General Light, Heat & Power Company, subject to the approval of the citizens.

FREMONT, NEB.—About $5,000 will be expended for improvements to the electric light plant. J. H. Mathews is superintendent.

RENO, NEV.—It is stated that a movement is on foot to form a company to install an electric lighting plant on the Truckee River, a short distance below Vista, where Henry Riter, W. G. Caffrey, Capt. Mills, R. K. Brown and H. B. Corey, of Boston, own a 40-acre tract of land, which is to be used as a site for the plant.

RENO, NEV.—Judge Turner and A. A. Hibbard, who recently acquired options on extensive water rights on the head waters of Walker River in Mono County, Cal., and Joseph A. Brown, treasurer of Mono County, are said to be interested in a power deal, with Tonopah as its ultimate market.

GOLDFIELD, NEV.—The California and Nevada Mining & Mill Company proposes to erect an electric power and light plant at Big Pine, Cal., for use in Goldfield, Lida, the Bonnie Clare mine, the mines of the Bullfrog district, as well as the towns of Rhyolite, Bullfrog and Beatty. The company is incorporated under the laws of Arizona, with a capitalization of $5,000,000. It claims to have 1,000 miners' inches of water at Big Pine, with a fall of several thousand feet in eight miles, and proposes to generate 6,000 hp.

VERDI, NEV.—The generating station built this year at Marmol, a few miles above here, for the purpose of furnishing electric power to run the Comstock mines, is practically completed. The station is the property of the Truckee River General Electric Company, behind which are the Fleishackers, who also own the Floriston Pulp and Paper Mill; the electric plant at that place; the electric plant at Laughton, six miles above Reno, and the plant at Reno—the four largest in Nevada. The Fleishackers now own the most valuable power sites on the Truckee River and have a complete monopoly on the lighting and power situation in western Nevada, supplying all that is used by Reno, Sparks, Verdi, Carson, Virginia, Silver City, Dayton and the other small towns in these vicinities.

EXETER, N. H.—Mr. William H. C. Follansby, of Exeter, has been appointed receiver of the Newmarket Electric Light, Heating & Power Company. A minority of the stockholders allege that the company is mismanged and that stock and bonds have been fraudulently issued.

WASHINGTON, N. J.—Chester Snyder and others, of Easton, have purchased the plant of the Washington Electric Light Company and will expend about $10,000 in improvements.

PERTH AMBOY, N. J.—C. D. Boynton, Secretary of the Citizens' Electric Light, Heat & Power Company, states that it is proposed to construct an electric light and power plant.

NEW BRUNSWICK, N. J.—A committee of citizens has appointed former City Surveyor A. Atkinson to look into the matter of constructing an electric light plant. No action has yet been taken by the city officials.

JERSEY CITY, N. J.—The Quito Electric Light Company, of Jersey City, has been incorporated by W. B. F. Rogers, F. A. Gaynor and John T. Smith. The capital stock is $400,000.

PASSAIC, N. J.—At the last meeting of the City Council the Public Service Corporation made an offer to supply arc lights at $85 per light per year and charge 12 cents per kw-hour for commercial lights. This proposition will hold good, provided the contract which the city made with the Weehawken Lighting Company is rescinded. The latter was to have built a plant in Passaic, but did not do so.

LITTLE FALLS, N. Y.—The Council has granted the Hudson River Electric Power Company, a 50-year franchise to build and operate its lines in Little Falls.

PALMYRA, N. Y.—The Niagara & Lockport Power Company is stated to have petitioned Council for a franchise to furnish electricity for heat, light and power.

WHITNEY, N. C.—The work of constructing the dam, canal and power house of the Whitney Company, at Whitney, N. C., is said to be about 25 per cent done and will be completed, according to the company's officials, in 1907.

HOPE, N. D.—The question of constructing an electric light plant and water works is under consideration here.

CLEVELAND, OHIO.—The Bradley Light, Heat & Power Company has been incorporated in this city with a capital stock of $1,000. The incorporators are: M. A. Bradley, George Lillis, J. L. Burgess and others.

KENT, OHIO.—An electric lighting system is to be installed in the round house and yards of the Erie Railroad Company at Kent, Ohio.

EL RENO, OKLA.—The electric light company in this city has sold all of its rights and title to the gas company for $68,500 in cash.

WOODWARD, OKLA.—The Woodward Cotton Company proposes to construct an electric light plant at a cost of $6,000.

HOMESTEAD, PA.—The Homestead Light, Heat & Power Company has been incorporated, with a capital of $5,000, by J. Clyde Miller and J. Jos. Gibson, of Homestead, and others.

PHILADELPHIA, PA.—S. L. Brumbaugh, general manager of the Juniata Hydro-Electric Company, states that the total cost of construction of the proposed electric plant on Juniata River will be about $1,000,000. Bids for electrical equipment will be received about Jan. 1. Wm. H. Cushman is the engineer.

NEWPORT, R. I.—The Old Colony Street Railway Company has entered into a contract to light the city of Newport with arc lights for 28½ cents per light per night, from dusk to drawn and 25 cents for lamps to burn from dusk till midnight and 9 cents for incandescent lights. The city of Newport was paying 45 cents per light per night. The new schedule of rates will effect an economy of $7,000 a year.

ABERDEEN, S. D.—The citizens have voted to issue $35,000 bonds for the construction of a municipal lighting plant.

DAYTON, TENN.—C. F. Dowker, of Grandview, has purchased of Thomas E. Stone the city electric light plant and assumed charge. It is understood that the consideration was $5,000.

EAGLE PASS, TEX.—The Texas-Mexican Electric Light & Power Company has increased its capital stock from $40,000 to $80,000.

SALT LAKE, UTAH.—The Blue Bench Co-operative Water Company, which is constructing irrigation works in the Blue Bench district, has filed an application for 200 second-feet of water from the East Fork of Rock Creek. The company proposes constructing an 850-hp plant to be operated under a head of 40 ft. for lighting and power purposes. The water will be diverted from Rock Creek through a canal six miles long.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Malad Light & Power Company, Malad, Idaho, have been filed. The new company has acquired the franchise and holdings of C. C. McLaughlin and Frank Moore, at Malad. The capitalization of the company is $100,000, and D. H. Taggart, J. A. Largent, G. C. McLaughlin, of Salt Lake, and G. H. Jay, of Great Falls, Mont., are named as the officers.

LARAMIE, WYO.—Articles of incorporation of the Laramie Light & Power Company, with a capital stock of $75,000, have been filed. The incorporators are H. E. Kelley, W. C. Sterne, Carleton Bliss and H. E. Nutting.

PHOENIX, B. C.—The Providence Mining Company will install a complete electric plant here at a cost of $30,000. P. J. Dermody, superintendent.

PHOENIX, B. C.—It is said that the Kootenay Light & Power Company will expend $1,000,000 on a new line into the Boundary districts. Poles are now being got out for the wire which will carry 60,000 volts.

MOOSEJAW, CAN.—The Council is having a by-law prepared to raise $30,000 for installing an electric light plant. Address the town clerk.

OWEN SOUND, ONT.—The Council is having a by-law prepared to raise $150,000 by the sale of debentures to install an electric lighting plant.

CAMPBELLFORD, ONT.—The Board of Trade has recommended to council that an electric lighting plant be installed.

NORTH TORONTO, ONT.—The Council has decided to call for tenders of the construction and installation of an electric lighting plant. Address the city electrician.

KINGSTON, ONT.—The light committee of the City Council of Kingston had the city engineer figure out the cost of lighting the city's streets by electricity, and he made it at $59.50 per lamp per annum. The committee then recommended that the price be reduced to $62 each per year and to increase the number of street lights. The price is about the lowest in the smaller cities of Ontario.

FORT WILLIAM, ONT.—The plant of Kakabeka Falls, near Fort William. Ont., will have a present capacity of 28,000 horse-power, and this can be provided without having, in the eye of the casual observer, any appreciable effect on the falls. It is intended that, from the power house at the point of generation, the electrical power will be transmitted to Fort William at a pressure of 25,000 volts to the sub-station now being erected at the west end of the town. From the river above Ecarte Rapids an aqueduct is being laid, and at an elevation that will add 40 feet to the height of the falls, which is 120 feet. An additional 20 feet will be obtained from the lower rapids where the turbines are being placed, making a total head of 180 feet.

MONTEREY, MEX.—Gustave A. Lilliendahl has obtained a concession from the federal government to install a large electric power plant in the municipality of Santiago, State of Nuevo Leon. The water of the San Juan River will be used to generate the electric power.

PARRAL, MEX.—A syndicate of Pennsylvania and Mexico capitalists are preparing to install a large hydro-electric plant on the Rio Verde River, in the State of Durango, for the purpose of generating electric power for supplying the city of Parral and the mines of the Parral district. The promoters of the enterprise have obtained concessions from the federal and state governments.

QUERETARO, MEX.—The new power house of the Hydro-Electric Company, at Queretaro, is completed and the machinery is being installed. It is expected that the plant will be ready to start about the first of the coming year. President Porfirio Diaz will probably be present at the opening ceremony. The old electric light plant of San Antonio, which has been supplying the city with lights, is worn out and has been shut down. The city will be in darkness until the new plant is started.

GUADALAJARA, MEX.—The installation of a hydro-electric plant at the junction of the Bolanos and Santiago rivers is being considered by Carlos Romero, a wealthy mining man. He has employed Engineer Felix Araiza to make the preliminary surveys for the proposed plant. He has made application to the federal government for a concession. It is Mr. Romero's intention to install a plant which will develop about 3,000 horse-power. The power will be used by the mines and towns of that district for lighting and power purposes.

CITY OF MEXICO, MEX.—A number of water-power concessions have recently been applied for or approved by the Mexican Government. The Yaqui Copper Company has applied for a concession to utilize 340,000 litres of water per minute from the Yaqui River for motive power. N. Dominguez and L. Sotomayor have applied for a concession to make use of the waters of the River San Pedro, in the district of Camargo, Chihuahua. L. G. Daza and J. Pita plan to establish a power plant in the district of Zacatlan, Puebla, and ask for a concession to use the waters of the River Tomotlan, a tributary of the Tecolutla River.

HALIFAX, N. S.—A municipal plant may be decided upon for Halifax, but at present the city is simply obtaining information in reference to the experience of other cities with municipally owned plants. F. W. W. Doane is city engineer.

The Electric Railway.

DENVER, COL.—The Denver & Southeastern Railway Company has been incorporated with a capital stock of $1,000,000. Those interested are W. H. Tunis, H. Ogle Tunis, T. B. Doane, W. E. Temple, L. W. Herring and W. C. K. Berlin, all of Denver, and I. C. Cockey, of Washington, D. C.; F. A. Sherwood, of Philadelphia, and R. D. Whiting, of New York

CENTRALIA, ILL.—Chicago promoters have made a proposition to build an electric railway between this city and Salem by way of Odin and Sandoval, provided the citizens along the line subscribe for $80,000 preferred stock. The proposed road would cost about $400,000. The Business Men's Association has the matter under consideration.

MATTHEWS, IND.—The Matthews, Marion & Muncie Railroad Company has been incorporated. This new line will be operated by electric power.

INDIANAPOLIS, IND.—The Columbus, Greensburg & Richmond Traction Company has revived the project to build an electric railway from Columbus to Greensburg and Richmond.

LAFAYETTE, IND.—W. S. Reed, of the Chicago & Southern Traction Company, announces that the Lafayette-Kankakee link will be constructed at once, without waiting for the completion of the line from Chicago to Kankakee.

WABASH, IND.—It is rumored that the Big Four Railroad has bought the completed grade of the Indiana Central Traction Company's line between this city to North Manchester, with a view of killing off the extension of the Indiana Northern, which now operates between Wabash and Marion and is now proposing to extend its line to North Manchester, paralleling the Big Four.

TISHOMINGO, I. T.—The Tishomingo Construction Company has been incorporated with a capital stock of $25,000. W. M. Lucas is president and A. H. Chapman, vice-president. It is empowered to build electric roads.

BOSTON, MASS.—The Railroad Commissioners have approved the issuance of $200,000 bonds by the Western Massachusetts Street Railway Company. Thee company applied for the right to issue to the extent of $300,000.

KALAMAZOO, MICH.—At the annual meeting of the Michigan Traction Company and the Michigan Traction Extension Company held in this city, directors were elected as follows: Michigan Traction Company: Evans R. Dick, Frederick J. Lisman, Gerald Holsman, J. Horace Harding and H. C. Winchester, of New York City; George S. Graham, of Philadelphia, and J. W. Osborn, of Kalamazoo. Michigan Traction Extension Company: Evans R.

Dick, F. J. Lisman, Gerald Holsman, of New York City; George S. Graham, of Philadelphia, and Alfred Mills, of Kalamazoo. The election of officers of both companies will take place in New York.

BOSWELL, N. M.—J. W. Hall, of Memphis, representing the eastern capitalists, is here with a view to securing a franchise for the building of an electric railway in this city.

OSSINING, N. Y.—Application has been made to build a new trolley line from Ossining to the Croton Dam, thence to Croton, Oscawana, Brugers, Montrose and Verplanck's Point, to open up a vast tract of land for residence and small farming purposes and to supply a demand expected to follow electrification of the New York Central lines. Maps have been made and surveys completed.

OKLAHOMA CITY, OKLA.—The City Council has granted a franchise to the Oklahoma Interurban Traction Company to construct an electric railway in the southern portion of the city.

ALLENTOWN, PA.—A controlling interest in the Allentown & Reading Traction Company has been purchased by the Pennsylvania Railroad Company. The Pennsylvania, it is understood, will come to Allentown by this route, the Berks County terminal of which is a few miles from Reading and the Pennsylvania's Schuylkill Valley branch.

ARDMORE, PA.—A special meeting of stockholders is to be held this week of the Ardmore & Llanerch Street Railway Company to consider the matter of increasing the capital stock from $200,000 to $300,000, and proxies for a majority of the stock in favor of the plan are held by the officers of the company. The stock will be offered to shareholders at par, every four shares entitling the holder to subscribe for one share of the new stock. Fifty thousand dollars of the new stock will be issued immediately.

GREENVILLE, PA.—The Shenango Traction Company, which proposes to build an electric railway from New Castle to Meadville, via Sharon, Sharpsville and Greenville, will on Dec. 5 make application for charters for the following lines: New Castle Northern and New Castle Central, covering the city of New Castle; Northern Middlesex, covering West Middlesex and south to New Castle, north to Wheatland; Shenango Southern, covering Wheatland; Shenango, Midland, covering Sharon and South Sharon; Shenango Northern, covering Sharpsville and vicinity. The incorporators are James D. White, E. A. Henry and C. G. Glatzau, of Pittsburg; Edwin C. Ripley, of Sherman, N. Y., and W. H. Waugh, of Greenville. Private right of way has been secured from New Castle to Sharpsville.

KNOXVILLE, TENN.—The Knoxville & Maryville Railway Company, with a capital stock of $100,000, is to be incorporated to build an electric railway from Knoxville to Maryville. Those interested are Joseph Burger, president of the Maryville bank, of Maryville; and J. P. Gaut, Robert Vestal, Howard Cornick, J. Cal Sterchi, Dr. W. S. Nash and others, of Knoxville.

LULING, TEX.—Mr. Oscar H. Stair informs us that the San Marcos-Luling Interurban Railway Company will build a trolley line between the two points a distance of 25 miles. They have bought ten acres of land at Tentress, 9 miles from Luling, on the San Marcos river. Mr. A. T. Fisher, of Boston, Mass., promotor of the railway, and R. E. L. Shaw, a bridge engineer for a Dallas firm of contractors, have been over the ground recently.

BELLINGHAM, WASH.—The Nooksack Valley Rapid Transit Company has filed articles of incorporation with the Secretary of State. The capital stock is $500,000, and the incorporators are Ed. Brown, of Custer; James Morrison and J. Wm. Welch, of Ferndale; A. J. Welch and J. W. Rose, of Bellingham, and W. L. Hart, of Custer.

NEW WESTMINSTER, B. C.—The British Columbia Electric Railroad Company is preparing to supply farmers in the Burnaby district with power for the running of farm machinery.

NEW WESTMINSTER, B. C.—W. H. Moore, of this city, is having plans prepared for an electric railway to run from Spence's Bridge to Thompson River, a distance of 100 miles.

ST. JOHNS, N. B.—The Carleton Electric Light Company's property, which was recently purchased by John Russell, Jr., has been transferred to the St. John Railway Company, Mr. Russell having sold to that company.

◆

New Industrial Companies.

THE UNIVERSAL LIGHT & EQUIPMENT COMPANY, of New York, has been incorporated, to deal in lighting appliances and fixtures. The capital stock is $1,000,000, and the directors are: James McIntosh, L. J. Lerolle and E. M. Fireman, New York.

THE TREMAIN ELECTRIC COMPANY has been formed at Brockton, Mass. Capital, $4,000; par $10. President, Arthur H. Anderson, Brockton; treasurer, John A. Brackett, Lawrence; clerk, Herbert N. Dean, Brockton. Directors as above and Amanda M. Brackett of Lawrence.

THE ARKNOT COMPANY, of Hartford, Conn., has filed a certificate of incorporation. The company will make and deal in devices for the generation, storage, control, transmission and utilization of electricity, etc. Joseph Sachs, L. P. Waldo Marvin and Charles E. Parker are the incorporators. The authorized capital is $75,000.

THE UNITED STATES ELECTRIC TOOL COMPANY has been incorporated at Columbus, O., with a capital stock of $25,000, by William A. McAllam, D. J. Hauss, J. A. Smith, C. F. Kleinschmidt and G. H. Felter. The company was a $3,000 Kentucky incorporation. It has been established for nearly a year, and is engaged in the manufacture of electric tools.

Legal.

NEW YORK LIGHTING COMMISSION.—Justice Henry T. Kellogg, of the Supreme Court, has handed down a decision restraining the village of Potsdam, N. Y., from building a municipal electric lighting plant, permission not having been obtained from the State Gas and Electric Commission, although the resolution to build the plant was adopted by the voters nearly three months before the law creating the gas commission went into effect. He holds that the matter is subject to the ruling of the new board.

◆

Obituary.

MR. CHAS. CUTTRISS.—During a fit of temporary dementia, occasioned by his poor physical condition, Mr. Charles Cuttriss, inventor of the Cuttriss syphon recorder and head of the electrical department of the Commercial Cable Company, shot himself in his home in New York City on Nov. 18. He leaves a widow and three children. Mr. Cuttriss had been in the employ of the Commercial Cable Company for twenty-one years, during which his work had taken him almost everywhere that the company's wires lead. His suicide was indirectly due to malaria, which he contracted while in the Philippines in 1903, when he had an important part in the work of laying the Pacific cable by his company. Those of his friends who had met him recently were greatly concerned as to his evident failure in health and strength. Mr. Cuttriss was a native of Bedford, England, where he was born 56 years ago. He graduated from Glasgow University, where he was a student and protege of Lord Kelvin, whose submarine cable apparatus he made a special study of for years. In addition to his own improvements on the syphon recorder, Mr. Cuttriss devised and invented several electrical instruments in submarine telegraphy, fire alarms, etc., and was always improving the mechanism in his charge. His body was buried at Duxbury, Mass., near the cables to which he devoted his whole life. Mr. Cuttriss was a member of the American Institute of Electrical Engineers and the British Institute of Electrical Engineers, and the New York Electrical Society.

◆

Personal.

ALEX. HENDERSON.

MR. ALEX. HENDERSON, who has just been added to the staff of the American Circular Loom Company, has the advantage of a close practical knowledge of the art. He is a Scotchman by birth, having been born at Edinburgh in 1859. Before he was 21 he had traveled extensively, visiting Germany, Spain, Italy, Russia, Turkey, Egypt, the West Indies, Africa, the United States, Canada, India, China and Australia. In Turkey, in 1878, he witnessed some of the most stirring events of the war of that year. Before the end of 1881 he had been twice around the world, and tiring of travel, settled down in New York in the employ of the old Weston Electric Light Company, in the Centre Street station. He next became connected with the Brush Electric Illuminating Co., and assisted in the construction of the masts on Madison Square, since removed. He was also actively connected with much of the early electric lighting line construction throughout the city. In 1883 he went West in the parent Brush Company's interests, and represented them as superintendent of construction in several parts of the United States, Canada and Mexico for about eight years. Returning to New York in the fall of 1890, he was appointed chief inspector for the Manhattan Electric Light Company, but again resumed construction work, etc., outside the city. In November, 1895, he was appointed the first chief inspector of the Bureau of Fire Alarm Telegraphs and Electrical Appliances of the Fire Department of New York. The position grew rapidly in importance, and Mr. Henderson became well known as an indefatigable official, anxious to secure the highest efficiency, and in spite of the difficulties of the work he was very popular throughout the field of supervision. In 1898, Mr. Henderson abandoned what he called the "political arena," and joined the forces of the Sprague Electric Company, with special charge of the introduction of their now standard heavily armored conduit. His successful work is familiar to our readers. More recently Mr. Henderson has been active as master of transportation for the conventions of the electrical contractors, and his efforts have been handsomely recognized by testimonial and otherwise. It is understood that his new duties will give him a roving commission all over the country.

CAPT. W. M. TALBOTT, the vice-president of the Havana Subway Company, reports the work is progressing in a satisfactory manner. The contractor, George M. Painter, of Chicago, is evidently hustling things as the following extract from the Havana *Telegraph* indicates: The work of building the subway of Havana has begun and more than a hundred men are now at work laying the pipes for the cables. Aguila Street is the scene of great activity, and the workmen who are engaged in laying the pipes are giving the people of Cuba an object lesson in construction work. Three blocks have already been laid with pipes, and the work is progressing at the rate of a block each day."

MR. H. B. SALE, general manager of the Indianapolis Telephone Company, has resigned that position. He contemplates spending a vacation in Bermuda.

MR. I. E. STOREY, the electric motor designer and inventor, has removed to Madison, Wis., in order to carry out more directly his work with the Northern Electrical Manufacturing Company.

MR. U. N. BETHELL, vice-president and general manager of the New York Telephone Company, has just returned from a brief trip to Europe, made for the purpose of securing much needed rest and recreation.

MR. GEORGE S. CARSON, of Iowa City, is now acting as secretary of the Iowa Electrical Association in place of P. E. Bellemy, of Knoxville, who has resigned. Mr. Carson is now engaged in getting out the printed proceedings of the last convention.

MR. D. G. EDWARDS, formerly of Cincinnati, has been appointed vice-president in charge of traffic of all the traction lines of Indiana and Ohio controlled by the Philadelphia interests, allied with the Randall-Morgan syndicate.

MR. JOHN C. WAIT, C. E., is to deliver the annual address at the tenth commemoration of Founder's Day, at the Thomas C. Clarkson Memorial School of Technology, Potsdam, N. Y. Mr. Wait is well known in the electrical field, and is the author of several books on engineering, jurisprudence, etc.

MR. CHARLES W. DODGE, who for the past ten years has been interested in engineering in New England, has entered the employ of Dodge & Day, of Philadelphia, and is at present giving his entire attention to extensive alterations and additions to the plant of the Link Belt Machinery Co., Chicago, Ill.

MR. E. V. ENSIGN.—After eleven years continuous service as superintendent of the Leominster (Mass.) Electric Light & Power Company, E. V. Ensign has handed in his resignation to take effect in the near future. Mr. A. N. Clarke, of Boston, a practical business man, well qualified to take charge of the plant, will be his successor.

MR. V. C. GILPIN has opened offices at 120 Liberty Street, where he will represent the Tower-Burford knife switches and panel boards, the Monarch special lamps and "Arc Burst," and the Acme refilled incandescent lamps. Mr. Gilpin is widely known in the electrical supply trade not only of New York, but throughout the country.

MR. GEORGE MOORES, secretary of the British Weight and Measures Association, has arrived in this country for a visit of a month. During his visit Mr. Moores will see a number of gentlemen particularly interested on the subject of weights and measures, and present to them the object of his association, which is the adoption of the inch as a base in a system otherwise greatly resembling the metric system.

BLUNDELL-BARATT.—On Tuesday, Nov. 14, 1905, Mrs. Maud Barratt was married to Mr. Alfred F. Blundell, the president of the Red Telefonica, Havana, Cuba. The ceremony was performed in Christ Church, East Orange, N. J. Only intimate friends were present. Mr. and Mrs. Blundell sailed for Havana on November 18. Mr. Blundell has been in Cuba for six years, and has many friends who will welcome the couple on their arrival.

Trade Publications.

GAS ENGINES.—The Jacobson Machine Manufacturing Company, Warren, Pa., has issued bulletin A, describing engines for operation with gasoline, natural gas, manufactured gas and producer gas.

CABLEWAYS.—The John A. Roebling's Sons Company, Trenton, N. J., has issued a well-illustrated 110-page publication dealing with cableways, tramways, suspension bridges, inclined planes and cable railways.

PNEUMATIC ROCK DRILLS.—Catalogue No. 18 of the Chicago Pneumatic Tool Company, Fisher Building, Chicago, describes a complete line of rock drills for mining, tunneling and quarrying work generally. This company has recently acquired the selling rights to the McKiernan rock drills.

RAILWAY LINE MATERIAL.—Publication No. 1049 of the General Electric Company, Schenectady, N. Y., is a well illustrated 84-page catalogue dealing with railway line material and rail bonds. An interesting feature of the catalogue resides in the description of the new form of catenary construction for high-tension alternating-current railway work.

REVOLVING-FIELD ALTERNATORS.—Bulletin No. 360 of the National Electric Company, Milwaukee, Wis., describes in detail alternating-current generators of the revolving-field type for direct connection to hydraulic turbines. The generators are of either the single-phase or polyphase type, in capacities ranging from 165 to 750 kilowatts.

WESTINGHOUSE STANDARD STEAM ENGINE.—Catalogue 7004 of the Westinghouse Machine Company, East Pittsburg, Pa., is a well prepared treatise on the vertical enclosed type of simple, non-condensing engine as exemplified in the Westinghouse standard engine. The constructional details of the engine are treated at great length.

PREPARATIONS APPLIED TO BELTS.—The Cling-Surface Company, Buffalo, N. Y., has issued an instructive booklet treating of the effect of preparations applied to belts, which was written by Thomas Farmer, Jr., and C. Willard Evans. Numerous curves obtained from tests are given to show the advantageous results following the application of "Cling-surface" to leather belts.

SMALL DIRECT-CURRENT MOTORS AND GENERATORS.—Bulletin No. 21 of the Sterling Electric Motor Company, Dayton, O., describes a complete line of small and medium size motors and generators of the direct-current type. These machines are of sturdy construction. The frame is made of soft cast iron, and the magnet-cores are of solid steel, cast welded into the frame, and provided with laminated pole shoes securely bolted to the magnet-core. These machines are built in sizes from 1/12 hp to 10 hp.

THE AMERICAN ARC LAMP COMPANY, of Kalamazoo, Mich., has issued an attractive little folder speaking of the use of enclosed arcs in factories, foundries and machine shops. The cover shows three shops and several detached buildings that are flooded with light, as indicating the value of the American arc lamp, while the inside pages of the circular show the lamp both closed and open, the latter illustration showing the ease with which all parts of the lamp may be inspected.

HYDRAULIC ENGINEERING.—The Roberts & Abbott Company, Schofield Building, Cleveland, Ohio, has issued an illustrated folder calling attention to its hydraulic engineering department. Views are given of four general types of dam construction, namely, masonry dam, steel concrete dam, steel gravity dam and timber gravity dam. It is stated that some one of these, with minor variations, adapting it to the local conditions, will usually be found best for any locality.

C. H. M'GIEHAN & CO., 11 Broadway, New York City, are manufacturers of machinery which makes and assembles parts automatically. Some of the work that the company has done is little short of marvellous in the fineness of the machinery, its delicacy and the precision with which it operates. Just as an advertisement they have distributed a thermometer with a Fahrenheit scale which, in addition to an announcement of their own contains the decimal equivalents of fractional parts of an inch from 1/64 to one. It will prove a useful adjunct in an engineer's office.

TELEPHONES.—The S. H. Couch Company, 156 Pearl St., Boston, Mass., has issued bulletin No. 12, dealing with telephone switchboards and parts. Illustrations are given of some standard apparatus and a few suggestions are made for the prospective customer. Booklet No. 9 of the same company treats in detail of switchless intercommunicating telephones. A view is given of a fifty-station automatic reset telephone which was furnished to the Northampton (Mass.) Insane Hospital. A single storage cell supplies all of the current needed for the talking circuits of the entire system. The company has also issued a folder illustrating and describing automatic intercommunicating telephones of the wall and portable desk types.

MECHANICAL DRAFT.—The B. F. Sturtevant Company, Boston, Mass., has just issued bulletin No. 75, entitled "Mechanical Draft. What It Is What It Does." This booklet not only briefly presents the salient features of this system of draft production, but illustrates a variety of plants which clearly show "what it is." The suggested query in the words, "what it does," is answered thus: It does what an ordinary chimney is incapable of doing. Its cost is from 20 to 40 per cent. of that of a chimney; its intensity permits of the burning of finely divided or low-grade fuel; it makes possible the utilization of the heat of the flue gases which a chimney wastes in producing draft; it is independent of the weather; is automatically regulated to maintain constant steam pressure, decreases smoke, increases the capacity of an existing plant and serves as an auxiliary to a chimney already overburdened; saves space and is portable.

News of the Trade.

FREIGHT ELEVATORS.—A very large order for freight elevators was recently closed through the Pittsburg office of the Otis Elevator Company for a single installation of 44 freight elevators in the new building of the Pittsburg Terminal Warehouse Company, of Pittsburg, Pa. These elevators have a lifting capacity of 6,000 lbs., and a car travel of about 100 ft.

TELEPHONE RECEIVER.—A new, permanently adjusted all-metal receiver, with no metal parts exposed, was recently placed on the market by the International Telephone Manufacturing Company, Chicago, which reports a brisk demand for this instrument, as well as for its improved granular carbon transmitter.

PAPER MILL INDUSTRY.—The Westinghouse Electric & Manufacturing Company has recently equipped a number of paper mill grinders with alternating-current motors. The question of driving grinders by means of electric motors has been agitated for several years, and there has always been some question as to the feasibility of the scheme. The operation of the grinders installed, however, has been so entirely satisfactory as to leave no question, so far as the practicability and efficiency of this drive are concerned.

CHICAGO ELECTRICAL EXHIBITION.—Reports from the management of the Electrical Trades Exposition Company, of Chicago, which is to hold the Electrical Show at the Coliseum in that city Jan. 15 to 27, 1906, are said to be very encouraging. Nearly one-half of the available 38,000 square feet in this building has already been taken. Most of the leading manufacturers have been assigned space. Homer E. Niesz, of the Chicago Edison Company, chairman of the committee on publicity, is getting in some good work in that department.

THE SHOW AT THE GARDEN.—The list of exhibitors at the Madison Square Garden Electrical Show, to be held Dec. 12 to 23, has already reached proportions gratifying to the management. The following firms have already definitely selected their spaces and signed contracts for them: National Carbon Co., Joseph Goldfinger, Eastern Carbon Works, American Telephone Journal, Thos. M. St. John, Guy M. Gest, Magneta Clock Co., Peerless Electric Co., Magnet Wire Co., Waterbury Co., Electro-Dynamic Co., Gray National Telautograph Co., General Storage Battery Co., Natural Food Co., Stow Mfg. Co., Chicago Pneumatic Tool Co., Vandyck-Churchill Co., Gold Car Heating & Lighting Co., New York Telephone Co., William Krug, Standard Vitrified Conduit Co., Niagara Tachometer & Instrument Co., National Battery Co., Clark Electric & Mfg. Co., National Meter Co., Electric Journal, Engineering News, Douglass Mfg. Co., International Correspondence Schools, Brunswick Refrigerating Co., Electro-Radiation Co., Simplex Electric Heating Co., American De Forest Wireless Telegraph Co., Mohican Springs, Wireless Railway Co., Burke Electric Co., George L. Mason Co., Electrical Age, Waite & Bartlett, Ovington Mfg. Co., Kinsman Block Signal System, Kinsman Electric Ry. Supply Co., Veedee Vibrator Co., Wireless Railway.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 14, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

804,204. COUPLING FOR CONDUITS; William S. Brown, New York, N. Y. App. filed Apr. 15, 1905. The usual connection box has an internally coarsely threaded stud projecting therefrom, which is divided longitudinally into two halves, one of which is removable. The cable end has correspondingly coarse threads formed thereon which are engaged with the fixed half of the stud; after which the removable half is clamped in position.

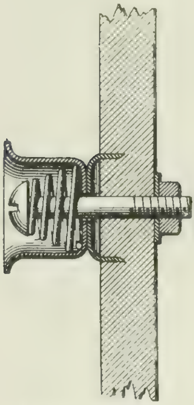
804,211. DENTAL SWITCHBOARD; Monroe N. Callender, San Francisco, Cal. App. filed Jan. 30, 1905. A small movable panel board has the various switches upon its face, and has a multiple wire flexible connection extending to the fixed wall plug or plugs.

804,231. RAILWAY SIGNAL; Joseph Irwin, St. Louis, Mo. App. filed Jan. 21, 1905. A transparent disc has radiating sectors of differently colored glass and a rotatable disc with alternating opaque sectors is supported adjacent thereto, so as to turn through a certain part of a revolution and cover up the glass sectors of one or the other color.

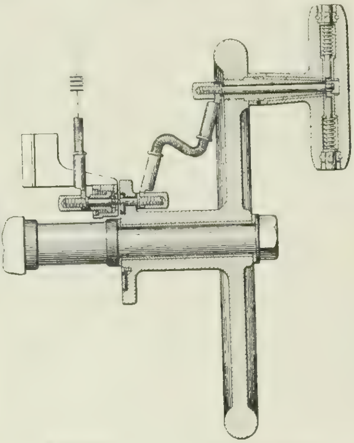
804,232. BINDING POST; Frank Jackson, Denver, Col. App. filed Dec. 14, 1904. A spring binding post, the two parts of which are formed of sheet metal cups in yielding spring pressed contact with one another at their bases.

804,250. APPARATUS FOR THE MANUFACTURE OF INDUCTION COILS; Leslie B. Miller, London, England. App. filed Mar. 9, 1904. For the purpose of manufacturing the "wafer" windings for induction coils, the patentee clamps a sheet of gummed paper upon the flat face of a spinning disc and leads the wire gradually outward toward the circumference so that it is wound in a spiral layer.

804,256. SIGNAL FOR TELEPHONE-SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filled July 11, 1902.



804,232.—Binding Post.



804,331. Firing Attachment for Guns.

804,279. TRANSMITTER; Anthony Van Wagenen, Sioux City, Ia. App. filed April 30, 1896.

804,280. TRANSMITTER; Anthony Van Wagenen, Sioux City, Ia. App. filed May 4, 1896.

804,291. ELECTRICAL APPARATUS FOR PRODUCING OZONE; Albert C. Wood, Philadelphia, Pa. App. filed Feb. 17, 1905. A series of blades with their outer edges serrated radiate from a central insulating core into proximity to longitudinal contact strips annularly spaced around the interior of the casing. The ozonizing discharge takes place between the serrations and the strips.

804,297. SAFETY CROSSING SYSTEM FOR RAILWAYS; Walter J. Bell, Los Angeles, Cal. App. filed May 15, 1905. All the trolley wires have tappets adjacent the crossing so that cars passing onto the crossing from one track strike the tappets and automatically disconnect the power from the crossing portion of the other line.

804,298. AUTOMATIC SAFETY CROSSING SYSTEM FOR RAILWAYS; Walter J. Bell, Los Angeles, Cal. App. filed June 1, 1905. Relates to improvements in the above for the purpose of avoiding collisions between the cars standing on a single block when the current is suddenly turned thereon by the automatic devices above mentioned.

804,331. FIRING ATTACHMENT FOR GUNS; John F. Meigs and Heman C. Jakobsson, South Bethlehem, Pa. App. filed Aug. 19, 1903. The usual hand wheel for manipulating the gun carriage has a button upon its operating crank by which the gun may be electrically fired at the precise instant the adjustment is satisfactory.

804,344. ELECTRICAL SWITCHING APPARATUS; Walter J. Richards, Milwaukee, Wis. App. filed Nov. 4, 1904. A row of dash pot controlled contactors are effective to gradually cut out resistances in the secondary circuit of an induction motor as the latter comes up to normal speed.

804,355. DYNAMO ELECTRIC MACHINERY; William L. Waters, Milwaukee, Wis. App. filed Dec. 5, 1904. A field magnet having a large number of annularly spaced internally projecting pole pieces over which the coils are wound. The coils are held in place by short wedges engaging suitable grooves upon end plates which are provided for this purpose.

804,365. DEVICE FOR PREVENTING CONTACT IN TELEGRAPH LINE-WIRES; William L. G. Appleby, Germantown, Md. App. filed Oct. 7, 1904.

804,370 SUPPORT FOR THE SHAFTS OF INSTRUMENTS; Frank R. Beckert, Lynn, Mass. App. filed Apr. 5, 1904. Has means for simultaneously moving the bearings out of supporting relation to the movable number and at the same time clamping said member to hold it.

804,371. ELECTROMAGNETIC WHEEL; Hugh Behan, Seattle, Wash. App. filed Jan. 6, 1905. A series of magnets are radially disposed within the driving wheel of an engine so as to be successively energized at the instant when they are in proximity to the track.

804,381. SNAP SWITCH CONTACT MECHANISM; Charles A. Clark, Hartford and Ellsworth A. La Har, New Britain, Conn. App. filed Mar. 25, 1904. A snap switch, the blade of which is supported by insulating studs, and has a slight longitudinal movement so as to make a more uniform engagement with the two contacts.

804,387. LOCKING DEVICE FOR INCANDESCENT LAMP BULBS; Ralph E. Davis, Alton, Ill. App. filed Feb. 18, 1905. An internally flanged ring is formed of two half sections hinged together with interlocking clasps at their free ends. The ring is clamped upon a lamp after which the latter is locked against removal until the ring is released by suitable key.

804,389. ELECTRIC CIRCUIT CLOSER; Alexander Dow, Detroit, Mich. App. filed Jan. 22, 1904. A floor push or button comprising a pair of circular metallic discs spaced apart by a rubber washer at their centers. Pressure at substantially any point is effective to bring some portions of the peripheries of the discs together so as to make electrical contact.

804,428. PAPER CUP; Charles G. Perkins, Hartford, Conn. App. filed Oct. 18, 1904. An insulating cup formed of a paper disc with tangentially corrugated edges, which crimp together spirally so as to form a paper shell.

804,429. PROCESS FOR MAKING CONTACTS; Frank Petz, Nuremberg, Germany. App. filed Oct. 20, 1904. A process of electrically connecting a metallic element with carbon blocks by enclosing all the parts in a rigid box, embedding them in cement which presses the elements into good contact when hardened.

804,431. TELEPHONE INSTRUMENT; Egbert A. Reynolds, New York, N. Y. App. filed Aug. 19, 1904.

804,436. TOOL; Charles D. Schultz, New York, N. Y. App. filed May 26, 1905. A blade projects from a cylindrical box, forming a handle, which has resistance wire wound therein so as to warm the blade.

804,440. DYNAMO-ELECTRIC MACHINE; Charles P. Steinmetz, Schenectady, N. Y. App. filed April 22, 1904. (See Page 913.)

804,484. THERAPEUTIC APPARATUS; Carl O. Lindstrom, Chicago, Ill. App. filed Feb. 20, 1905. Employs a two-part box with hinged covers into one compartment of which a patient may be placed. The other compartment has ozonizers and incandescent lamps therein for supplying light treatment.

804,595. ELECTRICAL CONTROLLER; Nathan K. Garhart, Indianapolis, Ind. App. filed May 25, 1905. A floor switch for dentists having two foot levers, one of which runs the dental motor in one direction at varying speeds, while the other reverses the motor and also controls its speed in the reverse direction.

804,603. BRANCH BLOCK FOR ELECTRIC WIRING; Nathan B. Hoyt and James H. Martin, New Haven, Conn. App. filed Nov. 14, 1904. Has three longitudinal main grooves and two branch grooves at right angles thereto, connection being made between the two outside main grooves and one of the branch grooves.

804,628. ELECTRICAL GENERATOR; Morris Schwartz, New York, N. Y. App. filed March 7, 1905. (See page 913.)

804,636. ELECTRIC SNAP SWITCH; George B. Thomas, Bridgeport, Conn. App. filed Nov. 3, 1904. A spring drum within the switch has a cord by which it is rotated to tension the spring. After a certain movement the spring is tensioned sufficiently to move the switch blades with the required snap.

804,648. TROLLEY; Michael Baker, Chicago, Ill. App. filed Aug. 31, 1904. The trolley pole has a supplemental spring pressed wheel thereon with a corrugated tread so as to break the ice upon the wire in advance of the usual contact wheel.

804,741. FUSE PLUG; Percy Q. Lawrence, Revere, Mass. App. filed Feb. 8, 1905. The usual cover plate of an Edison socket fuse plug is made of mica through which a plug within an interior wall may be observed. When the fuse blows the plug is dislodged, which can be noted through the transparent mica disc.

804,742. PUSH-BUTTON SWITCH MECHANISM FOR TELEPHONES; Burton Leonard Lawton, Meriden, Conn. App. filed Dec. 5, 1904.

804,745. ELECTRICALLY CONTROLLED FLUID PRESSURE RAILWAY BRAKE; John S. Lockwood, Kansas City, Mo. App. filed Feb. 5, 1904. The triple valves of all the cars are operable by electro-magnets in an operating circuit which extends throughout the train.

804,759. ELECTRICAL HEATER; John A. Noble, San Francisco, Cal. App. filed May 8, 1905. A hot water bag into which a slender cylindrical box having resistance wire is insertable so as to maintain the water at any desired temperature.

804,760. ELECTRIC BURGLAR ALARM; William E. Orr, Council Bluffs, Iowa. App. filed Jan. 17, 1905. An attachment for an ordinary lock having contacts within the door jamb which ring an alarm circuit whenever the door knob latch or the usual lock is withdrawn.

804,763. PROCESS OF ELECTRICALLY WELDING RAILS; Carl Pahde, Breslau, Germany. App. filed July 1, 1905. The process of electrically welding the ends of two contiguous rails by means of an electric arc, which consists in passing an electric current therethrough after the joint between said ends has been filled in the lower portion thereof with soft metal, and at the heads of the rails with hard material, thereby melting the rail ends together.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, DECEMBER 2, 1905. No. 23.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.......................................1139 Monadnock Block
PHILADELPHIA OFFICE.................................929 Chestnut Street
CLEVELAND OFFICE.................................402 Cuyahoga Building
EUROPEAN OFFICE.........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico....................Per year, $3.00
Foreign Countries, within the Postal Union..............................$6.00
Great Britain and Ireland...25 shillings
Germany...25 marks
France...31 francs
Single copies..10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **14,500** *copies are printed. Total circulation for* 1905 *to date,* **660,500.**

NEW YORK, SATURDAY, DECEMBER 2, 1905.

CONTENTS.

Editorial 929
Suggested Changes in the National Electric Code 932
Potsdam, N. Y., Enjoined from Establishing a Municipal Lighting Plant 932
Figures on a Municipal Plant for New York 932
Ohio Mechanical, Electrical and Steam Engineers 933
Wire Conduits for Greater New York 933
November Meeting of the American Institute of Electrical Engineers 933
Fires from Electrical Causes 934
The First Telegraphic Train Dispatching 934
Trees and Electric Pole Lines 934
Argentine Underground Roads 934
The Open Shop 935
Electrical Engineers of the Times.—XXXVIII. Irving A. Taylor 935
Current News and Notes 935
Hydro-Electric Power Under the Highest Head in New England 939
An Efficiency Meter for Electric Incandescent Lamps. By Edward B. Hyde and H. B. Brooks 942
The L'Hoest-Pieper System of Train Lighting 945
Some Central Station Operating Points in Topeka 946
Reflectors, Shades and Globes.—II. By J. R. Cravath and V. R. Lansingh. 947
New Telephone Patents 949
LETTER TO THE EDITORS:
  Sine and Cosine Diagram. By A. T. Brower 950
Digest of Current Electrical Literature 950
Book Review 955
New York Electrical Exhibition 955
Equipment of the Hastings, England, Trolleys 955
New Sangamo Alternating-Current Watt-hour Meter 956
Portable Tool Post 957
Electrical Apparatus for Japanese Mines 957
Motor-Driven Water Hoist 958
Some New Types of Rheostats for Motor Drive 958
Motor Driven Mercury Jet Interrupter 959
Repainting Feed Wires on Poles 960
Improving Speech Transmission 960
Electric Organ Blower 961
Power Plant for Alpena, Mich. 961
Primary Batteries for Operating Railroad Signals 961
Motor Driven Emery Grinder 962
Youngstown Steam Trap 962
Industrial and Commercial News 963
General News of the Week 966

THE GENERAL OUTLOOK.

The end of 1905 is in sight, and the whole world will soon be "taking stock," and measuring up its gains and losses. Americans in this Thanksgiving Week can view the situation with equanimity, for the whole course of the past eleven months has been away from depression toward activity and prosperity. With enormous crops marketing at good prices, and with capital and labor, in bulk, so well employed that there is scarcity of both, he would be an unreasonable man who found fault with the circumstances of the hour. In the electrical field, there are marked more particularly the beginnings of a revival in every branch, so that while last year production was far below the average, 1905 has seen a swinging back of the pendulum, and it may be doubted whether the year has not witnessed the largest production of electrical apparatus, the largest use of current, and the largest demand for electrical service ever experienced in the United States. The two greatest departments—electric railway work and central station supply—have shown a marked improvement of late in every direction, and the general cheapening of current has stimulated many allied branches of the art.

Outside of the United States, except Russia, the conditions are certainly improved, and in England welcome signs of activity and prosperity are everywhere noted. The increased production of gold has been a stimulant, and has been appreciated at a time when the cruel destruction of war had to be made good. It is a pity that the war cloud should have shifted merely from Manchuria to Moscow, but it is impossible not to infer improvement in the Russian situation from all that is happening. The Russian Empire lined up on the side of progress, humanity and constitutionalism cannot but be more helpful to civilization and prosperity than it has been under a régime that has simply made it a sink for the savings of France; and its resources in the hands of a liberated, educated people should soon be available as those of Japan, Korea, and China are becoming. Never was there a brighter day dawning for great engineering and electrical achievement, than that dating from the Peace of Portsmouth.

THE OWNERSHIP INVESTIGATION.

Attention has been directed from time to time to the investigation that is to be conducted under the auspices of the National Civic Federation into the questions of municipal ownership. The idea of this investigation is that formulated recently by Mr. H. W. Blake when he said before the New York State Street Railway Association: "If our present system of caring for public utilities is wrong, the sooner such a situation is realized the better; if it is right, every good citizen should be placed in a position to conscientiously uphold it." In other words, what we all need is the facts of the case. The arguments pro and con as theories, opinions, views, politics, etc., are pretty well known; now is the time for real data. The Federation committee will now proceed in its inquiries upon just that line, here and in Europe, determining from the accountant and actuarial standpoint just what there is in municipal ownership. It may take time to accumulate such data, and some money, but neither time nor money will be wasted if the sub-committees do their work as thoroughly as the membership would indicate and promise. At any rate we are likely to be spared in future some of the fuss and fury of the late Hearst campaign.

Permanent Water Storage.

We give in the current issue some account of a rather interesting Vermont plant, which is of some importance from being representative of a type which, while now unusual, may become of large economic significance. This type is that in which the entire available flow, or a considerable proportion of it, is the subject of storage, the natural flow of the steam being too small to be of any value for all the year round use. If the head is sufficiently great and storage area is available it becomes entirely possible to store water enough during the period of flood to give a considerable working flow distributed over the entire year. Such storage is well known in irrigation works and is employed in ordinary water supply systems, but is very unusual as a feature of hydraulic power development. The Chittenden reservoir with its 435,000,000 cu. ft. of storage capacity has only 15 square miles of drainage area, but works on a total head of nearly 700 ft., although in the present development most of this is, strangely enough, unutilized. At the full head the possibilities of storage are very striking since one may roughly reckon that a flow of one cubic foot per minute would give an output of one electrical horse-power. This means that the full storage would give an output of more than seven and a half million horse-power-hours, or more than a thousand horse-power twenty-four hours per day for every working day in the year.

And since the output rate from the storage is limited only by the equipment provided, it becomes easily possible to carry working loads very much larger than this in the ordinary course of electrical distribution. The one limitation is that the annual demand for water must not exceed that which can be furnished by the annual rainfall thus impounded. The water shed must be merely enough to insure the annual storage after due allowance for seepage and evaporation. In this particular instance the annual expected rainfall is about 45 in., while the retention of 11.5 in. is enough to provide the full amount of storage. There is ample margin for safety here. At the head here used a single square mile, assuming half the rainfall to be successfully impounded, would furnish about 50,000,000 cu. ft. of storage with all which that implies in the way of power; and it becomes entirely practicable if the topography is favorable to impound the rainfall even in the absence of any permanent stream. The long and short of the matter is that when one has storage facilities for a year's supply the natural flow of the stream, instead of being the determining factor in power development, is a matter of no consequence. The existence of a water power under so great a head in New England strikes one at first as very singular, but in fact another is even now being developed in Massachusetts under somewhat similar conditions, and a third and even higher head has been under consideration.

The particular plant here described required a dam 750 ft. in length and 54 ft. in maximum height to secure the necessary storage in the upper reservoir, but in other localities a much shorter dam would sometimes do the same work. The Chittenden plant has a secondary reservoir which is nearly 500 ft. lower than the one just mentioned, and which now serves as the source of power under about 200 ft. head. This is, of course, a temporary expedient, since the main fall is unused, but the necessary five miles of pipe line can be added at any time when it may prove profitable. Aside from the hydraulic arrangements the plant is in no wise remarkable. A search over the New England country would probably reveal several localities in which the Chittenden plan of campaign could be successfully carried out, perhaps upon even a larger scale. A similar search through the lower Appalachian range, which is rich in streams but singularly poor in natural lakes, would also doubtless be well rewarded. Any stream which passes through a gorge prior to a moderately abrupt but considerable descent gives a field of storage if back of the gorge lies a few square miles of fairly level drainage area. If this area rises to 10 or 15 square miles, the apparent volume of the stream becomes a matter of very little consequence, for it is rainfall as such that is to be stored. It may sometimes even happen that the drainage area and the available fall may not be upon the same stream. In irrigation works on the coast, tunnels are common and streams are carried wherever it seems desirable. If in a few miles of pipe a fall of 500 to 1,000 ft. can be secured, the cost of flumes and pipe lines drops to a moderate figure per horse-power, and operations of a character entirely different from those usual to Eastern hydraulic works become both feasible and advantageous. This Chittenden plant is an object lesson of no small value in teaching what can be done with very modest natural streams when they are skilfully treated. The annual rainfall represents a tremendous amount of power if it can be utilized under a considerable head. Under present conditions it is allowed to run to waste during the season of high water, and the lack of it is severely felt the rest of the year. In many cases this waste seems unavoidable, and so it probably is; but storage is so valuable, particularly at high heads, that the ground should be thoroughly gone over at the very beginning of every hydraulic undertaking, and no fair opportunity neglected.

Reflectors, Shades and Globes.

While considerable work has been done in the investigation of the absorption and distribution of light from shades, globes and reflectors, the data on the subject are much scattered, no small part is inaccessible to many who would be interested, and the most glaring differences exist in the results of reported test. Usually the investigations have been confined to special cases, of which an abstract printed last week in the "Digest" on some tests with Nernst lamp globes is an example; and the great discrepancies in photometric measurements made by different observers and with different apparatus combine to make the situation still more unfavorable. Considering the importance when planning illumination by incandescent lamps, of knowing what different types of reflectors, shades and globes may accomplish in the way of changing the natural distribution of light from the bare source, it is rather remarkable that the engineering world has so long been content with the condition above sketched. The reason is doubtless to be found in the indifference not only of architects, but of electrical engineers to scientific design in the lighting of interiors. In view of the present awakening on this subject, the series of articles on "Reflectors, Shades and Globes" by Messrs. J. R. Cravath and V. R. Lansingh, now running in our pages, is very timely and will, we believe, be much appreciated by readers.

While these articles naturally will not exhaust the subject, owing to the vast variety of electric light glassware on the market, they will place on record a large amount of data of the first importance in planning illumination. Later the authors will supplement this series with other articles discussing the practical applications of the data gathered to the lighting of interiors. As the value of engineering data of this kind lies largely in their use for making comparisons of one reflector, globe or shade with another, the authors have drawn all their data from tests made in a single laboratory, which is, moreover, especially well fitted in organization and apparatus for photometric work of this class. The tests are, therefore, of greater value for comparisons than if made in different laboratories and by different methods and observers. It is, however, true that there is little room for the splitting of hairs in this class of work, since the variations in performance of different reflectors, shades and globes are in most cases extremely wide and even rough tests would be a long step in advance in view of the present general lack of data on the subject. The immediate practical application of the data given is evident. No one having to do with the design or improvement of interior lighting can afford to be unfamiliar with the characteristics of the tools he uses to accomplish results. The electrical engineer and the architect, the central station man who has to deal with customers dissatisfied with the character of their lighting as well as offer suggestions on new work, all can find profit in the data that will be given in this series of articles.

AN INEFFICIENCY-METER FOR INCANDESCENT LAMPS.

It is well known that incandescent lamps having filaments of the same substance and character are strictly compared only when operated at the same temperature. If one lamp filament is operated at a certain temperature and another lamp filament is operated at an appreciably different temperature, the colors of the two filaments will differ appreciably, their sensitiveness to change in terminal voltage will be different, and their probable durations of life will be different. The comparison of the two lamps will be rendered complex and difficult. If, however, the two lamps could be operated at as nearly as possible the same temperature, their behavior as regards color, sensitiveness to voltage regulation, depreciation in candle-power with time, and duration of life, would all probably be the same. The comparison between the two lamps would become at once simple and convenient, even although one be a 100-cp lamp and the other be a 10-cp lamp. There is no way of applying a thermometer to the filament of an incandescent lamp in order to observe the temperature which it attains. In fact there is still some range of uncertainty and dispute between physicists as to the temperatures attained by incandescent lamps; but it is generally admitted that filaments of the same substance, having also the same quality of surface, emit equal fluxes of light per unit of surface, and consume equal quantities of electric power per unit of surface, when operated at the same temperature. Consequently without being compelled to measure either the temperature or the surfaces of two filaments under comparison, it suffices to ascertain that the ratio of total light-flux to total power consumed is the same in each, in order to infer that their temperatures are the same. An equivalent proposition is that the ratio of mean spherical intensity to power consumed will be the same at the same temperature; or that the mean-spherical-candles-per-watt are the same. If the forms of the two filaments are similar, it is probable that the mean horizontal candle-powers will be approximately proportional to the mean spherical candle-power; so that for similarly shaped filaments, the temperatures will be approximately the same when the mean horizontal candle-powers per watt are the same.

For this reason the candle-power per watt is an important criterion in the operation of an incandescent lamp. The higher this ratio, or the more candles per watt, the higher the luminous efficiency of the lamp and the higher the temperature. In the early days of the electric lamp industry, when attention had to be concentrated upon successful manufacture rather than upon logical nomenclature, the reciprocal of the above ratio, or the watts per mean horizontal candle-power, became the criterion of comparative operation and was called the "efficiency." As a criterion of operation, the watts per candle was possibly just as good as the candles per watt, and was the more convenient of the two because it came out in whole numbers instead of in fractions, and it was somewhat easier to speak of "three watts per candle" than "one-third of a candle per watt." By unfortunate oversight, however, the term "efficiency" became almost universally attached to watts per candle instead of to candles per watt, and although most practicians are not really misled by this misuse of terms, yet it is the usual practice to-day to speak of the efficiency of a lamp as the watts it consumes per normal mean horizontal British candle-power. The greater the "efficiency" of a lamp on this basis, the less the efficiency really is. To be logical, the watts per candle should be either an *inefficiency* or a *specific consumption* of power.

Notwithstanding the importance of the watts per candle in regard to the behavior of an incandescent lamp, there has hitherto been no instrument for measuring it directly. The watts have been measured at lamp terminals, either by a wattmeter, or by computation from the readings of an ammeter and a voltmeter. The mean horizontal candles have been measured simultaneously in the photometer and the ratio of watts-per-candle has been computed from these observations. On page 942 of this number, we publish an article by Messrs. Hyde and Brooks describing an ingenious form of photometer which automatically modifies the readings of an associated wattmeter in such a manner as to indicate directly the watts per candle upon the wattmeter scale. The article shows that the gist of the method is the automatic insertion of a definitely graded extra resistance into the voltage circuit of the wattmeter by a pair of sliding contacts attached to the photometer carriage. In order that the additional resistance should follow the required law, the resistance wire is wound upon a frame of definite geometrical form. The cartesian co-ordinates of this frame are defined by the scale of candle-power on the photometer bar, and by a uniform winding of insulated resistance wire on the frame, the resistance included between one end of the block and the slider will be proportional to the area of the curve under these points. The method thus involves the idea of determining the area between a curve and its boundaries in terms of ohms resistance instead of in square inches or square centimetres. The apparatus described is a very simple and ingenious solution of the problem, and introduces no room for extraneous errors except in regard to the electrical rubbing contact resistance in the traveling brushes, which should be negligible with good construction and reasonable inspection. We are glad to learn that such an apparatus has been constructed. According to the series of observations reported to have been made with the apparatus, the probable error of a single observation is only one-fifth of one per cent considered as a deviation from the results that would follow from dividing the observed watts by the observed candle-power.

It is perhaps open to discussion, and a matter for experience to decide, whether the criterion of watts per mean horizontal candle-power is of sufficient importance to call for the use of a specially modified photometer bench. There is very little doubt that it would be of sufficient importance if the filaments tested all had the same geometrical form, and, therefore, approximately the same reduction factor to mean spherical candle-power. As the authors point out, however, it is the mean spherical candle-power per watt that is the true criterion of comparative behavior, and since the photometer bench described is only capable of yielding observations on horizontal candle-power the result in watts per candle will have to be multiplied by a reduction factor for evaluating the watts per spherical candle-power. As soon as it becomes necessary to resort to computation with the indications of the apparatus, a part at least of its advantages disappears. In any case, however, the same method is capable of being applied to a spherical-candle-photometer. The only criticism that we have to offer is in regard to the name of the apparatus which the authors adopt. We think that instead of "efficiency-meter" its name should be either "inefficiency-meter" or "specific-consumption meter." To many this may seem a trivial question. It is true that if a person speaks of an efficiency in watts per candle we grasp the idea and ignore the contradiction in terms just as though a person were to speak of a speed in "hours-per-mile." But we look to the National Bureau of Standards as being beyond impeachment either in measurements or in expression, and it is to be hoped that the Bureau will avoid placing the seal of its adoption upon so glaring a misuse of terms.

Suggested Changes in the National Electrical Code.

The Electrical Committee of the Underwriters' National Electric Association at its meeting in New York on December 6 will consider a large number of suggested changes in the National Electrical Code. Among the more important of these are that the grounding of secondaries, which is now permissive, shall be made mandatory, and that outlet boxes be required at all outlets, whether conduit is used or not. A recommendation of the committee that no single pole switches be allowed on any circuit was not approved. A committee on high-tension motors reported a large number of recommendations on this subject. It recommended that a voltage above 550 be only approved when every practicable safeguard has been provided and that plans for motor installation shall be submitted before any work is begun; that the motor leads must be of the multiple conductor, metal-sheathed type, installed in unlined metal conduit, the metal sheath being permanently grounded.

A number of changes is recommended in the specifications applying to the use of flexible tubing. Other recommendations are that switches designed for use on three-wire systems shall be marked both with the voltage between the outside wires and between these and the neutral, together with the number of amperes. Under the new head of "Variable-Speed Motors," it is recommended that in the case of motors where speed control is by means of field regulation, the field regulating resistance shall be so arranged that the motor cannot be started under weakened field. Under transformers a new rule is suggested whereby in central sub-stations the casings of all transformers must be permanently and effectively grounded through conductors equivalent to copper of not less than No. 4 B. & S. gauge. It is recommended that joints in rubber-covered wires and cables must be covered with a coating of rubber at least as thick as the rubber covering of the conductor, the layers of this coating to be cemented together by heating, then covered with tape and finally with insulating paint. An interpretation is given to a rule covering house services rendering it permissive for the inspection department to require that all current entering a building must be through a single service cut-out except when different systems are employed. In order to protect lamp sockets and small wire, for fixtures, pendants, etc., and also to lessen the chance of extinguishing a large number of lights if a short-circuit occurs, it is recommended that the fuses in branch cut-outs shall not have a capacity greater than 6 amp. on a 110-volt circuit.

Other suggestions are that conductors carrying a current of over 10 amp. shall not be placed in metal mouldings; that motor-starters or main line regulators must stand without injury or alteration a current of 50 per cent in excess of the full load motor current for one minute when cold; authorizing the use of weather-proof wire for house top wiring; not to require protective devices on switches in the neutral of a three-wire system; that porcelain bases for link fuses be permitted on switchboards; that a special set of rules be prepared for theatre wiring; that specifications for wiring electric fixtures shall require more space in the shells and arms; that a minimum distance of 6 in. be established between gas pipes and electric conductors when not protected by approved tubing; that all cut-outs be grouped and placed in a cabinet located in an easily accessible place; that the rule requiring insulating joints on fixtures be abrogated, and that all fixtures shall be grounded; that architects be urged to provide properly in modern buildings for the wires of signaling systems; that receptacles with open contacts be excluded from show windows and other places where similar conditions exist, such as display booths, dens, cozy corners, large show cases, etc.

Potsdam, N. Y., Enjoined from Establishing a Municipal Lighting Plant.

On November 22 Judge Kellogg handed down a decision enjoining the village of Potsdam from establishing a municipal lighting plant, based upon the act creating the New York State Gas & Electrical Commission. This act went into effect June 3 of the present year, and the municipality had passed a resolution authorizing a lighting system on March 21 preceding. The court held that a lighting plant could not be built according to the terms of the resolution without obtaining a certificate from the State Commission, for the reason that power under the resolution had not been exercised by the expenditure of money or property or the incurring of any obligation in the carrying out of the then existing power to establish a lighting system. Several applications that had been made to the town trustees by persons who expressed themselves desirous of placing contracts with the village, and which applications had been accepted by the trustees, were held by the court to have no significance for the reason that they did not specify a definite number of lights, price and period of contract.

This decision appears to have a bearing in connection with the numerous incorporations for electric lighting and power purposes which took place between the passage of the Commission act by the Legislature and the date when it went into effect.

Figures on a Municipal Plant for New York.

At a meeting of the Municipal Engineers of the City of New York, at the Chemists' Club, on November 22, Prof. G. F. Sever read a paper or report on the proposed municipal lighting plant. This paper rehearsed the course of events since the end of 1904, and noted the formation of the commission composed of Prof. Sever and Dr. Cary T. Hutchinson to investigate the subject under the instructions of the Board of Estimate. The scheme outlined in the report is one based on alternating-current supply, without the element of a storage battery as reserve or insurance against interruption. Three power plants on the water front are proposed: one for Manhattan Island, one for Brooklyn and one for Staten Island, the first two to be connected. All plants are to have turbo-generators, three-phase, 60-cycle, 11,000 volts, with oil switches, etc. The various sub-stations are to step down the current to 2,200 volts, with distribution at 230 volts, the cables being underground.

The report includes various plans. One of these, "A," deals with the public electric lighting as it is. Under this estimate it was found that a power plant capacity of 10,000 kw was required to supply 6,000 arc lamps and a connected load equivalent to 250,000 16-cp incandescent lamps. The total cost of the power house, sub-stations and distributing system was found to be $4,100,000; the cost of operation per arc lamp, $75.40; cost per incandescent lamp service per kw-hour, 5.15c.; total cost of operation, $906,000.

The estimate includes neither the cost of construction of ducts for cables, nor rental charge for duct space, as the Corporation Counsel has informed the commission that the city has the right to use all duct space that it requires, free of charge.

Another report, "B," was submitted on June 19, 1905, and contains the plans and specifications of the power stations, which are the same for Manhattan and Queens. Between the submission of report "A" and report "B," $600,000 had been appropriated for power house sites in Manhattan and Queens and the same had been purchased. This estimate, which includes the lighting under "A," and in addition the replacing of all gas, naphtha and other illuminants, in the streets of Manhattan and the Bronx, by electric lights, provides for a power house of 15,000 kw capacity and a distributing system designed to supply 15,000 arc lamps and 300,000 16-cp incandescent equivalents, at a total cost of $7,567,000.

The total annual operating and fixed charges are $1,269,000. The proposed plant, it is claimed, would effect a saving, based on the prices in effect before the passage of the recent law reducing the price of electric power and light, of $434,000.

Another report, "C," covers the Boroughs of Brooklyn and Queens on the same basis as "A" covers Manhattan and the Bronx. It was found that a plant of 10,000 kw capacity would be necessary and a distribution system designed to supply 7,500 arc lamps and 200,000 16-cp equivalent incandescents, at a total cost of $6,138,000. The total operating and fixed charges would be $845,000 or $27,000 more than it would cost to obtain service for the same number of lamps from existing sources of current, under the new prices.

It is claimed in this connection, however, that the service contemplated in this report is superior, both in quality (electricity being substituted for gas in all buildings), and candle-power, to that now furnished the city. And also that the estimate covers the cost of a conduit system consisting of 156 miles of trench, principally located in the central part of Brooklyn, where it is desired to place no additional overhead wires. Also, that the cost of incandescent service is high, the lamps burning on an average only 200 hours, as compared to 373 in Manhattan and the Bronx.

A report, "D," includes the lighting under report "C," and in addition the replacing of all gas, naphtha and other illuminants, in the streets of Brooklyn and Queens, by electric lights, and provides for a power house, of 15,000 kw capacity, and a distributing system designed to supply 15,000 arc lights and 200,000 16-cp incandescent equivalents. The total cost will be $9,485,000. The total annual operating and fixed charges will be $1,424,000. The annual cost per arc light will be $76.89 and the cost per kw-hour for incandescent service will be 13.53c. Taking the exact number of buildings and street lamps connected on December 31, 1904, as a basis of comparison, the annual cost of the city lighting for the Boroughs of Brooklyn and Queens, from the proposed plant, would be $68,000 in excess of the cost under the rates fixed recently by the State Legislature. It should be borne in mind, Prof. Sever said, that as the territory to be lighted becomes more thickly settled, the annual cost per arc lamp and kw-hour of incandescent service will decrease.

As a summary of the above, Prof. Sever said: "It will require an investment of $10,238,000 to light the four boroughs of New York City, other than Richmond, in accordance with the conditions under reports 'A' and 'C' and $17,052,000 to light them as outlined in reports 'B' and 'D.' There will be a saving in the cost of lighting, even under the new rates passed by the Legislature, considering reports 'A' and 'C' of $301,000 and taking reports 'B' and 'D' of $360,000; or taking Manhattan and the Bronx alone, report 'A' will save $328,000 and report 'B' $427,600.

'A municipal lighting system for the Boroughs of Brooklyn and Queens, similar to that provided under report 'C,' will make the cost of lighting $27,000 greater than under the ruling rates. One similar to that in report 'D' will make the cost $68,000 greater than under the ruling rates."

◆

Ohio Mechanical, Electrical and Steam Engineers.

The annual meeting of the Ohio Society of Mechanical Electrical and Steam Engineers was held in Canton, November 17 and 18. The society's constitution was amended to enable it to hold meetings outside of the State of Ohio; also to accept as honorary members those connected with the management of plants, whether they are engineers or not.

Among the papers read were the following: "Switchboards," by Henry Jackson, of Steubenville, and "Losses in Power Plants," by Charles N. Harvey, of Zanesville, and topics of special interest to the members were brought forward for discussion. Trips were made to manufacturing plants at Salem and Alliance.

Officers were elected as follows: President, W. T. Magruder, Columbus, O.; vice-presidents, Oscar F. Rabbe, Toledo, O.; and H. E. Stone, Cambridge, Mass.; secretary, F. W. Bullard, Cleveland, O.; assistant secretary, H. H. Kelly, Atlanta, Ga., and treasurer, W. D. Theobold, Canton, O. The next meeting will be held in Pittsburg, Pa., in 1906.

◆

Wire Conduits for Greater New York.

After hearing the report of Assistant Chief Engineer Nichols, of the Finance Department, the Board of Estimate of New York appropriated last week $175,000 to put underground all electrical wires and conduits in the Boroughs of Brooklyn and Queens. The Municipal Commission on Electric Lighting, consisting of Cary T. Hutchinson, George F. Sever and Nelson P. Lewis, was directed to prepare plans for a system of subways in both boroughs to carry all underground electrical conductors, including the distributing wires of proposed municipal electric lighting plants for those boroughs. The plans also will cover necessary extensions of existing subways in Manhattan and the Bronx. The cost of the work will be estimated by the commission.

In this the Board of Estimate reverses the method adopted years ago for Manhattan. In this borough and in the Bronx the subways for underground wires were built by the companies, which were required to pay annual sums for the privilege. These sums, however, are in arrears and much litigation has resulted. By the new method in Brooklyn and Queens the city will build the subways and then will make rental charges with the power to dispossess the lessees if the rents are not paid.

The subway companies in Manhattan and the Bronx are the Consolidated Telegraph & Electrical Subway Company, which controls the ducts for the high voltage light, heat and power wires, and the Empire City Subway Company, Limited, which controls the ducts for the low-tension telegraph, telephone and messenger call wires. The Consolidated Subway Company is owned by the New York Edison Company, which in turn is a Consolidated Gas property, and this point was raised by Mr. Nichols in his report to show why the city should inaugurate its own duct system in Brooklyn if it is to control the lighting situation of the city. Mr. Nichols estimates at fully $2,000,000 the cost of the ducts in Brooklyn.

◆

November Meeting of the American Institute of Electrical Engineers.

The two papers presented at the November meeting of the American Institute of Electrical Engineers dealt with testing laboratories and were largely descriptive in nature. The paper by Dr. S. W. Stratton and Prof. E. B. Rosa gave an outline of the history connected with the establishment of the National Bureau of Standards at Washington, and explained the methods by which the work of the Bureau is accomplished. The working unit of the Bureau's force is the section based upon a definite class of work and headed by an expert. For the purpose of administration, these sections are grouped into three divisions. The first division, under the immediate charge of the director, comprises six sections, as follows: 1. Weights and measures. 2. Heat and thermometry. 3. Light and optical instruments. 4. Engineering instruments. 5. The office. 6. The instrument shop. The second division, in charge of the physicist, also comprises six sections, as follows: 1. Resistance and electromotive force. 2. Inductance and capacity and absolute measurements. 3. Electrical measuring instruments. 4. Magnetism. 5. Photometry. 6. The engineering plants. The third division comprises the chemical work of the Bureau, and is in charge of the chemist, but has as yet not been subdivided into sections.

The functions of the Bureau as defined by law include the custody and construction of primary standards, the construction of secondary standards, their multiples and subdivisions, and the comparison of these standards with the secondary or working standards used by the public. The Bureau is also authorized to determine physical constants and the properties of materials. The relation of the Bureau's work to the manufacture of scientific instruments and apparatus is very close and important. The Bureau is co-operating with the makers of such apparatus in every way possible; they visit the Bureau from time to time for suggestions and advice, and are regularly submitting apparatus to the Bureau for testing and investigation. The major portion of the paper is devoted to a detailed description of the various buildings and their equipments.

The paper by Dr. C. H. Sharp described the practical operation of the Electrical Testing Laboratories in New York City. It was stated that, although the Electrical Testing Laboratories was formed as a business enterprise, it is not engaged in producing any manufactured product. It does not attempt or expect to supplant the testing laboratories organized by operating and manufacturing companies, but rather to supplement them. By abstaining from giving advice or rendering opinions, it does not encroach upon the particular province of the consulting engineer, while it places at his disposal facilities for obtaining such experimental data as he may need in his practice. It will thus be seen that the purposes of this enterprise are not in the least antagonistic to any other industry or established interests, but the establishment is in a position to be of impartial service to all. The National Bureau of Standards maintains the primary standards; the Electrical Testing Laboratories devotes itself to commercial electrical measurements for the promotion of electrical industries; thus these two laboratories are mutually supplementary, the one undertaking a work which is essentially a function of government, and the other applying the results of such work to productive industries.

The two papers were discussed by President S. S. Wheeler, Prof. F. B. Crocker, Prof. W. E. Goldsborough, Mr. C. O. Mailloux, Prof. G. F. Sever, Prof. C. A. Doremus, Mr. William McClellan, Past President John W. Lieb, Jr., and by the authors.

Fires from Electrical Causes.

The Electrical Bureau of the National Board of Fire Underwriters in its quarterly fire report, No. 49, points out the specific dangers that lie in a lax enforcement of the rules of the Board by giving an account of the electrical fires reported for the three months from July 10, to October 10, 1905. Two crosses between high-potential and low-potential circuits, and nine between light or power wires and signaling systems, have been reported. Twenty fires have been caused by short-circuits in interior wiring, six of which were in flexible cords. Twenty-two fires were reported due to accidental grounding of circuits, of which four were on gas pipes, the resulting arcs burning holes through pipes and igniting escaping gas. Nine reports of damage by lightning entering buildings over service wires, were received. Six fires have been attributed to incandescent lamps, in five of which heat from the lamp ignited material near by. Five fires were caused by dynamos and motors; two of these evidenced carelessness on the part of the attendants. Three fires were due to loose connections in electrical fittings. Two pole and tree fires were reported. Four reports were received of fires due to overheated rheostats in elevator contol apparatus.

Reports of forty-two other fires attributed mainly to electrical heating irons, moving picture machines, and defective electrical apparatus have been received making a total of 115 electrical fires that have been reported during the past quarter, the losses aggregating over $256,403. Reports have been received of 82 fires, losses aggregating $959,302, supposed to have been due to electricity, but they were not included in the report, as the causes could not be definitely proven as electrical, principally because the fires destroyed the conclusive evidences of their origin. Eleven fires, losses aggregating $362,761, reported as due to electricity upon further and more reliable investigation, were found to have been due to other causes.

◆

The First Telegraphic Train Dispatching.

Mr. A. H. Copeland, who for nearly 30 years was agent for the Chicago & Alton Railway, at Chenoa, Ill., claims to be the first man who ever dispatched a train by telegraphic train orders. When the event took place in the early fifties Mr. Copeland little dreamed of the far-reaching result of a simple act of kindness.

It came about in this way: In the winter of 1852 Mr. Copeland worked in the post office at Middlebury, Vt., and was also telegraph operator, the telegraph offices in those days being generally located in the post offices and not in depots. Railways had no telegraph service of their own; the trains were operated wholly by time card rules which provided that one train would wait at a certain station until the other train had passed. If one train was late at the meeting point the other was required to wait twelve hours or until the other showed up. Such a condition existed on the winter morning in February, 1852, when the first telegraphic train order flashed over the wires. The north-bound train, due to meet the south-bound train at Middlebury, was in a snowbank in the Green Mountains south of Rutland. The conductor of the south-bound train was of course unaware of this, and only knew that he and his passengers had before them a wait at Middlebury anywhere from twelve minutes to twelve hours, when at the expiration of the latter time his train regained its right to proceed south to Rutland. As the length of delay increased, the restless, irritated passengers grew bold and wandered uptown from the depot. Some of them straggled into the post office and happened to tell Copeland of the delay. The operator thought a moment. Then he said, "You bring the conductor up here and perhaps we can fix it so that you can go on to Rutland without waiting for the north-bound train." The conductor demurred, but finally acceded to the demand of his irate passengers. Upon arrival at the post office Mr. Copeland handed him a message from his superintendent at Rutland. It read something like this: "North-bound train in snowbank south of here. You come on down to Rutland and I will not let any train go north until you arrive." Mr. Conductor read his order, looked Copeland straight in the eye and said, "I am afraid to do this. I might be taking a chance. How do I know it's genuine?" Copeland quietly replied, "I'll ride on the engine to Rutland." That settled it and the train went on its way, the passengers rejoicing and heartily thanking the operator, who kept up a wonderful amount of thinking while quietly sitting in the cab from Middlebury to Rutland.

It was not until 1868 that Copeland went to the Chicago & Alton, where he found in full effect the perfected result of his original and accidental use of the telegraph in the movement of railway trains.

◆

Trees and Electric Pole Lines.

In an address before the American Civic Federation at Cleveland, Ohio, Mr. Henry Clay Weeks said: "In New York State two decisions, in the same case, of the Supreme Court, applying to the whole State, have been recently gained which declare that the use of the highways for telephone purposes (for instance) is not a proper use of the road and that a trespassing company on a rural road owned by a person can be ousted though the company hold the proper permits of street officials. Such a damaging decision was far-reaching in its effects and was earnestly and lengthily delayed by the tactics of the company. The case was not appealed by the company, and hence it is assumed that it accepts as the law what it always knew was a law. In the case of electric light companies which have a contract to light a street (to add to its further usefulness) the case is different, but probably not different if the pole line is for private use or simply for corporate gain. Hence, it is preferable to light streets with the more pervasive light from Welsbach burners.

"Use self-protection, and unless the men are very indiscreet they will yield. An instance near the writer illustrates: Recently a gentleman of means and standing told linemen if they put up a pole in front of and on his ground he would chop it down. They did it and he went with his man and shortly nearly severed the great pole. Then the company removed it a few inches away, compensating the other owner by the free use of a telephone, under the guise of his allowing a pay station on his place. Thus is it frequently shown that standing on one's rights secures them.

"And then even use sentiment—arouse it by every proper means and teach thoughtless people of the beauty and value they are allowing to be sacrificed for corporate greed. Arouse them to the importance of the moral issues where companies manipulate pliant public officials. Tell them truly that such courses carried to their ultimate end, will drag our country to ruin. Our contest is against the tree butcher—and to make it effective it is against overhead wires where possible and against the threatening evil of the corporate control of public officials by unworthy means in this contest."

◆

Argentine Underground Roads.

Argentina has passed a law providing for the construction of a system of underground railroads in Buenos Ayres. Under the provisions of the bill the municipality will be authorized to concede the construction and exploitation of a system of underground electric railways for the service of the city and such other branches as may in succession be deemed advisable. The terms of the concession are as follows:

First. The contracting party shall construct the works at its own expense and in accordance with the plans approved by the executive.

Second. The contracting party shall also pay for all lands expropriated for tracks, stations, shops, etc.

Third. The contracting party shall administer and exploit the lines at their own expense and risk for a period of not more than forty years, at the end of which time they, with all their tracks, stations, shops, rolling stock, etc., shall become the property of the municipality.

All material intended for the construction and exploitation of these lines shall be admitted free of duty.

It is reported that German capital is already interested in this matter.

◆

British Association.

The general committee of the British Association has decided to accept the invitation of the Leicester Corporation to hold the 1907 meeting of the association in that town. An invitation having the same object in view was received from Dublin. The committee expressed the hope that the invitation to meet in Dublin might be renewed at an early date.

The Open Shop.

In *The World's Work* for December, Isaac F. Marcosson describes the battle for the open shop, and thus sums up the results of the year's work of the associations of employers:

The end of the year finds a bristling battle line between employer and employee extending to nearly every state. The large results of the fight for the open shop are these:

(1) The employer has learned the value of organized opposition to excessive union demands and is securing control of his shop or business.

(2) The power of the walking delegate as a disturber of peace and industry is passing.

(3) The non-union worker now knows that he can be protected in his constitutional right to work where he pleases.

(4) Organized labor is on the defensive instead of the offensive.

(5) The labor agitator has been taught to respect the law.

The employers do not maintain nor wish that labor unions should be destroyed; nor do they question the right of temperate and constructive (not destructive) organization. They have proved, too, that the union and the non-union man can work in peace side by side under free and fair conditions. This is industrial democracy.

◆

Electrical Engineers of the Times—XXXVIII.

MR. I. A. TAYLOR.

Irving A. Taylor was born in Scotch Plains, N. J., October 29, 1874. After finishing a common school course he entered at the age of fifteen the shops of the C. & C. Electric Company, where he served three years, passing through all of the various departments and learning the use of tools and of his hands. After this period of apprenticeship work he joined the Edison Electric Illuminating Company, of Brooklyn, N. Y., with which he remained for nine years. His first duties here were in connection with isolated plant and motor power work, and later on with construction work at the company's new Union Station. During this employment his nights were spent in studying mathematics and various physical and mechanical branches of knowledge in the evening high schools of New York City and at the Pratt Institute in Brooklyn. At the same time a course of reading was followed in literature, science and every branch of engineering.

IRVING A. TAYLOR.

Leaving the Brooklyn Company, Mr. Taylor went with the Lachine Rapids Hydraulic & Land Company, of Montreal, Canada, where he served as wireman, foreman, superintendent of meters, engineer and assistant general superintendent. During this engagement he took full advantage of the very broad opportunities afforded for obtaining a wide knowledge of alternating-current station engineering. This work was followed by considerable experience in association with Mr. Albert B. Herrick in the installation of station plants and in consulting work, including the construction engineering of an artificial ice plant and the testing of the Mechanicsville-Schenectady plant for the hydraulic contractors. Engineering work for the Lachine Rapids Company was then again taken up, including an extended investigation of lightning and static charges and protection, a peculiar local electrolytic action on lead cable sheaths, and a number of other matters involving original investigation. Still another line of work was in the investigation of problems in relation to the handling of anchor and frazil ice.

Upon his return to this country in 1902, Mr. Taylor acted for a time as New York engineer of the Bullock and Wagner Companies, during which he installed many large plants in the East, including a polyphase plant at Niagara Falls. Subsequently he opened an office in New York and made numerous investigations, tests, etc., in connection with electrical, steam and pumping propositions. During the last winter considerable of his time was spent in investigation of conditions at several Canadian hydro-electric plants. Mr. Taylor is now general superintendent of the St. Lawrence Power Company at Massena, N. Y., this plant having at present a capacity of 25,000 hp.

Mr. Taylor has written for the technical press occasionally and for some years has been a member of the American Institute of Electrical Engineers.

◆

CURRENT NEWS AND NOTES.

TELEPHONE CORNS.—According to a Pittsburg dispatch telephone girls in that city are deserting their places because they find that the constant wearing of a receiver produces corns on their ears.

MEETING AT THE ELECTRICAL TESTING LABORATORIES.—Undoubtedly the most successful meeting ever held by the New York Section of the American Electrochemical Society took place on Thursday last at the Electrical Testing Laboratories, 80th Street and East End Avenue, New York City. The meeting was extremely well attended and after some introductory remarks by the chairman, Dr. Charles A. Doremus, Mr. J. W. Lieb, Jr., president of the Laboratories, explained the history of the institution laboratory and its relation to the Edison companies, emphasizing the absolute independence of the Testing Laboratories from any commercial relations. Dr. Clayton H. Sharp and Mr. W. S. Howell explained in very interesting speeches the leading general ideas of the arrangement of the laboratory and of the work which is there being performed. While by far the most important work of the laboratory is still the testing of lamps, the equipment is so complete that almost any electrical tests desired are easily performed there. Rooms are also available, it was stated, that may be rented to inventors and those who want to make their own tests. Then followed a thorough inspection of the laboratories beginning with the top floor and ending in the basement, where refreshments were served. The equipment of the laboratories was described in full by Dr. Sharp in our issues of January 7, 14 and 21, 1905.

THE NEW HAVEN LOCOMOTIVE.—With regard to the single-phase locomotives of the Consolidated Railroad, the Boston *Herald* of November 24 has the following dispatch from New Haven, Conn.: "In regard to the type of electric locomotives to be used by the New York, New Haven & Hartford Railroad Company in its New York terminal service, an explanation has been made at the offices of the company in this city. The explanation appears in a letter of B. G. Lamme, chief engineer of the Westinghouse Company, who says that the equipment for the locomotives to be used has a high-class direct-current arrangement, also adapted for operation on an alternating current. The style of locomotive is in reality designed for the very highest class of direct-current service, but it will operate successfully on an alternating current. It is further explained officially that in this way the New York, New Haven & Hartford Company secures an option between the two kinds of current. The company, under its arrangement with the Westinghouse Corporation, is not compelled to accept the 25 locomotives contingently ordered unless, after an initial test of a single locomotive, it is shown that they will work successfully. The test locomotive will be put in operation in a few months. As to the style of cars to be used in the New York terminal and suburban service, and whether they are to be of a fire-proof character, President Mellen makes the statement that his company will do whatever is necessary for the accommodation of the public patronizing his lines, and that the cars will conform to the New York Central standard, with such improvements as have been made in electrical traction subsequent to the placing of the New York Central's orders."

NEW YORK ELECTRICAL SOCIETY.—At the November meeting last Wednesday of the New York Electrical Society, Mr. O. S. Lyford, electrical engineer of Westinghouse, Church, Kerr & Co., gave a lecture, illustrated by lantern slides, on the "Electrification of the Long Island Railroad." The details of the electrification of this system were given in these columns in the issue of November 4.

HEATING WARSHIPS.—With regard to our recent comment on the possibility of heating the British man-of-war *Drake*, on the bitterly cold night when the ball was given by Prince Louis of Battenberg, Mr. Max Loewenthal, the electrical heating expert, writes us that he visited the *Drake* two days before the ball and suggested to the officer in charge of the arrangements the use of luminous radiators as best suited for the heating of the open-air improvised ballroom. It is a great pity this timely and pertinent advice was not taken, as the cold air did much to lessen the success of that brilliant function.

CLEVELAND THREE-CENT FARES.—At Columbus, Ohio, on November 28, by a decision of the Supreme Court, Mayor Tom L. Johnson, of Cleveland, won a victory in his fight for three-cent fares. On one ground or another all the other franchise ordinances granted by the Cleveland City Council proposing three-cent fares have been set aside by the courts in litigation inspired by the opposition companies. The court has reversed the judgment of the Circuit Court of Cuyahoga County in the case of the Forest City Railway Company and E. A. Greene vs. W. J. Day, and dismissed the petition of the plaintiff. This, it is said, is final.

STARTER FOR MERCURY-VAPOR DEVICES.—Two patents issued November 21 to Mr. Peter Cooper Hewitt relate to the method of starting mercury-vapor devices by electromagnetically projecting a stream of mercury from one electrode into contact with another electrode. The negative electrode, which is at the bottom of the lamp, consists of mercury contained within a cylinder or socket. Above the cylinder is located an armature of soft iron, annular in form and coated with glass. The armature floats in the mercury. Outside the chamber containing the mercury is placed an actuating coil so located that when current flows through it the armature will be drawn down, causing a piston to enter the lower cylinder and to force a stream of mercury upward through a perforation in the piston and into contact with the upper electrode.

STEAM TURBINE MODELS.—In a decision by Judge Waite, the Board of United States General Appraisers has sustained a protest filed by G. W. Sheldon & Co., of New York, it being held that samples or patterns of portions of steam turbines are entitled to free entry under the provision in the Dingley tariff law for "patterns for machinery." Collector Stranahan assessed the articles under Paragraph 193, which provides for "manufactures of metal" with duty at the rate of 45 per cent ad valorem. The merchandise consisted of various articles of steel or other metal illustrating the construction and assemblage of the blades of a steam turbine engine. Judge Waite says in his decision for the board that the articles are in no sense molders' patterns, but are used after the manner of models as instruments or tools in the practical operation of manufacturing the machine. It is understood that the actual importers are the Allis-Chalmers Company, which concern intends to use the models in the manufacture of its steam turbines.

SINGLE-PHASE INDUCTION MOTORS FOR TRACTION.—Two patents issued November 21 to Mr. A. G. Davis on applications filed April 4, 1898, describe a system by means of which single-phase induction motors may be rendered applicable to railway work. The system involves the use of two motors connected electrically in tandem and having their rotors mounted on the same shaft. The primary of the one motor is wound to receive single-phase current, while its secondary and both the primary and secondary windings of the second motor are of the polyphase type. A striking feature of the equipment resides in the means employed for producing a revolving field in the single-phase motor, even when the active rotor is stationary. This motor is provided with a so-called flux screen, which is independently rotatable in the air-gap, and contains a short circuited squirrel cage winding. When this rotor is set in rotation the e.m.f's generated within it cause currents to flow, which produce a certain quadrature field which gives torque to the flux screen, and it at once accelerates approximately to synchronism. The quadrature field is proportional to the speed of the flux screen, and at synchronous speed it is equal to the main single phase field. These two fields are in quadrature both in time and in space, and they combine to produce a true revolving field. The action of this revolving field upon the polyphase secondary winding is the same in all respects as though the field were produced by a polyphase primary winding, and the two motors when connected in tandem operate as though they were polyphase machines, and reach a limiting speed at one-half of synchronism. The flux screen, which is intended to revolve continuously, is placed in operation initially by means of a miniature split phase motor.

GEORGE WASHINGTON UNIVERSITY.—The plans for the development of the George Washington University at Washington, D. C., have already been described in these pages, and a large amount of work is being done this winter to put them into effect, so far as relates to the curriculum. Recent additions to the faculty of graduate studies are as follows: Henry Larcom Abbot, U. S. A., retired, member of the Board of Consulting Engineers for the Panama Canal, professor of hydraulic engineering; George Lansing Raymond, late of Princeton, professor of æsthetics; Edward Bennett Rosa, physicist of the National Bureau of Standards, professor of physics; Brig.-Gen. George Miller Sternberg, U. S. A., retired, professor of preventive medicine. These professors will assist in supervising the work of graduate students in their respective branches. The Washington College of Engineering has been incorporated under the same act amending the charter of the university. The head of the college is a dean and its affairs are conducted similarly to those of Columbian College. The first board of ten trustees comprises John M. Wilson, Bernard R. Green and Charles Whiteside Rae, who serve until June, 1908; Thomas M. Chatard, T. Commerford Martin and Otto H. Tittmann, who will serve until June, 1907, and John B. Larner, Charles D. Walcott and John Joy Edson, whose terms expire in June, 1906. In the course of this college and of the Columbian College proper is embraced the undergraduate work of the university, the Columbian College, including all courses in arts and pure science leading to the degree of B.A. and B.S., and the Washington College of Engineering, embracing the technical undergraduate courses leading to the degree of B.S. in civil, electrical and mechanical engineering.

LONG-DISTANCE TELEGRAPHY.—We have received from the electrical engineer's branch of the General Post Office, Melbourne, Australia, an account of long-distance telegraphic work on Australian lines Sunday, September 24. The circuit nearly encircled the continent, from Cape York on the northeast tip to Broome on the northwest. The length was 6,601¼ miles, in which there were 13 repeating stations. The experiments were begun at 11 a. m. Melbourne, Sydney, Brisbane, time, which under the prevailing zone system was 9 a. m. at Perth. Adelaide, Melbourne, Sydney, Brisbane and Townsville were in attendance and ready at the former hour and greeted each other. Cape York was then joined to the circuit, the signals to and from being clear and firm. Owing to an unexpected delay at Eucla, which is a main repeating station situated on the Great Australian Bight, Perth was not in a position to communicate with Melbourne and the other capitals until 12 noon, but when he did appear there was no difficulty in speaking through to Cape York freely and well. Broome, a duplex station, 1,466 miles distant from Perth, was then connected to the circuit and it and Cape York passed the time of day and carried on a conversation for 15 minutes, at a key speed of 20 words per minute, without the least sign of lag in the signals. Broome stated that the temperature was 100° in the shade there, while Cape York set it down at 80 at that end. The signals passed from one terminal station to the other splendidly, annihilating distance in a most pronounced manner, and amply demonstrated to the satisfaction of all concerned that through telegraph working from one end of Australia to the other was a practicable feat. With the arrival of this successful issue the terminal stations were taken off, the intermediate circuits were dismantled, and the experiments came to an end. The following were the technical officers principally concerned in the test, viz.: Messrs. Jenvey and Diercks, at Perth; Mr. Unbehaun at Adelaide, Messrs. Howard and Fitzgerald at Melbourne, Mr. Nelson at Sydney, Mr. Hesketh at Brisbane, and Mr. Murphy at Townsville.

A. S. M. E.—The American Society of Mechanical Engineers will hold its fifty-second meeting in New York City December 5-8, inclusive, as already noted in these columns, and a large attendance is expected. The Edison auditorium of the New York Edison Company will be the center for some of the sessions.

ST. PETERSBURG STRIKE.—A despatch from St. Petersburg, dated November 22, in regard to the labor disturbances in that city states that an extensive lockout has been declared in the engineering and metal industries consequent on the Admiralty closing the Neva works. It was reported that the Westinghouse works were to be closed also.

OWNERSHIP IN INDIANA.—According to a bulletin of the Indiana Bureau of Statistics, in 1905, 32 cities of the 84 in the State owned their electric light plants and 52 cities were lighted by contract with private parties. The entire cost of lighting for all the cities was $890,666.44. The cost of the 32 cities was $320,327.61, and for the 52 cities $570,338.83.

THE CHRISTMAS TREE.—The *Country Life in America* for December has the following: "The family were afraid to have candles on the Christmas tree because of all the little children, so they used colored electric lights. The tiny little batteries that can be bought in a store did not make a sufficiently powerful light, so they hired a 40-hp gasolene automobile to come and stand outside the door, attached the electric bulbs to the batteries, and got all the light they wanted."

MURGAS WIRELESS TEST.—A test took place of the Murgas wireless telegraph system last week between Wilkesbarre and Scranton, when a number of messages were successfully exchanged over that distance, some of the messages being in Latin and Slovak. Lieut.-Com. S. S. Robinson was present on behalf of the United States Navy. A speed is said to have been reached of 45 words per minute. The current used was 7 amp. on the low-tension side and this was afterward reduced to 3 amp. Prof. A. W. Goodspeed, Mr. E. W. Stevenson and other experts were in attendance.

TURBINES IN THE NAVY.—It is stated from Washington that the Bureau of Steam Engineering of the Navy Department will conduct an official efficiency and steam economy test of a 1,200-hp Curtis turbine erected for demonstration purposes at the works of the Bliss Company in Brooklyn, N. Y. There are many questions involved in the adoption of this type of machinery in place of the ordinary reciprocating engines, and the experts who have charge of the designs of the machinery of the battleships are making a full inquiry into the whole subject. It is for this purpose that a board of naval engineers will visit the Brooklyn plant and observe the test early in December. The bureau will detail the board to conduct the test on the invitation of F. T. Bowles, formerly chief constructor of the navy.

GASOLINE-ELECTRIC CAR.—A special dispatch from Baltimore, Md., of November 23 says: "General Superintendent Bent, of the Baltimore & Ohio Railroad, and Superintendent of Motive Power Gibbs, of the Pennsylvania Railroad, were among the railway officials who went on a short trip out of Philadelphia to-day to test a new electrical locomotive designed to replace the ordinary steam locomotive, especially on branches and spur lines. The new engine, which is capable of making fifty miles an hour, and which is of a peculiar type, is the invention of Lars Nelsen. It was built at the Brill Car Works, Philadelphia, by the Strang Gas Electric Company, of New York. The equipments consist of an 80-hp gasoline engine connected to a 50-kw Westinghouse generator, supplying a storage battery of 103 cells of two and one half volts each. It is understood that the test was satisfactory."

A NEW INDUSTRIAL CITY.—It is stated from Trenton, N. J., that John A. Roebling's Sons Company is to build at Kinkora, ten miles south of there, a city for the housing of its employes. Arrangements have been completed for the erection of three workingmen's hotels and nearly a hundred private dwellings, in addition to the big hotel and the half hundred houses already erected. These buildings will be used exclusively for the housing of the company's employes who will work in the new rolling mill plant soon to be put in operation at Kinkora. The building of the mill and the completion of the city will represent an outlay of more than a million dollars. All of the work is to be done in less than a year. Paved streets, private water and gas plants, electric lights, schools, churches, a library and other adjuncts of a modern city will be provided by the Roeblings, all for the use of the workingmen. None of the property will be sold and all of the houses will be rented at a very moderate rate.

COST OF AUTOMATIC TELEPHONY.—Mr. C. E. Tarte, general manager of the Citizens' Telephone Company, of Grand Rapids, Mich., has recently issued an interesting statement as to the relative cost of manual and automatic telephony. The manual exchange for the year 1903, with an average of 4,977 telephones during the year, cost $9.40 per telephone, as follows: Exchange labor, $32,120.28; inspection department, $8,039.38; maintenance wagon and reconstruction wagon, $6,648.57; a total of $46,808. The automatic exchange for the year ending June 30, 1905, with an average of 6,119 telephones, cost $4.60 per telephone, as follows: Exchange labor, $3,601.42; switchboard men, $5,981; inspection department, $10,720; maintenance wagon, $4,440; reconstruction wagon, $3,440; a total of $28,182.42. It is noted that the automatic exchange operated an average of 1,142 telephones more than the manual. With the same number of telephones in operation the total cost of the manual system would have been $57,543.03, against $28,182.42 for the automatic, a difference in favor of the latter on an average of 6,119 telephones of $29,360.61.

A HUDSON EXPOSITION.—About 200 business and professional men of New York gathered at Carnegie Lyceum last week to formulate plans for a permanent exposition in New York, to begin in 1909, when the three hundredth anniversary of the discovery of the Hudson River is to be commemorated. The meeting, presided over by John R. Van Wormer, president of the Lincoln Trust Company, decided to appoint an executive committee of fifteen to investigate the project. George N. Kingsbury directed attention to the fact that there are 200,000 strangers in New York every day from whom support might be secured. Dr. E. Parmley Brown said that J. P. Morgan & Co. would act as treasurer of a fund to be raised, and that Miss Helen Gould and others of prominence would serve upon committees. The idea of the exposition is contained in this extract from the resolutions adopted: "The proposed celebration should take the form of a permanent international exposition, to be opened in 1909 and to continue annually thereafter, not a mere ephemeral world's fair, but a permanent and significant enterprise, which shall offer such a panoramic registry of the world's progress in all directions as to make it the object of continual pilgrimage from all parts of the world, and a perpetual stimulus to inventors, discoverers, scientific research, and all industrial, economic, intellectual and moral progress."

LIGHTING IN DENVER.—With regard to the development of lighting at Denver, Colo., the local *Post* says: "With the plans going forward for the additional municipal lighting that will make Denver the real 'City of Lights,' we should not overlook the fact that the business men were the first practical exponents of the new idea. Their displays of lights, almost countless now on the downtown streets, were the first practical step toward making the city beautiful with lights. They have practiced what we all have preached. The desire for lights for commercial purposes grew upon the business men almost imperceptibly, so they say. Before they knew it they found that lights were one of the most effective advertising mediums. Those who adopted the lights told of increased business, of an indescribable feeling of greater cordiality produced between merchant and patron. Their neighbors heard of this; they began to consider. The result is evident on every business street, and even into the residence sections and the suburbs. Drug stores, groceries and other smaller business houses far out from the heart of the city have their light signs, have their windows illuminated by numerous electric bulbs. It must be to the interest of them all or they would not continue the use of the lights. They benefit, the people benefit, because the lights form a pleasing break in walking through streets made more or less dark by the foliage. The 'City of Lights' soon will be a reality, one of the best that has ever befallen Denver."

[illegible] CABLE.—The Commercial Cable Company's new cable between Makasser, Celebes, and Balikpapan, Borneo, was opened for business last week.

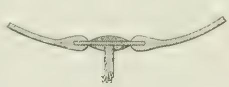
BERLIN SUBWAY.—The municipality of Berlin voted to build an underground railroad from the north to the south of the city. The line, which will cost about $13,750,000, will be electrical and will be operated by the city. The measure still requires the sanction of the town council.

ELECTRIC HEATING.—A lecture on "Electric Heating" will be given by Mr. W. S. Hadaway, Jr., before the Electrical Engineering Society of Columbia University, New York City, in room 301, Engineering Building, on the evening of December 6, at 8.15 o'clock, to which all interested are cordially invited.

LIGHTING PARIS CABS.—A cable dispatch from Paris, of November 18 says: "Travelers by taximetre cabs are shortly to enjoy the advantage of electricity. By means of an ingenious automatic machine, into the slot of which a ten centime piece is to be dropped, the interior of these cabs will be illuminated by electricity during a space of ten minutes."

WORCESTER POLYTECHNIC INSTITUTE.—By the will of the late Stephen Salisbury, the Worcester Polytechnic Institute receives a bequest of $200,000. This money comes without restrictions of any kind on the part of the testator. In addition to this bequest Mr. Salisbury, at the time of his resignation a few weeks ago from the presidency of the board of trustees, made an additional gift to the Institute of $100,000, to be paid immediately.

LEADING-IN CONDUCTOR.—A patent granted November 21 to Mr. Peter Cooper Hewitt describes an interesting leading-in conductor for a mercury vapor tubbe, which method also appears applicable to other uses where large currents are to be introduced into a closed glass receptacle. The periphery of a disk of platinum is sealed into the edges of an opening in the glass receptacle, as shown in the figure. To reinforce the disc a copper plate is brazed to the two exposed surfaces.



LIGHTING AT HAVANA, CUBA.—The Havana Gas & Electric Company is showing up-to-date methods by placing an electrical engineer at the disposal of its customers every day from 10 to 12 a.m and from 2 to 4 p.m. In its notice to the public it said it was its business to sell current and that if it induced its prospective patrons to install apparatus, through consultation with its engineer, free of charge, they would both be benefited. Such a policy ought to bring it unusually good business. The new president, Edmund G. Vaughan, seems to be trying out many good ideas of this nature

A NOVEL SHIP PLANT.—The *American Shipbuilder*, discussing ship plants, says: "The Canadian exploring steamer *Arctic* (Captain Bernier), which has made an extended voyage North Poleward, is provided with a novel electric light installation. Since fuel cannot be obtained for the generation of steam, and as the ship will have to spend many months in darkness, it was decided to install an air-compressor plant which is being operated by a windmill. The compressed air is then used to drive the generators, which in turn furnishes current for charging the storage batteries used for lighting the vessel." We should like to be advised whether our readers know of any other such plant.

INVITATION TO ENGLAND.—We learn that arrangements are being made by the Institution of Electrical Engineers to entertain in Great Britain in June, 1906, representatives of kindred societies from the Continent and the United States. Official invitations have been sent to the American Institute of Electrical Engineers, the Canadian Electrical Association, the Associazione Elettrotecnica Italiana, the Elektrotechnischer Verein, the Verband Deutscher Elektrotechniker, the Schweizerischer Elektrotechnischer Verein and the Societe Internationale des Electriciens. It is proposed that a week shall be spent in London, and then a tour be made of the principal industrial centers of the United Kingdom.

ELECTRICITY FOR SIMPLON.—Advices from Geneva, Switzerland, state that the Swiss Federal Council is now considering the possibility of using electricity as the traction force in the Simplon Tunnel instead of steam, and for this has sent to Italy a commission accompanied by M. Zemp, the state engineer, who has just reported. The plan of electrifying the road through the tunnel is now considered feasible, as the power plants in Brigue alone can furnish sufficient force for the south side of the tunnel. It is intended to utilize some of the power belonging to the electric railroads in the north of Italy for the same purpose, and it is probable that the inaugural train, propelled by electricity, will go through the tunnel on May 1 as a complete success.

CAB CALL TELEPHONES.—Note was made in these columns recently of the calling of cabs in London by telephone. This system of calling cabs by telephone to cabmen's shelters, tried experimentally in London by the Post Office Telephone Department some months ago, is proving so successful that the scheme is being gradually extended. By arrangement with the committee of the Cabmen's Shelter Fund the system was first established at Hampstead, where, especially in wet weather there are numerous calls for cabs over the telephone on Sundays. Arrangements are being made to apply the scheme more extensively. It is to be noted that while arrangements have been made to receive telephonic messages at the shelters no messages may be transmitted from them. The system is not in use in the city for the reason that no cabmen's shelters exist within its boundaries.

HYPNOTIZING BY TELEPHONE is not a new thing, but has been little heard of lately. A cable dispatch from London of November 18 says: "Remarkable experiments in the way of hypnotizing have just been carried out in the Savoy Hotel by Frederick Fant Abbott. The experiments were conducted in the presence of a considerable number of medical men. Mr. Abbott introduced a young Scotchman named Mackie, whom he had hypnotized seven times during the previous fortnight. After passing his hand over the face of the subject Mr. Abbott soon reduced the man to a passive state, and then, accompanied by one of the medical men, he left the building and from a distance of two miles telephoned to the hotel in which the seance had been held. When the bell in the hotel room rang Mackie went to the telephone, and, with a shudder, fell back quite unconscious. Mr. Abbott had commanded him over the telephone to go to sleep, and Mackie remained in a hypnotized state until Mr. Abbott returned and woke him up."

ONE TELEPHONE DIRECTORY.—It will interest many of our readers to know that about 2½ pounds is the weight of the October issue of the New York Telephone Company's directory. Almost a quarter million names of subscribers are shown in the book. About one-half this number are subscribers in Manhattan and The Bronx. Since the last book went to press about 25,000 names have been added. The new edition of the directors represents about twenty-five carloads of paper. Although the telephone directory is issued every four months, a dozen men are constantly at work on it. All changes and additions in directory matter are sent to the printer daily. They are issued at once as an addendum and forwarded every morning to the exchanges, which thus are kept posted. When the new directories are completed the old ones are taken away and destroyed by the company. This is done to prevent the further use of the old books, which would cause inconvenience to subscribers on account of wrong numbers and wrong addresses. The general use of the telephone directory as a business and social register is one of the developments of the business not expected. Almost every firm or individual doing business in the city depends to a great extent on the listing in the telephone book. Every four months the telephone directory is brought up to date and a new edition is issued, which insures a degree of accuracy not obtained in any similar publication. This book is used so generally, not only by subscribers but by the New York public in general, that the lowest estimates place the number of times it is consulted daily at more than a million.

Hydro-Electric Power Under the Highest Head in New England.

CHITTENDEN reservoir lies in the Green Mountains some 1,600 ft. above tide water, covers an area of 800 acres, receives the drainage of fifteen square miles, and stores 435,000,000 cu. ft. of water behind a dam across the valley of East Creek, about eleven miles from Rutland, Vt. Another dam five miles below on the same stream creates a reservoir that covers 320 acres, has a drainage area of nine square miles, and contains 63,000,000 cu. ft. of water, at East Pittsford.

Between the upper and the lower reservoir the fall of the creek is 475 ft., and from this lower reservoir to the tail race of the station, where its water is utilized for power development, a distance of 8,000 ft. down stream, the fall is 222 ft. From these figures it may be seen that the water from the upper reservoir, representing the drainage of 15 square miles, has a total fall of 697 ft. to the tail race of the power house.

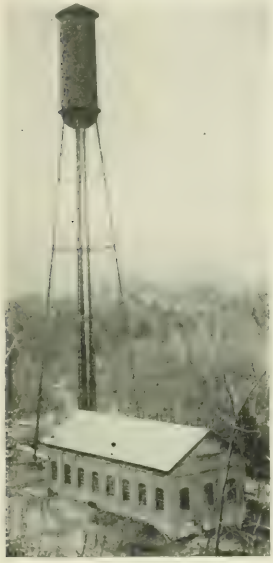


FIG. I.—VIEW OF GENERATING STATION AND WATER TOWER.

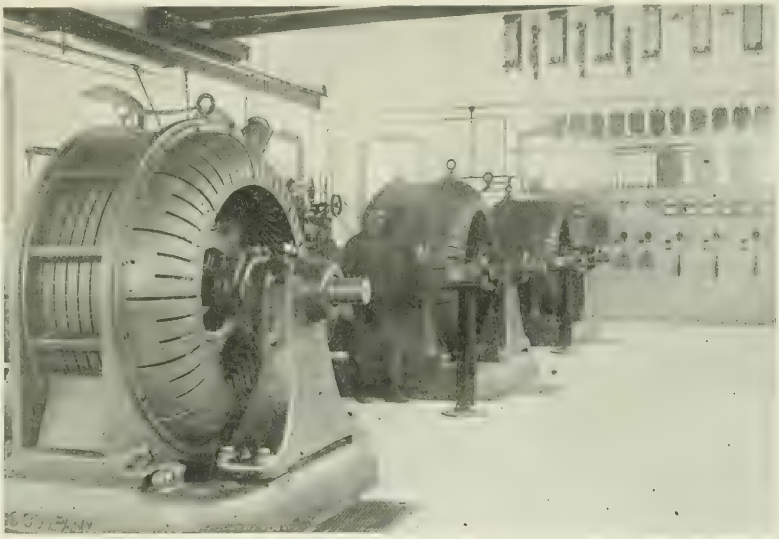


FIG. 2.—INTERIOR OF GENERATING STATION.

At the present time the water of the upper reservoir follows its natural channel in passing to the lower reservoir, and no electric power is developed in this part of its course. Between the lower reservoir and the power station there is a steel pipe designed to carry the discharge from the 24 miles of drainage area, and the water from this pipe drives horizontal turbine wheels direct-connected to electric generators in the station. At any time when the power wanted is greater than that developed with water from the lower reservoir under a head of 222 ft., the discharge of the upper reservoir into the lower may be utilized under the head of 475 ft.

Over the area which drains into the two reservoirs the estimated rainfall is 45 in. per annum, and measurements have shown the percentage of run-off to be as much as 70 per cent from the Chittenden reservoir. This hydro-electric system, the property of the Chittenden Power Company, has been under construction for several years, and is just going into regular operation. A dam with a total length of 750 ft. and a maximum height of 54 ft. above its foundation holds back the water in the upper and larger reservoir. A waste weir takes up 100 ft. of the length of the Chittenden dam and the remaining 650 ft. acts as a retaining wall to impound the water.

In its deepest part the natural bed of the creek is about 43 ft. below the top of the retaining wall section of the dam. At the waste weir the natural surface of the ground was only about 3 ft. below the crest, but the entire height of this section of the dam is 14 ft. Within a few feet of the lowest part of the creek bed, and with centers 35 ft. below the crest elevation of the waste weir, two 48-in. pipes pierce the dam under the gate house. One of these pipes serves to discharge the waste water and to empty the reservoir when necessary. The other pipe will form the head of a pipe line when the power represented by the fall of 475 ft. between the Chittenden and the East Pittsford reservoir is developed.

At its waste weir the Chittenden dam is built of stone masonry laid in cement, but elsewhere the dam is of earth with a masonry core wall. This core wall rises from the foundation 3 ft. below the top of the earth embankment. In its lower part the earth section of the dam is paved with rock, and on the upper part it is sodded. As one square mile is equal to 27,878,400 sq. ft., the storage capacity of 435,000,000 cu. ft. in the Chittenden reservoir will hold enough water to form a layer 11.5 in. thick over its 15 square miles of drainage area.

The dam that maintains the lower reservoir, at East Pittsford, has a length of 585 ft., of which 111 ft. are represented in the spillway and 474 ft. in earth embankment. This embankment has a height of 31 ft.

The crest of the spillway is 475 ft. below the crest of the spillway of the Chittenden dam and 5 ft. below the top of the earth embankment. This entire embankment, save a length of 52 ft. between one of the spillway abutments and the bank, contains a core wall of stone masonry that rises from the lowest foundation to 3 ft. beneath the level of the embankment, and is 30 in. wide at the top. In its deepest part the earth embankment has a bottom width of about 108 ft., the uniform top width is 12 ft., and the slope on both the up and downstream surface is two to one.

On the upstream face of the embankment there is a stone paving to a grade several feet above the water line, and the top and downstream face are covered with 12 in. of loam and sodded. The crest of the spillway is built of concrete and it is paved with stone on both the up and downstream faces. In its deepest section the downstream side of the dam has a rock filling. The lowest part of the bed of the stream is about 20 ft. below the flow line, and the center of the 60-in. steel pipe that pierces the embankment beneath the gate house is about 15 ft. under the flow line. The gate house is of brick on a foundation of stone masonry, and its well is lined with brick. Into this well water from the forebay enters through a rack set at a slope of two to one, and from the downstream side of the well near its bottom go one 24-in. and one 60-in. steel pipe. Gates are provided for the openings of these two pipes, that of the 60-in. pipe being motor operated.

The 24-in. pipe serves to carry waste water through the dam, and to discharge it into the bed of the creek on the downstream side. The 60-in. pipe follows the valley of the creek for a distance of

8,000 ft. to the power station and terminates there at the cases of the horizontal turbine wheels. At this station the normal surface of the tail water is 222 ft. below the level of the lower reservoir, and the effective head on them under operation at full load is 200 to 204 ft.

The thickness of the steel sheets of the 60-in. pipe line varies from ¼ in. at its upper end to ⅜ in. at the lower end, and it has a coating of pitch and tar inside and out. Besides this coating the lower part of the pipe has an interior coating of cement for its entire length. The entire pipe line lays in a trench and the minimum thickness of the earth covering is 15 in.

Connected with the pipe line at a point a few feet from the power station is a standpipe terminating in a tank at the top, this tank being supported by a steel tower. Above the foundations the height of this standpipe and water tower is 220 ft., which gives its top an elevation 17 ft. above the flow line of the lower reservoir. Both the standpipe and water tank are of double structure; that is, each has an inner and an outer part with a space between them. The outer part of the standpipe is 5 ft. 8 in. in diameter, and the inner part has a diameter of 3 ft. At a point 50 ft. below the top the outer pipe connects with a tank 18 ft. in diameter and the inner pipe with a concentric tank 15 ft .in diameter.

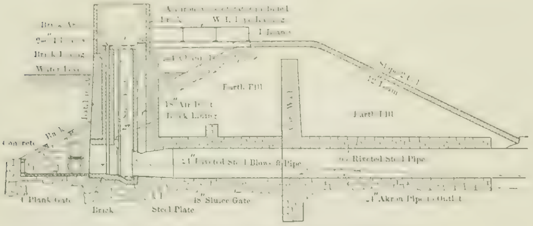


FIG. 3.—SECTION OF DAM AND GATE HOUSE.

From a point near the top of the tank to one 7 ft. above the foundations of the steel tower, the annular space between the outer and inner standpipe and between the outer and inner water tank contains a sufficient length of 2-in. steam pipe to give 265 sq. ft. of heating surface. This system of piping is connected with a boiler in the power station nearby, so that any water flowing down between the inner and outer tanks and standpipes may be kept from freezing in cold weather.

Connection is made between the inner 3-ft. pipe just named and the 5 ft. pipe line from the lower reservoir, so that water rises in the inner tank to an elevation corresponding with the head at the lower end of this pipe line. When one or more generators are quickly loaded in the power station the stored water in the tank at the top of the standpipe is sufficient to prevent more than a small drop in head. At the time when the load at the station is reduced by a large amount, the surplus energy of the column of water 8,000 ft. long that is flowing down from the reservoir is expended in an overflow from the inner to the outer tank of the standpipe. This overflow passes to the tail race beneath the power station as the outer pipe discharges into the tail race.

FIG. 4.—VIEW OF PIPE LINE.

At a point a few feet beyond the connection between the 60-in. pipe line and the standpipe, a branch 30 in. in diameter leaves the pipe line and enters the pit beneath the turbine wheels in the station. With intervals of 12 to 15 ft. between them three other such branches connect with the pipe line, and from its lower end goes a branch 18 in. in diameter into the same pit. The four branches of 30-in. pipe are intended to connect with turbine wheels for four main electric generators, and the 18 in. branch delivers water to the turbines that drive a pair of exciter dynamos.

The power station is located near the bed of the creek from which water is diverted by the pipe line at the lower reservoir, and the tail race beneath it is continued to join this bed a few rods down stream. In outside plan the station measures 37¼ by 79¾ ft., and it is one story high. The foundation and floor are of concrete, the walls of brick and the roof of concrete slabs with expanded metal, supported on steel trusses. Along that side of the station next to the 60-in. pipe line runs a concrete pit 10 ft. wide and 14 ft. deep beneath the floor level. Into the upper part of this pit come the branch pipes from the 60-in. line, and in its lower part is the tail water. At the downstream end of the station this pit joins an open conduit of similar dimensions, with sides and bottom of concrete, which carries the tail water to the creek a few rods below.

The top of the pit in the station is spanned with steel I-beams, and these same beams extend over the tops of piers beneath the floor that are ranged in a row parallel with the pit. Each of four sets of beams over the pit is intended to support a horizontal double discharge 90-in. turbine wheel, rated at 770 hp and 500 r.p.m., under a water head of 200 ft. Three of these wheels are now in position.

Water rises into each wheel from its 30-in. supply pipe underneath, in which the valve operates by water pressure, and is discharged through two 24-in. draft tubes, so that there is no unbalanced end pressure. Each of these wheels has its center 12½ ft. above the normal level of the tail water, and 18 ft. above the bottom of the pit. A type Q Lombard governor regulates the speed of each turbine. The wheel is supported on a shaft that passes through a bearing on each side of its case, and this shaft has a flange coupling on the end toward the center of the station. On the same set of beams that carries the wheel case and bearings a complete electric generator with its own bedplate is mounted, and the coupling on the extended shaft of this generator connects with that on the wheel shaft. Each of the generators thus connected is of the revolving-magnet type, and is rated at 400 kw, 13,200 volts, 25 cycles, three-phase.

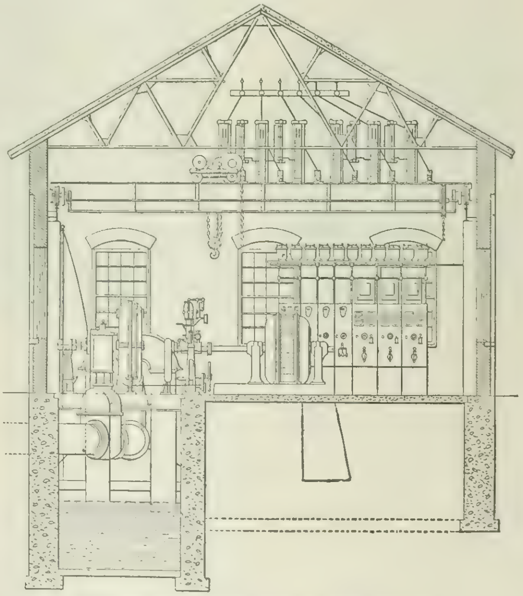


FIG. 5.—CROSS SECTION OF MAIN POWER STATION.

With the three generators in position the station has a present capacity of 1,200 kw, and this can be increased to 1,600 kw by the addition of another wheel and generator at any time. Exciting current for the magnets of these alternators is supplied by either of two 45-kw, 125-volt dynamos, each of which is direct-connected to a 34-in. horizontal turbine designed for 725 r.p.m., and regulated by a Lombard governor. Both of these wheels take water from the 18-in. branch pipe named above, and discharge it into the pit through draft tubes.

Rising from the floor level at a distance of 8 ft. 4 in. from one of the shorter end walls of the station are the eight marble panels of the switchboard, and between these panels and the wall a row of oil switch cells is located. Cables from the generators and exciters lie in clay conduits beneath the concrete floor and come up for connection to the switches and other apparatus between the front of the switchboard and the wall. The oil switch for each three-phase generator and for each of the two transmission circuits that enter the station is operated by hand levers on the front of the board. Each of these two circuits consists of three bare No. 4 copper wires, and these wires after passing through the brick end wall in porcelain tubes are secured to a row of insulators and connect first with lightning arresters and then through choke coils with the oil switches.

A Tyrrel regulator, which is used to limit voltage variations, is located near the switchboard. At the switchboard four panels are devoted to the alternators, two to the exciting dynamos, one to the transmission line and one to regulation. The generator panels have ammeters, voltmeters and polyphase wattmeters. On the exciter panels are ammeters and voltmeters. With the panel for the transmission circuits is an ammeter for each phase and a three-phase watt-hour meter. Each of the alternators is belted to a Shafer & Budenberg indicating and recording tachometer, so that the speed of rotation may be noted.

Forty incandescent lamps operated by the exciting dynamos light the generating station, and warming will be done by the steam heater above named. Spanning the smaller dimension of the station floor and traveling over almost its entire length there is a hand-operated crane supported by abutments inside of the two longer walls. At these abutments the total thickness of the brickwork is 30 in., and between them the wall is 13 in. thick. On these walls rests the weight of the steel and concrete roof, as well as that of the traveling crane.

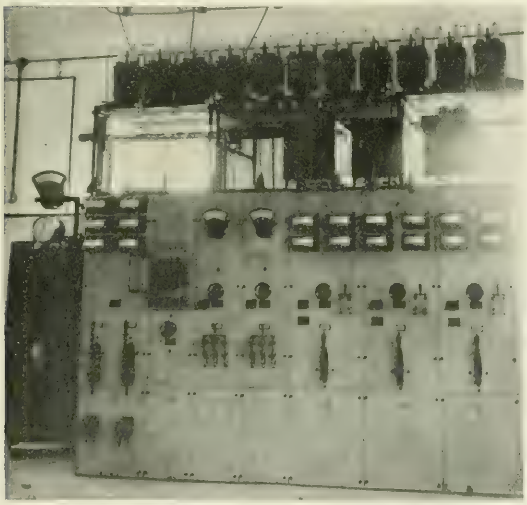


FIG. 6.—SWITCHBOARD IN MAIN GENERATING STATION.

After passing through its porcelain tube with a slope toward the outside of the end wall of the power station, each of the No. 4 bare copper wires of the 13,200-volt circuits is secured to an insulator about 27 in. from the wall, on a wooden cross arm and steel bracket. The porcelain tubes through which the wires pass are set 18 in. apart in the brick wall.

From the generating station just considered to the sub-station of the Chittenden Power Company in Rutland, a distance of 4 miles, the two three-phase circuits run by separate pole lines. Each pole has a single cross arm and carries the three wires in triangular form, one at the pole top and the other two at the ends of the arm. On the run between the generating station and the Rutland sub-station the wires of each circuit are transposed twice, and they are supported partly by glass and partly by porcelain insulators. Poles not over 30 ft. long are used for much of the transmission line.

The sub-station in Rutland is a one-story building measuring 30 ft. by 32 ft. in outside ground plan, and having concrete foundations and floor, brick walls and a roof of concrete and expanded metal. Six inches is the thickness of the floor and 3½ in. that of the roof, which latter is supported by 18-in., 55-pound I-beams, cross laid with others of 8 in. height and 18 pounds weight per linear foot.

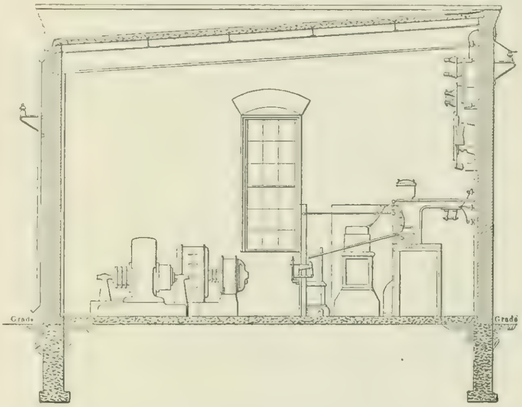


FIG. 7.—LONGITUDINAL SECTION OF RUTLAND SUB-STATION.

Into this sub-station the two circuits come through porcelain tubes set 18 in. apart in one of the brick side walls, and 18 ft. 9 in. from the ground. Before entering its tube each wire is secured to an insulator about 9 in. below the opening, and the six insulators are carried by a single cross arm that is held 15 in. from the brick wall by iron brackets. On entering the sub-station the wires of the two circuits are first supported by another set of insulators, and then connect with lightning arresters and pass through choke coils before reaching the oil switches. From these switches the circuits go to a group of three 125-kw transformers that reduce the 13,200-volt pressure to that necessary for 600-volt rotary converters. Two such converters have been installed, each having a capacity of 150 kw, and their output is to be used for the operation of the Rutland Street Railway. In connection with these converters two reactance coils are provided.

In addition to the equipment for the operation of the local street railway, the Rutland sub-station will contain a rectifier, series transformer and booster, which will be used to give the rotary converters a generator action when this is necessary to maintain the transmission voltage on a line running to Castleton. In connection with this sub-station equipment, a storage battery of 280 cells will be employed and will be located in a battery house only a short distance away.

The battery house measures 30 by 50 ft. on the ground outside, is one story high, has a concrete floor, brick walls and a roof of concrete slabs with expanded metal, laid on 60-pound rails used as rafters, with 6-ft. centers, and covered on top with tar, felt and gravel. The concrete floor is 3 in. thick, and carries the 280 cells of battery ranged in three double and two single rows, so that there are 35 cells per single row. When charged this battery will yield fully 600 volts, and its capacity is 400 amp.-hours, with ability to deliver 800 amp. during 20 minutes, or 900 amp. during five minutes, without injury to its plates.

From the sub-station at Rutland to that at Castleton the distance is 12.5 miles, and the transmission line between them is a single circuit of No. 4 copper wires, arranged like those between the power house and Rutland. In the Castleton sub-station there are three 150-kw transformers and two rotary converters of 150 kw and 200 kw capacity, respectively, for the street railway. The prospect is that a general distribution of light and power will also take place from this sub-station. At both the Rutland and the Castleton sub-stations the transformers are of the air-blast type, and there is a motor driven blower equipment in each.

In Rutland it is expected that the Chittenden Power Company will supply power for lamps and stationary motors, as well as for the street railway. The railway load is represented by 15 open and 11 closed cars operating on 23.5 miles of track. Of the closed cars, six are 27 ft., one is 23 ft., and four are 40 ft. long. Each of the open cars is provided with 15 benches.

Rutland, the second city of the State, had a population of 11,499 in 1900, and is the commercial center of southern Vermont. Here is located a large marble industry that consumes a considerable amount of power. Other large power users include the scale works and the railway shops.

Much of the work on the two reservoirs has been done by day labor under the Chittenden Power Company. The pipe line was laid by contract. Both the design and the construction of the standpipe and tank are due to the Chicago Bridge & Iron Company. For the entire power station and the sub-stations with their equipments, the J. G. White Co. is the contractor, and has aided in the design. All the turbine water wheels were furnished by the S. Morgan Smith Co. Electric generating and regulating equipments at both the power station and the sub-stations were made by the General Electric Company. The storage battery is of the Gould make.

Messrs. French & Bryant, of Boston, are the engineers of the entire hydraulic and electric work above described. Mr. John Bogart, of New York, has been consulted as to some part of the hydraulic development.

Of the Chittenden Power Company, Mr. G. Tracy Rogers is president, Mr. Leo H. Wise vice-president, Mr. Charles H. West secretary and treasurer, and Mr. David Fox is general manager.

The above facts have been obtained through Mr. Fox and Messrs. French & Bryant.

◆

An Efficiency Meter for Electric Incandescent Lamps.

By Edward P. Hyde and H. B. Brooks.
Bureau of Standards.

THE life of a normal incandescent lamp depends primarily on the temperature at which the lamp is operated, and the temperature of the filament is a function, not of the watts or of the candle-power simply, but of the ratio, watts per candle; that is, of the so-called efficiency[1] at which the lamp is operated. For lamps of the same type, the higher the efficiency the shorter the life and vice versa; and since uniformity in life is one of the first qualifications of a good lot of lamps, uniformity in efficiency is of great importance.

There is at present no direct reading "efficiency meter" on the market, so far as the writers know, and it may be that this is partly the reason for the present custom of specifying limits of watts and candle-power, and not limits of efficiency. In order to meet the need for an efficiency meter in the photometric work of the Bureau of Standards, the writers have recently designed and constructed such an instrument, the theory and operation of which will be described in this paper. A more detailed account will appear shortly in the *Bulletin* of the Bureau of Standards.

The problem to be solved consisted in devising some method by which the readings of a wattmeter would be made to vary inversely as the candle-power. Two general methods suggested themselves, a mechanical method and an electrical one. According to the former either the scale of the wattmeter would be moved by the motion of the photometer carriage, or the motion of the latter would vary the counterforce opposed to the moving coil, as, for example, by increasing or decreasing the effective length of the spring. Either of these methods would require the wattmeter to be specially constructed, and to be fixed in position relative to the photometer, and would present other serious practical difficulties, so that the mechanical method was abandoned for the more promising electrical method.

According to the latter there are three possible ways of decreasing the wattmeter reading in the ratio of $\frac{\textit{constant}}{\textit{candle-power}}$: (*a*) by placing a variable resistance in parallel with the current coil of the wattmeter; (*b*) by placing a variable resistance in parallel with the moving coil, and (*c*) by placing a variable resistance in series with the pressure circuit in the wattmeter. Before discussing these methods it should be pointed out that in every case this variable resistance must be controlled by the motion of the photometer, as by the use of a sliding contact moving over a coil, so that for all positions of the photometer the reading of the instrument shall be *constant watts/candle-power,* where the candle-power is given by the index on the photometer carriage. If we should make the constant equal to unity the reading on the instrument would be so small compared with the full scale deflection that only a relatively low accuracy could be obtained, so that it seemed desirable to make the constant 10, since then the reading would come at a good point on the scale and at the same time the scale reading would give the true watts per candle by moving the decimal point. To take an example, suppose that a 16-cp lamp requires 64 watts at normal voltage. In order to make the instrument read watts per candle directly, we must so alter the resistance of the instrument by one of the above methods, or by some combination of them, that the instrument shall indicate 1/16 of its original reading; that is, 64/16 = 4. If, however, instead of reducing the reading to 1/16 we reduce it to 10/16 of its original value, it will now give a reading of 10/16 × 64 = 40, which will be ten times the watts per candle, but which will come at a much more desirable part of the scale of the instrument. At 10 cp the instrument will read 10/10 × *watts* or watts directly, at 20 cp 10/20 × *watts* or one-half the watts, and so on for other candle-power values.

To return to the three electrical methods suggested for the reduction of the wattmeter reading, case (*a*) is objectionable because of the low resistance of the series coil in a wattmeter of the required range. It would necessitate a low resistance in the shunt circuit controlled by the moving screen, and hence would be liable to error due to variations in the contact resistance. In case (*b*) this objection will not arise, since the resistance of the moving coil will be about 50 ohms, and hence the shunt controlled by the movement of the screen will not, in general, be less than 50 ohms, in comparison with which variations in the resistance of well-made sliding contacts will be negligible. This method requires that an extra lead be brought out to an extra binding post on the wattmeter, as both terminals of the moving coil are not directly accessible.

In both the shunt methods the range of the efficiency meter, in case the instrument is to read 10 times the efficiency, will have as its lower limit 10 cp, for at 10 cp the resistance of the external shunt must be infinite, or, in other words, the shunt circuit must be open. Moreover, in case (*b*) if the instrument is to be used for candle-power values above 20 cp, the shunt resistance would become smaller than 50 ohms, and hence care must be exercised to have the contact resistance sufficiently constant to produce no appreciable error. In general practice, however, in testing 16-cp lamps the range is seldom greater than from 10 to 20 cp, so that these difficulties are not serious.

Method (*c*) is more nearly free from errors and limitations than either of the other two methods. According to this method a variable resistance is placed in series with the pressure circuit in the wattmeter, and since the latter will have a resistance of several thousand ohms, the contact resistance is of much less importance than in the other cases. Moreover, there are practically no limits to the range of the instrument, if we take out of the wattmeter part of the resistance in series with the moving coil. This becomes necessary only in case we desire to use the efficiency meter below 10 cp; otherwise the wattmeter can be used without any modification. Method (*c*), therefore, seemed more promising than either of the other two methods, and was hence adopted.

THEORY OF METHOD.

Assuming that the wattmeter to be used reads correctly as a wattmeter, the resistance in series with it should be zero at 10 cp, since the reading at 10 cp should be total watts. At 20 cp the reading should be one-half the total watts; that is, the added resistance for the position of the photometer corresponding to 20 cp should equal the resistance of the wattmeter. It only remains, therefore, to determine the relation between the candle-power reading and the resistance for other points on the bar, and to find some convenient practical way of introducing the additional resistance.

---

[1] In the following paper the term "efficiency" will be used to designate the watts per mean horizontal candle. Although this constant of a lamp is not nearly so significant as the watts per mean spherical candle, yet for lamps of the same type it gives relative values in approximate agreement with the corresponding relative mean spherical efficiencies. Moreover, all that is said here in regard to mean horizontal efficiencies would apply equally well to mean spherical efficiencies if the photometer gave readings of mean spherical instead of mean horizontal intensities.

Let $2a$ be the distance (supposed to be constant) between the two lamps, I_1, the intensity of the comparison lamp, I the intensity of the test lamp, and x the distance from the test lamp to the photometer screen when in a position of balance. Then by the inverse square law,

$$I = I_1 \left(\frac{x}{2a - x} \right)^2. \tag{1}$$

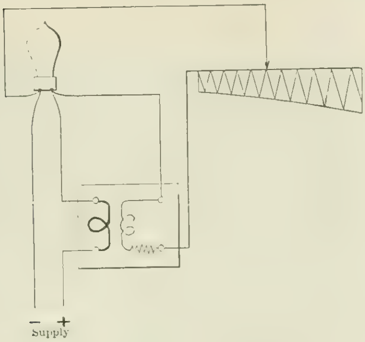


FIG. 1.—DIAGRAM OF CONNECTIONS.

Moreover, if W is the total watts supplied to the lamp, and η the efficiency, or watts per candle,

$$\eta = \frac{W}{I}. \tag{2}$$

and if S denote the scale reading of the instrument when the external resistance, r, is in series with the wattmeter pressure winding of resistance, r_1, and K the factor of proportionality between the scale reading and the efficiency, we get

$$S = \frac{r_1}{r_1 + r} W = K \eta = K \frac{W}{I}, \tag{3}$$

or

$$\frac{r_1}{r_1 + r} = \frac{K}{I}. \tag{4}$$

from which

$$r = r_1 \left(\frac{I}{K} - 1 \right). \tag{5}$$

Substituting for I its value as given in equation (1),

$$r = r_1 \left[\frac{I_1}{K} \left(\frac{x}{2a - x} \right)^2 - 1 \right], \tag{6}$$

which gives the resistance, r, which must be added to the resistance, r_1, for any position, x, on the bar.

The method which seemed most desirable for the construction of a rheostat to follow this law consisted in winding closely a fine silk-covered resistance wire on a block of insulating material. After coating with shellac varnish and drying, the insulation was removed along a strip over which travels a contact brush attached to the photometer carriage. The variable rheostat thus formed is connected in the pressure circuit of the wattmeter, so that the resistance of this circuit varies with the position of the photometer. The electrical connections are shown diagrammatically in Fig. 1. The top of the block, along which the contact is made, is straight, and the bottom of the block must have whatever form is necessary to give the proper increments, $d\,r$, to the resistance as the contact moves over successive small distances, $d\,x$. By differentiating equation (6) with respect to x we get the equation

$$\frac{d\,r}{d\,x} = \frac{4\,a\,r_1\,I_1}{K} \cdot \frac{x}{(2a - x)^3}. \tag{7}$$

If we let h be the thickness of the block, y the height of the block at any point, that is, the ordinate of the curve measured downward, ρ the specific resistance of the wire, $2b$ the diameter of the bare wire, and n the number of turns of the covered wire per unit distance on the block, then the resistance, $d\,r$, contained in a small distance, $d\,x$, is

$$d\,r = \frac{2\,(y + h)\,\rho}{\pi\,b^2} \times n\,d\,x, \tag{8}$$

or

$$\frac{d\,r}{d\,x} = \frac{2\,n\,\rho}{\pi\,b^2}\,(y + h). \tag{9}$$

Equating this value of $\frac{d\,r}{d\,x}$ to that obtained in equation (7),

$$\frac{2\,n\,\rho}{\pi\,b^2}\,(y + h) = \frac{4\,a\,r_1\,I_1}{K} \cdot \frac{x}{(2a - x)^3}, \tag{10}$$

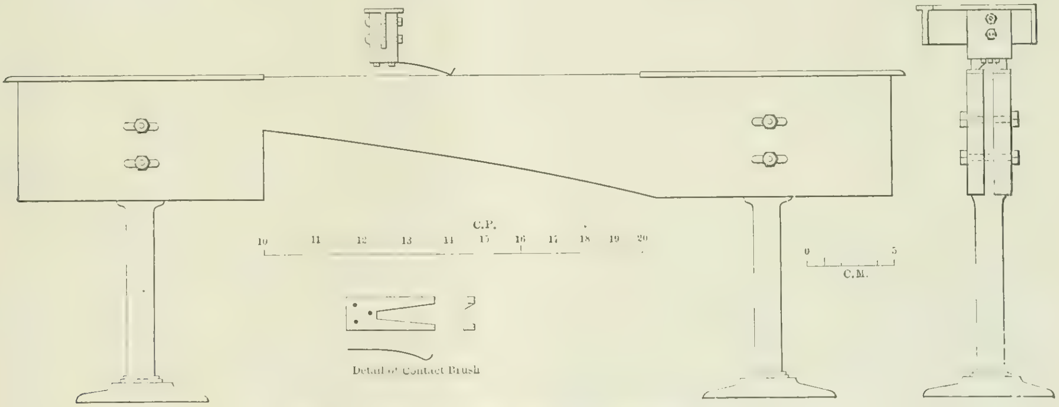


FIG. 2.—DIAGRAM SHOWING FORM OF INSULATING BLOCK.

from which

$$y = \frac{2\,\pi\,a\,b^2\,r_1\,I_1}{K\,n\,\rho} \cdot \frac{x}{(2a - x)^3} - h, \tag{11}$$

which relation determines the form of the bottom of the block. In this equation a, r_1, I_1, K and h may be taken as constants, while b, n and ρ depend on the wire that is used. We may introduce the resistance per unit length, ρ_1, instead of the specific resistance, ρ, using the relation

$$\rho_1 = \frac{\rho}{\pi\,b^2}.$$

Combining this with equation (11) we get the more convenient form

$$y = \frac{2\,a\,r_1\,I_1}{K\,n\,\rho_1} \cdot \frac{x}{(2a - x)^3} - h. \tag{12}$$

involving the two wire constants, n and ρ_1. If then a block of insulating material is constructed, having the general form indicated in Fig. 2, the curvature of the bottom conforming to equation (12), and if the wire whose constants are used in equation (12) is wound closely on this block, the variable rheostat thus formed, if put in the pressure circuit of the wattmeter, as indicated in Fig. 1, will cut down the reading of the wattmeter for all positions of the photometer within the limits of the coil, so that the instrument will indicate, not watts, but a constant K times the efficiency of the lamp.

CONSTRUCTION OF INSTRUMENT.

It has been shown that it is desirable to give the constant, K, the value 10, since then the wattmeter reads watts per candle directly, by moving the decimal point. We will assume that the apparatus is to be designed for 16-cp lamps. In adjusting a photometer for the measurement of 16-cp lamps the voltage on the comparison lamp is adjusted until the reading on a 16-cp standard lamp placed in the test lamp socket comes at 16 cp, the middle point on the bar. Then the intensity of the comparison lamp, I_1, is 16 cp. The distance between the two lamps in commercial photometry is always constant and equal to some standard length such as 100 or 200 in., or 250 cm. Hence a, which is one-half this distance, is the constant distance from either lamp to the center of the bar. In the commercial photometer at the Bureau of Standards, $a = 125$ cm. A Weston wattmeter was used having a resistance of 2,630 ohms. The other constants entering into equation (12) are h, the thickness of the block, which was made 1 cm., and the two wire constants, n and ρ_1. In designing the resistance block it is necessary to work both ways from equation (12). First having decided what the approximate dimensions of the block shall be, put in equation (12) the value of y for some value of x, preferably that corresponding to 20 cp, and from this equation determine the product $n\rho_1$. Then select some wire having approximately this value of $n\rho_1$, put the exact values, as obtained from measurements of a sample of the wire, back into equation (12), and plot the desired curve.

It may be well to say a word at this point in regard to the limits of the efficiency meter in practice. As stated, if we make $K = 10$ there will be no resistance in series with the wattmeter when the photometer is at 10 cp. Hence the coil begins at this point unless it is desired to read efficiencies for points below 10 cp, in which case some of the resistance in series with the moving coil can be taken out of the wattmeter and placed in the external coil. This can be accomplished without unfitting the wattmeter for other uses, by bringing to an extra binding post on the instrument a tap from some point in the resistance depending on how far below 10 cp the meter is to be used. While there is no difficulty in doing this, there is also no need generally of having the meter read below 10 cp on a 16-cp bench. The upper limit can be as high as desired, although the ordinates of the block increase very rapidly as we reach higher candle-power positions, so that unless there is some particular reason to the contrary, it will be found desirable to take as the upper limit 20 or 25 cp. The meter at the Bureau reads watts per candle for a range of from 10 to 20 cp.

We have spoken thus far of a single block wound with wire; we have found it very desirable, however, to have two blocks instead of one. First, because for any wire large enough for mechanical strength the slope of the curve at 20 cp is so great that it not only makes an awkward looking device, but also introduces difficulties in the winding. By using two blocks side by side, equal in every way, the curvature of each is much less than that of the single block. Secondly, with the single block the sliding contact that moves with the photometer must carry with it a flexible wire, which is objectionable. If two blocks are used, however, the photometer merely carries a brush which spans the gap between the two coils. In this arrangement the ends of the wire at the 20-cp point are joined together, keeping the wattmeter circuit closed in case the contact between the brush and the coil should be momentarily broken.

For two blocks of the same thickness the values of $y + h$ deduced from equation (12) must be divided by 2, so that

$$y + h = \frac{1}{2} \times \frac{2a\,r_1\,I_1}{K\,n\,\rho_1}\,\frac{x}{(2a-x)^3},$$

or

$$y = \frac{a\,r_1\,I_1}{K\,n\,\rho_1}\,\frac{x}{(2a-x)^3} - h \qquad (13)$$

If we put

$$C = \frac{a\,r_1\,I_1}{K\,n\,\rho_1} \qquad (14)$$

we get

$$y = C\,\frac{x}{(2a-x)^3} - h, \qquad (15)$$

where C is a constant depending on the values chosen for n and ρ. Having decided on the wire to be used, by substituting in equation (15) the values of x corresponding to successive candle-power positions the curve may be plotted. The general form of the curve may be seen from Fig. 2.

Lack of uniformity in the wire or in winding may produce an accumulating error, so that it is desirable to test the resistance at a number of points as the wire is wound. In this connection it may be well to call attention to another way of considering the curve in Fig. 2, which is helpful in checking the resistance from point to point. Since the reading at 11 cp is to be 10/11 of the reading at 10 cp, the total resistance of the pressure circuit at this point should be 11/10 of the resistance of the wattmeter, so that the added resistance should be 1/10 the resistance of the wattmeter. Similarly the added resistance between 11 cp and 12 cp, or between 12 cp and 13 cp, should be 1/10 the resistance of the wattmeter. Hence the resistance between points on each block corresponding to successive candle-powers should be equal to each other and equal to 1/20 the resistance of the wattmeter. If greater accuracy is desired, the resistance may be checked during the winding at every half candle-power point. Moreover, if slight errors are introduced in winding one coil, they may be partially neutralized in winding the other coil, so that the resultant error will be very small.

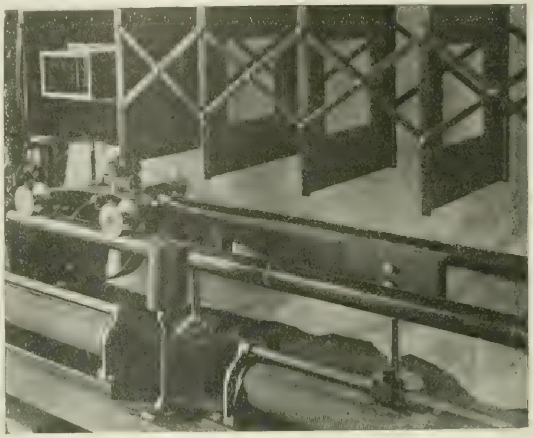


FIG. 3.—BLOCKS IN POSITION ON PHOTOMETER.

The wattmeter should be calibrated to read correctly as a wattmeter over the range for which it will be used, in order to avoid the necessity for applying a correction to the efficiency readings. It should have a compensating winding on the fixed coil, through which the potential current is carried in the opposite direction to the main current, so that the energy used in the potential circuit will not be measured along with that supplied to the lamp. This compensating winding is regularly supplied in low range wattmeters by at least one well-known maker.

The reading of a wattmeter on direct current is affected by the earth's field. To eliminate the error from this source, it is customary to take the mean of two readings, the direction of current flow through the circuits of the instrument being reversed for the second reading. Another way of accomplishing the same result is to balance the earth's field at the moving coil by the use of a small permanent magnet. This is the method we have used. A magnet 10 cm. long and 1.3 cm. diameter, when placed north and south at about 5 or 6 cm. under the bottom of the wattmeter case balanced the earth's field almost exactly for all points of the scale that are used (see below), the wattmeter being placed with its longer dimension approximately north and south. Another way of eliminating the effect of the earth's field is to use an astatic wattmeter. Such instruments are not on the market in portable form, but they can doubtless be had from instrument makers if required. If the instrument is to be used in a location subject to strong and variable stray fields, the use of an astatic wattmeter might be necessary;

but in most cases the ordinary wattmeter with a compensating magnet will doubtless answer all requirements.

Fig. 2 is the working drawing from which the blocks and supports were made. Although a range of from 10 to 20 cp is sufficient, it is desirable to make the blocks longer so that the wattmeter circuit will not be broken should the photometer move beyond these limits. On the top of each block, beyond the limits of the coil at each end, a copper strip was placed over which the contact brush moves when off the coil. The resistance wire at the end of the coil corresponding to 10 cp was soldered directly into the copper strip at that end, but the other end of each coil was insulated from the metal strip beyond it. On each block the copper strip at one end was joined to the copper strip at the other end, so that the instrument reads watts per candle so long as the contact brush remains on the coil; that is, for all candle-power values between 10 and 20, while beyond these limits the instrument reads watts. In order that for any position of the photometer the watts can be read directly, a switch is used by means of which the resistance external to the wattmeter can be short-circuited, so that either watts or efficiency can be read.

The blocks were mounted on stands with the tops of the coils at a convenient distance below the photometer carriage. On the latter was mounted a hard rubber block carrying the phosphor-bronze contact brush which completes the circuit from one coil to the other. The blocks were slotted to receive bolts holding them in place on the stands. Thus a linear adjustment of each coil independently can be made, which is desirable. Fig. 3, which was made from a photograph, shows the blocks in position on the photometer, the wattmeter not being shown.

EXPERIMENTAL RESULTS.

The coils having been mounted and the wattmeter put in place, it was necessary to find the position of the small magnet in which it would neutralize the earth's field at the moving coil, for the range used. By trial, using a 16-cp lamp, a position was found such that the wattmeter reading at one point was the mean of direct and reversed readings taken before the magnet was put in place. To test other points, the photometer was then set at 10, 16 and 20 cp, direct and reversed readings being made at each point. The agreement of the results is shown in Table I.

Table I.

Photometer position.	Wattmeter reading— Direct.	Reversed.
10 c.p.	49.3	49.4
16 c.p.	30.8	30.8
20 c.p.	24.6	24.6

The next step consisted in placing the blocks in proper relation to the sliding contact to give a correct reading of watts per candle. To do this a 16-cp lamp was placed in the socket of the rotator, and the screen was set at 16 cp. The blocks were then adjusted until the wattmeter read the known efficiency of the lamp, and were then bolted to the supports. The efficiency meter was then in calibration for this one point. To check it at other points the lamp was kept at the original voltage, the photometer screen was placed successively at different positions on the bar, and readings were taken. The accuracy of the instrument at all points is shown in Table II, in which the first column contains the successive positions of the photometer on the bar. The second column gives the calculated efficiencies corresponding to these positions, as determined by dividing the watts supplied to the lamp by the values given in the first column. The third column contains the corresponding values observed on the efficiency meter.

Table II

Photometer position	Calculated efficiency.	Observed efficiency.
10 c.p.	4.78	4.78
11 "	4.34	4.34
12 "	3.98	3.98
13 "	3.68	3.67
14 "	3.41	3.40
15 "	3.18	3.18
16 "	2.98	2.98
17 "	2.81	2.80
18 "	2.65	2.63
19 "	2.51	2.51
19.8 "	2.41	2.40

It is thus seen that for 16-cp lamps ranging in efficiency from 2.4 to 4.8 watts per candle the apparatus gives true results to within less than one per cent. The instrument as adjusted for 16-cp lamps can be used without change for 32-cp and 8-cp lamps. If we place a 32-cp lamp in the comparison lamp socket, so that the photometer comes in the middle of the bar for 32-cp test lamps, the efficiency of such lamps can be read by dividing the reading of the instrument by 20 instead of by 10. In our instrument the wattmeter has two scales, the upper with a range of 0—150 watts, being used for 16-cp lamps. By using the lower scale of 0—75 watts when measuring 32-cp lamps the instrument is still direct reading. This refers only to the reading of the deflection; the electrical connections are the same for 16 and for 32-cp lamps.

In a similar way the same instrument can be used for 8-cp lamps by dividing the wattmeter readings by 5. An objection to this is that the deflection being about one-half that for 16-cp lamps, the accuracy of reading is reduced. It is still, however, ample for commercial testing.

Besides the ordinary use of the instrument in reading watts per candle when lamps are tested for candle-power at some constant voltage, or for voltage at some fixed candle-power, it is very convenient for determining directly the voltage at which a lamp has a definite efficiency. Oftentimes, as in making life tests, it is desirable to know at what voltage the lamps have a given efficiency, say, 3.1 watts per candle. The only way to do this at present is to estimate the approximate voltage, and from the candle-power and wattage readings at that voltage to calculate the voltage corresponding to the required efficiency. This computation involves the use of the law of variation of efficiency with voltage, and is hence both tedious and unreliable. By the use of the efficiency meter, on the other hand, one operator gradually raises the voltage and observes the efficiency meter, while the other observer follows the change in candle-power with the photometer. When the instrument indicates the proper efficiency, the corresponding voltage is read. This method is not only quicker, but much more accurate and satisfactory.

The possible sources of error of the efficiency meter have been investigated, and will be discussed in the more detailed paper referred to above. It has been found that the errors are no greater than those of the ammeter or wattmeter. The efficiency meter is more flexible than either, and gives by a direct reading one of the most important constants of the incandescent lamp.

The L'Hoest-Pieper System of Train Lighting.

The Compagnie Internationale d'Electricite exhibited at the Liege Exposition a novel system of train lighting which possesses several features worthy of notice. The system aims to eliminate the axle-driven generator, and to reduce the equipment of each car to a small battery just sufficient for lighting the car in case it is disconnected from the locomotive.

The locomotive carries a small generating set which operates continuously. A feature of the system which serves to distinguish it from other isolated lighting equipments resides in the fact that the generator supplies a current of constant strength to lamps in series, rather than an electromotive force of constant value to lamps in parallel. The current is automatically maintained at the proper value, while the voltage of the generator is varied according to the number of lamps in service.

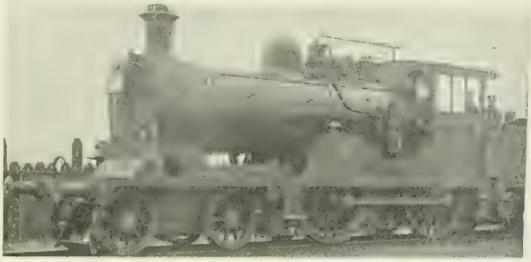


FIG. 1.—VIEW OF GENERATING SET AND STORAGE BATTERY ON LOCOMOTIVE.

The generator is driven by a small steam engine, which, when fed with steam at a constant pressure, operates at a constant torque at any speed. The field strength of the generator is kept at a constant value, so that the armature automatically assumes that speed which will cause the machine to deliver a current of constant strength independent of the external resistance. Thus the simplest regulation is obtained without a speed regulator on the engine. In order to prevent an excessive speed in case of an open circuit on the train lines, a resistance is automatically thrown into the armature circuit when the current decreases below a certain value.

Fig. 1 shows the direct-connected generating set placed on a locomotive immediately in front of the engineer's cab. Although the set can be placed in operation from the steam end, the starting may also be performed by means of a small storage battery, the case for which is seen on the side-beam of the locomotive below the smoke-stack. A three-position cylinder controller operated by steam is provided in the engineer's cab. The first position of the controller is the "off" position, and is the one occupied by the cylinder when no lighting service is required.

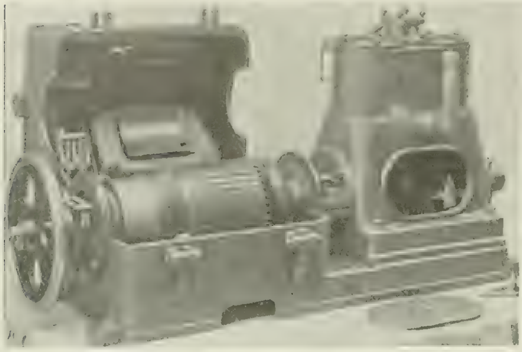


FIG. 2. ENGINE-DRIVEN GENERATING SET FOR TRAIN LIGHTING

The connections made by the controller in the second position, in which it remains for only about one second, are indicated in Fig. 3. This is the starting position, and serves to start up the generating set electrically. The dynamo, acting as a motor, is driven by the batteries, *b* and *B*. The lighting circuit, *L*, of the locomotive is closed by the switch *I*.

The third position of the locomotive controller corresponds to the regular operation of the lighting system. The operating circuits of the locomotive are indicated in Fig. 4, while the circuits of a single car are shown in Fig. 5. The resistance, *R* (Fig. 4), serves for limiting the speed of the dynamo when the train line is open. When the train circuit is complete, current from the armature passes through the battery, *B*, the circuit-breaker, *D*, and to the train line, *T*. When this current is of sufficient strength, the circuit-breaker draws up its armature, *C*, and thereby disconnects the local resistance, *R*. If the train line, *T*, happens to be cut for any reason the circuit-breaker armature, *C*, falls down, thus restoring the local circuit. The restoration of the train line will again open the local circuit automatically.

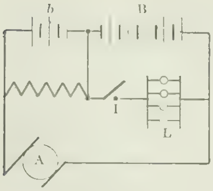


FIG. 3.—STARTING CONNECTIONS OF GENERATING SET.

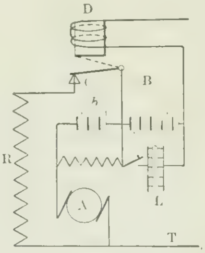


FIG. 4.—OPERATING CONNECTIONS OF GENERATING SET.

Each car is equipped with a small battery just sufficient for lighting the car in case of an accidental breaking of the train, or in case the locomotive is removed. In this system, however, the car batteries are not used when the train is at rest in a station. Referring to the circuits shown in Fig. 5. The current enters the car by way of the conductor, *C*, follows the coil winding, *J*, through the contact, *P*, and the resistance, *R*, and passes to the next car through the conductor, *C'*. The return circuit is through the conductor, *OO'*. When the current reaches a sufficient value for impressing across the resistance, *R*, a voltage equal to the battery e.m.f., the strength of the electromagnet, *J*, becomes sufficient for lifting the armature and opening the lower circuit through *R* and for closing the batttery circuit, *P B*.

The pivoted contact *P'* short-circuits the resistance, *X*, when the generator is not working, or when it is working with insufficient voltage on the resistance *R*. As soon, however, as the generator current is sufficient for lifting the armature at *P* and connection is made at *D*, it divides itself between the battery, *B*, and the circuit, *XL*, that is, the lighting circuit and the resistance, *X*, which is a compensating resistance provided for absorbing the difference between the voltage of the battery when charging and when discharging.

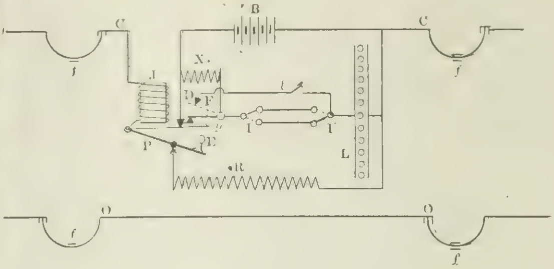


FIG. 5.—OPERATING CONNECTIONS OF A SINGLE CAR.

The upper contact, *F*, and the switch, *t*, are installed for allowing the locomotive engineer to illuminate the cars from the cab when passing through a tunnel. It is necessary for that purpose that the switch, *t*, be kept closed during the daytime. The normal night service, however, involves the opening of the switch, *t*, and the operation of the three-point switches, *I* and *I'*, which are located at opposite ends of the car, so that the lamps in the car can be controlled from either end.

In practical operation the whole of the power for lighting comes directly from the generating set on the locomotive, which also serves to keep the batteries fully charged for any emergency. It is worthy of note that when a battery is fully charged its e.m.f., which is in a direction opposed to that of the generator, is sufficient to limit the current which reaches it through the compensating resistance to an inappreciable value. It is stated that this system is in satisfactory operation on trains between Bruxelles and Verviers, as well as at the Liege Exposition.

Some Features of Central Station Operation in Topeka.

In a recent issue of the ELECTRICAL WORLD AND ENGINEER an account was given of the campaign for new business which is being carried on by the Topeka Edison Company, which recently had its franchise extended thirty years. Some points as to the company's operating methods may also be of interest. The company has a generating station close to the business portion of the city, which station is in excellent physical condition. Steam heat is supplied to business houses within two blocks from the station, enough business being obtained within that radius to utilize all of the exhaust steam during the day.

The station has a boiler capacity of 2,640 hp, consisting of four 300-hp and four 360-hp B. & W. water tube boilers with B. & W. chain grate stokers. Coal is received by wagon. The wagons dump into receivers located under the alley, from which the coal is conveyed by McCaslin coal conveyors to storage bins and stokers. As the same interests now control the lighting and railway companies at Topeka, it is expected to haul coal on the street railway tracks soon. The flues are provided with 2,000 hp in Green fuel economizers.

A water purifying system for 4,000 boiler horse-power has been installed in a room next to the boiler room. This is known as the Tweeddale system. This was one of the first stations where it was installed. It consists in treating the water by the well-known Porter-Clark process with the proper amount of lime water and soda ash to precipitate the carbonates and sulphates of lime and magnesia. The precipitation in the Tweeddale system is accomplished in settling tanks; compressed air being used to agitate the water and hasten the chemical reaction which causes the precipitation. The apparatus costs about $1 per rated horse-power installed. The cost of treating water is from 2½ to 3 cents per thousand gallons. The patents on this system are now owned by the United States Marine Engine and Pump Company, of Batavia, Ill. An open Hoppes feed-water heater is used and a Hoppes oil separator serves for taking the oil out of the engine exhausts before the feed-water heater is reached. The steam piping is built throughout of Crane extra heavy material.

The steam heating system employs the underground mains and apparatus developed by the American District Steam Company. The exhaust steam is all sold by meters, which measure the condensation. The rate is 60 cents per thousand gallons. The maximum back pressure from the steam heating system is seven pounds per square inch in extreme cold weather.

The engine room has three 500-kw direct-current railway generators, direct connected to Buckeye compound vertical engines, and 1,100-kw in 120 and 240-volt, direct-current, generators for lighting, all of G. E. make. There is 240 kw in alternating-current, 60-cycle, single-phase generating apparatus. The alternating-current lighting business has never been developed much in Topeka, but it is the intention soon to extend the alternating-current circuits.

Besides the generating machinery, there is a 220-kw, 3-unit, motor generator set, which has direct-current machines giving 600, 240 and 120 volts. This can be used for supplying a small lighting load from the railway generators, or battery or a railway load from the lighting generators. A Gould storage battery, rated at 800 ampere hours, has been installed to take the fluctuations of load on the railway generators. This battery is accompanied by a Gould booster set, which causes the fluctuations to be taken by the battery and a constant load to be maintained on the generators.

This battery has the Gould arrangement of plate terminals which permits of a glass plate being placed so as to cover the entire surface of the cell. Of course a floating battery of the kind used to take momentary fluctuations of load does not give off the fumes that a battery used for peak work does as the latter is each day fully charged and discharged. Even considering this, however, the battery room is remarkably free from acid fumes, being undoubtedly one of the best of its kind in this respect at present installed in the United States.

METER TESTING.

It is the practice to test the customers' meters in place on the customers' premises about once a year, although the frequency of testing is dependent somewhat on the amount of current used by a customer, some small residences being allowed to go longer than this without testing. Meters are tested by connecting them with a portable lamp bank, with a voltmeter and ammeter connected in circuit. Instead of a stop watch, which is open to some error, a chronograph is used, one specially suited for this purpose being supplied by William E. Lurch, of 3 Maiden Lane, New York. Besides the portable lamp bank used in testing meters, the company has also a more ornamental lamp bank outfit containing lamps of various candle power and known as the "kickers' box." It is used to demonstrate to complaining customers that meters are correct. It contains lamps of various candle powers which can be turned on when the box is connected to the customer's circuit, and the employe of the company can let the customer see for himself just what the meter reads with various numbers and candle powers of lamps in circuit.

RESIDENCE DISTRIBUTION MAPS.

A large map of the distribution system in the residence district is kept in the office, and on this, in addition to the usual data on such maps showing the locations of primary and secondary lines and transformers, there are placed the telephone numbers of various customers. This is for the purpose of saving time in answering trouble calls to replace fuses. For example, if a customer on a certain secondary circuit reports lights out, the near-by customers are called up to determine how far the trouble extends and whether the fuse that is out is the one on a customer's premises or one through which several customers are supplied. In this way much time can be saved where a fuse blows in a circuit which involves several customers.

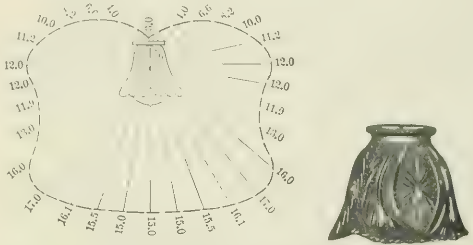
For these points we are indebted to C. R. Maunsell, general superintendent, and Frank Maunsell, assistant superintendent, of the Topeka Edison Company.

Reflectors, Shades and Globes.—II.

By J. R. Cravath and V. R. Lansingh.

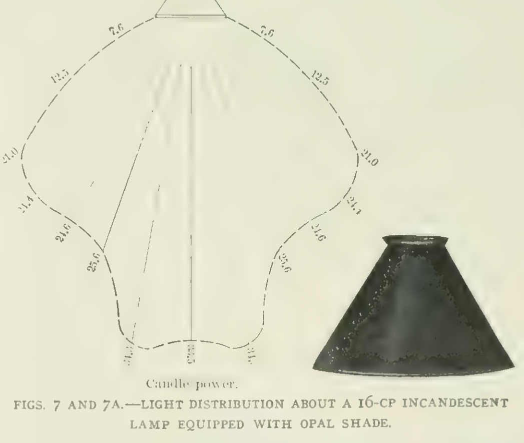
In a previous article tests were cited on a number of common reflectors and the present article is a continuation of that series of tests.

Fig. 6 gives the light distribution of a rated 16-cp incandescent lamp in an ornamental glass bell-shaped shade or reflector, the form of which is shown in Fig. 6A. This reflector is of a very common shape. The outside is lightly frosted and the ornamentation is cut into it. The frosting on the outside would make it a good reflector were it of a proper shape. It is seen that this glass bell causes some increase in the candle-power in downward directions and a decrease in horizontal directions. While it makes some improvement over the distribution of light from the bare lamp, it does not make any such marked change as do the reflectors shown in Figs. 3A and 4A. A reflector of this bell type is usually chosen simply as a matter of ornament without any attempt to re-direct the rays of light. This particular reflector probably changes the natural distribution of light from the lamp more than would many others of the same general shape, because of the frosting on its outside, which tends to make it a good reflector. Frequently a glass bell such as this is used on a bracket or chandelier in an upright position. In such a case it is evident that instead of adding to the useful downward light, it detracts considerably from the downward light and throws much light towards the ceiling.



FIGS. 6 AND 6A.—LIGHT DISTRIBUTION OF 16-CP INCANDESCENT LAMP IN ORNAMENTAL SHADE.

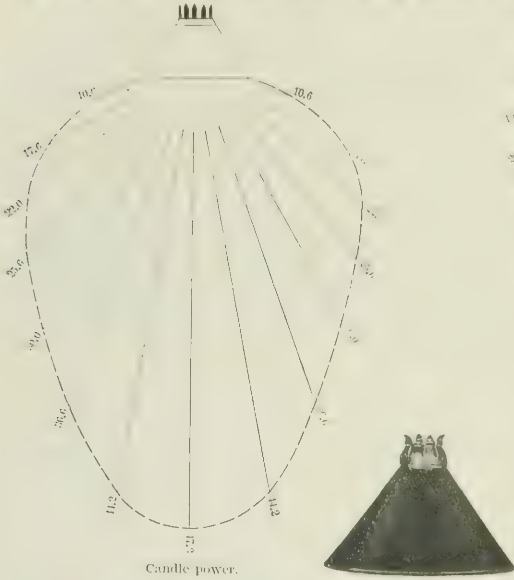
It would be useless to report here on many tests with this general type of bell shade, as they are made in such immense variety, and designs change from year to year. They must always be considered mainly as ornamental, as they usually absorb and waste considerable light, and are as a rule of little value in redirecting the light rays. For locations where expense is no consideration globes of this kind can be freely used. It is nevertheless true that by certain changes in shape and design much of the glassware now manufactured purely for decorative purposes might be made



FIGS. 7 AND 7A.—LIGHT DISTRIBUTION ABOUT A 16-CP INCANDESCENT LAMP EQUIPPED WITH OPAL SHADE.

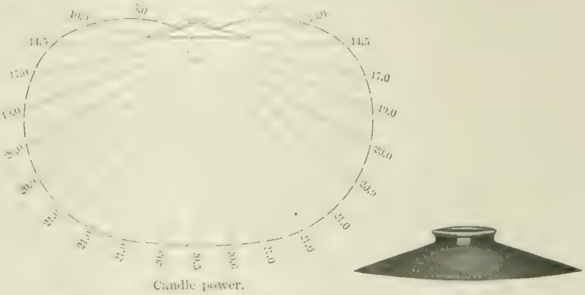
useful as well, and on the other hand some of the staple glassware which is now to be considered as mainly useful rather than ornamental could be made ornamental as well. The manufacturers of unpatented types of glassware might well give attention to these matters.

Fig. 7 gives the light distribution about a 16-cp incandescent lamp equipped with an opal desk shade 7 in. in diameter with green backing. This is the type of shade most commonly found in offices to-day, as will be seen by reference to Fig. 7A, and is, of course, intended to concentrate light below the tip of the lamp for office desk purposes and let but little light through where it can reach the eyes of the users. The maximum candle power is about 34. The candle power tests on this shade do not show the very objectionable feature of it, namely, that it throws a very streaked light. A frosted bulb lamp should invariably be used with such a shade, as this would eliminate the streaks and make its use tolerable. Otherwise it should be prohibited by law.

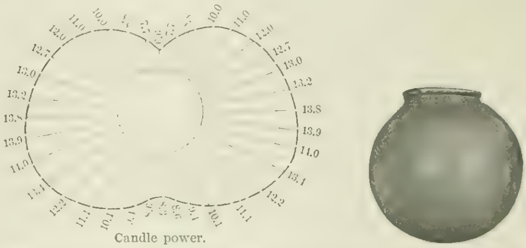


FIGS. 8 AND 8A.—LIGHT DISTRIBUTION ABOUT A 16-CP INCANDESCENT LAMP WITH ALUMINUM CONE REFLECTOR.

Fig. 8 gives the light distribution about a 16-cp incandescent lamp in an aluminum cone reflector with frosted aluminum finish inside. This reflector, which is shown in Fig. 8A, is a fairly powerful concentrator, giving about 47 cp below the tip of the lamp. On the whole, it is much to be preferred to the green opal reflector shown in Fig. 7A. It is perhaps not as pleasing in appearance as the green opal when lighted, as it is an opaque reflector. It gives a well diffused light free from streaks on account of its frosted reflecting surface. A point to be remembered in purchasing aluminum reflectors for office and draughting room use is that they should have a frosted rather than a polished aluminum surface. A polished surface will invariably give a streaked light, which is trying to the eyes if the light is perfectly stationary and still worse when the light swings or vibrates slightly. Besides its excellent light reflecting qualities, the aluminum cone in Fig. 8A is very light and not easily broken. This fits it well for use on portable and adjustable fixtures in offices and shops. It should be considered along with other efficient opaque reflectors mentioned later.

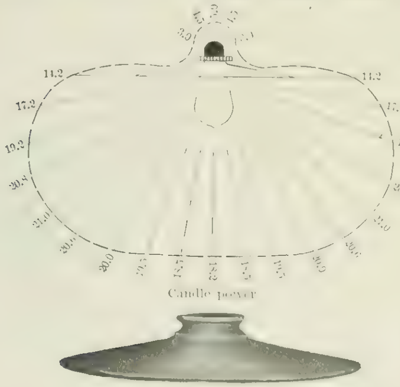


FIGS. 10 AND 10A.—LIGHT DISTRIBUTION ABOUT A 16-CP INCANDESCENT LAMP WITH METAL REFLECTOR.

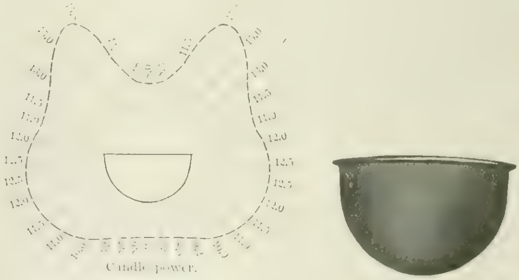


FIGS. 11 AND 11A.—LIGHT DISTRIBUTION ABOUT A 16-CP INCANDESCENT LAMP IN GLASS BALL.

Fig. 9 gives the light distribution about a flat opal reflector 10 in. in diameter, the form of which is shown in Fig. 9A. The reflector so changes the natural distribution of light from an incandescent lamp as to give an increase of light in all directions below the horizontal and very little above the horizontal. It is good for use wherever it is desired to light dimly a large area from one lamp without concentrating much light below the lamp. Its most extensive application is in basements, where it should be placed near the ceiling to keep the lamp out of the line of vision, and also in halls of the cheaper class of buildings. It does not throw enough of its light down to fit it for use on high ceilings. One of its chief disadvantages is that it leaves the lamp absolutely unshaded.



FIGS. 9 AND 9A.—LIGHT DISTRIBUTION ABOUT A FLAT OPAL REFLECTOR.

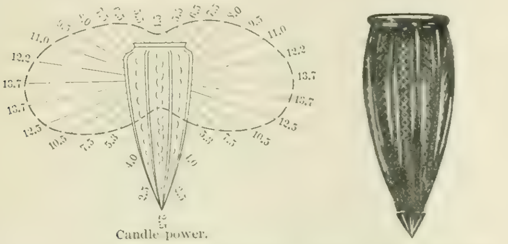


FIGS. 12 AND 12A.—LIGHT DISTRIBUTION FROM SAND-BLASTED GLASS BOWL.

so that frosted lamps should be used in it both to diffuse the glare and obviate the streaked light from the bare filament.

Fig. 10 gives the light distribution about a 16-cp incandescent lamp with an 8-in. flat metal reflector painted white inside, shown in Fig. 10A. This is similar to the light obtained from the flat opal reflector in Fig. 9, and the suggestions made with reference to that apply equally here.

Fig. 11 gives the light distribution about a 16-cp incandescent lamp placed in a glass ball 6 in. in diameter, sand-blasted on the inside. This ball is shown in Fig. 11A. Glass ball globes of this kind are very common at the present time. It will be seen that the distribution of light is not altered materially from that of the bare incandescent lamp. Such a sand-blasted globe is of considerable value in diffusing the light, as mentioned in a paragraph on the frosted bulb incandescent lamp. In practice, when such a bulb is put in a pendant position on a chandelier or fixture, the open space at its neck should be filled with an asbestos gasket, to prevent dirt collecting in the globe. In the test of this globe such a gasket was not used and allowance should be made for this. If used in an upright position the gasket can be omitted.



FIGS. 13 AND 13A.—LIGHT DISTRIBUTION FROM PRESSED GLASS STALACTITE GLOBE.

Fig. 12 gives the light distribution obtained from a sand-blasted glass bowl with a 16-cp incandescent lamp. Such bowls or hemispheres are frequently used for ceiling lights and sometimes on basket fixtures. The sand-blasted bowl evidently acts somewhat as a reflector, as much light is thrown up. In practice this upward light would, of course, be thrown against the ceiling, and most of it would probably be absorbed unless a good reflecting surface was provided inside the bowl. It is evident that if a better downward distribution of light is desired with a ceiling bowl of this kind, it can be obtained by equipping the lamp or lamps with efficient small reflectors inside the bowl.

Fig. 13 shows the distribution of light about a 16-cp lamp enclosed in a pressed glass stalactite globe shown in Fig. 13A. This globe absorbs considerable light, and does not alter the direction of the rays materially. The absorption or loss of light in passing through the thick glass of the stalactite amounts approximately to 25 per cent. This is another example of a globe which is purely ornamental and of very little use as a diffuser of light. The glare of the filament received through a globe of this kind is much more than would be received through a frosted globe or bulb or a Holophane globe, any of which absorbs much less light.

New Telephone Patents.

TRANSMISSION SYSTEM.

In all practical telephone work thus far it has been the custom to provide, for the main portion of the line at least, through metallic connection, either complete or with ground return. Several patents have recently been issued for a transmission system wherein at least one limb of the line circuit is composed of metallic conductors, intimately associated, but insulated from each other. I. Kitsee, of Philadelphia, has obtained five patents for various modifications of such a system. In the simplest form two ordinary twisted pair conductors are required for a "metallic" line. One wire of each pair is connected to the telephone set at one end, the other ends of these two wires being left open. The remaining wire of each of the two pairs at the near end is left open and at the far end is connected to the terminals of the second telephone set. Such an arrangement is shown in Fig. 1. It will be seen that there is no metallic connection between the two telephones, the circuit being completed by electrostatic and other inductive influences. It is quite evident, at first sight, that such a system will transmit, and not only that, but the longer the line, the greater the condenser effect.

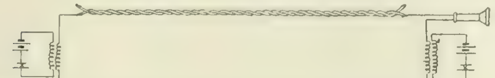


FIG. 1.—KITSEE TRANSMISSION SYSTEM.

There does, however, arise a doubt, at first sight, as to the practical value of such a system, for in order to avoid extraneous inductive effects it will be necessary to associate closely the two parts, and there will at once arise mutual inductive effects between each of the wires of one pair and those of the other. All such inductive effects will be in the nature of shunts on the transmission circuit, and it would seem that the value of these shunts would rapidly approach the value of the mutual inductive effects between the two wires of a pair. This action of interference would apparently increase more and more as other sets of conductors are associated together. It may be argued that such shunt effects exist with the ordinary telephone circuits. This is undoubtedly true, but it is also true that with the ordinary telephone circuits no attempt is made to utilize these inductive effects for the main transmission circuit.

Mr. Kitsee's modifications of this scheme comprise the above-mentioned four-wire circuit, wherein all four wires of the two pairs comprising the limbs of the line circuit are twisted together in a single spiral, and a modification of this wherein one of the wires of the set is abandoned, three wires being used—two with one end open and the third connected at both ends to the telephone sets. Another modification covers a circuit wherein two wires are twisted together to form one side of the inductive line circuit, while a third wire, forming a metallic side of the line circuit, is spiraled about these, the direction of spiral being reversed at intervals as though to give a non-inductive effect. In addition to these modifications, Mr. Kitsee has covered the forming of such sets of conductors into a cable.

Mr. M. S. Lewis, of Medford, Mass., has also been working along this line, but in his circuits, covered by a patent, he has bridged ordinary condensers between the two sides of the circuit at intervals to increase the mutual capacity effect.

In this connection Mr. Kitsee has obtained a patent for a transmission circuit in which he has inserted at intervals reinforcing coils. Each coil is composed of a twisted pair wound inductively upon a non-inductive support. These reinforcing coils are then connected into the circuit, one on each side, exactly as for his other transmission circuit. Thus the approaching line wire is connected to one wire of the twisted pair at one end of the coil, the corresponding end of the mate being left open, while at the far end of the coil the receding line wire is connected to the mate wire of the twisted pair, the first wire being left open.

TELEPHONE REPEATER.

Still another attempt has been made to solve the repeater problem. In the new repeater, which is a modification of the telephone-microphone instrument, the peculiarity lies in the microphone part. The movable electrode consists of a series of iron and steel wires of small calibre, coated on the surface with granular or powdered carbon secured by means of an adhesive gum. These wire electrodes rest at the ends upon stationary carbon electrodes, to which the primary side of the repeater is connected. These magnetic electrodes are subjected to opposing magnetic influences as well as to the force of gravity. It is the idea to connect the set of magnets which reinforce gravity as the receiving side of the repeater. The opposing set of electromagnets, those opposing gravity and tending to lift the electrodes, are included in an auxiliary circuit. It is the idea to adjust the pull of these magnets so that the movable electrodes just retain their seat upon the stationary electrodes. In this condition it will be seen that any variation of the pull of the receiving magnets is almost wholly effective in changing the contact pressure between the movable and stationary electrodes. This relay is also the invention of I. Kitsee, of Philadelphia.

INSULATOR TIE.

Another attempt has been made to supersede the old-fashioned tie wire used for securing line wires to glass or other insulators. This consists of a specially formed tie, so bent that a loop is formed on the line wire side of the insulator. This loop is bent to hook shape, with the point of the hook pointed toward the petticoat of the insulator. In using the tie it is proposed to secure it to the groove of the insulator by twisting up the free ends of the tie, this twist, of course, occurring on the side of the insulator opposite the line wire. The line wire will then be placed in the hook by passing it up from below, whereupon a key piece will be dropped through the loop in a manner such as to hold the wire tightly in the bend of the hook. The key piece consists of a short length of wire with the top crooked so that it will engage the main body of the tie wire and thus be held securely in position. This tie is the invention of Messrs. E. McDaniel and M. Barr, of Paris, Ill.

COMPOSITE SYSTEM.

C. Turchi, of Ferrara, Italy, has patented a composite apparatus for the simultaneous transmission of telephonic and telegraphic communication. The improvements claimed reside in the special design of the composite coil. In this case this is built in three sections, all upon a single core. The middle section, which occupies by far the greater portion of the core, is provided with a bifilar winding, so as to get exactly equally distributed inductance and resistance in the section. The end sections are wound with a single coil each, one of these coils being associated with one of the non-inductive coils of the middle section, and the other with the other non-inductive coil. The arrangement is well indicated in Fig. 2, the method of connecting the coil to the circuit being as shown in the upper part of that figure.

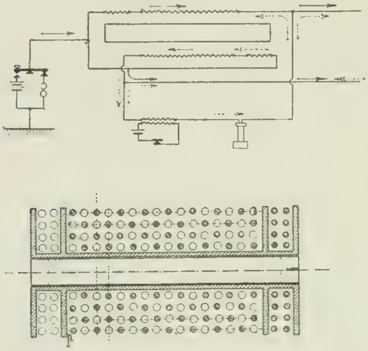


FIG. 2.—TURCHI COMPOSITE SYSTEM.

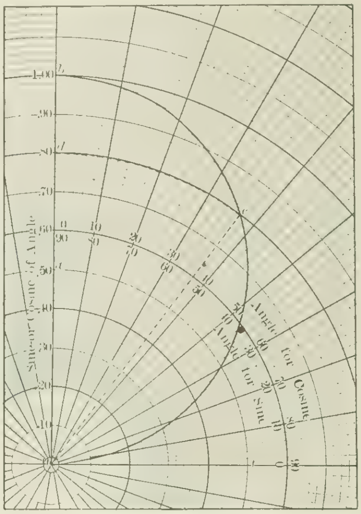
Letter to the Editors.

Sine and Cosine Diagram.

To the Editors of Electrical World and Engineer:

Sirs:—A simple diagram from which the sine and cosine of any angle may be obtained can easily be drawn on a sheet of polar-co-ordinate paper. While not as accurate as a table, compactness and convenience would suggest its use for rough calculations, or where the accuracy in determining the figures employed is not of a high order, as in commercial testing.

The basis upon which the diagram works consists of a familiar geometrical theorm. In the construction there are required only a compass, a ruling pen and a sheet of polar co-ordinate paper. In the figure, with "*a*" as a center, describe a semi-circle passing through the polar origin, the diameter being so chosen as to make the scale convenient for figures from 0 to 1.00. Mark the angles from 0° to 90° for the cosine and from 90° to 0° for the sine, commencing at *o b*. If *o b* be taken as unity, then *o e* = *o d* will be proportional to the cosine of angle *e o d* and to the sine of angle *e o f*. Thus, in finding the angle whose cosine is .80, follow the circle passing through .80 until it cuts the semi-circle at *e*, this point lies on a line making an angle of 36.8°. Likewise the angle whose sine is .8 is 43.2°. The tangent may be deduced, knowing the sine and cosine of an angle.



SINE OR COSINE DIAGRAM.

The percentage accuracy depends upon the scale used for the cosine; below 70° for the cosine and above 30° for the sine; the diagram can be read within ½ per cent on a semi-circle 3 in. in diameter. The result will be within the range of accuracy of electrical measuring instruments, such as used for general testing. The diagram can be pasted into the back of a note book or upon the wall, where it can be used for rapid reference.

Schenectady, N. Y. A. T. Brower.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Determining the Dimensions of Single-Phase Commutator Motors.—Bethenod.—The first part of a mathematical article in which the author endeavors to give some rules concerning the best dimensions for single-phase commutator motors. He introduces a certain ratio which he considers to be of great importance. The starting operation is the more satisfactory the greater the ratio of the torque to the apparent absorbed power. In order to make this ratio a simple numerical coefficient without dimensions the authors defines the ratio d by the equation $d = \frac{c\,s}{e\,i}$, where d is the coefficient in question, c the torque in dyne-centimeters, s the speed of synchronism, e the primary voltage at starting, i the primary current absorbed during starting. The author then proposes to discuss the series motor, the repulsion motor and the Latour motor. In the present installment he gives the theory of the series motor. He discusses the following two types: First, the motor provided with a short-circuited compensating stator winding. In the second case the motor is provided with a compensating stator winding in series with the other windings. In both cases the maximum of the above coefficient d is obtained for such dimensions of the motor for which the power factor is a maximum. He explains why he thinks that the first method of arranging the compensated stator winding is superior to the second method.—*L'Eclairage Elec.* November 11.

Wave Shapes in Three-Phase Transformers.—Clinker.—On the basis of simple considerations concerning harmonics in the voltage waves of three-phase systems, the author arrives at the following two conclusions: (1) the e.m.f. wave across each leg of a set of star-connected transformers will have a different shape from that across the lines, and (2) the core loss of a star-connected transformer may be different from that of the same transformer delta-connected for the same voltage. The author describes some tests which he has made to verify these conclusions. He shows that in certain instances it is incorrect to assume that if three similar transformers be star-connected to a three-phase supply having a sine wave form, the voltage across each transformer is $1/\sqrt{3}$ times the voltage between mains. The paper is discussed in some editorial notes.—Lond. *Elec.*, November 10.

LIGHTS AND LIGHTING.

Metal Arc.—An account of a recent investigation of Stark and Kuech on metallic arcs. The experiments were made with lamps made from fused quartz. Such lamps have already been used for mercury arc lamps, instead of glass tubes, because the latter absorb a part of the ultra-violet rays given out from the mercury arc. The author studied the cadmium arc, zinc arc, lead arc, bismuth arc, antimony arc, tellurium arc and selenium arc. Electrically all these arcs resemble the mercury arc. All of them have a line spectrum as well as a band spectrum. Some details are given.—*Zeit. f. Beleucht.*, November 10.

POWER.

French Water Power Station.—SOLIER.—A long and well illustrated article on the new water power station which utilizes the falls of the Sioule River for power transmission to Clermont. The station is designed for six 900-kw units, of which one will be used for reserve. At present three units and two exciter sets have been installed. The station has been equipped by the Westinghouse Company. Three-phase alternating currents of 1,000 volts are generated. For transmission the voltage is raised to 20,000. The controller room is designed to contain four groups of three single-phase transformers. At present two groups have been installed. The capacity of each single-phase transformer is 375 kw. The length of the transmission line is 30 kilometers. In the sub-station at Clermont the voltage is reduced to 3,000.—*L'Eclairage Elec.*, November 11.

Power Transmission and Line Construction.—RANSOM.—A paper presented before the Pacific Coast Electric Transmission Association. It deals especially with the line construction of the Lewiston-Clarkston system, which at present consists of two power stations with a combined steam and hydraulic capacity of 1,500 hp and fifty miles of transmission lines with secondary distributing systems and sub-stations in five towns and extensions under construction to several other towns in the Palouse country.—*Elec. Jour.*, November.

Direct-Current Motors.—DUBOIS.—The conclusion of his serial on different applications of direct-current motors. In the present installment he discusses the theory of starting and braking direct-current motors for traction and elevator work.—*L'Ind. Elec.*, October 25.

Electricity in Mines.—RAVENSHAW.—The second of his lectures on the uses of electricity in mines. He discusses electric lighting, signalling, shot-firing, the use of direct and alternating-currents, the precautions which are necessary in mines and the safety rules of the British Home Office. The questions of capital expenditure and running cost are finally discussed.—Lond. *Elec.*, November 3.

Electricity in Mining.—SCHOLL.—A general discussion of mine power stations and electric hoisting engines.—*Mining Mag.*, November.

Driving of Stamp Mills.—WILMS.—A thorough discussion of the electric driving of stamp batteries.—From South African *Assoc. of Engs.*, in *Mining Mag.*, November.

Recommendations Against an Electrically Driven Pumping Plant.—A report by Symons, Field and Hering recommending against a 150,000,000-gal. electrically-driven pumping plant for Buffalo, N. Y. The main argument against it is that the electric power was to be furnished from Niagara Falls, and this was not considered to be sufficiently safe. It would have been necessary to install an auxiliary steam power plant, and with this the chief advantage of the electric installation, i.e., its low cost, would have disappeared.—*Eng'ing News*, November 23.

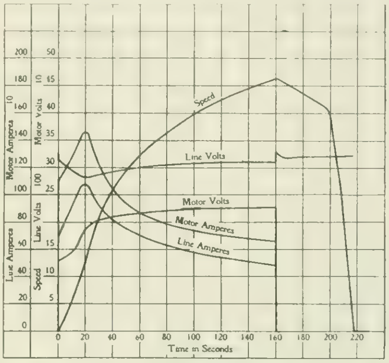
Turbine Pumps.—MUELLER.—An article on modern turbine pumps with diagrams of their construction and results of tests.—From *Zeit. d. Ver. Deutscher Ing.; Scient. Am. Sup.*, November 18.

Gas Engines.—A well illustrated article on four-cycle gas engines driven by blast furnace gas, made by a German company.—Lond. *Eng'ing*, November 3.

Gas Turbine.—CLERK.—His presidential address to the (Brit.) Junior Inst. of Engs., discussing the problem of the gas turbine. His view of the future of it is not favorable. Lond. *Elec.*, Nov. 10.

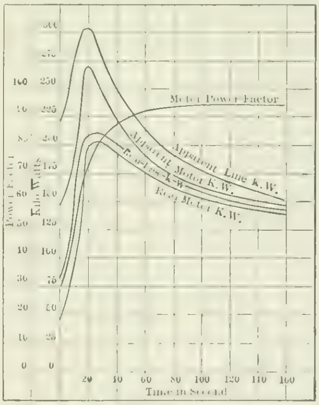
TRACTION.

Single-Phase Traction. BRIGHT.—An account of tests recently made with the Westinghouse single-phase traction system. Figs. 1 and 2 show a test on a 49.4-ton interurban car equipped with four 75-hp Westinghouse single-phase, alternating-current railway motors geared for a speed of about 50 miles per hour. The test extended over a run of two miles in length. The controller was operated to the full-on position in about 15 seconds and was thrown off at about 3,000 ft. from the end of the run. The car was allowed to drift about 2,500 ft., and then the brakes were applied. In looking at the speed curve, the acceleration for the first 30 seconds is seen to be 0.7 mile per hour per second. In another test on this car the initial acceleration was increased to one mile per hour per second by operating the controller a little faster. In this test the maximum apparent line kw was about 350. An acceleration of one mile per hour per second is higher than is ordinarily required with cars of this weight and gearing. The decrease in speed during coasting and braking is shown very clearly in the curve. The rate of acceleration can be obtained at any point by taking a tangent to the speed curve at that point. The difference between the line real kw and motor real kw curves represents the losses in the transformer and car wiring. The kw per car mile and watt hours per ton can be calculated from the average kw which is obtained by integrating



Gear ratio, 18 64
Size of wheels, 37 in.
Length of run, 2 miles.
Time of run including stop, 227.5 sec.
Length of stop, 10 sec.
Schedule speed, 31.65 miles per hour.
Average speed, 33.1 miles per hour

FIG. 1.—SPEED, VOLT AND AMPERE CURVES.



Kw-hrs.per car mile 3.7 Watt-hrs.per ton mile,75.
Average Power Factor.81.6

FIG. 2.—TEST CURVES.

the line real kw curve and dividing by the entire time of the run including the stop. The actual power drawn from the line is very low as the car starts, but rises rapidly, reaching a maximum a little later than the maximum for the apparent kw. The power factor is rather low at the start, but rises very rapidly, passing a value of 80 per cent in less than twenty seconds, and soon reaching 91 per cent in one test and 94 per cent in the other. The average power factor will run from 80 to 85 per cent in these tests, and with longer runs at full speed would be considerably higher. The sudden rise in the line voltage curve at 160 seconds is due to the line current being cut off, which allows the voltage to rise owing to the decrease in line drop. The lowering of the load of the engine and generator will also cause the voltage to rise slightly. The gradual rise of the motor volts after the controller is on full, is due to the decrease in the line and transformer drop. Results of a test of a somewhat lighter car are also given.—*Elec. Jour.*, November.

High-Frequency for Single-Phase Railways.—A communication by the Allgemeine Elek. Ges., stating that the Winter-Eichberg motor is capable of operating up to 50 cycles without any changes in construction. A frequency of 42 is used successfully on the Stubaitalbahn and a frequency of 40 on the Borinage road.—*St. R'y. Jour.*, November 18.

Electrolysis from Tramway Return Currents with Alternating Current Systems.—KINTNER.—An illustrated account of tests which were intended to represent extreme conditions in actual practice such as would tend to aggravate any electrolytic action on water or gas pipes from the return currents of a tramway system. While certain laboratory tests extending over short periods of time may indicate trivial losses due to alternating-current electrolysis, the results of this long time test made under conditions approximating those met in service show quite conclusively that if there is any action it is very small. The conclusion is, therefore, that with alternating-current traction no electrolytic effects should be expected.—*Elec. Jour.*, November.

Third-Rail Insulation.—In notes on the recent electrical Olympia Exhibition in London a description is given of a new third-rail insulator of Monte-Callor, consisting of a solid block of glass shaped as shown in Fig. 3. The advantage claimed for this appliance is that it permits of greater flexibility than the ordinary third-rail insulator, such as is used on certain electric railways. When these insulators are fixed on the same sleepers as the running rails, it is obvious that a certain amount of tension is put on them when a train passes over. This is because they are incapable of vertical motion relatively to the sleeper, as they are, of course, rigidly attached to the conductor rail. The present insulator overcomes this difficulty by means of a circular boss, which fits into the wooden supporting base, and hence the insulator is capable of both vertical and circular motion relatively to the sleeper.—Lond. *Elec.*, November 3.

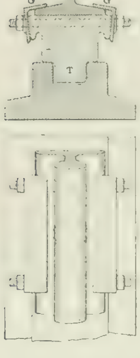


FIG. 3.—THIRD-RAIL INSULATOR.

Roller Bearings.—How.—A paper read before the Tramways and Light Railways Association. The efficiency of roller bearings largely depends upon true parallelism, proper spacing of the rollers and proportionate diameter, length and hardness of the rollers. The author advocated the employment of solid rollers of special quality steel rather than of spiral or hollow ones, or rollers threaded on spindles. The want of success of earlier experiments made with roller bearings was due to excessive rigidity and improper load adjustment. These are now obviated by means of swivel seatings, so that the alignment of the load is evenly distributed. The use of roller bearings on tramways was discussed. On the London, Brighton & South Coast Railway an economy of 15 per cent in coal consumption was obtained on the drawbar pull. The results of exhaustive tests on the Indian State railways showed an economy in coal consumption of from 9 to 12 per cent.—Lond. *Elec. Eng.*, October 27.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Central Station Development in England.—MOUNTAIN.—His presidential address to the Leeds section of the (Brit.) Inst. Elec. Eng. He discussed the developments of central stations in England, during the last ten years. At the end of 1894 there were 60 undertakings with a capital expenditure of $30,538,400; at the end of 1904 there were 445 undertakings, with a capital expenditure of $309,-806,565. The consuming devices reduced to the equivalent of lamps connected in 1894 numbered 2,031,398, and 19,971,435 at the end of 1904. The kw-hours sold in 1894 numbered 30,203,766, and 448,078,-057 in 1904. The average price obtained per kw-hour sold in 1894 was, by companies, 12.10 cents, and by municipalities, 10.64 cents; in 1904 the average price obtained by companies was 7.8 and by municipalities 5.4 cents. These figures show that the capital expended and lamps connected have each increased proportionally by 10 times, and the kw-hours sold nearly 15 times while the price obtained has decreased by 48 per cent. He concludes that greater care must be exercised in the expenditure of capital, that the introduction of large generating plants will lead to ultimate economy and will enable central stations to compete with the comparatively small engines employed for driving factories, and that reduced charges will still further enormously increase the output of energy for both lighting and motive power purposes, if by exhibition or other practical demonstration the actual advantages are shown to be derived from the use of electricity.—*Lond. Elec.*, November 3.

Electricity in Newspaper Plant.—A description of the power and lighting plant of the Free Press building in Winnipeg, Canada. A 75-kw. generator supplies power for motors at 500 volts, while a 50-kw generator supplies power for lamps at 110 volts. The individual motor system is used in every department where electrical power is used. There are in all 33 motors, varying in capacity from a ¼-hp driving a lintoype machine, to a 35-hp driving a Hoe Quad press. For the speed control of this latter machine, two motors are used, one of 5 hp for starting the press and running at the slow speeds, the other of 35 hp for the higher speeds.—*Can. Elec. News*, November.

Central Station for Power Distribution in the Country.—MANASSE.—The first part of an illustrated description of the central station, Kaiserwerke, which was recently built near Kufstein in Northern Tyrol. There is a waterfalls of some 3,000 hp available. For the present two 1,200-hp generating sets and two 60-hp exciting sets have been installed. The generators supply power for both lamps and motors, three-phase current at 10,500 volts and 40 periods being produced.—*Elek. Zeit.*, November 9.

Central Station Results.—An article giving the operating results during three years of the Dresden 2,500-hp central heating and electric station. Practically, as well as financially, the whole plant and its disposition have proved an unqualified success, particular advantages being attributable to the practice of superheating, the arrangement of subways, mains, etc.—*Eng'ing Record*, November 18.

Increasing the Profits in Central Stations.—WALSH.—An article enumerating the advantages to be derived by central stations from disposing of exhaust steam for heating purposes. The author cites many instances where this has been done with profit, and also cites an instance of a station which utilizes the exhaust during the summer months for manufacturing ice.—*Amer. Elec.*, November.

Avoiding the No-Load Loss of Transformers.—SCHMIDT.—The conclusion of an illustrated paper describing various arrangements for avoiding or diminishing the no-load loss of single-phase and polyphase transformers.—*Zeit. f. Elek.* (Vienna), October 29.

ELECTROPHYSICS AND MAGNETISM.

Electromechanics of Galvanism and Heat.—RIECKE.—An abstract of a paper presented before the recent meeting of German Naturalists in Meran. The author reported on papers by Drude, Lorentz and himself, the common goal being the development of an electromechanical theory of galvanism and heat. With reference to older views of Wilhelm Weber, he first developed the foundations which are common to his own theory and that of Drude and then their differences. The most important one relates to the value a which is the kinetic energy of the moving electrical particles at the absolute temperature I. The theory of Riecke does not decide the question as to what is the value of a for different particles, while Drude considers a as a universal constant, the value of which may be determined by means of the kinetic theory of gases. The author then reported on the laws of conduction of heat and electricity in metals. Comparisons with experimental facts can be made for the ratio of heat conductivity to electric conductivity. The value which follows from the theory of Riecke becomes essentially that of Drude if, in the former, Drude's value of a is inserted. However, there is a difference in the numerical coefficient. According to experiments it is on the average 1.41, while Riecke finds theoretically 1.5, Drude 1.33 and Lorentz, on the basis of a broader foundation, finds 0.89. The author then discussed phenomena in magnetic fields and explained why in this field neither his own theory nor that of Drude agrees with the facts. He indicated the way in which the theory is to be improved. He then discussed the application to thermo-electricity and contact e.m.f.'s. The author concluded with a report on the investigation by Lorentz in which the emission and the absorption of a metal is calculated for the case of long waves, and from this he derived the radiation law of Planck in the simple form which is valid for long waves.—*Phys. Zeit.*, November 9.

Theory of Magnetism.—Langevin.—A theoretical paper in which he elaborates Ampere's hypothesis of molecular currents for the explanation of magnetic phenomena. Ampere's molecular currents, Weber's circuits of zero resistance, and Ewing's molecular magnets are all identified with electrons revolving about centers of attraction, such as constitute the basis of Lorentz's theory of the Zeemon phenomenon.—Lond. *Elec.*, November 3, 10; from *Jour. de Phys.*, October.

Electron Theory.—Tommasina.—A paper presented before the recent International Congress of Radiology on the kinetic theory of the electron as the necessary foundation for the electronic theory of radiation.—*L'Eclairage Elec.*, October 21.

Recombination of Ions.—Hendren.—If a gas is ionized by any ionizing agent such as Roentgen or radium rays, the positive and negative ions will immediately begin to recombine due to their motion and mutual attractions. A simple law analogous to that of mass action in physical chemistry has been found to cover this phenomenon. It states that the rate of disappearance of either charge is proportional to the positive and negative electric densities. The proportionality factor is called the coefficient of recombination. The author gives results of tests as to the variation of this coefficient with pressure and has extended the limits of pressure within which this law has been investigated. He finds that the coefficient decreases with pressure.—*Phys. Rev.*, November.

Negative Corpuscles from Alkali Metals; Energy of Emission of Corpuscles.—J. J. Thomson.—An account of an experimental investigation of the emission of negative corpuscles by the alkali metals. It is well known that the alkali metals when exposed to light, even if it is of very feeble intensity, give out negative corpuscles. Thus Elster and Geitel found that the light emitted by a piece of glass rod raised to a dull red heat was sufficient to make rubidium emit corpuscles. The author now shows that with these metals there is a small emission of corpuscles even when all external light is excluded. His experiments show that iridium and a liquid alloy of sodium and potassium give out corpuscles in the dark. The alkali metals give out corpuscles when in the gaseous as when in the solid state. The result that some substances emit many corpuscles, while others at the same temperature emit only a few, if any, has important consequences when considered in relation with the second law of thermo-dynamics. It follows that the energy of the emission of corpuscles cannot come from thermal sources, but must come from some change in the state of the working substances, presumably from some diminution in the internal energy of the atoms of this substance. On this view, the energy of the corpuscle emitted is not derived directly from the work done on the corpuscles by the electric field which exists in the Roentgen rays or in the light. The rays act as detonators, causing some of the atoms on which they fall to explode, and the energy of the corpuscle is derived from the energy liberated by this explosion. In the case of radium and other radioactive substances we have probably also the transformation of internal atomic energy into the kinetic energy of corpuscles and particles, but in this case, as far as is known, the transformation is quite uninfluenced by external physical conditions, and is thus beyond our control.—*Phil. Mag.*, November.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—Scheuer.—An account of a long series of experiments on the production of nitric acid from air by means of electric discharges. The author varied the conditions of the experiments in many directions and tried especially different forms of apparatus and different forms of the electrodes between which the discharges took place. Some good results were obtained with electrodes shaped like the horns of a horn lightning arrester. The efficiency in all experiments was considerably below the theoretical one.—In abstract in *Zeit. f. Elektrochemie*, September 1; the full paper printed as Thesis at Univ. of Geneve, Switzerland.

Electrolysis of Water.—Richards.—A Franklin Inst. paper discussing first the general problem of water electrolysis and then several commercial apparatus for the production of oxygen and hydrogen.—*Jour. Franklin Inst.*, November.

Dielectric Constants.—Mathews.—An account of an experimental investigation on the relation between electrolytic conduction, specific inductive capacity and chemical activity of certain liquids with a long and careful bibliography on dielectric constants.—*Jour. Phys. Chem.*, November.

Units, Measurements and Instruments.

Wattmeter.—Among the notes on exhibits at the recent Olympia exposition in London a description is given of the Duddell-Mather standard wattmeter. Two patterns of instrument are made, one suitable for use on circuits between 100 and 2,500 volts, and the other for extra high pressure of 11,000 volts. The instrument is of the electro-dynamometer type, having a set of fixed coils marked *C, C, C, C* in the elevation (Fig. 4), and movable coils *c, c* (set astatically), which are brought into the same relative position by a torsion head, *F*, on which the reading is taken. The frame and supports are constructed entirely of insulating materials, chiefly ebonite and ivory, the only conducting material used being in the coils and controlling spring. The coils are built up of strands of fine wires, and the spring is of high-resistance material. By these means eddy currents, which vitiate the readings of so many wattmeters on alternating-current circuits, are eliminated. Sub-division of the windings enables the sections of the fixed coils, of which there are usually 10, to be connected in series or parallel, or partly series and partly parallel, thus giving the instrument several sensibilities in known ratios. By the fixed coils and torsion head a useful range of 1 to 100 is obtained without using deflections less than 50 divisions of the head. A further set of sensibilities may be got by putting different non-inductive resistances in series with the moving, or pressure coil, the resistances supplied being suitable for any voltage between 100 and 10,000. A total range of 1 to 10,000 is therefore possible. The strength of the controlling spring is adjusted so that with 1,000 ohms, or convenient multiples of 1,000 ohms, in the pressure circuit, the scale is direct-reading with the principal arrangements of the current coils. Efficient damping of the moving system is obtained by air friction, projections from the plate of insulating material, *I*, which carries the pressure coils, *cc*, passing into brass boxes, *bb*, and thus serving both as damping vanes and pointers, *PP*. By this means the movements are made practically aperiodic. All the resistances used in the pressure circuits of these wattmeters are of the "anti-capacity" type and are made of manganin wire (silk covered) woven into a fabric with silk threads as warp. They take the form of a ribbon 7 in. to 10 in. wide and of length sufficient to give the required resistance. The ribbon is wound in a zig-zag fashion round porcelain insulators supported from the ebonite top of a box.—Lond. *Elec.*, October 27.

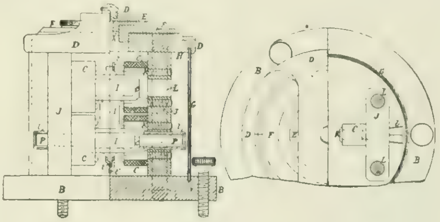


FIG. 4.—PART SECTIONAL ELEVATION AND PLAN OF WATTMETER.

Instruments.—Reyval.—An illustrated description of several instruments exhibited by Richard at the Liege exposition, especially non-periodic galvanometers, hot-wire instruments and a great many different recording instruments.—*L'Eclairage Elec.*, November 11.

High-Pressure Air Gap and Condenser.—Fessenden.—A long communication giving historical notes on the use of compressed air as dielectrics. The compressed-air spark-gap and compressed-air condenser are described. For equal capacities and potentials a compressed-air condenser occupies about one-tenth of the space that an oil condenser does, and a somewhat less space than a glass-plate condenser.—Lond. *Elec.*, November 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Velocity of Electricity Along Wires.—Slaby.—In another paper of his serial on tuning wireless telegraph senders, the author points out that it is improper to assume the velocity of electricity along wires or along systems of wires to be equal to the velocity of light. This point is of importance for the calibration of "multiplication rods," i. e., the author's well known device for measuring wave lengths in wireless telegraphy. This measurement is really based on the determination of the frequency, and the wave length can be found therefrom only when the velocity of electricity is known. The velocity of an electric wave through free space equals the velocity of light $v = 30,000,000,000$ centimeters per second. Hence the "true wave length in space" $= v\,T$, where T is the period. This does not necessarily hold true for the propagation of waves along a system of wires, since in this case v may have a different value. The author discusses the calibration of multiplication rods with a single straight wire as standard (his own former method) or with a Lecher double wire as standard (Drude and Gehrcke in the German Reichsanstalt). The two methods give different results, and it is now certain that the Lecher double wire is the only reliable standard, since in measurements with a single straight wire in free air there are disturbing factors which may cause errors amounting to some 6 per cent. When the mechanical difficulties of winding multiplication rods with perfect uniformity by means of purely mechanical apparatus will be overcome, they may be used themselves as standards of sufficiently great exactness. In transmitters which are coupled with capacity circuits for the sake of damping, there is a difference between the velocity of electricity in the transmitting wire proper and in the closed circuit. In the latter the velocity equals the velocity of the light. This difference represents a formal difficulty for calculations, which, however, may be overcome by substituting for the real transmitting wire an ideal wire for which the velocity would equal the velocity of light. The author shows how by simple experiments the length of this ideal wire may be found. In the case of a cable in his laboratory the real length and the ideal length differed by 7 per cent; this means, that in the real cable the velocity of electricity is 7 per cent smaller than the velocity of light. The "harp" of Fig. 5 of 10 meters length, consisting of 10 wires of 0.8 mm thickness in a distance of 10 centimeters, placed at a height of 1 meter over a zinc floor and excited by a spark-gap earthed through a thick zinc cylinder, assumed oscillations of a quarter wave-length equal to 13.4 meters. This means that the velocity of electricity along such a harp is 34 per cent smaller than the velocity of light. When this harp was replaced by a single wire of 0.8 mm thickness and 20 meters length, the quarter wave length was 20 meters; i. e., in this case the velocity of electricity equaled the velocity of light. The zig-zag wire system of Fig. 6 of 95 meters length of wire showed a wave length of only 17 meters. If the electric wave should progress in zig-zag along the wire, it would follow that the velocity was 5.5 times greater than the velocity of light. It seems more probable that the wave propagates through the space between the parallel wires. By such a zig-zag arrangement of the wire it is possible to adjust its capacity and self-induction within wide limits.—*Elek. Zeit.*, November 2.

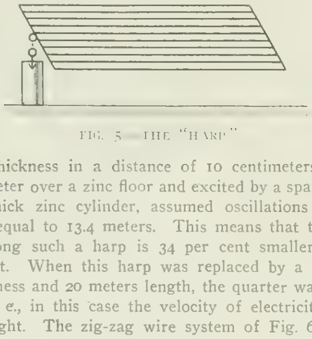


FIG. 5.—THE "HARP."

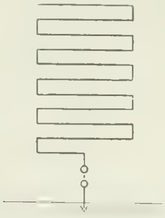


FIG. 6.—ZIG-ZAG SYSTEM.

Earthed and Unearthed Radiators in Wireless Telegraphy.—Eccles.—An article discussing the question of earthed versus unearthed radiators. Marconi's original success was largely due to the use of the earthed air wire. Its merits are: First, its great length ensures slow vibrations, and therefore long waves; second, it sets the waves up so that the electric force in a wave front is, from the very beginning, in a vertical plane; third, what is partly implied in the last, it attaches to the surface of the earth the free ends of the moving lines of force; fourth, it is a good radiator (and absorber). Long waves are advantageous, largely for reasons connected with diffraction; the setting vertically of the electric force near the earth avoids losses such as would otherwise occur from the generation of profitless currents in the earth's substance; and the attachment of the waves to the earth's surface prevents them straying wholly into space and gives them such guidance (similar to that given by a wire to the current it carries) as enables ranges of hills to be surmounted without suggestion of penetration. Lodge early perceived an inadequacy of the simple earth air wire for syntonic working. His first radiator had nearly all the advantages of Marconi's. But it fails in this that it does not attach the waves to the earth's surface. On the other hand it has the advantage of complete freedom from earth connection with all the difficulties due to the variability in the goodness of the earth. This variation of quality of earth did not matter so much in untuned working, but in tuned telegraphy it is more important. In the case of the Lodge-Muirhead radiator, working over the badly-conducting earth, a 50 per cent ohmic loss of the whole output of radiation is possible; whereas with the earthed radiator there are losses in vibrational energy, amounting probably to a smaller figure. Data are so difficult to obtain that calculation promises at present no trustworthy answer to these questions. The only appeal is to experiment.—Lond. *Elec.*, October 27.

Electrolytic Rectifiers for Telephone Stations.—A note stating that electrolytic rectifiers are now being used for working telephones with rectified three-phase currents of 120 volts. The four aluminum cells consist of stamped sheet-iron cases, in which aluminum electrodes are suspended. The electrolyte is a sodium salt; sodium sulphate and sodium phosphate are, as a rule, used. The cells are coupled in such a way that all the positive and negative-current impulses from two of the bus-bars are combined to give a direct-current of fairly constant voltage about 20 volts. The cells have a resistance of 320 ohms, and require a kind of "formation" before use. When the current is first switched on, eight incandescent lamps, in series with the cells, flash up; after a few minutes their glow will have diminished to dark red, and the telephone circuit can be closed. The current now passes from the one bus-bar to a transformer, and back to the other bar, while a branch current flows through the rectifier and returns through a resistance of 1,600 ohms. This branch comprises a split battery of four accumulators, which feed the signal lamps coupled to the relay contacts of the connection of the telephone switchboard. The cells have occasionally to be refilled. This becomes necessary when the resistance-lamps continue to shine brightly instead of toning down; the aluminum electrodes have then to be cleaned of crystals and the cells recharged with fresh electrolyte, the salt being dissolved in distilled water. An efficiency of 70 per cent is claimed for these rectifiers. But these electrolytic "valve" cells have not, so far, been regarded with much confidence, because the aluminum electrodes do not last long.—Lond. *Eng'ing*, October 27.

Telegraphy and Telephony.—Gavey.—The first part of his presidential address to the (Brit.) Inst. Elec. Engs. He first spoke of telegraphs for special requirements, such as for railways, fire signals, etc., and then on ordinary telegraphy, giving statistical data on the rise of telegraphy during the last 24 years. "Although the ordinary telegraph traffic has now been checked by the advent of the telephone, that young and lusty child threatening to monopolize the greater portion of the short-distance work in all countries where it has free play, still for long distances the questions of cost and the physical limitations of the telephone will check the rivalry of the latter, and there appears to be but a small prospect of serious interference or serious competition between the two methods of communication after a certain critical distance is reached."—Lond. *Elec.*, November 10.

Common-Battery Telephone System.—Henry.—An illustrated description of the Kellogg system as installed in one of the Keystone Telephone Company's exchanges in Philadelphia.—*Amer. Elec.*, November.

MISCELLANEOUS.

Engineering and College Graduates.—BUCK.—An article pointing out that no college course alone can make men into engineers. The undergraduate work is simply a preliminary step. It serves to lead a man's mind into accurate and systematic habits of thought. Although comparatively few graduates of technical schools or colleges follow strictly engineering work, a much larger number engage in work in which a general knowledge of technical subjects is of great value, such as in the manufacturing arts. The status of the engineer in society to-day is far from commensurate with that which mankind owes to him. This is perhaps largely the fault of the engineer himself.—*Electric Jour.*, November.

Telluric Currents.—GUARINI.—An illustrated paper read before the Belgian Astronomical Society on telluric currents, their origin, direction, their disadvantages and their possible utilization.—*Scient. Am. Sup.*, November 18.

Obituary.—Notices of the death of Prof. H. Meidinger, known by the Meidinger primary cell, and of Charles Brown, the father of the present partners of Brown-Boveri & Co. Brown was for twenty years connected with Sulzer Brothers and for fifteen years with the Swiss locomotive and machine factory in Winterthur. In 1884 he entered the Oerlikon Company and founded its electrical department; he also introduced there the manufacture of high-speed steam engines. He died at the age of 79 years.—*Elek. Zeit.*, November 2.

Mica.—ZOLLES.—A continuation of his serial on mica and the mica industry. The subject is treated under eight captions: Mineralogy, geology, geographical distribution, history, mining, uses, statistics and conclusions. The treatment is industrial rather than theoretical or scientific, and aims at setting forth the present, past and probable future of mica mining in this and other countries. The present installment deals with the geology of the micas.—*Jour. Franklin Inst.*, October.

Assay Furnace Tools.—KELLER.—An illustrated description of new assay furnace tools designed by the author for the new Baltimore works laboratory of the Anaconda Copper Mining Company.—*Electrochem. and Met. Ind.*, November.

Storage Batteries.—WOODBRIDGE.—An illustrated article of a general nature on electric storage battery engineering.—*Cassier's Mag.*, November.

Electrical Exposition.—A very fully illustrated account of the Olympia Exposition in London.—The *Elec. Mag.*, October 28.

BOOK REVIEW.

HAND BOOK OF PATENT LAW. By W. D. Thompson, 13th edition. New York: D. Van Nostrand Company. 211 pages. Price, $1.25.

While this little book is largely an advertisement for the Liverpool firm of patent solicitors, of which the author is a member, its contents should be of service to inventors who desire to take out foreign patents. The preface states that the book is not written with the object of enabling one to become his own patent agent, but rather to act as a useful guide to patentees, manufacturers and investors in patents, and was undertaken with a view to answering inquiries as to cost and law of patenting which the author's firm receives in the course of its business. There is a section for each country of the world issuing patents, in which is given information concerning grant and duration, what can be patented, novelty, examination, patent office procedure, taxes, working, publication, rights conferred with patents, etc. In each case also are given the patent fees, which, however, in most all cases appear not to be the official fees but the charge for service by the author's firm.

BOOKS RECEIVED.

LEHRBUCH DER PRAKTISCHEN PHYSIK. By F. Kohlrausch. Leipzig: B. G. Teubner. 656 pages, illustrated. Price, 9 marks.

MACHINE DESIGN. Part II, Form, Strength and Proportions of Parts. By Forrest R. Jones. New York: John Wiley & Sons. 426 pages, 243 illustrations. Price, cloth, $3.00.

BERECHNUNG UND ENTWURF ELEKTRISCHER MASCHINEN, APPARATE UND ANLAGEN. By Dr. F. Niethammer. Stuttgart: Ferdinand Enke. 572 pages, 609 illustrations.

TRAITÉ DE PHYSIQUE. Par O. D. Chowlson. Traduit en francais par E. Davaux. 2 vols. Paris: A. Herman. Vol. I, 407 pages, 219 illustrations; Vol. II, 202 pages, 104 illustrations. Price, 22 francs.

New York Electrical Exhibition.

The preparations for the electrical show, which will be held in Madison Square Garden from December 12 to 23, are now nearing completion. The list of exhibits ranges from factory power engines and electrical heating, lighting and cooking instruments to surgical instruments, talking machines, motion pictures and the wireless apparatus used in the recent Japanese-Russian war. The exhibition aims to include every phase of electrical invention in which the visitor may be interested. Attention will be called particularly to the model kitchens, where practical demonstrations of the use of electrical machinery will be conducted through the mediums of stoves, ovens, chafing dishes, coffee urns, tea pots and also curling iron heaters, warming bags, laundry irons and numberless other devices for the home.

In the middle of the hall will be located the telephone exhibit. Here will be seen the "theatrephone," by means of which visitors to the exhibition will be enabled to listen to the words and music of the various theatres over a wire connected direct to the stages during the actual time of the performances. This apparatus is now in use in London, where subscribers are thus permitted to keep in direct touch with the plays, concerts, lectures and other forms of entertainment and instruction in the city.

By courtesy of the Street Cleaning Department and of the Department of Bridges of the City of New York, steel models, 30 ft. long, will be shown of the Williamsburg Bridge and of the incinerating plant connected with it, where the refuse of the city is burned. A sample bale of the refuse from the streets is also exhibited. The value of this "waste" matter may be implied from the fact that a contractor pays the city $20,000 a year for the ownership rights to it.

The music will be one of the features of this exhibition. The "Electrical Show March," composed expressly for this occasion by d'Aguin, will be played at the afternoon and evening concerts by the band that bears the composer's name. Both classic and popular music compose the daily programmes. To add to the interest of the visitors each evening will be devoted to some special interest. Thus, "Telephone Night" will be especially devoted to those persons interested in this subject. In the concert hall, adjoining the main exhibition floor, lectures will be held at 3.00 and 4.00 o'clock every afternoon and at 8.00, 9.00 and 10.00 o'clock every evening by Earle L. Ovington. These lectures will be supplemented by practical demonstrations and explanations of the latest and most spectacular electrical experiments, on special apparatus secured for this purpose. These experiments will cover the phenomena of high-tension discharges, high-frequency currents, electro-therapeutics, wireless telegraphy, Röntgen rays and many of the Tesla demonstrations.

Equipment of the Hastings, England, Trolleys.

When complete the system of the Hastings & District Tramways Company, at the popular English watering place, will be 30 miles in length, partly in the city and partly outside on private right of way. The first part of the large contract has just been carried out by Dick, Kerr & Co., Limited, with Messrs. Kincaid, Waller, Manville & Dawson as consulting engineers. The power house is at Hastings, with sub-stations at Silverhill and Bulverhythe. Sixteen miles of road have already gone into operation, with forty double-decked cars, built by the United Electric Car Company, of Preston, on Brill trucks

The power house electrical plant consists of three of Dick-Kerr's standard alternators and two of the same firm's standard direct-current generators. Two alternators and one direct-current generator are each direct-coupled separately to a "Belliss" engine. The fourth engine drives an alternator and generator coupled together so as to form a reserve in case of the break-down of either an alternating-current or a direct current unit. The alternators generate three-phase current at 6,600 volts, 25 cycles, each machine being provided with a direct-driven exciter. They are designed for a continuous output of 300 kw and to sustain an overload of 25 per cent for one hour with a moderate rise in temperature. All three machines are designed to run in parallel with each other, and means are provided for raising their voltage up to 6,600 when running at a constant speed to compensate for loss in the mains.

The direct-current machines are designed to give an output of 300 kw when running at 375 r.p.m. at a pressure of 500-550 volts. The switchboard consists of twenty marble panels, each supported independently on an iron frame. The board consists of three alternating-current generator panels, one alternating-current spare generator panel, one alternating-current total output panel, four alternating-current outgoing feeder panels, two direct-current generator feeder panels, one direct-current total output panel, one B. O. T. panel, one negative booster panel, six direct-current feeder panels. The whole of the high-tension oil switches is contained in a special chamber beneath the main switchboard gallery. Each switch is isolated in a separate cell and the front is closed by a sheet-iron door. The switches are operated from the main gallery by wooden rods and levers, and the panels on the gallery contain no instruments or switches carrying current at high pressure.

The sub-stations are fed from the main station by Callender three-core, high-tension, lead-covered cables. At the Silverhill sub-station there are three Dick-Kerr standard 200-kw compound-wound rotary converters, running at 750 r.p.m. and generating direct current at 500-550 volts. Each rotary has its complement of three single-phase, oil-cooled, step-down transformers. The rotaries are capable of dealing with an overload of 25 per cent for one hour. The Bulverhythe sub-station is similar to the one at Silverhill, and is equipped with a similar number of rotaries with the necessary transformers and switch gear. Each rotary has three 70-kw, single-phase, oil-cooled transformers. The transformers, which are mesh-connected, transform current from 6,600 volts to 340 volts; they are contained in ribbed cast-iron tanks. The secondary coils are insulated from the iron by mica insulation and oil-proof material; the high-tension coils, outside the secondary coils, are insulated in the same manner. Special circulating ducts are provided for free circulation of the oil between the iron and secondary and secondary and primary, in order that the core and winding may be thoroughly cooled. The cores and yokes of the transformers are built up of annealed iron plates of special quality and high permeability, and of minimum hysteresis loss. The plates are insulated from one another by special varnish. The laminations used are free from ageing or increase in hysteresis loss. For mechanical reasons the cores and yokes are securely clamped together in order to reduce the magnetic resistance.

◆

New Sangamo Alternating-Current Watt-hour Meter.

After a number of years' experiment the Sangamo Electric Company, of Springfield, Ill., has placed on the market a new type of watt-hour meter based upon radically new principles in alternating-current measurement, and which, owing to its design and construction, is stated to eliminate practically all chance of trouble from jewel wear or bearing friction, at the same time having high torque, great accuracy on all loads, large overload capacity and the ability to work accurately with shunts of any capacity.

In series with the shunt coil of the meter, which is carried on a laminated iron yoke, as shown in Fig. 1, is a condenser, which has the effect of changing the phase of current in the shunt coil in such a way as to bring the magnetism of the shunt field in phase with the circuit pressure. The main current goes directly through the copper disc armature, shown in Fig. 2, which is completely enclosed in a mercury-tight insulating chamber. The current is led in and out from the disc chamber by means of contact ears on each side, as shown in Fig. 1.

The magnetic field due to the load current in the strong shunt causes rotation of the armature, the motion being transmitted to the recording train in the usual manner. The armature spindle or shaft, as shown in Fig. 2, projects through a ring-shaped sapphire jewel set in the upper cover of the mercury chamber, which is formed in such a way that no mercury can escape, no matter in what position the meter is turned. The upper end of the armature shaft proper keys freely into an external spindle, which carries the aluminum damping disc. On this spindle is the worm for driving the recording train, this being underneath the disc so that the worm wheel is well protected from accidental injury.

The adjustment of the meter on light load is obtained by means of a small soft-iron piece slid back and forth on the face of one of the shunt field poles just below the disc chamber, this movement giving a wide range of adjustment on light load. The main speed adjustment is obtained without moving the permanent magnets, two in number, which are rigidly held in clamps in the back of the meter.

The adjustment for speed is obtained by moving a small soft iron disc above the upper poles of the two magnets facing each other, this disc being carried on a fine pitched screw working in the bracket above. More or less lines of force are thus shunted between the upper poles of the two magnets and away from the disc gap below, which causes a wide variation in the damping effect, and consequently great ease of speed adjustment. The insulating chamber in which the armature and mercury is carried is formed of a special material durable at very high temperature. This chamber and the laminated magnet structure are carried from the base of the meter by one large screw at the center and four smaller ones at the side, the removal of which allows the entire working part of the meter to be taken out of the base in a very short time, and with the least possible trouble. The shunt coil is carried on a laminated yoke held by the two lowest screws in the laminated magnet structure, as shown in Fig. 1, which allows one to drop out the coil in a moment, if desired.

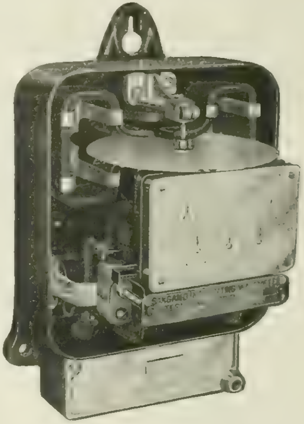


FIG. 1.—FRONT VIEW OF METER.

The method of eliminating friction and wear on the bearings is perhaps the most important point about the meter, aside from the use of the condenser to obtain the necessary torque. The armature, as shown in Fig. 2, has a dome of closed cup form at the center, this constituting the air-float when the armature is immersed in mercury. The displacement of this float and the armature itself in the mercury is sufficient to buoy up the disc shaft and the outer aluminum damping disc, plus a very slight but positive thrust upwards.

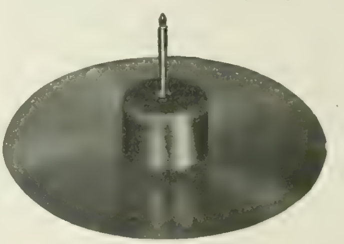


FIG. 2.—COPPER DISC ARMATURE.

There is no bearing in a true sense inside the disc chamber at the bottom of the armature spindle, there being simply a soft steel guide at this point for holding the shaft laterally. At the top the shaft presses upward against a carefully selected flat sapphire jewel, the proportioning of the float on the armature being such that the thrust does not exceed thirty to thirty-five grains, which is so slight that it is impossible to detect any wear whatever on the jewel at the top after long and continued operation of the meter.

The top bearing is adjusted by a micrometer screw and is set so that the end-shake between the top bearing and the spindle cannot exceed a little over .01 in. Under these circumstances, no matter how a meter may stand during shipment, or where it may be installed and under the worst conditions of vibration and pounding, there will be no trouble from wear or friction on the bearing.

The principle of the meter makes it as accurate on inductive loads, down to low power factors, as the best induction meters. The adjustment for inductive load is obtained in somewhat the same way as the light load adjustment and can be very quickly made.

The drop through the series element of the meter is extremely small, as there are no series windings. In a 10-ampere, 100-volt meter the drop between binding posts is not over 0.2 volt at full load. In larger capacity meters, where a part of the current is shunted across the binding posts, the drop through the disc is increased by means of resistance wires in series with it, so as to eliminate the effect of variation in the joints or contacts, either in the shunt across the binding posts or in the disc circuit. The shunt loss is also very small. The drop between posts in meters from 20 to 60 amperes capacity does not exceed .08 to .10 volt. Sizes from 80 amperes and upwards are shunted externally. The torque is very high, being about the same as the better class of induction meters on the market. The curve of the meter shows that the variation from one-thirtieth load to twenty-five per cent overload does not exceed two per cent total. On variations in voltage, the meter holds its accuracy over a wide range. It is accurate for ordinary variations in frequency, and is not appreciably affected by change in temperature. It is very easy to readjust the meter for an entirely different frequency than that for which it was originally calibrated; in fact, all adjustments can be made with the greatest possible facility and speed. For three wire work the meters are made with small series transformers properly constructed so as to measure the total power on both sides of the system.

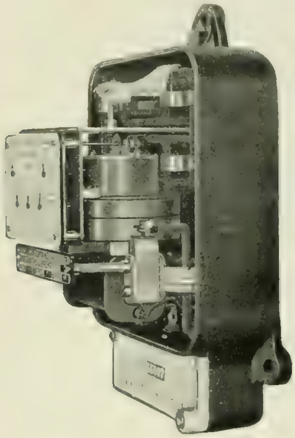


FIG. 3.—SIDE VIEW OF METER.

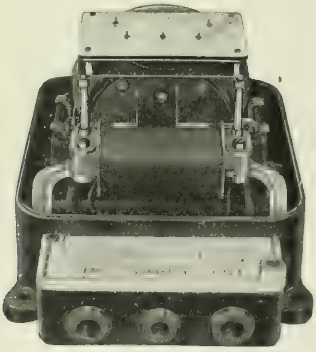
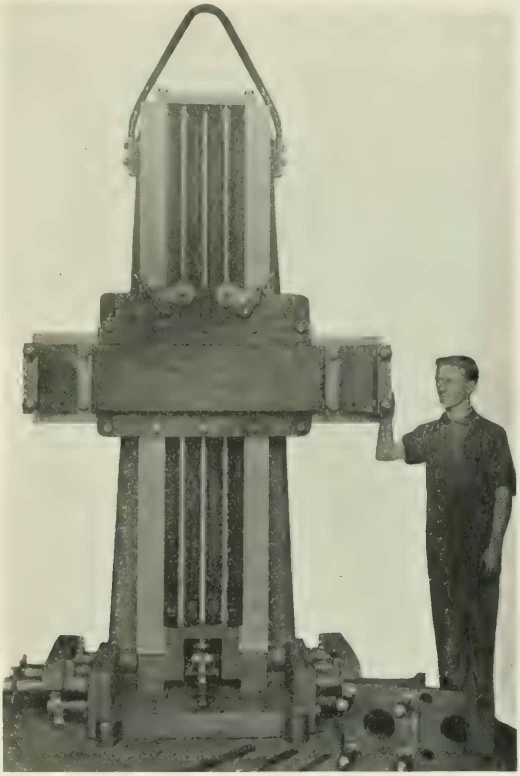


FIG. 4.—END VIEW OF METER.

◆

Portable Tool Post.

The portable tool post shown in the accompanying illustration, which is provided with mechanisms for feeding in all directions, has been designed for use in conjunction with large boring mills and planers. This machine can either be placed on the platen of a large boring mill and be used for turning the inside of large work clamped on the stationary bed plate part of the machine, or it can be placed on the stationary bed plate and used to turn up the outside of work clamped on the revolving table of the boring mill.



PORTABLE TOOL POST.

In order to give the required stiffness for a tool of this character steel castings are used throughout, and the machine is very strongly made. It is manufactured by the Epsen Lucas Machine Works, Broad and Noble Streets, Philadelphia.

◆

Electrical Apparatus for Japanese Mines.

Large orders for electrical apparatus for Japanese mines have recently been received in this country. The Furukawa Mining Company has contracted with Takata & Co. for the following: One Westinghouse compound vertical, single acting steam engine, size 18 and 30 by 16, capable of developing 305 hp when operating at a speed of 240 r.p.m.; the engine to be direct-connected to a Westinghouse 200-kw, 500/570 volt, direct current, engine type generator. The contract also calls for one marble switchboard, consisting of two generator panels and one feeder panel for the control of one 200-kw generator, one 62½-kw generator and four feeders, the 62½-kw generator being furnished on a previous order. The switchboard is complete with all instruments, etc. The above engine is fitted with one Knowles horizontal automatic relief valve, and the contract calls for one Knowles patent air pump and cone jet condenser, regular horizontal pattern, size 10 by 16 by 16.

The contract also covers probably one of the first lots of large Worthington turbine pumps ever ordered for Japan, as follows: Four 8-in., three-stage, horizontal Worthington turbine pumps, each pump having a capacity of 150 cu. ft. of water per minute against a total head of 220 ft., including suction vertical and friction. These pumps are to be arranged with base plates and couplings for direct connection to Westinghouse 500-volt, direct-current, 150-hp motors, normal speed 825 r.p.m., this speed to be adjustable by means of a combination rheostat, so that the motor can be operated at 10 per cent above and below the above mentioned normal speed. Each pump is to be provided with all parts of brass, except the outer casting. Suction and discharge heads, bearings and hand primers are to be provided with each pump. The contract also calls for four 4-in., three-stage, horizontal Worthington turbine pumps, each having a capacity of 50 cu. ft. of water per minute against a head of 220 ft., including suction vertical and friction. Each pump is to be arranged with base plate and coupling for direct connection to a Westinghouse 35 hp. motor, and the speed is adjustable at 10 per cent above and below normal speed, the same as the large pumps. These pumps have the same fittings as the large ones, but in addition are mounted on trucks with platforms, so that they can be moved to different parts of the mines. These pumps are to be used by the Furukawa Mining Company in pumping out flooded portions of its mines.

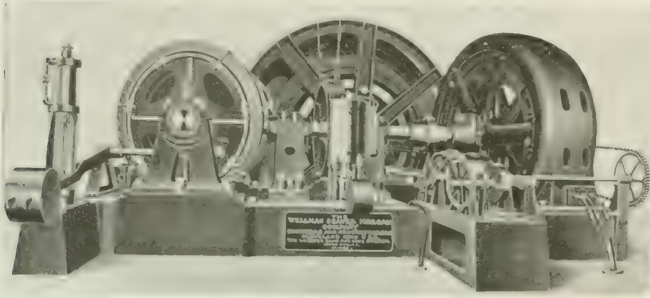


FIG. 1.—FRONT VIEW OF HOIST, SHOWING DRIVING MOTOR.

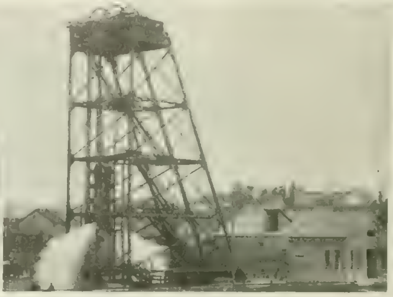


FIG. 2.—VIEW OF HEAD FRAME, SHOWING THE BUCKET WHEN DISCHARGING.

Takata & Co. have also received a contract from the Tanaka Gold Mine for one Westinghouse 150-kw, direct-current, compound-wound, 500-600-volt generator, speed 580 r.p.m. This generator is to be direct-coupled to a special Pelton water wheel 34 in. in diameter, which, under 340 ft. effective head, will have a maximum capacity of 260 hp, the wheel to be mounted on a hammered steel shaft, and to be complete with bearings, etc., the wheel being enclosed in a lower housing of cast iron mounted on masonry foundations, with upper housing of steel plate riveted to planed cast-iron flange. The contract also calls for one 65-hp, compound-wound, 500-volt motor and one 50-hp, compound-wound, 500-volt generator.

◆

Motor-Driven Water Hoist.

The motor-driven hoist shown above has been installed at an anthracite coal mine of the D., L. & W. R. R. Co., and was designed for raising 4,000 gallons of water per minute to a height of 550 ft. It is driven by an induction motor which runs continuously in one direction, change of motion being obtained by means of bevel gearing and clutches. Throwing in one clutch runs the drum in one direction and throwing in the other clutch reverses this direction. Only one clutch can be thrown in at a time, but both clutches can be thrown out together. A pinion on the bevel wheel shaft meshes with a gear on the drum shaft, which carries a cylindrical conical drum having a hoisting speed at 550 ft. per minute at about 15 r.p.m. The clutches and all the brakes are operated by auxiliary air cylinders fitted with oil cushion cylinders, the compressed air being furnished by a motor-driven air compressor.

The controlling mechanism is such that all operations of the hoist are automatic. That is to say, the bucket is hoisted, discharged, returned, filled, and again hoisted, continuously and automatically. Safety auxiliaries are provided whereby the main brake can be released only when current is on a solenoid operating a valve that admits air to the under side of the brake piston. If either the supply of current or air is interrupted a lever sets the brake. Similarly, if either the current or air fails the clutches will not operate. The motor shaft is fitted with an emergency brake operated by a weight controlled by a solenoid, so that any interruption in the flow of current stops the machine, throws out the clutches and puts on the brakes. A safety cut out is provided in the head frame so that in case a bucket is carried beyond the proper height the current is cut off.

The capacity of each of the two buckets is 17 tons of water, and each bucket makes a round trip in one minute and fifty seconds, the total lift being 555 ft. This water hoisting equipment has been developed by Mr. H. H. Warren, electrical engineer for the D., L. & W. R. R. Co. The execution of the mechanical details of the hoist and its automatic devices was entrusted to the Wellman-Seaver-Morgan Company of Cleveland, O. Most of the electrical controlling devices were furnished by the Electric Controller & Supply Company, Cleveland.

◆

Some New Types of Rheostats for Motor Drives.

The General Electric Company has developed several new types of controlling apparatus of the dial pattern for motor-drives, as illustrated herewith. Two forms for the insertion of shunt field resistance are shown in Figs. 1 and 2. These are compact speed-regulating rheostats, and are made for motors of capacities from ¼ to 15 hp inclusive, 110, 220 and 500 volts, and designed for 2:1, 3:1 and 4:1 speed variation by field control. In all sizes of these controllers, the field resistance is self-contained and is within the controller; in large sizes the armature resistance is external. The reversing style has the same number of contact points for either

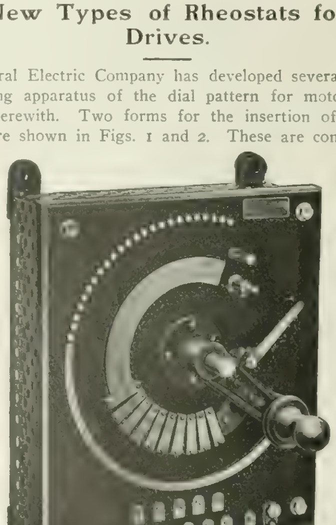


FIG. 1.—NON-REVERSING RHEOSTAT.

direction of speed. Above 3 horse power a magnetic blowout coil is connected on the back of the controller front to protect the first starting points from burning, while in the non-reversing style (Fig. 1) this is accomplished by an auxiliary quick break device. Renewable segments are used for all starting contacts in both reversing and non-reversing styles. Variation in speed for these types is obtained entirely by field control, and the armature resistance is not designed for continuous service, although it is liberally rated and will stand unusually severe service without injurious heating or burning.

If controlling rheostats of this type are operated where chips are apt to fly from the work, a cover for entirely enclosing the front is used; with the addition of an insulated sprocket wheel or gear, the controller can be mounted in any desired location. Fig. 3 shows one of these regulating rheostats enclosed in iron casing complete with circuit breaker equipped with no-voltage release.

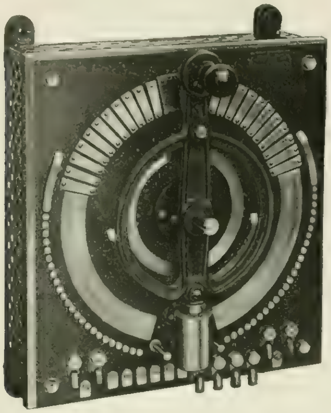


FIG. 2.—FULL REVERSING RHEOSTAT.

For armature resistance speed control, a type of rheostat shown in Fig. 4 is employed. This line of rheostats is designed for controlling the speed of shunt or compound-wound motors from 1/8 hp to 20 hp at 125, 250 and 500 volts direct-current. A speed reduction of 50 per cent under normal full load conditions and 25 per cent at half load can be obtained by inserting resistance in the armature circuit. Nine divisions of resistance are provided in these regulators so that ten different motor speeds may be obtained. In the smaller sizes the resistances are wound on tubes, while in the larger capacities cast iron grids are used. These rheostats will carry currents corresponding to 25 per cent overload on the motor without injurious heating.

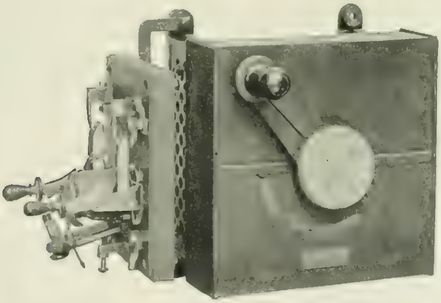


FIG. 3.—RHEOSTAT WITH COVER AND CIRCUIT BREAKER.

This latter type of controller is equipped with a no-voltage coil connected in series with the shunt fields, so that if the voltage fails or the shunt field of the motor be broken, the contact arm returns automatically to the starting position and stops the motor. When this no-voltage coil is unexcited, the tension of a band brake around the base of the switch is increased and holds the contact arm in whatever position it is left. This method of holding the contact arm in any position is simple and very durable, as the tension on the band brake can be easily adjusted for wear. For the smaller capacities, the switch arm is mounted on the top, while in the larger sizes it is mounted on the sides of the box, as shown in the illustrations.

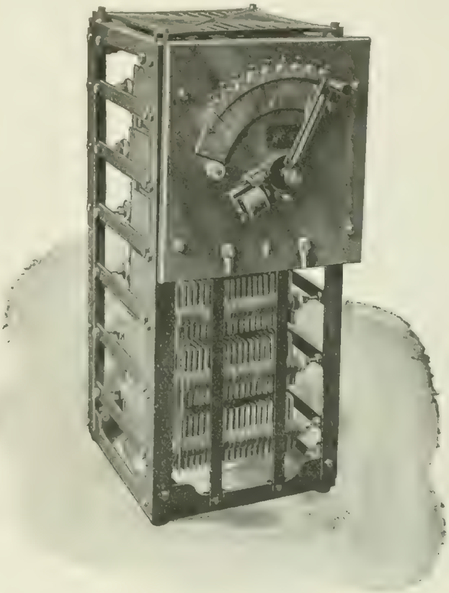


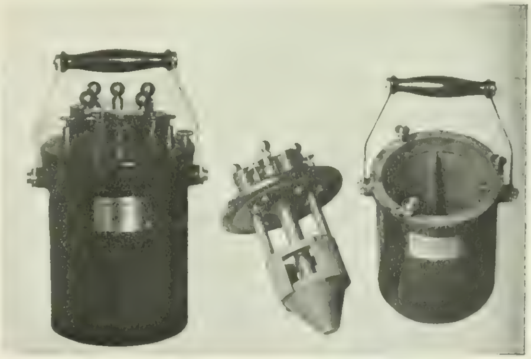
FIG. 4.—FLOOR STYLE RHEOSTAT.

◆

Motor-Driven Mercury-Jet Interrupter.

An interesting novelty in the field of high-frequency apparatus is shown in operation at the Liege Exhibition in the form of a mercury jet interrupter for induction coils, which has been designed and constructed by Mr. G. Gaiffe, of Paris.

The device, which is used successfully with a 40-cm. induction coil, is a combination of a mercury jet interrupter with the simplest possible form of driving motor. Fig. 1 illustrates the apparatus assembled and in running order. It is contained in a casing of convenient and transportable form. Fig. 2 shows the apparatus divided into two parts, the fixed and moving sections of the motor and the interrupter and the outer casing to which the former part is normally joined by means of three posts and thumb-screws.



FIGS. 1 AND 2.—MERCURY JET INTERRUPTER.

The central shaft of the interrupter carries a conical turbine from which the mercury jet is thrown on to the opposite side contact segments. The motor part of the equipment is composed of a soft-iron armature, *P* (Fig. 3), keyed to the shaft carrying the turbine. It is subjected to the attraction of four magnets provided with windings connected in series with the interrupter. These windings are cut into and out of the circuit by the interrupter itself, and, with a proper angular relation between the position of the armature and that of the mercury outlet, the armature is drawn by the magnets at the proper moments with corresponding impulses of current through them and the primary of the induction coil, which is in series in the same circuit, as indicated in Fig. 3.

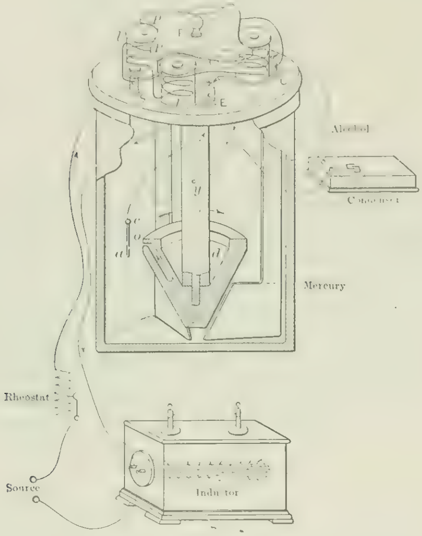


FIG. 3.—SECTIONAL VIEW OF MOTOR-DRIVEN INTERRUPTER.

The partitions which can be seen inside of the casing in Fig. 2 are provided for the purpose of counteracting the tendency of the liquid mass to follow the movement of the turbine. On the supporting plate which carries the turbine and the motor parts two lugs are placed for holding segmental contacts, the width and distance apart of which are designed for a given succession of contacts and interruptions. The mercury fills the bottom part of the casing up to a level below the lowest level of the segmental contacts. The remaining part of the casing is filled with ordinary burning alcohol.

Repainting Feed Wires on Poles.

A device has recently been tried on some of the overhead lines of the Commonwealth Electric Company, Chicago, for saturating with compound the insulation of the feed wires in place on poles. The device consists of a tank holding the paint or compound, which is provided with suitable rollers so that it is hung over the wire and pulled along from one pole to another by a lineman walking along the ground, as shown in Fig. 1. Fig. 2 shows the machine in detail. To put it on the line, it is first hung on the wire by means of the hook which also forms the handle. A large roller, which is held up by springs, is then depressed so that the small rollers which take the weight of the device can be placed over the wire, as in Fig. 3. The function of the roller is to carry the compound from the bottom of the tank up on to the wire. The compound is then spread over the wire as it passes through a trough and then through a thimble, which not only spreads the insulation but takes off loose threads or strings that may be on the wire. It is asserted that by recoating the feed wire in this way, the insulation can be kept in good condition many more years than if it is neglected. The device is just being introduced by the National Insulator Protector Company, 405 Hartford Building, Chicago.

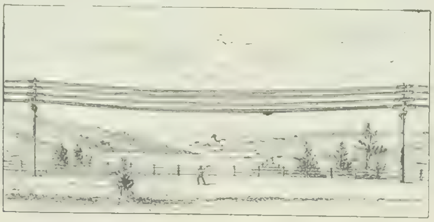


FIG. 1.—MACHINE IN OPERATION.

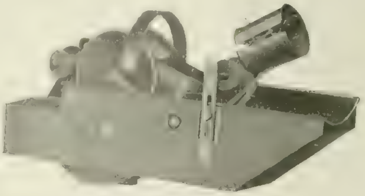


FIG. 2.—PAINTING MACHINE.

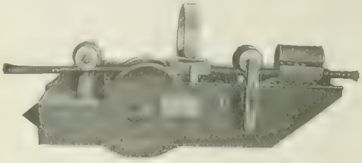
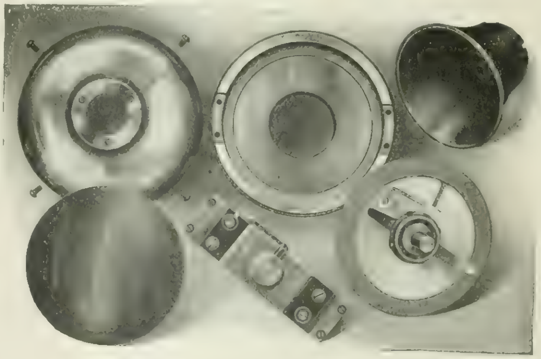


FIG. 3.—MACHINE ON WIRE.

Improving Speech Transmission.

A new telephonic transmitter has recently been put upon the market by the International Telephone Manufacturing Company, of Chicago. The accompanying cut shows exterior of the transmitter and the various parts. All the working parts are supported on the front, which is built of heavy brass. The seat for the diaphragm is accurately turned down and the sides are slotted to the required depth, to form a firm seat for the bridge. This brings the bridge at all times into proper relation with the diaphragm and dampening springs. These springs answer the combined purpose of dampening the diaphragm, forming the enclosure for one side of the carbon chamber, and serving as the front electrode. The carbon chamber is constructed of a very light ring with an ingoing ledge at one end, to which is clamped the auxiliary mica diaphragm with a tight-fitting inner tube. The diaphragm prevents the entry of moisture and also lends to the transmitter a soft and natural tone. The binding ring clamps the ledge of the carbon chamber firmly to the combined electrode and dampening spring, and also presses the inner tube of the chamber solidly against the mica diaphragm, and at the same time securely holds all of the working parts directly in the center of the main diaphragm.



COMPONENT PARTS OF TRANSMITTER.

This construction makes a transmitter with all of the essential working parts self-contained and firmly riveted together, and prevents loss of proper adjustment. The chamber being supported on the diaphragm, it agitates the carbon whenever the transmitter is used, keeping it alive at all times, thus absolutely preventing packing.

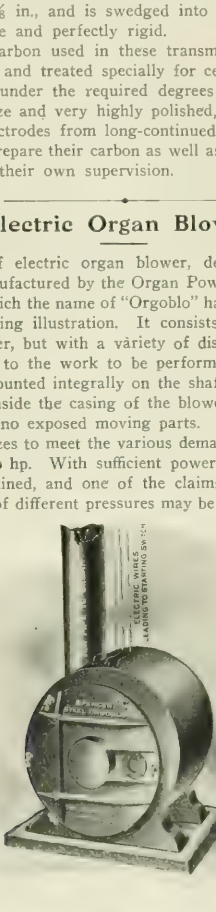
The dampening springs are formed by machine into the proper shape, so that when the diaphragm is set into the front case and the bridge is screwed down in position, the back electrode set-screw can be fastened, and the transmitter is in the proper adjustment. The collet for the back electrode post is insulated from the bridge by mica washers. A substantial German silver punching, forming a connecting lead, is swaged to the back electrode post and terminates at a terminal screw mounted in an insulating block on one end of the bridge. An aluminum punching, forming a connecting lead for the front electrode, is riveted to the outer edge of the diaphragm and terminates at a terminal screw on a rubber block at the other end of the bridge.

The diaphragm is provided around its outer edge with a rubber band, insulating it from the frame and preventing moisture entering the working parts. No exposed metal part of the transmitter is anywhere left to form a part of the circuit, thus avoiding all danger of bad connections. The bridge is formed up of heavy bar brass ¾ in. by ⅛ in., and is swedged into proper form to make the corners square and perfectly rigid.

The granular carbon used in these transmitters is made of the very hardest coal and treated specially for central energy work or local battery use under the required degrees of heat. The grains are uniform in size and very highly polished, to avoid dusting and filming of the electrodes from long-continued usage. The International Company prepare their carbon as well as all other parts of the equipment under their own supervision.

Electric Organ Blower.

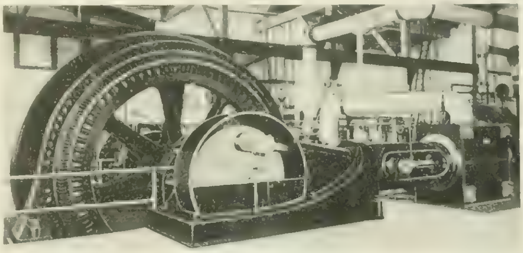
A new type of electric organ blower, devised by Mr. R. H. Spencer, and manufactured by the Organ Power Company, of Hartford, Conn., to which the name of "Orgoblo" has been given, is shown in the accompanying illustration. It consists essentially of a centrifugal fan blower, but with a variety of distinctive features especially adapting it to the work to be performed. The disc bearing the air fans is mounted integrally on the shaft of the motor, which latter is placed inside the casing of the blower, the result being an apparatus having no exposed moving parts. The apparatus is built in a number of sizes to meet the various demands of organs, varying from ¼ hp to 20 hp. With sufficient power any desired air pressure may be obtained, and one of the claims for the apparatus is that any number of different pressures may be had by simply providing orifices at the proper points on the circumference of the revolving fans. Some organs call for four or five different pressures, but it is stated that an ordinary 15-stop church organ may be provided with a ½-hp "Orgoblo." The apparatus can be made practically noiseless by surrounding the casing with a packing of mineral wool. The blower can be run either by a direct-current or alternating-current motor. We are informed that in a number of cities in vaious parts of the country, central stations have, for the sake of increasing the sale of current, taken up the Spencer blower and succeeded in introducing it in local churches.



ELECTRIC ORGAN BLOWER.

Power Plant for Alpena, Mich.

The city of Alpena, Mich., which recently voted an issue of bonds to defray the cost of a municipal lighting plant, has contracted with Allis-Chalmers Company, of Milwaukee, for the complete electrical and power equipment. This consists of a 60-cycle Bullock alternating-current generator, normal capacity 150 kw, direct-connected to a Reynolds Corliss cross-compound, heavy-duty engine, an exciter unit, jet condenser, switchboards, sub-station apparatus and equipment for 100 arc lamps connected in series. A feature of this installation will be its compactness, as provision has been made for the future enlargement of the plant, when the growth of the city demands it, by an extension of the existing building and the addition of another generating unit. The installation will duplicate that shown herewith, being the equipment of the municipal lighting plant at Owensboro, Ky.



VIEW OF INTERIOR OF STATION.

Primary Batteries for Operating Railroad Signals.

The published accounts of the automatic signals on the North Eastern Railroad and the London and South Western Railroad do not give a description of the batteries used to operate the signals, and which are the "SS" type of the Edison primary battery (formerly known as the Edison-Lalande), supplied by the Edison Manufacturing Company, of New York, and 25 Clerkenwell Road, London, E. C. Each cell consists of two oxide plates, suspended one above the other, in a frame, the sides of which are grooved and pass through the porcelain lid of the jar, and are secured by two outer nuts. The copper plates are slid up the grooves from the bottom, and each is supported by a copper rod passing through the channel sides of the frames and secured by nuts. Between the top of the upper copper plate and the lid of the jar hollow hard rubber insulators are placed on the frame sides, to prevent leakage of current between the stems of the zinc plates and the frame sides at the surface of the solution.

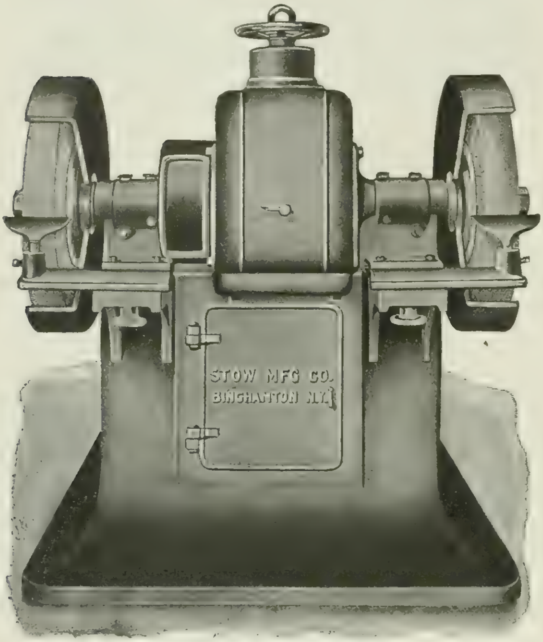
Each battery has also two zinc plates, between which the copper plates are held. The zinc plates have bent stems, which pass through the lid of the jar, and are secured on either side of the porcelain knob of the lid with a brass bolt passing through. The solution consists of 20 per cent of caustic soda and 80 per cent of water. A small quantity of oil is placed on the top of the solution to prevent creeping and evaporation. The proper quantities of soda and oil are supplied by the makers. The inside of each jar is marked to indicate the height to which it is filled with water. The amount of copper oxide used in each cell is so calculated that it will be entirely reduced to metallic copper simultaneously with the zincs and the exhaustion of the solution.

The battery is very simple in construction and is readily renewed. New copper and zinc plates can be fixed in position, the old solution thrown away, new put in, oil added and the battery be again ready for work and as good and as effective as when it was new, in a very few minutes. One of the chief points of merit claimed is the absence of local action when not in actual service, and it is stated that in an actual test made with forty of these cells it was found that the average loss in zinc in each cell, for a period extending over three months, was a fraction over 1 per cent per month.

It is also claimed that this battery requires no attention until the charge is entirely exhausted; that it generates no noxious or poisonous fumes; that its permanent parts do not deteriorate with use, and that extreme frost has no effect upon it. The type "SS" cell has a capacity of 300 amp.-hours. Its size over all is 6¾ in. diameter and 12¾ in. high.

Motor-Driven Emery Grinder.

The accompanying illustration shows a substantial motor emery grinder which can readily be changed from one place to another without regard to countershafts or line shafts, by simply loosening a few bolts. The speed of the emery wheels can be regulated to the fraction of a revolution, between the highest and the lowest speed, so that the operator can always have, not approximately the speed he needs, but just the proper speed for the work he has to do. The wheels are mounted on the same shaft with a multi-speed motor which is started and stopped by turning the short lever on the motor to the right or left, speed variation being obtained by turning the hand-wheel on top of the motor.



ELECTRICALLY DRIVEN EMERY GRINDER

The motor is of the variable-reluctance type, the field current remaining constant, and the field strength varied by changing the reluctance of the magnetic circuit. No field circuit rheostat is used, and the motor is entirely self-contained. The simplicity and ruggedness of the construction of the motor specially fits it for a tool of this kind. This grinder is built by the Stow Manufacturing Company, Binghamton, N. Y.

Youngstown Steam Trap.

The accompanying illustrations show a new type of steam trap now being manufactured by the Youngstown Steam Trap Company, Pittsburg, Pa. As will be seen, the trap differs very considerably in appearance from the older types of steam trap. It is mounted to swing on trunnions, as shown in Fig. 1, where it is in discharging position. The diagrammatic view of Fig. 2 shows the trap in normal position. Referring to this figure and to Fig. 3, the condensation passes into a trunnion at *U* and thence into the receiving chamber through the port, *P*. When the latter is filled to its discharging capacity, equilibrium is overcome, the trap tips and falls into the position shown in Fig. 1. While the trap is assuming this position the ball, *F*, rolls toward the trunnion, thus accelerating the tipping motion and at the same time the valve ball rolls off the discharge port, *M*, thus allowing the water to pass into the discharge pipe, *C*, and thence out through the trunnion, *J*. When the water has all been discharged the preponderance of weight of the counterweight end of the trap causes it to drop back until brought to rest on the bracket, *G*. The ball, *F*, simultaneously rolls back to its original position at the extreme end, and the valve ball, *L*, rolls over the discharge part. As will be seen, the valve mechanism is of extreme simplicity. The ball valve, *L*, is not lifted off the seat against the steam pressure, as is usually the case in other traps, but is caused to roll off its seat automatically and is returned to its seat in the same manner. Since the ball is moved entirely off of its seat when the trap is discharging, mud, scale or other foreign matter passing through with the water will be blown through the large discharge opening and the seat cleaned to receive the ball as the trap returns to its filling position. The valve ball is easily accessible, and the absence of packed valve stems, floats, levers and pins subject to wear all conduce to efficient working. Another advantageous point is that the rocking of the trap gives visible evidence of its proper working.

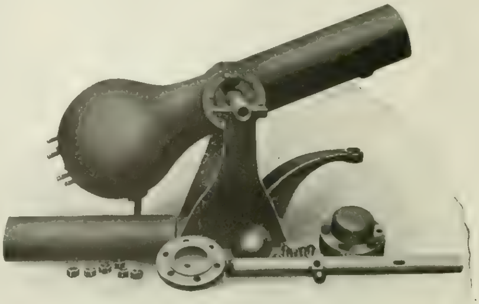


FIG. 1.—STEAM TRAP.

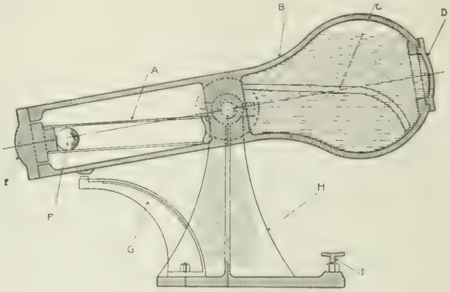


FIG. 2.—TRAP IN NORMAL POSITION.

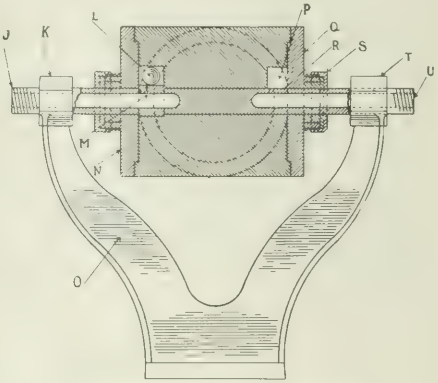


FIG. 3.—SECTIONAL VIEW OF TRUNNIONS.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—In all industrial lines, activity is unprecedented, as a result of the mild weather. Retail trade in wearing apparel is, however, unfavorably affected, and from the same cause collections are retarded. Fundamental conditions, however, are unchanged. Labor conditions have not improved, but otherwise the situation is satisfactory and the outlook bright. In wholesale and jobbing lines the backwardness of retail trade is reflected in slower reorder trade than expected, but there is confidence in the general outlook. There was an extraordinary display of strength in demand and of prices in the metal markets. Pig iron was strong but quiet; prices are rising slowly but steadily, and imports of material are becoming actual facts. All other metals are strong, particularly copper, which at one time during the week reached 17⅜c. This is the highest price attained since 1901. The closing quotations were 17¼c. for Lake and electrolytic and 17c. for casting stock. Leading industrial establishments report little idle machinery, and there is less complaint regarding car shortage. Finished products in iron and steel are active beyond precedent for this season. Some structural material has been bought for import, and large quantities for foreign pig are reported under consideration. Hardware is active and manufacturers are hard pressed for delivery of goods ordered. Railway earnings show further expansion, the gain for the first half of November being about 9 per cent. The net returns for nine months show a gain of 7 per cent. There is every indication that the holiday trade this year will be a record-breaker, all sections of the country reporting active demand from jobbers and manufacturers. On the other hand, the mild weather has the effect of limiting retail buying. The business failures reported to *Bradstreet's* during the week ending Nov. 23 numbered 224, against 198 the week previous and 193 the corresponding week last year.

ORDERS FROM JAPAN.—Takata & Company, 10 Wall Street, New York, have secured a contract from the Nippon Seido Riusan Hirio Kaisha for considerable electrical apparatus, orders for which have been placed by their New York office as follows: One Westinghouse 225-kw., 440-volt, three-phase, 60 cycle, rotating field, alternating current, engine type generator, operating at a speed of 225 r.p.m., direct-connected to a Westinghouse 18 and 30 by 16 compound engine. A 12½-kw, type "S," 125-volt, compound-wound generator has been ordered for an exciter. This exciter will be driven by means of a belt from a pulley on the engine. The order also includes a Type 6-B, three-phase generator panel and a Type 6-B, three-phase feeder panel, together with all the necessary instruments, etc., mounted upon it; also one 20-hp, 400-volt, three-phase, 7,200 alts., induction motor; one 30-hp ditto, one 50-hp ditto, and one 75-hp ditto. The order also includes a lot of portable instruments, etc. Takata & Company have also ordered for the same contract, from the Knowles Steam Pump Works, one surface condenser containing 600 square feet of cooling surface, mounted over a combined air and circulating pump, size 10 x 12 x 12 x 12, and one horizontal duplex power pump, double acting piston pattern, size 5½ x 6; speed 50 r.p.m., direct driven by a Westinghouse 7½-hp motor; also from the Burt Manufacturing Company, for use on the engine, one standard exhaust head. The contract also calls for one 10 x 10 air compressor having a capacity of 135 cubic feet of air at 150 r.p.m. This compressor was ordered from the Bury Compressor Company, Erie, Pa., and is direct driven by a Westinghouse 30-hp motor.

A NEW CARBON POINT.—The North Adams, Mass., *Herald* of November 11 says: "H. E. Davis tested last night in the mills of the Berkshire Cotton Co., an "indestructible" carbon, which is expected to revolutionize electric lighting. Mr. Davis is a nephew of the discoverer of the famous sulphur ore mines of Davis, in the town of Monroe. The carbon will not wear under the action of the electric current, as all other carbons do. A test has been made by other persons in this town, and the new carbon has stood up well. The degree of heat at which it will melt is said to be away up in the dizzy numbers. A set of these carbons has been under test in Brattleboro, Vt., and since last March it cannot be seen that they have perceptibly worn, or that the light has diminished in intensity. The use of the carbon for fusing purposes in electric welding will be of the first value if all the claims of inventor are sustained."

NEW AMERICAN BLOWER FACTORY.—In order to provide for its increasing business the American Blower Company, of Detroit, is erecting a three-story addition to its plant. This particular addition is rendered necessary by the growing popularity of its type "A" enclosed, vertical, self-oiling engine which was placed upon the market some two or three years since. The building will be of steel and brick construction. The first floor will be used for erecting and testing engines, a very complete new outfit being put in for the latter purpose. The power from engines under test will be absorbed by generators and air compressors. An electric crane will form part of the equipment in this department. The second floor will be used for storing engine parts and painting the completed engines, and the third floor will be utilized for storage purposes entirely.

CROSBY, CRAFT & CO.—The firm of Crosby, Craft & Co. has been formed with offices in the Williamson Building, Cleveland, O. It will carry on business as manufacturers' agent of electrical apparatus, and will handle in addition to other lines the products of the Switchboard Equipment Co., manufacturers of "S. E." circuit breakers; the Northwestern Mfg. Co., makers of "Browning" motors and generators; the Whitney Electrical Instrument Co., Henry D'Olier, Jr. Co., the American Conduit Mfg. Co., and the Garton-Daniels Co. The active personnel of this firm consists of Geo. L. Crosby, who was until recently with the Stanley-G. I. Elec. Mfg. Co., and R. H. Craft, who has for several years been associated with the home office of the Adams-Bagnall Elec. Co., of Cleveland.

NAVY SUPPLIES.—Bids will be received at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., until December 5, to furnish at the navy yards, at Portsmouth, N. H., Boston, Mass., New York, N. Y., League Island, Pa., Washington, D. C. and Norfolk, Va., a quantity of naval supplies as follows: Arc lamps, incandescent lamps, electrical wire. H. T. B. Harris, Paymaster Gen., U. S. N.

CUBAN TROLLEY EXTENSION.—The Havana Central Railway, of which Mr. G. F. Greenwood, the successful trolley builder of Cuba is the general manager, has just secured the concession for an electric railway from Guines to Cienfuegos and from Guines to Batabano. This was secured after quite an active fight with the Cuban Central Railway, which corporation has just secured the same concession.

ILLINOIS CENTRAL TELEPHONY.—A contract has just been signed between the Illinois Central and the Cumberland Telephone & Telegraph Company, under which the telephone company is to equip the railroad with telephone wires from Louisville to New Orleans. They are to be of the largest type used in telephone construction, requiring nearly 1,000 pounds of copper to the mile.

THE ROBINS CONVEYING BELT CO. has recently secured the contract from John R. White & Son, of Providence, R. I., covering hoisting machinery, belt conveyors and cable railroads. Among the other work now being completed by the Robins Company is the manufacture of belt conveyors for the Blaisdell Co., of Los Angeles, and for the Carvin mines, in France.

BIDS OPENED.—The following are the totals of bids opened on November 18 by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for underground, lead cased, braid covered, arc and incandescent lighting cables at the Navy Yard, League Island, Pa.: Standard Underground Cable Co., $13,165, and John A. Roebling's Sons Co., $12,911.

LARGER OTIS WORKS.—The Otis Elevator Company has purchased for $1,000,000 twelve acres of land in Yonkers on the Hudson River to be used for an additional factory site. There is a rumor afloat that the company will make its own motors there.

STROMBERG-CARLSON TELEPHONE CO., Rochester, N. Y., reports having closed contracts for switchboards for the following places: Tremonton, Utah; Columbus, Ohio; Robinson, Ill.; Lakewood, Ill.; Chillicothe, Mo.; Garland, Utah.

BIDS FOR STORAGE BATTERY.—Bids will be received by the Village Council, Appleton, Minn., until December 5, for furnishing a storage battery to the village, of the capacity of 200 amp.-hours. H. E. Sorlien is village recorder.

ELECTRIC LIGHT PLANT.—Bids for an electric light plant, sewers, etc., at Abbeville, La., will be received until December 18. The probable cost of the work will be $50,000. J. R. Leguenec is mayor.

STEAM HEATING FACTORY.—The American District Steam Heating Company has let contracts for the construction of a large addition to its plant in North Tonawanda, N. Y.

4,500-HP GAS PLANT IN CEMENT WORKS.—The Iola Portland Cement Company, of Iola, Kan., has recently placed an order with the Westinghouse Machine Company, of East Pittsburg, Pa., for three 500-hp horizontal double acting gas engines and one 125-hp vertical single acting gas engine to increase the capacity of their already large gas power plant. The three horizontal gas engines now on order will be the first of this type to be installed in the power house, the remainder being of the vertical type. After the installation of the engines now on order, the power equipment will comprise 15 engines of the Westinghouse vertical single acting type and three of the horizontal double-acting type, aggregating about 4,500 hp. The company operates its plant upon Kansas natural gas fuel and is one of the largest users of gas power in the cement manufacturing field. The engines are used to operate various classes of machinery, such as rock crushers, rotary kilns, line shafting and generators for supplying power and light throughout the works. The machinery is in general arranged in groups upon sections of counter shafting driven by a single engine either direct connected or rope driven.

TROLLEY RAILS FOR LONDON.—The United States Steel Corporation, through its Lorain Steel Company branch, submitted in competition with the leading British and Scotch railmakers, the lowest tender to the London County Council for the rails required for the change from horse to electric motive power of the street railway system, to be operated in the northern part of the British Metropolis. The American price quoted was about $31 per ton, delivered on the other side. The freight charges from the mills to London plus the lighterage and landing expenses at the other end, entail a cost of almost $6.50 per ton, so that the American price is equivalent to about $24.50 at the mills. The existing price for rails made by the acid process, for which the London contract specifies, is around $30 per ton at the mills. The lowest British bid was furnished by Bolckow, Vaughan & Company, Limited, of Middleboro'-on-Tees, which concern controls one of the largest American designed and equipped iron and steel plants in Europe. The British price was nearly $34.50 per ton.

A BIG LIGHTING CONTRACT.—In addition to using electric power for traction purposes on their Tyneside branches, the North-Eastern Railway Company, of England, are shortly to use electricity on a very extensive scale for the illumination of their locomotive works at Gateshead, and for the lighting of many of their principal passenger stations, goods warehouses, and marshalling yards. After having for some months conducted a series of exhaustive trials the directors of the North-Eastern Railway, acting upon the advice of Mr. Wilson Worsdell, their chief mechanical engineer, have now placed a contract for no fewer than 885 five-ampere, direct-current, and 600 seven and a half alternating-current lamps, with the British Thomson-Houston Engineering Company, of Rugby, who were the contractors for the "electrification" of the North-Eastern Company's Tyneside suburban branches. This order is said to rank as far and away the largest ever placed for electric lamps in Great Britain.

THE PRICE OF COPPER.—The *Copper Gossip* of the National Conduit & Cable Company says: "It would be folly to go against the tide of business expansion and waste energy in making useless comparisons between those past periods when copper was 11 cents and the present when it is 16¾. Possibly at some time copper may be at a much lower basis than it now is, but that day is nowhere in sight at this writing. Before that time there will have to be a radical and overwhelming reversal of conditions. Our tremendous consumption and exportation of copper in 1905 are expected to reach approximately 502,000 tons, or considerably more than the estimated production and imports. Production has grown, but demand appears to be the more lively, and the urgency of the latter has about completely effaced surplus stocks in this country. Facing such conditions it is not strange to see a strong copper market, and to perceive indications of extended activity."

ELECTRICAL MANUFACTURING "GRAFT."—In our issue of November 22, an article was published giving details of a litigation at Sandusky, O., over alleged "graft" in electrical manufacturing and quoting evidence that reflected seriously on the integrity of Mr. L. G. Read as manager of the Warren Electric Manufacturing Co. We have a letter from Mr. Read characterizing the matter printed as "full of inaccuracies and wholly false in its inference." Mr. Read also says: "Your paper says that my resignation was demanded. This is absolutely untrue, and you may draw your own conclusions as to the irreparable damage this will cause me."

STEAM TURBINES IN PORTUGAL.—The leading electrical firms on the Continent competed very keenly for the contract for the electrical equipment of the first sewing-cotton mill so equipped in Portugal. It has, however, just been awarded to a British firm, the Brush Electrical Engineering Company (Limited), of Loughborough. The equipment includes 43 motors and an alternating-current turbo-generator set, all of Brush manufacture, and further interest attaches to the fact that this is the first steam turbine to be erected in Portugal.

TELEPHONE MANUFACTURE.—Mr. John Roach and Mr. J. A. L. Moller, formerly vice-president and secretary, respectively of the Lambert Schmidt Telephone Manufacturing Company, have formed a partnership for the purpose of manufacturing telephones and telephonic appliances, and have leased from the receiver the Lambert Schmidt factory at Hoboken, N. J., with its complete equipment of machinery and tools, where they will carry on their business.

ELYRIA POWER PLANT.—It is stated that the Lake Shore & Michigan Southern Railroad Company is to erect a power station at Elyria, O., to supply power for automatic block signals recently adopted by the company. This will be one of three power stations between Cleveland and Chicago, the locations of the other two not having been determined as yet. Each station will have about 400 hp of steam and generating equipment.

NEW GREGORY PLANT.—The Gregory Electric Company, Chicago, is building an addition to its factory at Sixteenth and Lincoln Streets. The improvement is one story 50x120 ft.

Financial Intelligence.

THE WEEK IN WALL STREET.—The New York stock market was active, features being a series of manipulative movements in prominent specialties, notably, Brooklyn Rapid Transit, American Smelting and Union Pacific. Much irregularity prevailed, however, in the standard stocks and the general list, but there was a strong undertone. Brooklyn Rapid Transit was the most conspicuous object of the manipulative operations and had a remarkable advance, touching 91½, the lowest quotation of the week being 81¾. Stories that the Pennsylvania Railroad is acquiring the property were, however, emphatically denied, and neither the Metropolitan nor the Interborough interests seem to be negotiating for it. On Tuesday and Wednesday there was a bearish raid on the Metropolitan Street Railway group, the prices for which gave way easily. These issues were fairly prompt, however, in recovering from the attack. Brooklyn Rapid Transit closed at 88, which is a net gain of 6 points, 741,200 shares having changed hands. Of Metropolitan Street Railway, 146,200 shares were sold at prices ranging between 114¼ and 120⅝, the closing quotation being 120, a net gain of 3⅞ points. Interborough Rapid Transit closed at 210⅞, a decline of 1⅞ points. Both the Allis-Chalmers issues were weak and closed at 20 for the common and 62 for preferred, the net results being losses of ⅜ and ⅛-points, respectively. General Electric made a net gain of 2½ points, closing at 188, and Westinghouse common advanced 2, the last quotation being 174. Preferred closed at 190. Western Union Telegraph closed at 92¾, ⅛-point lower than the last quotation, and New York and New Jersey Telephone rights are held at 13⅛. In the curb market, Mackay Companies advanced 1½ points net, closing at 51¼. The market in a general way reflected the movements of the Stock Exchange. Trading was quite active. Following are the quotations on the Stock Exchange at the close of business on Nov. 28:

NEW YORK

	Nov. 21	Nov. 28		Nov. 21	Nov. 28
Allis-Chalmers Co	20¾	20⅜	General Electric	187¾	186
Allis-Chalmers Co. pfd	62¾	62	Hudson River Tel	..	..
American Dist. Tel	37	37	Interborough Rap. Tran	212	210¼
American Locomotive	69¼	71	Mackay Cos	50¾	52¾
American Locomotive pfd	117¾	118½	Mackay Cos. pfd	72¼	72¾
American Tel. & Cable	91	91	Marconi Tel	..	..
American Tel. & Tel.	134	136	Metropolitan St. Ry	115¾	120⅝
Brooklyn Rapid Transit	87⅛	87¾	N. Y. & N. J. Tel	..	.
Electric Boat	32	32	Western Union Tel	92¾	92⅝
Electric Boat pfd	70	70	Westinghouse com	169	170
Electric Vehicle	14	14	Westinghouse pfd	.	..
Electric Vehicle pfd	20	20			

BOSTON

	Nov. 21	Nov. 28		Nov. 21	Nov. 28
American Tel. & Tel	135½	136	Mass. Elec. Ry. pfd	56	59⅞
Cumberland Telephone	122½	121½	Mexican Telephone	1½	1½
Edison Elec. Illum.	*246	.	New England Telephone	134½	
General Electric	186	.	Western Tel. & Tel.	13	13
Mass. Elec. Ry.	13	14½	Western Tel. & Tel. pfd	90¼	

PHILADELPHIA

	Nov. 21	Nov. 28		Nov. 21	Nov. 28
American Railways	53	53	Phila. Electric	8¾	8½
Elec. Co. of America	11½	11½	Phila. Rapid Trans	31¼	32½
Elec. Storage Battery	81	80	Phila. Traction	.	..
Elec. Storage Battery pfd.	..	..			

CHICAGO

	Nov. 21	Nov. 28		Nov. 21	Nov. 28
Chicago City Ry	200	200	National Carbon	69	75
Chicago Edison	.	162	National Carbon pfd	114	114½
Chicago Subway	.	49¼	Union Traction	.	..
Chicago Tel. Co	..	.	Union Traction pfd	..	..
Metropolitan Elev. com	27	27½			

* Asked.

WESTCHESTER LIGHTING.—The annual report of the Westchester, N. Y., Lighting Company for the year ended June 30, 1905, shows $378,545 income from electric service and $174,215 operating expenses. The gross sales of current were 4,740,436 kw-hours, as against 4,371,021 in 1904 and 2,921,234 in 1903.

ELECTRICAL EARNINGS.—Stone & Webster, Boston, report the following September earnings for companies managed by them:

	1905.	1904.	Increase.
Edison Electric Illumination Company of Brockton:			
Gross	$11,272	$9,682	$1,589
Net	3,270	3,487	*217
Surplus over charges	2,541	2,722	*180
Jacksonvile Electric Company:			
Gross	25,070	22,946	2,123
Net	9,112	8,448	664
Surplus over charges	5,732	5,431	301
Lowell Electric Light Corporation:			
Gross	20,670	19,200	1,469
Net	7,764	8,171	*406
Surplus over charges	7,068	7,052	15
Savannah Electric Company.			
Gross	48,721	46,843	1,878
Net	19,677	20,743	*1,065
Surplus over charges	9,116	10,131	*1,014
Houghton County Electric Light Company:			
Gross	17,570	15,501	2,068
Net	9,320	7,783	1,536
Surplus over charges	7,132	5,595	1,536
Minneapolis General Electric Company:			
Gross	61,233	52,774	8,458
Net	29,432	26,859	2,572
Surplus over charges	20,361	17,513	2,848
Tampa Electric Company:			
Gross	33,034	31,201	1,832
Net	14,826	14,606	219
Surplus over charges	12,941	12,721	219
Terre Haute Traction & Light Company.			
Gross	54,987	52,148	2,838
Net	24,272	23,442	830
Surplus over charges	13,443	13,778	*334

*Decrease.

HELENA, MONT., BONDS.—The Helena Light & Railway Company, of Helena, Mont., which has taken up the properties of the Helena Light & Traction Company, is offering abroad $850,000 5 per cent twenty-year sinking fund gold bonds. This is part of an authorized issue of $1,500,000 of which $1,000,000 are to be issued at once, the remainder being reserved for additional plants and betterments. The company is capitalized at $1,500,000, of which $600,000 is preferred and $900,000 is common stock. Of these amounts there are issued $374,000 preferred and $561,000 common stock. The prospectus offering the bonds in Holland shows the following earnings for the four months ending September 30:

	1905.	1904.
Gross	$71,822	$65,434
Expenses	42,215	48,411
Net	$29,607	$17,023

The prospectus estimates the net income for the current year at not less than $88,823 on the basis of the above earnings. Among the directors are: C. A. Coffin, Arthur Coppell, F. S. Smithers, S. Z. Mitchell, J. G. White, F. H. Reed and P. G. Gossler, the last three being members of the J. G. White Co., the engineers of the properties.

NORTH AMERICAN VALUES.—Spencer Trask & Company have prepared a circular containing the observations of Edwin M. Bulkley, of that firm, made on the recent inspection trip of the North American Company's properties. Speaking of the United Railways Company, of St. Louis, it says: "The surplus earnings of the company for the year will cover the preferred stock dividend of 5 per cent, with ample margin, after the large allowance for depreciation, already noted. The common stock of the company has advanced materially in market since the purchase by the North American Company. Everything points to the ownership becoming one of the most valuable assets of the North American Company. The 5 per cent preferred stock at 81 to 82, the 5 per cent bonds at 97 to 98 and the senior 4 per cent bonds at 88 to 89, are all low, considering intrinsic values and the assurances of the future." In summing up the conditions Mr. Bulkley says that it is reasonably claimed that the value of the assets of the North American Company, which are chiefly securities of the companies named, will be largely increased as time passes, and that a moderate basis of inventory shows a "book value" of a fair premium for the stock of the North American Company, as compared with the quotations in the open market of 97 to 98.

GENERAL ELECTRIC STOCK.—The directors of the General Electric Co. have recommended that the new stock recently authorized be offered to stockholders on the basis of 12½ per cent of their holdings at par. The amount of new stock to be authorized by the General Electric Co. at the special meeting of stockholders on December 5 is $11,674,500, which will make a total outstanding of $60,000,000. The directors have now recommended that approximately $6,000,000 of this new stock be issued to stockholders at par, which is equal to 12½ per cent of their present holdings. The "rights" are worth about $10 per share at the price of 190. In asking for proxies President Coffin says: "The orders received by your company since February 1, 1905, have exceeded the orders for a like period in the previous year by 40 per cent. It is obvious that a largely increased business will require additional capital, and your directors therefore recommend to the stockholders the increase of the share capital of the company. Should the increase be authorized by vote of the stockholders it is the intention of the directors to issue part of the new stock at the present time and the remainder as the needs of the company may require it."

NATIONAL ELECTRIC FINANCES.—The report of the appraisers shows that the total value of the real assets of the National Electric Company, bankrupt, of Milwaukee, is $1,033,517.46, after a depreciation of all items amounting to $322,951.36, had been charged off. Mr. John I. Beggs, trustee of the company, made a report from the time he took charge of the affair until September 30, wherein it is shown that during his management of less than two months the concern earned $52,968 and reduced its liabilities by $85,256. The total valuation of the company, including its patent rights, insurance policies it holds on the lives of Frank G. Bigelow and H. W. Watkins, former officers, and all the accounts and bills receivable, is $5,020,643.63. The liabilities of the concern, according to the statement, are $4,737,038.06.

MONTREAL TROLLEY GROWTH.—The Montreal Street Railway Company has set aside $1,000,000 for the purchase of new rolling stock and erecting new feeder lines next year. When the reorganization of the Montreal Street Railway is effected the increased capital of $12,000,000 will represent the present capital of $7,000,000, the $1,500,000 of bonds issued to bring the securities of the Park & Island Railway; $800,000 owed the Montreal Street Railway by the Park & Island system; $650,000 owed the Bank of Montreal by the Montreal Street Railway; $1,000,000 that will be expended as above on additional rolling stock during the coming year, making a total of $11,050,000. The remainder will be kept in the treasury to provide for improvements.

ELECTRIC COMPANY OF AMERICA, of Philadelphia, is issuing new stock, which will make about 448,646 shares, par $10, or $4,486,465 outstanding. The company is paying 7 per cent dividends and earned last year 10 per cent, or about $450,000 on the capital stock then issued. As gross earnings have increased in 1905, and as the 7 per cent dividend on all the stock including the new issue will require but $314,050, the company is now earning on a basis that will take care of this dividend and show a substantial surplus for the stock. The company has announced an allotment of stock capital equal to 10 per cent of present holdings at par, to stock of record Dec. 12.

DETROIT TELEPHONE.—A special dispatch from Detroit, Mich., says: "Judge Donovan in the Wayne Circuit Court has denied the petition of John Winter and H. W. Wells for an order permanently enjoining the sale of the Independent Co-operative Telephone Company of this city, to the Home Telephone Company, organized by St. Louis capitalists, and dissolved the temporary injunction granted several weeks ago. Judge Donovan denied the petition on the ground that Winter and Wells are not bona-fide stockholders in the Co-operative Company."

B. R. T. OWNERSHIP.—Denials are forthcoming of the report that the Pennsylvania Railroad will take over control of the Brooklyn Rapid Transit Company. President Cassatt, of the Pennsylvania Railroad, says: "There has never been any intention on the part of the Pennsylvania Railroad Company to acquire this property or take any pecuniary interest in it whatever, and it is not possible that any occasion will arise which will modify or change this position." The stock has been very active.

LAKE SHORE ELECTRIC.—It has been decided to terminate the voting trust of the Lake Shore Electric at once and return the original securities to the owners in exchange for their voting trust receipts. This will be done as soon as the voting trustees can get around to it. The stock of the company which has been tied up by the voting trust, amounts to $4,500,000 of the common and $2,968,000 of the 5 per cent preferred. Neither issue has ever paid a dividend, although the preferred is cumulative.

DIVIDENDS.—The Philadelphia Electric Company has declared a regular semi-anuual dividend of 2½ per cent, payable December 15. Laclede Gas directors have declared the regular quarterly dividend of 1¼ per cent on the common stock and the regular semiannual dividend of 2½ per cent on the preferred stock, both payable December 15.

E. W. BLISS STOCK.—Stockholders of the E. W. Bliss Company will meet Dec. 5 to vote on a proposition to increase the capital stock from $2,000,000 to $3,000,000, equally divided between the common and preferred stocks. The new stock will be sold to stockholders at par and only one-half of the increase will be issued.

CHICAGO EDISON GROWTH.—The Inter-Ocean says that substantial increases will be made next year by the Chicago Edison Company and Commonwealth Electric Company to extend facilities. The system is growing rapidly under the vigorous Insull management.

General News of the Week

The Telephone.

BIRMINGHAM, ALA.—The People's Telephone Exchange in this city was destroyed by fire recently.

MENA, ARK.—The Mena City Council has granted a new franchise for 50 years to the Kizer Telephone Company.

GILHAM, ARK.—The Rural Telephone Company, composed of H. Shufeldt, G. W. [illegible] and E. L. Hogle, has installed an exchange in this place.

PINE BLUFF, ARK.—The City Council has passed the ordinance granting the Southwestern Telegraph & Telephone Company the right to place its wires underground in the business portion of the city. The franchise is for [illegible] years.

RIVERSIDE, CAL.—Mr. C. H. Burbridge and associates are negotiating for the purchase of the Home Telephone Company in this city.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company has commenced work on its underground conduit system in Oakland, which will cost $[illegible], and cover sixty blocks. The additional overhead work will amount to $[illegible]. A new sub-station will be built at once at East 12th Street and 17th Ave., at a cost of $20,000. A report has been submitted to the capitalists who are expected to finance the project.

DOVER, DEL.—The Riverton & Delmar Telephone Company has filed articles of incorporation, the capital stock being $[illegible].

ATLANTA, GA.—The Southern Bell Telephone & Telegraph Company has secured a permit for the erection of a new building on Auburn Ave., in this city.

CORDELE, GA.—The Southern Bell Telephone Company is making extensive improvements here, including the addition of three new sections to the switchboard.

LEWISTON, IDAHO.—The Pacific States Telephone Company is making extensive improvements in its local system.

WILLIAMSFELD, ILL.—The Williamsfeld Trunk Line Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are C. H. Pulver, J. A. Tucker and John B. Gale.

WATERLOO, ILL.—Farmers have organized the Finney Rural Telephone Company. One line will be built through Saline County to Belleville and another will connect with the Waterloo Farmers' Telephone line.

CHICAGO, ILL.—The Chicago Telephone Company has made a general reduction of rates along the north shore, and it is stated that the rate between Kenosha and Chicago will be cut 10 cents for each three minutes. An effort is being made to have the Wisconsin Telephone Company grant similar concessions to points north of Kenosha.

DILLSBORO. IND,—Ernst W. Swarthout, of Aurora, will build a telephone exchange and system in this town.

MILAN, IND.—The Milan Telephone Company has been organized to install a new telephone system in Milan.

LOWELL, IND.—The Lowell Telephone Exchange was destroyed by fire on Nov. 14. A new exchange with modern apparatus will be installed.

GOSHEN, IND.—It is announced that the Bell Telephone Company will expend $50,000 on a new exchange and in making improvements to the plant in this city.

CRAWFORDSVILLE, IND.—The Home Telephone Company of this city has made long-distance connections with points in Indiana, Ohio, Illinois, Missouri, Kentucky and Kansas.

CLAYTON, IND.—R. D. Stone has purchased the Clayton Telephone plant and will greatly improve the same. He will also extend the lines throughout Putnam and Hendricks counties.

BURNETTSVILLE, IND.—The Burnettsville Co-operative Telephone Company has been organized to build an exchange in this city and extend the lines throughout White and Carroll counties. The company starts with sixty subscribers.

TERRE HAUTE, IND.—The Central Union Telephone Company has submitted plans for putting the company's wires in the city in conduits. The contract provides that the Western Union and the Postal Telegraph companies may make a joint working contract with the telephone company and that one duct shall be reserved for the city's low-tension wires.

SHELDON, IA.—The Sheldon Telephone Company has been incorporated with $15,000 capital stock.

COUNCIL BLUFFS, IA.—The Independent Telephone Company has taken out a permit to build a new exchange at a cost of $15,000.

DES MOINES, IA.—The Prole Farmers' Mutual Telephone Company has been formed; capital, $1,800; Martin Deheck and others are the incorporators.

TERRE HAUTE, IND.—The Citizens' Telephone Company, reorganized, will increase its capital stock from $150,000 to $800,000, and improve the system. A new office building will be erected and a new switchboard installed. About 55 per cent. of the stock will be taken by outside capitalists. C. Marquard Forster, of St. Louis, is president; Roy McCanne, of St. Louis, secretary-treasurer, and O. L. Hutchinson, of St. Louis, general manager. Messrs. Forster and McCanne are members of the board of directors.

NEW ORLEANS, LA.—Mr. Albert von Hoffman, representing the Registering Telephone Company, of Milwaukee, will ask the City Council for a franchise to establish an exchange in this city.

NEW ORLEANS, LA.—The Cumberland Telephone & Telegraph Company recently laid a new cable under the river, between New Orleans and Algiers. This is the fifth cable laid by this company between these two points.

PORTLAND, ME.—Telephone communication has been established between Little Diamond Island and Portland. The U. S. lighthouse tender Lilac laid a cable between the city and the island.

MARSHALL, MICH.—The North Marshall Telephone Company has filed articles of association. The company is formed by farmers in this township.

SAULT STE. MARIE, MICH.—Local business men have started a movement to organize an independent telephone company to fight the Michigan State Telephone Company, because of an increase in rates from $18 to $24.

ST. IGNACE, MICH.—Because the Michigan Telephone Company is installing improved telephones at Sault Ste. Marie, incidentally increasing the residence charge, there is talk of forming an independent company. The Michigan company, it is stated, has no franchise.

BRITTON, MICH.—The annual meeting of the stockholders of the Britton Telephone Company has been held. The capital stock was increased from $2,000 to $4,000, and the following directors were elected for the ensuing year: Wm. Rinn, W. L. Exelby, Jos. Wiggins, Will Hiser, N. H. Ackley, L. S. Palmer, Sam Steele, Jacob Hiser, Ben Haight.

NORTHVILLE, MICH.—The Northville Telephone Company has sold its plant here to R. B. McPherson, of Howell, and J. B. Ware, of Detroit; consideration, $8,500. It is understood the purchase was made for the Peninsular (independent) company, and the local management will be much the same as in the past, except that the stock will be owned by outside capital.

HAMPTON, MINN.—The Northwestern Telephone Company has been asked to establish a local exchange.

HARDWICK, MINN.—R. A. Heckt and others are making arrangements to establish a telephone exchange in this place.

STARBUCK, MINN.—The directors of the White Bear Telephone Company have decided to install an exchange in this place.

FARIBAULT, MINN.—The Webster Farmers' Co-Operative Telephone Company, with a capital stock of $50,000, has been incorporated.

ALBERT LEA, MINN.—The local telephone company, which is owned by the Northwestern, is extending its lines and the city is powerless to prevent the work. The company has secured an injunction restraining the local authorities from interference. The Tri-State Telephone Company is laying conduits and preparing to install a system in the city.

ANACONDA, MONT.—The Cascade Telephone Company has been incorporated with a capital stock of $3,000 by C. H. Austin, R. P. Thoroughman and W. J. Bickett.

CHILLICOTHE, MO.—The sale of the Carrollton and Kirksville telephone exchanges to the Bell company has precipitated a panic among the independent exchanges of Central Missouri. Ninety thousand dollars was the price paid for the Carrollton exchange. On November 21 it was learned that the Bell company had secured contracts of sale from the owners of the independent exchanges at Brookfield, Linneus, Marceline and Trenton and half of the Richmond exchange, which is owned by a partnership. The owners of the Chillicothe exchange have been asked to put a price on their plant, but have so far refused to do so. Owners of other exchanges, hearing of the inroads the Bell company is making into the independent ranks, are said to be anxious to sell, and the disorganization of the Bell's opposition is threatened.

SMARTVILLE, NEB.—The Johnson County Telephone Company has been organized here.

GOLDFIELD, NEV.—A company will be organized here shortly for the purpose of constructing a telephone line between this city and Lida. C. H. Gordon is promoter of the enterprise.

NEW YORK, N. Y.—Comptroller Grout has asked the corporation counsel to pass upon a claim made by the United States Telephone Company that under the charter rights which it has bought from the Mercantile Electric Company its privilege to lay telephone wires under the city streets ought to be recognized by the Board of Estimate. The Mercantile Company obtained a grant in 1894 of a right to lay electric wires under the streets.

ROXBORO, N. C.—The Harris Telephone Company has been chartered here.

HURDLE'S MILLS, N. C.—The North Carolina Telephone Company, of Hurdle's Mills, has been organized with $100,000 authorized capital. D. F. Miller and associates are the stockholders.

MINOT, N. D.—An ordinance has been presented to the council for a franchise for the Northern Telephone Company.

BISMARCK, N. D.—An ordinance has been introduced in the council granting a 30-year franchise to the Interstate Electric Telephone Company.

CROOKSTON, N. D.—The Northwestern Telephone Company has purchased the business of the Iron Range Telephone Company, with exchanges at Crookston, Bemidji and Cass Lake. The Iron Range Company owned a total of 140 miles of toll line reaching from Crookston to Cass Lake. The consideration is placed at $100,000. C. D. Carter will remain in charge of the system with headquarters at Crookston until the transfer is completed.

NEW BEDFORD, OHIO.—Residents of New Bedford are organizing an independent telephone exchange.

LORAIN, OHIO.—A movement is on foot in the county to consolidate all the telephone plants in the various townships.

NEW LEXINGTON, OHIO.—The Perry County Telephone Company, of New Lexington, has increased its capital stock from $35,000 to $50,000. William A. Allen is the president.

FRAZEYSBURG, OHIO.—The Frazeysburg Telephone Company, of Frazeysburg, $10,000 capital, has been incorporated by S. H. Frazier, A. J. Stitt, N. Nethers, W. L. Drake and Max Frazier.

COLUMBUS, OHIO.—The United States Long Distanee Telephone Company has closed a contract with the West Virginia Telephone Company for a long-distance service to Columbus via Athens.

STILLWATER, OHIO.—The Stillwater Mutual Telephone Company; capital, $5,000, has been incorporated by A. W. Collins, O. H. Groves, M. O. White, T. J. Murphy, Fred A. Groves and I. H. Smith.

COLUMBUS, OHIO.—With the Charlestown Home Telephone Company as the foundation, an effort will be made to consolidate all the independent telephone companies of West Virginia. Ohio capital will be interested in the project.

BOWLING GREEN, OHIO.—The Home Telephone Company, of North Baltimore, has been absorbed by the Wood County Telephone Company of this city. The purchasing company will overhaul the North Baltimore plant and extend the business.

GALLIPOLIS, OHIO.—By the purchase of $30,000 of the stock of the Gallipolis Telephone Company, a syndicate, composed of Toledo and Columbus men, has come into control of that property, and steps will be taken at once to greatly improve and extend the exchange. At present the Gallipolis exchange has about 500 subscribers. The men who have purchased the controlling interest are Cyrus Huling, of Columbus; Dwight Sapp and Frank Beam, of Mt. Vernon, W. W. Morrison and J. F. Gardner, of Toledo, and E. N. Coen, of Vermillion. The new owners will build exchanges in Pomeroy and Middleport and a long distance line will be constructed to Athens.

GUTHRIE, OKLA.—The Anadarko & Apache Telephone Company has been formed and is capitalized at $30,000, with the following directors: A. J. Stevens, W. F. Leaganky and G. A. James.

GUTHRIE, OKLA.—The Pioneer Telephone Company, which purchased the M. K. and T. lines last June, is now at work installing an entire new telephone system in the city. A new fifteen hundred telephone board is being installed by the company at a cost of $75,000 and all the wires will be placed in cables so that there will be no open wires in the city.

ABERDEEN, ORE.—The Sunset Telephone Company has purchased a lot in this place on which it will erect a new exchange building.

PORTLAND, ORE.—It is stated here that the Idaho Independent Telephone Company contemplates making an early connection between its lines and the independent system of this city. With this end in view a trust deed of $500,000 has been filed by the Idaho company.

PORTLAND, ORE.—Mr. Frank Andrews, of the Farmers' Telephone Company, has organized an independent telephone company at Central Point, with the following named officers: President, Geo. Randall, Sr.; vice-president, J. M. Olds; secretary and treasurer, Geo. Randall, Jr.

PITTSBURG, PA.—The Vandalia & Southwestern Telephone Company has been formed; capital, $5,000. Incorporators: A. J. Tedrick, T. J. Inman and W. T. Rodeker.

NEW BEDFORD, PA.—There is a movement on foot in this place to organize an independent telephone company to affiliate with the Citizens' Company doing business in Sharon, New Castle and other Pennsylvania cities.

GRATZ, PA.—The old Lykens telephone line from Gratz to Goodspring, a distance of 20 miles, has been sold to the Dauphin & Schuylkill Telephone Company. It was formerly owned by the United Telephone & Telegraph Company.

ALLENTOWN, PA.—At a meeting of the board of directors and the executive committee of the Consolidated Telephone Companies of Pennsylvania, held in their office in Allentown, orders were placed for the installation in this city of an automatic telephone exchange of 4,000 lines, and similar exchanges of smaller capacity in Hazleton and Emanus. The plant in Allentown will alone cost nearly $75,000 and will be installed in from three to four months. The Hazleton exchange will cost $25,000.

ABERDEEN, S. D.—A new telephone exchange is to be built in Aberdeen, and improvements worth $20,000 put in to better the service in the city.

GEORGETOWN, S. C. The Home Telephone Company, of Georgetown, has been commissioned by the State, with a capital of $16,000. W. W. Lawton is president and St. Julien A. Lawson, manager and treasurer.

DOVESVILLE, VA.—The Dovesville Mutual Telephone Company has been formed. Siram May is president; B. J. Smith, vice-president; L. P. Sowder, secretary; S. G. Wittig, treasurer, all of Dovesville. Capital, $5,000.

TAZEWELL, VA.—The Interstate Telephone Company, with headquarters in this place, has been incorporated with a capital stock of $1,000 maximum; minimum $200. The incorporators are: President, J. W. Chapman, Tazewell; vice-president, H. G. McCall, Tazewell; secretary and treasurer, George Wolf, Berwind, W. Va.

OSHKOSH, WIS.—The Wisconsin Telephone Company proposes to extend its south side conduit system.

DEERFIELD, WIS.—The Deerfield Telephone Company has been incorporated with a capital stock of $10,000 by H. C. Winter and others.

MANISTEE, WIS.—The City Council has passed an ordinance requiring telephone companies to remove their wires from certain streets and place them under ground.

CHEYENNE, WYO.—Articles of incorporation of the Badwater Telephone Company have been filed with the Secretary of State, the capitalization being $5,000. The headquarters of the company are at Lost Cabin, Wyo.

WINNIPEG, MAN.—Col. T. A. Potter, of Mason City, Ia., will petition the Manitoba Legislature to incorporate the Independent Telephone Company, of Manitoba. He proposes to cover the entire province with the system.

Electric Light and Power.

POCHAHONTAS, ARK.—S. C. Dowell, of Walnut Ridge, Ark., proposes to establish a $25,000 electric light plant at Pochahontas.

PHOENIX, ARIZ.—L. M. Hoghe has petitioned council for an electric light and gas franchise.

LOMPOC, CAL.—A franchise has been granted J. M. Stamp for an electric light plant.

VALLEJO, CAL. The citizens have petitioned the Board of Trustees to call an election to vote on issuing about $70,000 bonds for a municipal electric light plant.

RED BLUFF, CAL.—The Northern California Power Company has decided to build an electric power line from the Volta power plant near Shingletown to Red Bluff or Tehama.

SANTA ANA, CAL.—The City Council is considering the question of calling an election to vote on issuing $140,000 bonds to be used for the construction of a gas and electric light plant and for street improvements.

GILROY, CAL.—At a recent meeting of the Council bids were received for the construction of an electric plant for the city. Mr. Thirber, consulting engineer, was asked to prepare new specifications, calling for an alternating-current equipment.

SAN FRANCISCO, CAL.—Mr. George L. Dillman, who is now associated with A. M. Hunt of this city, recently visited Bakersfield, Cal., in the interests of a new electric power project. Dillman represents the Pierce estate, owning lands along the Kern River, and has made preliminary surveys.

SAN JOSE, CAL.—The National Park Electric Power Company, of this city, contemplates building in the near future some 15 miles of pipe line and an electric power plant on the Merced River. The officers of the company are A. C. Kuhn, of San Jose, president; C. J. Kuhn, general manager; G. F. Wakefield, engineer.

RIO VISTA, CAL.—J. S. McDonald, of San Francisco, Cal., representing the Rio Vista Electric Light & Power Company, has petitioned the town trustees for a franchise to erect poles, also for the lease of certain property on which the company proposes to construct a power plant. This company has been incorporated with a capital of $25,000. Directors: J. A. Flood, of Bakersfield, R. Barks and H. S. Richmond, of Coalinga, and others.

VISALIA, CAL.—The Mt. Whitney Power Company has completed arrangements for the erection of an auxiliary steam plant in this city of 1,500 hp, to be used for the generation of electricity, to make up for the lack of power when the season of low water in the mountain cripples the plant on the Kaweah. During the past summer the low water in the Kaweah was the cause of much concern on the part of the directors of the power company, and they now propose to so arrange for power that the patrons of the service will be practically insured against any failure or partial loss of the power. The plans and specifications for the plant have all been completed, and bids will soon be advertised for. The new plant is to be ready for operation by August 1, next.

LAS ANIMAS, COL.—The Las Animas Electric Light Company will enlarge its plant.

STAFFORD SPRINGS, CONN.—A. J. Printon has been appointed manager of the Stafford Springs Electric Lighting Company. The plant will be considerably improved, and some additional machinery will be installed.

ATLANTA, GA. During a meeting of the committee on ordinances, Mayor Woodward announced that he would oppose the granting of a franchise to the Southern Light & Power Company to do business in Atlanta until that company should obtain a Georgia charter. At the present time the Southern Light & Power Company exists under the laws of Delaware.

SPARTA, GA.—Bids will be received until Dec. 7 for furnishing material and installing a complete electric light plant, embracing a 66-in. x 18-ft. high pressure boiler and stack; a 100-kw alternating-current generator unit, either for belted connection to Corliss engine or direct connection to automatic engine, 9 arcs and 40 50-cp series incandescents; 800-light transformers, meters and pole line. Address J. B. McCrary, engineer, Senoia, or R. W. Moore, mayor.

LOMBARD, ILL.—The Lombard Utility Company has been formed with a capital stock of $2,500 to operate an electric plant. The incorporators are Samuel J. Lombard, John W. Burdette and Samuel W. Norton.

PARIS, ILL. The Paris Gas & Electric Company, Paris, Ill., has been reorganized and additional bonds to the amount of $20,000 have been issued to enable the company to make improvements to its plant. Wm. J. Hunter is president.

CHICAGO, ILL.—Bids will be received until Dec. 6 by Wm. Carroll, city electrician, for furnishing the Department of Electricity one marble switchboard, equipped with switches, watt meters, ammeters and voltmeter, about 1,000 ft. of 300,000 c.m. stranded cable, rubber and braid insulation for 250 volts; about 1,000 ft. No. 3 B. & S. gauge stranded conductor cable, rubber and braid insulation, for 10,000 volts, to be delivered and installed at the City Hall.

TERRE HAUTE, IND. Alvin M. Higgins is chairman of a committee appointed by Mayor Bidaman to make arrangements for the construction of a municipal electric light plant.

ATOKA, I. T.—The council has granted a franchise to the Atoka Light and Power Company.

GRAND JUNCTION, IA.—Zenor & Meek are interested in the construction of an electric light plant here.

AFTON, IA. The citizens have voted to issue $4,000 bonds for the construction of an electric light plant. I. C. Robinson is Town Recorder.

MARSHALLTOWN, IA.—The Woman's Club of this city has taken a hand in the matter of municipal ownership of the electric light and gas business here. The Club has presented a petition to the city council with this object in view. The petition refers to the poor quality of electric light and power service.

AUGUSTA, KY.—Bids will be received by J. P. Reese, clerk of committee, until Dec. 8 for the installation of a municipal electric light plant.

CAMPTON, KY.—The Campton Fuel & Light Company has been incorporated, with a capital of $8,000, by A. F. Byrd, of Winchester; Chas. Kerr, of Lexington; J. H. Stamper, Jr., of Campton, and others.

ABBEVILLE, LA.—Wm. McIntosh, of Abbeville, is preparing plans and estimates for the construction of an electric light plant.

MARKSVILLE, LA.—Bids will be received until Dec. 4 by the Mayor and Board of Aldermen for constructing an electric light plant and system of water works; also until Dec. 5 for $15,800 bonds for the above work.

QUINCY, MASS.—A petition has been presented to the City Council, asking that the city take measures to secure by purchase or otherwise, a municipal gas or electric light plant.

HINSDALE, MASS.—The town is to have electric street lights. The Pittsfield Electric Street Railway Company has agreed with the selectmen to install the street lights at such points along the line of its road, as the selectmen shall designate. The company agreed to put the lights in at once.

MEDFIELD, MASS.—The stock of the Medfield Electric Light & Power Company has been sold to the Edison Illuminating Company of Boston. The territory covered by the Medfield Company is the towns of Medfield, Millis, Norfolk, Walpole and Sharon. It is understood that the power plant at Medfield will be closed and power taken from the distributing station at Dedham.

BOSTON, MASS.—The town of Wellesley has voted to make a contract with the Edison Electric Illuminating Company for a term of seven years for all the power required for municipal and commercial lighting delivered at the switchboard at the town line. Interests allied with the Edison have purchased the entire capital stock of the Medfield Electric Light & Power Company, and petitions will shortly be presented to the town governments of Medfield, Sharon, Walpole, Norfolk and Millis, in which towns the company furnishes supply, to transfer to the Edison company the town contracts for municipal lighting and the pole lines. As soon as these petitions are granted the Medfield company will be merged into the Edison company.

GRAND RAPIDS, MICH.—The Michigan Hydraulic Power Company, recently organized here, is preparing to develop some of the water power controlled by it on Manistee River. H. von Shon, of Detroit, is the consulting engineer.

ALBION, MICH.—The Albion water works system is now being operated by electricity, the power being furnished by the Commonwealth Power Company, of Jackson. This will effect a saving to the city of $1,400 a year, which saving will be applied on the purchase of the 1,000,000-gallon electric pump.

MUSKEGON HEIGHTS, MICH.—The committee appointed by the council to investigate the advisability of installing an electric lighting and water works plant favors the project and the council has authorized the preparation of plans and specifications for the water works, the lighting plant to follow later. The plants will cost about $50,000.

BOWLING GREEN, MO.—N. H. Ledford, president and manager of the Pike County Light & Power Company, writes that bids will be received until Dec. 15 for the construction of the proposed plant; the probable cost will be $7,000.

TECUMSEH, NEB.—H. H. Herndon, of Tecumseh, has petitioned for a franchise for a lighting plant.

RENO, NEV.—W. D. Arnett, of Reno, is interested in the construction of a power and lighting plant, to cost about $100,000.

RENO, NEV.—The Forestry Department has granted to the Nevada Power Mining and Milling Company a right of way for a pipe line and power-house site in the Sierra Forest Reserve, California.

LITTLE FALLS, N. J.—The Economy Light, Heat & Power Company has petitioned for a franchise in Little Falls township. H. W. Wood, of Little Falls, and W. C. Clift, of Newark, are among the incorporators of this company.

SOCORRO, N. M.—The Socorro Water, Light & Ice Company has been incorporated, with a capital of $30,000, by H. O. Bursum, Elfego Baca and W. E. Martin, of Socorro, and Frank Owen, of Santa Fe.

OSWEGO, N. Y.—The Citizens' Lighting Company has been incorporated, with a capital of $75,000. The incorporators are: John C. Knight, Thos. Moore and others.

BREVARD, N. C.—An electric light and ice plant will be erected at Brevard during the coming winter.

MORGANTOWN, N. C.—The Morgantown Furniture Company has secured the privilege of operating an electric light and power plant in connection with its other interests.

LENOIR, N. C.—A charter has been granted to the Citizens' Light and Power Company, at Lenoir, with a capital stock of $25,000, W. P. Ivey and others being interested.

CINCINNATI, OHIO.—The Cincinnati Realty Company has decided to erect a power house for use of the Fourth Street Hotel.

EAST LIVERPOOL, OHIO.—W. A. Calhoun, president of the Lake Brady Development Company, writes that it is proposed to construct an electric light plant of 3,000 16-cp lights capacity.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has submitted a bid for the city lighting contract of $60 per light per year for 275 or more enclosed arcs, the contract to cover a period of five years. The contract will be closed. It is expected that new equipment will be installed in the company's plant.

MASSILLON, OHIO.—The Board of Public Service has been instructed to advertise for bids for lighting the streets with gas or electricity or both. The contract of the Massillon Light, Heat & Power Company has expired and a new one is desired by the council and the company by Jan. 1. A municipal plant is one of the possibilities of the future.

McMINNVILLE, ORE.—This city has sold bonds for the construction of water works and an electric light plant.

ELGIN, ORE.—H. D. Spencer and John D. Sappring have purchased the electric light plant, and will make improvements to the same.

PORTLAND, ORE.—The Rainer Water, Light and Power Company, of Portland, has been incorporated here, with a capital stock of $50,000, by E. S. McCoon, A. B. Richardson and T. D. Richardson.

SALEM, ORE.—The Willamette Valley Company has been incorporated by A. Welch and C. B. Rhodes, representing a Philadelphia banking firm, to control and operate water and lighting plants in different parts of the State.

STEELTON, PA.—The plant of the Steelton Electric Light Company was destroyed by fire a few days ago.

ETNA, PA.—Bids will be received until Dec. 5 by A. R. Dunlap, borough clerk, for one direct-current arc light machine, to be installed at the borough electric light plant.

DUQUESNE, PA.—From a statement made by an officer of the Dusquesne Light Company there will be no competition for the contract to furnish the electric lighting of the city, if the proposed four-year ordinance is passed. A reduction so as to bring the price down to $75 or $76, as prevails in other cities, will probably go in effect.

ABERDEEN, S. D.—The citizens voted on Nov. 9 to construct a municipal electric light plant. The proposed plant will cost about $35,000. D. C. Washburn is the city engineer.

MIDLOTHIAN, TEX.—The Midlothian Ice, Light & Water Company has been incorporated, with a capital of $20,000, by C. A. Moore, W. W. Meyer, and others, all of Midlothian.

FARMINGTON, UTAH.—The County Commissioners have granted I. E. Willey and N. T. Porter an electric light franchise. The estimated cost of the proposed plant is $40,000.

SALT LAKE CITY, UTAH.—It is reported that the Denver & Rio Grande Railroad Company has decided to install electric lighting plants at the Burnham Shops, at Pueblo, Grand Junction, Salida and Salt Lake City.

SHENANDOAH, VA.—The Town Council has awarded to Geo. C. Morgan, of Chicago, Ill., the contract to construct a combined water works and electric light and power plant. Bids for machinery and material will be received by A. R. Martin, Town Clerk, until Jan. 2. The probable cost of the work is $30,000.

PASCO, WASH.—Bonds will probably be issued for the construction of water works, a sewerage system and an electric light plant.

GARFIELD, WASH.—The Moscow Light & Power Company, of Moscow, Idaho, has secured a franchise for lighting the city of Garfield.

OAKESDALE, WASH.—The Moscow Electric Light & Power Company, of Moscow, Idaho, proposes installing an electric light service in Oakesdale, at a cost of $5,000. Bids for construction will be received in April.

WEST SEATTLE, WASH.—The citizens have voted to issue $9,000 bonds for the construction of an electric light plant.

WASHBURN, WIS.—The Council is considering the question of constructing a municipal electric light plant. The present franchise expires next year. Wm. R. Hering is the city clerk.

SASKATOON, CAN.—Willis Chipman, C. E., Toronto, Ont., is preparing plans for an electric light system for this town.

GRANDVIEW, MAN.—T. A. Burrows, M.P., is interested in a scheme to supply this town with electricity for lighting and power purposes.

STRATFORD, ONT.—The Water Commissioners are considering the question of operating an electric light plant in connection with the water works.

SAN JUAN, PORTO RICO.—The question of municipal ownership of the water works and electric light plant is under consideration here.

The Electric Railway.

STOCKTON, CAL.—The Central California Traction Company has been granted a franchise for an electric railway over San Joaquin County roads for $5,500, the opposing bidder being a representative of the Southern Pacific Company.

SAN JOSE, CAL.—An electric railway up Mount Hamilton to Lick Observatory from San Jose is an assured fact. The financiers of the project are W. S. Tevis, of San Francisco, and the men associated with him in the Bay Cities Water Company.

VALLEJO, CAL.—The East Shore Electric Railway Company, which has a suburban road on the Oakland side of San Francisco Bay, is said to be obtaining rights of way from San Pablo to Vallejo Junction, from which point it will tap Mare Island and divide traffic with the Monticello Steamship Company and the Southern Pacific.

SAN JOSE, CAL.—The entire plant of the San Jose Railway Company, consisting of the power house, car barns and all of the contents, including cars, was burned to the ground, Nov. 9. The property was owned by the German Savings and Loan Society, of San Francisco, and was valued at $225,000. The insurance is about $75,000.

NORWICH, CONN.—There was a meeting of the directors of the Norwich-Westerly Electric Railway Company last week, at which it was decided to give the contract for building the road to the National Construction Company, of New York. The cost and equipment of the road will be over half a million dollars. It is understood that work will be started as soon as possible at both ends of the line, and that it will be rushed to a rapid completion. The line will be built for fast service.

PAYETTE, IDAHO.—A proposal for the construction of an electric railway between this city and New Plymouth, a distance of 12 miles, has been submitted to the Commercial Club of this city by Donald Fitzgerald, representative of the American Railway Construction Company, of New York.

BLOOMINGTON, IND.—The Indianapolis, Vincennes & Evansville Traction Company has been granted a franchise by the City Council.

PERU, IND.—Interurban competition between Fort Wayne and this city has occasioned the Wabash Railroad to discontinue two local trains that have been in use over this division for 20 years.

WARSAW, IND.—Ground has been broken here for the electric powerhouse from which the Winona & Goshen and the Winona Lake & Peru interurban lines will be operated by the Winona Interurban Company.

KOKOMO, IND.—It is proposed to build an extension to the Kokomo, Marion & Western traction line from this city west to Burlington, Flora and Delphi, with the ultimate purpose of connecting with the line building from Lafayette to Chicago. The Burlington people offer $35,000 in aid of the road.

INDIANAPOLIS, IND.—That the interurban lines throughout Indiana will eventually take away from the railroads all the local mail service is evidenced by a number of contracts entered into by the government with Indiana interurbans—the last one with the Kokomo, Marion & Western Traction Company to carry all local mail between Kokomo and Marion, thus doing away with the local mail service on the steam lines. Other contracts will be entered into with interurbans in a short time.

CRESTON, IA.—Articles of incorporation of the Creston & Western Railway Company were filed with the Secretary of State, Nov. 23. The amount of authorized capital stock was fixed temporarily at $250,000. Creston is made the principal place of business. The immediate object of the company, as stated by one of the incorporators, is to build a steam line from some point on the Great Western to Creston, providing the people of Creston and those along the proposed line vote taxes and grant other aid already promised. The company also expects in the near future to construct one or more interurban lines in the vicinity of Creston, and make connections at that place with the first line constructed. The directors are Ezra T. Dufur and Edwin D. Samson, of Des Moines; Thomas A. Way and Irving W. Keerl, of Mason City, Ia.; and Harvey O. Sargent, of La Crosse, Wis.; Ezra T. Dufur is president; Thomas A. Way, vice-president; Irving W. Keerl, secretary.

SKOWHEGAN, ME.—There is talk of building a third-rail electric railway from Skowhegan to Farmington, a distance of 28 miles.

CLEVELAND, OHIO.—The Roberts & Abbott Company is getting out preliminary plans and profiles for the proposed Cleveland, Ashland & Mansfield Railway, which the company is financing in connection with Col. C. V. Hurd, of Wooster. These parties have arranged for certain financial support in Cleveland, it is believed, with the Pomeroy-Mandelbaum syndicate, but the future of the road depends upon the efforts of prominent people along the route to finance a considerable part of the securities. The situation looks encouraging, and it is believed the road may be built next year.

PORTLAND, ORE.—The Portland-Salem Electric Railway Company has filed articles of incorporation in the County Clerk's office, with a capital stock of $100,000. The incorporators are W. J. Walsh, L. H. Cordes and H. Dunn.

SALEM, ORE.—Two new electric railway companies proposing to construct electric lines in the Willamette Valley, have filed articles of incorporation in the Secretary of State's office. One is the Willamette Valley Traction Company, with a capital stock of $1,250,000, incorporated by James F. Pershing, of Chicago; C. B. Rhodes, of Philadelphia; A. Welch, of Salem; E. W. Hall, of Eugene; Frank W. Waters, of Salem, and John H. McNary, of Salem. The other company is the Willamette Valley Company, with a capital stock of $800,000, organized by A. Welch, C. B. Rhodes and John H. McNary. This company proposes to own and operate electric light and street railway plants in Salem, Eugene, Albany, Corvallis and other cities in Oregon. It also proposes to own and operate water works and gas works for municipal purposes and to operate telephone and telegraph lines along its roads. Both companies will have headquarters in Salem.

ANDERSON, S. C.—The directors of the Anderson Traction Company have decided to call a meeting of the stockholders to be held on Dec. 5 to arrange to increase the capital stock to $280,000, the proceeds of half of this amount to be used in building the line from Anderson to Belton. As soon as the line is completed to Belton it will then be extended to Williamston and Pelzer and thence to Greenville.

OGDEN, UTAH.—A franchise for the construction of an interurban electric railway in Weber County has been granted by the County Commissioners to J. F. McCarren. This line will be part of the system which will eventually extend from Salt Lake to Brigham City.

RUTLAND, VT.—The Vermont Internal Improvement Company has been organized here with a paid-up capital of $100,000. Its business will be the buying, selling, leasing of electric railways in Vermont. The officers are: President, G. Tracy Rogers, of Binghamton, N. Y.; vice-president, Leo. H. Wise, of New York City; secretary and treasurer, Charles H. West, of Rutland.

CENTRALIA, WASH.—The City Council has passed the ordinance of the Centralia-Chehalis Electric Railway & Power Company for a franchise to operate electric cars in Centralia.

New Industrial Companies.

THE PEOPLE'S ELECTRIC POWER COMPANY, of Galesburg, Ill., has been incorporated, with a capital stock of $2,500. The incorporators are Charles S. Harris, Addison P. Higgins and Frank W. Harris.

THE ELECTROLIAN ORGAN COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $2,000,000. The incorporators are Eben Smith, Frederick R. Coffin, Arthur S. Brook and William B. Fleming.

THE ROCHESTER PRISM ELECTRIC LIGHT COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $100,000. The directors are M. M. Buyck, Irondequoit; H. R. Glynn and S. W. Long, Rochester.

THE CENTRAL ELECTRIC MANUFACTURING COMPANY, of Rock Island, Ill., has been incorporated with a capital stock of $30,000. The incorporators are William H. Edwards, Gustav Stengel and Henry Tappendorf.

THE SALAMANDER ELECTRICAL HEATING COMPANY, with a capital stock of $25,000, has been incorporated in San Francisco, Cal., by W. A. Gribble A. T. Tregoning, E. C. and A. C. Gribble and Jas. Davis; place of business, San Francisco.

THE INTERNATIONAL FIRE ALARM COMPANY will be incorporated at Lima, O., with a capital stock of $200,000. Among those interested are J. C. Riley, James Keenan, of Marion, Ind., S. A. Mahen, Charles McFarland and S. M. Finch.

THE CALIFORNIA ELECTRIC COMPANY has been incorporated at Los Angeles, Cal., with a capital stock of $50,000. The directors are Richard Spencer, E. M. Scribner, W. F. Gibbs, Oscar Lawler, of this city, and E. L. Sperry, of San Francisco.

THE NATIONAL ELECTRIC & MANUFACTURING COMPANY has filed articles of incorporation at Des Moines, Ia., the capital stock being $10,000. The incorporators are: Perry A. Williams, Fred Esprey, L. H. Heffner, John McLennan, C. E. Todd and C. L. Page.

Obituary.

CHARLES A. THOMPSON, president of the Charles A. Thompson Company, New York City, and of the Thompson-Bonney Company, Brooklyn, died at his home Nov. 27 from the effect of an injury received from a fall on Nov. 7, not having regained consciousness from that time until his death. Mr. Thompson was born in Elkhart, Ind., and was 44 years of age. His early electrical training was commenced under Mr. J. J. Wood, of the Fort Wayne Company, 25 years ago. He was superintendent of the Old Manhattan Electric Light Company, of New York, and served on the engineering staff of the Stanley Electric Manufacturing Company and later was superintendent of the Winston-Salem Electric Light Company of Winston, N. C. Mr. Thompson had a large acquaintance in the electrical field, and his numerous friends will keenly feel his untimely death.

Personal.

MR. J. S. LEHMAN.

MR. J. S. LEHMAN, whose portrait is presented herewith, has been long and widely known in the commercial side of the incandescent lamp business. He entered the incandescent lamp field in 1893, being cashier and book-keeper for the Columbia Incandescent Lamp Company, of St. Louis, Mo. Four years later he was put in charge of all of their city business which he handled successfully until 1899, when he was transferred to Texas. He spent the following three years in that State as well as in Louisiana and Mexico. In 1902 he was recalled to St. Louis and assigned to the Western territory including the Pacific Coast. He continued in that territory until the first of November, 1905, when he entered the employ of the Westinghouse Electric and Manufacturing Company as general lamp agent for the Sawyer-Man Electric Company. He has now been assigned to the St. Louis office, thus finding himself again in familiar territory.

MR. CHARLES Y. McVEY has been appointed general manager of the Federal Telephone Company, with headquarters in Cleveland, O.

MR. WILLIAM PAXTON LITTLE, for some years past assistant treasurer of the Niagara Falls Power Company, and well known as a skilled accountant, has recently been made treasurer of the company.

MR. W. R. GARDINER, long and well known to the electrical fraternity as assistant manager of the Pittsfield (Mass.) Electric Company, has retired from that position, and is no longer connected with the corporation.

PROF. B. V. SWENSON, the recently elected secretary of the American Street & Interurban Railway Association, has opened offices for that body at 60 Wall Street, New York City, room 609, and with telephone call 5882 John.

MR. C. E. WILSON, general manager of the Keystone Telephone Company, of Philadelphia, has been appointed a member of the executive council of the National Interstate Telephone Association, to succeed the late Mr. W. D. Barnard.

DR. P. E. MURRAY, assistant district superintendent for the Western Union Telegraph Company, at Atlanta, Ga., has resigned. He was with the company for 40 years and 28 years at Atlanta headquarters.

MR. IRWIN LEHMAN, who has for some years represented the Columbia Lamp Company in Texas, has joined the forces of the Sawyer-Man Electric Company, and will continue operations in the same territory.

MR. H. T. PURDY, electrical engineer of the Abangarez Gold Fields Company, Puntas Arenas, Costa Rica, is on a visit to this country, after an absence of seven years. Mr. Purdy was formerly with the Sprague, Thomson-Houston and General Electric Companies.

MR. H. L. DOHERTY.—At a recent meeting of the board of directors of the New York and Queens Electric Lighting & Power Company, Mr. Henry L. Doherty, who is now making New York more than ever his headquarters, was elected a director to fill an existing vacancy.

DR. F. A. C. PERRINE, from the beginning of this week, will have his offices in the suite of Henry L. Doherty, fourteenth floor, 60 Wall Street, New York City, where he will carry on his large and growing practice as a consulting engineer, with special reference to hydro-electric enterprises.

MR. W. H. DARBEE.—Mr. William H. Darbee, general superintendent of the Connecticut Railway & Light Company, has resigned to become engineer to the New York State Gas and Electric Commission. A banquet was given him by his old associates, to express regret and wish him success in the new sphere of labor.

MR. C. S. POWELL, general agent of the Westinghouse Electric & Manufacturing Company, who has for some time occupied the branch offices at 11 Pine Street, New York, has removed to the general offices of the company, which occupy the entire nineteenth floor of the Trinity Building, 111 Broadway.

MR. C. W. SPEIRS, M. I. E. E., of the Morgan Crucible Company, Ltd., of London, is now visiting the United States and will spend about a month in the country. Mr. Speirs, who has done a good deal of active work in the electrical engineering field, is interested in the introduction of improved graphite brushes for dynamo-electric apparatus.

N. Y. E. S. MEMBERS.—At the last meeing of the New York Electrical Society the following new members were elected: W. H. Warren, Albert Roe, Bernhard Hoffman, Charles Rogalsky, Walter Neumuller, E. A. Skehan, Albert Baldwin Hoffman, B. P. Wiltberger, Robert A. Broadfoot, Arthur J. Arwine, Felix Preston, Frank Davidson.

MR. W. L. HOLDEN.—The Pine Bluff (Ark.) *Commercial* says: "Mr. W. L. Holden, who is one of the owners of the American Electric Company, has disposed of his interest in the concern to his partner, Mr. W. T. Williams. In a few days Mr. Holden will leave for Ilmo, Mo., to accept the position as electrician with the Cotton Belt Railway."

MR. H. M. BAXTER.—Mr. H. M. Baxter, who was connected for three years with the Westinghouse Electric and Manufacturing Company, in the purchasing and advertising departments, has established an office at Nos. 522-23-24 Park Building, Pittsburg, to handle the advertising appropriations of firms in the machinery and mechanical products business.

MR. S. SALISBURY, the Worcester (Mass.) millionaire, who died recently, was active in the electrical field, and has contributed largely to the Worcester Polytechnic Institute. He was director of the Worcester Electric Light Company, director of the Worcester Consolidated Street Railway Company, director of the Worcester Railways and Investment Company, and director of the New England Telephone and Telegraph Company.

MR. J. J. BURNS.—Mr. James J. Burns, formerly of Worcester, who has been superintendent of the Pittsfield Spark Coil Company for several years past, has severed his connection with the concern to take a well-earned rest before engaging in other business. Mr. Burns has several inventions patented, in the manufacture of which he will engage. He will be succeeded by Arthur W. Wentworth, who has been superintendent of the inspection department of the Pittsfield (Mass.) Electric Company.

MR. H. T. EDGAR, for the past four and one-half years vice-president and manager of the El Paso Electric Railway Company and International Light and Power Company, both of El Paso, Tex., has resigned to accept the position of second vice-president and manager of the Northern Texas Traction Company, of Fort Worth, Tex., comprising the local lines in Fort Worth and the Interurban between Fort Worth and Dallas. All the properties mentioned are under the general management of Stone & Webster, of Boston.

PROF. GISBERT KAPP.—The London *Times*, in its engineering supplement of November 15, says: "That the Birmingham University should have been successful in securing a gentleman of the all-around attainments of Mr. Gisbert Kapp to fill the chair of electrical engineering is a matter on which the University deserves to be congratulated. It is to be wished that there were more candidates of the same distinction available for similar positions, for it is the belief of not a few who have made a study of technical education in this country that there are educational institutions with us in which reforms would most usefully begin at the top. In saying this there is no intention of casting any slur on the many educational centres whose preceptors are perhaps more distinguished for abstract than for practical knowledge of the subjects on which they impart instruction. But it must be acknowledged that men like Mr. Gisbert Kapp are rare. That gentleman is not only possessed of scientific attainments of the highest order, but he has had the advantage of experience in utilizing them in two different directions—viz., as a journalistic exponent of electrical theory and practice and as a practical electrical engineer. In both of these directions he has made his mark and achieved in them what may be justly described as a European reputation." This is language that will be echoed and approved by a host of friends and admirers in America.

Trade Publications.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has just perfected a portable pipe-thawing transformer of five kilowatts capacity, also a choke coil to work in connection with standard 15 to 20-kw lighting or power transformers, thus making standard capacity transformers available for thawing purposes in winter. The company has some interesting printed matter describing this apparatus, which can be had by addressing any of its district officers.

INCANDESCENT LAMPS.—The General Electric Company, Schenectady, N. Y., has issued price list No. 5141, dealing with high-efficiency lamps with Holophane Pagoda reflectors and fittings. Publication No. 3366, of the same company illustrates various forms of Edison lamps for all purposes. These lamps have an apparent specific power consumption of from 3.1 to 4 watts per candle. Flyer No. 2108 treats of porcelain weatherproof sockets which have been designed for outdoor decorative lighting. They are intended to be supported by a single wire which is independent of the circuit wires and which is attached to the socket cap.

MERCURY-VAPOR DEVICES.—Bulletin No. 7 of Cooper Hewitt Electric Company, 220 West Twenty-ninth St., New York, gives a complete discussion of the operating characteristics of mercury-vapor lamps. These lamps are characterized by extremely high efficiency, and the absence of sharply defined lights and shadows. Bulletin No. 10 of the same company deals particularly with mercury-vapor lamps for direct-current and describes indoor types for general illumination. Bulletin No. 11 treats of alternating-current Cooper Hewitt lamps. Single-phase vapor converters for charging storage batteries are illustrated and described in Bulletin No. 9.

DIRECTORY OF THE COUNTRY'S MANUFACTURERS.—The fifth edition of the "Manufacturers of the United States" has recently appeared. The original volume, the first edition, came out in 1892, and was a pamphlet of less than 50 pages. This 1905 edition has grown to 2,700 large pages, each arranged in two columns. It is a very carefully compiled, arranged and indexed directory of the manufacturers of this country. It gives the particulars of no less than 512,734 different manufacturing concerns and reports their products under 52,596 separate names of articles. The book is coming to have such a large circulation in foreign countries and at home as its importance and the care devoted to its compilation warrant. It is proposed hereafter to put out a new and revised edition every year. The publisher is the Manufacturers' Red Book Publishing Company, 225 Fourth Avenue, New York City. The book is not sold; it is loaned to subscribers.

NORTHERN HOISTING MOTORS.—The Northern Electrical Manufacturing Company, of Madison, Wis., has issued leaflet 148, showing some applications of Northern motor drive in hoisting work. The leaflet reveals the special adaptability of the various types of motors for hoisting service. Two of the illustrations show some motor-driven hoists embodying the box type machines designed especially to meet the requirements of hoisting work. They are built with exceptionally sturdy shafts and liberal bearings, and can be applied to practically any type of service. These box type motors are built with bosses which can be drilled and tapped for fastening to the machine to be driven, or supplied with feet, so that the equipment can be mounted with great ease under any condition. The box type motors are built dust proof, and are frequently supplied for use out of doors without requiring any special protection against weather and rain excepting that embodied in the machine design.

DIRECT-CURRENT RAILWAYS.—Bulletin No. 4421 of the General Electric Company, Schenectady, N. Y., describes the GE-80 40-hp motor for direct-current railway service. The bulletin discusses the rating of motors and treats at length the factors which determine the service that may be expected from railway motors. Bulletin No. 4422 gives a complete description of portable sub-stations as designed by the General Electric Company for the Cincinnati and Columbus Traction Company, the Exeter, Hampton and Amesbury Street Railway Company. Each equipment consists of a specially arranged car upon which is mounted a complete sub-station equipment comprising an air-blast step-down transformer, with its motor-driven blower fan, a suitable rotary converter and the necessary instruments and switches. These portable sub-stations can be hauled to any convenient turnout to which the high-tension line has been carried, and there used to supply current to the trolley wire or feeders.

News of the Trade.

FAHNESTOCK ELECTRIC COMPANY is the new name of the Fahnestock Transmitter Company. The address remains the same, viz., 132 Havemeyer Street, Brooklyn, N. Y.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, Ohio, has recently established a New England branch with offices in the Oliver Building, at 141 Milk Street, Boston, Mass. Mr. H. C. Freeman, for many years with the home office at Columbus, is the engineer in charge. Catalogues, prices and specifications covering the Jeffrey complete line, can be had by addressing this office.

APPROVED MATERIAL.—Mr. C. E. Bradshaw, City Electrician of Charlotte, N. C., writes us as follows: "Please insert in your paper that this department will be glad to receive samples and information regarding approved materials and fittings, from the manufacturers as we allow only approved material. We have had considerable trouble with contractors and others buying unapproved material and fittings and think if we could show them just what is approved it would be to the advantage of manufacturers and contractors alike, besides saving a great deal of trouble.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

American Electrical Salesmen Association. Secretary, Geo. H. Erich, 218 North Court Street, Rockford, Ill.

American Electrochemical Society. Secretary, S. S. Sadtler, 39 S. 10th St., Philadelpnia. Next meeting Ithaca, N. Y., May, 1906.

American Electro-Therapeutic Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday each month.

American Railway, Mechanical & Electrical Association. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

American Society of Civil Engineers. Secretary, Chas. W. Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, 60 Wall St., New York.

Association of Edison Illuminating Companies. Secretary, W. S. Barstow, 56 Pine St., New York City and Portland, Ore.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

Association of Electric Lighting Engineers of New England. Secretary, C. R. Brown, 516 Atlantic Ave., Boston, Mass. Annual meetings held in Boston on third Wednesday in March.

California Independent Telephone Association. Secretary, P. T. Whittier, Spencer, Cal.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Niagara Falls, Ont., 1906.

Colorado Electric Light, Power & Railway Association. Secretary, George B. Tripp, Colorado Springs, Col.

Connecticut State Street Railway Association. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November, 1906.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Electrical Contractors' Association of New York State. Secretary, F. Fish, Rochester, N. Y. Next meeting, Buffalo, Jan. 16, 1906.

Electrical Trades Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa.

Electrical Trades Association of Canada. Secretary, J. A. Mann, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

Empire State Gas and Electric Association. Secretary, T. R. Beal, Poughkeepsie, N. Y. Annual meeting, October, 1906.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Ottawa, Ill.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Railway Association. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

Iowa Street and Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Iowa Electrical Association. Secretary, George S. Carson, Iowa City, Ia. Next meeting, Des Moines.

Iowa Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Des Moines, second Tuesday in March, 1906.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky.

Maine Street Railway Association. Secretary, E. A. Newman, 471 Congress St., Portland, Me.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association.. Secretary, A. C. Marshall, Port Huron, Mich.

Missouri Independent Telephone Association. Secretary, Frank S. Leach, Sedalia, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting, June 14, 1906.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Cleveland, O., July 18, 1906.

National-Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn.

National Electric Light Association. Secretary, W. C. L. Eglin, Philadelphia, Pa.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 1142 Wells Building, Milwaukee, Wis. Next meeting, Milwaukee, Wis., third Wednesday in January, 1906.

New York State Independent Telephone Association. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Elmira, N. Y., June, 1906.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, O.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, O. Annual meeting, Columbus, March 30, 1906.

Ohio Street Railway Association. Secretary, Chas. Currie, Akron, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, F. W. Bullard, Cleveland, O.

Old Time Telegraphers and Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Washington, D. C., Oct. 9, 10 and 11, 1906.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

Pennsylvania State Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

Southwestern Electrical and Gas Association. Secretary, Frank P. Duffy, Beaumont, Tex. Next meeting, second Tuesday in May, 1906.

South Dakota Telephone Association. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, C. B. Fairchild, Jr., 114 Liberty St., New York.

Underwriters' National Electric Association. Secretary Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass. Annual meeting of Electrical Committee, 32 Nassau Street, New York, Dec. 6, 1905.

Vermont and New Hampshire Independent Telephone Association. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

Western Society of Engineers, Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 21, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

804,819. SIGNALING SYSTEM; James E. Allison, St. Louis, Mo. App. filed Aug. 14, 1902. Telegraph outfits are contained in boxes along the roadway, and means are provided at each for depressing a semaphore arm whenever the train despatcher's office desires to communicate with a train. The arm is repositioned manually by the train officer after he has received the message.

804,820. SIGNALING SYSTEM; James E. Allison, St. Louis, Mo. App. filed May 4, 1904. Relates to details of the above system and particularly the automatic switch mechanism by which the central station can communicate with any desired point. Employs synchronously moving magnet-operated ratchet wheels with release magnets for re-positioning all the wheels after an actuation.

804,843. LEADING-IN CONDUCTOR FOR ELECTRIC VAPOR APPARATUS; Peter Cooper Hewitt, New York, N. Y. App. filed March 26, 1904. (See Current News and Notes).

804,848. TELEPHONE SIGNAL SYSTEM; Amiel R. Hoover, Pleasanthill, Ill. App. filed April 20, 1905.

804,849. ELECTRIC SWITCH; Frederick Huffer, New York, N. Y. App. filed Apr. 9, 1904. A fixture for supporting electric lamps so arranged that swiveling movements of the lamp in one direction alternately turn on and off the current, while movements in the opposite direction are without effect.

804,861. MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES; Milo G. Kellogg, Chicago, Ill. App. filed Feb. 13, 1892.

804,862. TELEPHONE-EXCHANGE SYSTEM; Milo G. Kellogg, Chicago, Ill. App. filed Dec. 20, 1894.

804,931. APPARATUS FOR ELECTROLYTICAL DECOMPOSITION; Gunnar Elias Cassel, Stockholm, Sweden. App. filed May 4, 1905.

804,940. ELECTRIC SWITCH OR DISCONNECTING DEVICE FOR TELEPHONES; Leonard J. Fletchall, Hatfield, Mo. App. filed Aug. 11, 1904.

805,026. STAFF SYSTEM FOR CONTROLLING THE TRAFFIC ALONG SINGLE TRACK RAILROADS; Thomas H. Patenall, Wilkinsburg, Pa. App. filed Feb. 6, 1905. Employs an independent staff, and has a socket or holder adapted to receive a train staff removed from the usual instruments, whereby said independent staff is released, and the main circuits between the instruments are opened and the instruments locked to prevent the removal of other staves therefrom.

805,057. **RINGING KEY; Edward B. Craft, Chicago, Ill.** App. filed Apr. 8, 190[illegible]. A telephone operator's switch in which the two swinging parts are interconnected by compound levers so that the movement of either one is effective to reposition the other.

805,0[illegible]. GUARD FOR THIRD RAILS; Augustus A. Hickerson, Reynoldsburg and William H. Fisher, Shepard, O. App. filed Feb. 6, 1905. A housing for third rails comprising a wooden structure with a pitch roof depending over the rail, and a wall to which the usual feed wires are secured.

805,092. ELECTRIC TRANSMITTER; Jerome Prince, Milford, Mass. App. filed Feb. [illegible], 1905.

805,093. **COUPLING FOR ELECTRICAL CONDUITS; Alexander C. Proudfit,** New York, N. Y. App. filed Oct. 14, 1903. In order to avoid the abrasion of conductors drawn through ordinary gas pipe sheathing by the burr at the end of the sections, the patentee employs a coupling having an internal rounded wall or head which bears against the conductor and prevents its contact with the burr.

805,096. TROLLEY WHEEL AND MOUNTING THEREFOR; Frank N. Russell, Elmira, N. Y. App. filed April 15, 1905.

805,1[illegible]8. **SIGNALING SYSTEM; Paul Winsor, Weston, Mass.** App. filed Aug. 11, 1905. An alarm circuit for giving the go-ahead signal to the motorman of a multiple unit train. A signal circuit from a battery on the rear car is completed by the closure of all the doors on the train.

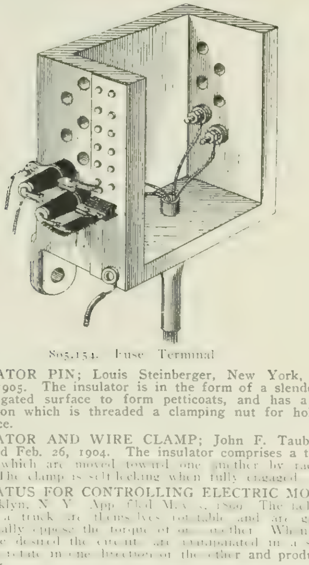
805,126. MULTIPLE STATION TELEPHONE SYSTEM; Arthur J. Farmer, Detroit, Mich. App. filed Dec. 26, 1903.

805,131. INCANDESCENT ELECTRIC LAMP; Reval Gerow and George H. Gerow, Northport, Canada. App. filed Dec. 31, 1904. The filament is designed to be removable so as to permit of being replaced when burned out. The filament support is threaded into the lamp body, and has a check valve for exhausting the air.

805,154. **FUSE TERMINAL; Henry E. Procunier, Oak Park, Ill.** App. filed Apr. 3, 1903. A method of connecting telephone wires to their terminal box in which the wires are led to a point near the cast iron grounded box where there is a lightning arrester, and subsequently through the thermal coil, and centrally through an insulating plug into the box.

805,159. **AUTOMATIC DAMPER AND VALVE REGULATOR; Clark E. Sanford,** Oswego, N. Y. App. filed Sept. 21, 1904. Clockwork mechanism is adapted to alternately open and close the furnace damper when started in operation by a magnetic release. The magnetic release is controlled by a thermostat.

805,166. **ELECTRIC RAIL; Louis Steinberger, New York, N. Y.** App. filed Jan. 3, 1905. The high potential part of the third rail is M-shaped in cross section and dove-tailed into a continuous insulated support bolted to the ties. The third rail has heating coils along its length which are sufficient to melt ice and snow thereon in winter.



805,154.—Fuse Terminal.

805,167. **INSULATOR PIN; Louis Steinberger, New York, N. Y.** App. filed Jan. 3, 1905. The insulator is in the form of a slender vertical pin with a corrugated surface to form petticoats, and has a saddle at its upper end upon which is threaded a clamping nut for holding the conductor in place.

805,169. **INSULATOR AND WIRE CLAMP; John F. Taubold, Scranton,** Pa. App. filed Feb. 26, 1904. The insulator comprises a two-part clamp, the parts of which are moved toward one another by rack and pinion mechanism. The clamp is self-locking when fully engaged.

805,188. **APPARATUS FOR CONTROLLING ELECTRIC MOTORS; Harry** E. Dey, Brooklyn, N. Y. App. filed May [illegible], 1899. The fields of the two motors upon a truck are themselves rotatable and are geared together so as to normally oppose the torque of one another. When special breaking effects are desired the circuits are manipulated in a special way so that the fields rotate in one direction or the other and produce an electromagnetic drag.

805,240. ELECTRIC CONDUCTOR; Lewis E. Underwood, Lynn, Mass. App. filed Apr. [illegible], 1905. An arrangement for making good electrical connection between carbon brushes and their connecting leads. The conductor enters the block through an opening and is knotted around into an internal cavity where it may be soldered if desired.

805,253. VOLTAGE REGULATOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Mar. 10, 1905. A system for maintaining a constant potential on a circuit which is connected in parallel with a second circuit in which the current fluctuates. Employs a transformer of the open coil type having a secondary winding in series with one circuit supplied, and a primary winding in series with a different phase of another circuit supplied.

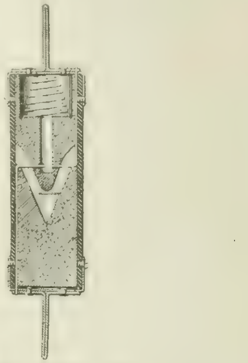
805,263. TIME LIMIT DEVICE FOR CONTROLLERS; Alexander Churchward, New York, N. Y. App. filed Oct. [illegible], 1903. A starter for electric vehicles in which an electromagnetic [illegible] admits fluid to a cylinder which [illegible] cuts out the starting resistance. The circuits are arranged [illegible].

805,2[illegible]8. INCANDESCENT LAMP; [illegible], Pittsburg, Pa. App. filed Oct. [illegible], 1904. In order to [illegible] of the platinum [illegible] in an incandescent lamp, the terminals are passed through the glass at a point widely removed from the heat of the filament and [illegible] are led therefrom into the [illegible] and the filament is secured [illegible].

805,2[illegible]. INCANDESCENT LAMP SOCKET; Lewis J. Hartley, Syracuse, N. Y. App. filed May [illegible], 1905. Details of the switch mechanism of a socket [illegible] Hart[illegible]. A horizontally movable [illegible] pressed by a [illegible] contact with the [illegible] terminal.

805,288. INCLOSED FUSE; Carl D. Haskins, Schenectady, N. Y. App. filed June 24, 1904. In order to prevent the destructive arc which follows the blowing out of a fuse in a high potential circuit, the fuse is made to support a spring pressed insulating plug or cone which moves forwardly when the fuse blows, so as to intercept any arc which may be formed.

805,289. MAGNETIC SEPARATOR; Harry E. Heath, Windsor, Conn. App. filed Sept. 17, 1903. The ore particles travel slowly forward on a conveyor belt under transversely moving soft iron shoes which straddle a conductor carrying a heavy current. The shoes are magnetized in this way during their passage across the conveyor.



805,288.—Inclosed Fuse.

805,291. **SEMAPHORE SIGNAL; Reinhold Herman, Crafton, Pa.** App. filed Apr. 26, 1905. Relates to details of a "semi-automatic" block signal system. Employs clutch magnets for gripping the semaphore arm to a shaft so as to permit its movement when the shaft is turned.

805,292. **METHOD OF STARTING ELECTRIC, GAS OR VAPOR DEVICES; Peter Cooper Hewitt, New York, N. Y.** App. filed Nov. 24, 1903. (See Current News and Notes.)

805,293. **STARTING DEVICE FOR MERCURY-VAPOR APPARATUS;** Peter Cooper Hewitt, New York, N. Y. App. filed Oct. 19, 1904.

805,315. **UNIPOLAR MACHINE; Jakob E. Noeggerath, Schenectady, N. Y.** App. filed Apr. 1, 1905. A unipolar dynamo in which the collector rings are in contact with the conductor at uniformly spaced points around the same so as to give uniform current density therein, without necessitating the brushes being so spaced around it.

805,322. **ELECTRIC ARC LAMP; William R. Ridings, Stretford, England.** App. filed Mar. 1, 1904. A pair of revoluble magazines contain a plurality of carbons, and are automatically stepped around so as to feed the carbods into position as soon as the preceding carbons have been used up.

805,327. **ELECTRIC SELF-WINDING CLOCK; Charles F. A. Sturts, San Francisco, Cal.** App. filed June 3, 1904. A dry battery is intermittently connected to a motor magnet which winds up the main spring.

805,338. **CABLE TROLLEY; John E. Boyle, Scranton, Pa.** App. filed Nov. 12, 1904. A single forging has its ends bent to form a hook to engage a messenger cable, and its central portion formed into a loop within which is swiveled a bearing roller for the cable.

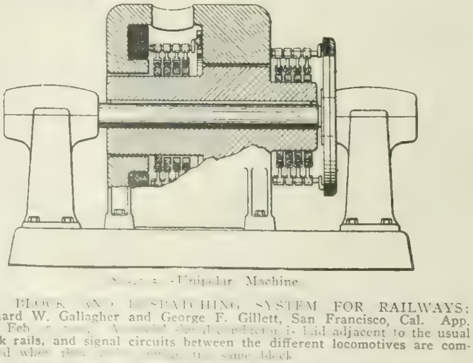
805,346. **ALTERNATING-CURRENT MOTOR SYSTEM; Albert G. Davis,** Schenectady, N. Y. App. filed April 9, 1902. (See Current News and Notes.)

805,400. **ICE REMOVER FOR TROLLEY WIRES; Montraville M. Wood,** Chicago, Ill. App. filed Mar. 24, 1905. An elastic band has spaced steel cutters thereon, and may be passed around the usual trolley wheel so as to cut ice and snow from the wire.

805,412. **SYSTEM FOR WIRELESS TELEGRAPHY; Thomas E. Clark,** Detroit, Mich. App. filed Feb. 17, 1902. A spark gap for wireless telegraph systems in which a pair of conical plugs are adjustably disposed between the usual copper balls so as to produce a multiple gap, the parts of which can be simultaneously adjusted.

805,415. **ALTERNATING-CURRENT MOTOR SYSTEM; Albert G. Davis,** Schenectady, N. Y. App. filed April 9, 1902. (See Current News and Notes.)

805,416. ELECTRIC MOTOR; Ernest R. Esmond, New York, N. Y. App. filed Oct. 25, 1904. The motor field is revolvable and has armature windings upon its external service so as to virtually constitute the armature of a second motor field. The internal armature is geared to its field so as to have a fixed relation of movement.



805,315.—Unipolar Machine.

805,419. BLOCK AND DESPATCHING SYSTEM FOR RAILWAYS; **Richard W. Gallagher and George F. Gillett, San Francisco, Cal.** App. filed Feb. [illegible], 1905. A special signal conductor is laid adjacent to the usual track rails, and signal circuits between the different locomotives are completed when they [illegible] the same block.

805,433. **SEMAPHORE SIGNAL; Reinhold Herman, Crafton, Pa.** App. filed Nov. 22, [illegible]. The semaphore is adapted to go to the danger position automatically by gravity and is returned by an electric motor and which also serves to [illegible] for the semaphore.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, DECEMBER 9, 1905. No. 24.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................1139 Monadnock Block
PHILADELPHIA OFFICE..............................929 Chestnut Street
CLEVELAND OFFICE..............................402 Cuyahoga Building
EUROPEAN OFFICE..........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **673,500.**

NEW YORK, SATURDAY, DECEMBER 9, 1905.

CONTENTS.

Editorial 973
Proposed 700-Mile Direct Current Transmission 976
Gas Situation in Chicago 976
National Conference of Standard Electrical Rules 976
Some Municipal Data Comparisons from England 976
Natural Gas Under Steam Boilers 977
Books Relating to Benjamin Franklin 977
Some Suggestive Lighting Arguments 977
Electrical Development in South Africa 977
The Proposed Manhattan Municipal Lighting Plant 978
First Ganz Three-Phase Railway in America 979
Chicago Electrical Show 979
Electrical Engineers of the Times. XXXIX. Mr. Kempster B. Miller 980
Current News and Notes 980
Hydraulic Station at Cusset, near Lyons, France. By F. M. Bryan 983
Belt Transmission of Power as an Analogue of Electric Transmission. By Byron B. Brackett 986
Temperature Effects in Spans. By C. P. Nachod 988
London's Power Supply. By T. H. Minshall 989
Reflectors, Shades and Globes. III. By J. R. Cravath and V. R. Lansingh 991
Electrically Operated Pillar Cranes. By Chas. Smith 993
New Telephone Patents 994
LETTERS TO THE EDITORS:
"London's Telephones." By A. L. Stanton 995
Belgian Single Phase Railway. By Allgemeine Elektricitats Gesellschaft. 995
Digest of Current Electrical Literature 995
Electric Furnace Hoist. By L. Ramakers 1000
Portable Test Set. By Chas. H. Coar 1001
Danger of Christmas Decorations 1002
The Proposed Washington Plant 1003
Cabinet Telephones 1003
Ceiling Fixture Block 1003
Industrial and Commercial News 1004
General News of the Week 1007

A LESSON FROM CHICAGO.

In another column a brief account is given of the gas situation in Chicago at present, where a popular outcry has been made for a cheaper gas rate, and a campaign of education has been begun by the gas company to educate that part of the gas-using public which is on the "kickers' seat" to the fact that poorly kept gas appliances, rather than poor gas, are responsible for most of the dissatisfaction from alleged poor gas. The company is spending a good deal of money at present advertising the fact that it maintains a "special order department," which makes it a business to put gas appliances in proper shape, free upon request, of any customer. There are two lessons in all of this, that should not be lost upon electric light or gas companies. First: Do not wait until there is talk of reducing rates, municipal ownership or the giving of a franchise to a competing company before you take up a movement, such as has been started by the gas company in Chicago. Second: Do not imagine that the duty of the central station company ends at the customer's service switch. It may end there legally, but practically, and in a business way, the customer judges by the results that the lamp or motor or heating device give. Even when these latter devices belong to the customer, the company should see to it that they are working properly. While it is, of course, not feasible for the company to do extensive repairs free, it can—by advertising the fact among its customers, that it stands ready to see that they are getting the best results from the apparatus employed—do much to prevent a bitter feeling against the company. It is this problem of insuring good results to the customer, that has resulted in the adoption of the plan of free lamp renewals, by so many of the large central station companies. The presence on the line of dim, inefficient lamps, purchased by the customer from dealers selling such lamps on the strength of their long life, is sure to result in so much dissatisfaction with the electric light service that the large companies have almost been forced to take this matter out of the hands of the customers entirely and offer free renewals, using high-efficiency lamps —thus insuring against dissatisfaction in this respect. The customer is interested in the results only, and the results are what the company should use every effort to give.

CIVIL ENGINEERS AND OTHER ENGINEERS.

At the annual meeting in January of the American Society of Civil Engineers, the following amendment to the constitution of that society will come up for discussion: "A member shall be a civil engineer who shall have reached a position of recognized standing in the profession, in its several branches, including Military, Naval, Mining, Mechanical and Electrical Engineering, or in Architecture or Marine Architecture." The punctuation and placing of the additive and alternative particles render the meaning of the proposed amendment somewhat obscure. Under one construction the intent would appear to be to divide civil engineers into three classes, namely, architects, marine architects and engineers who combine the qualifications of army, naval, mining, mechanical and electrical engineers. Until man advances in mental capacity to a point that the great range of scientific and engineering knowledge implied in the third grouping can be encompassed by one mind, the effect of the proposed amendment, as thus construed, would appear to limit future membership in the Civil Engineers to architects, shore and marine. According to another construction, electrical engineers and the other classes of engineers enumerated are to be considered also civil engineers and as such welcome into the society. If the real object is to make membership in the Civil Engineers as inclusive as this construction implies, might it not best be attained by petitioning the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and other bodies affected, to give up their respective organizations and deliver *en bloc* their members to the Civil Engineers? Finally, in view of the growing frequency of the inquiry, "What is a Civil Engineer?" would it not be well, instead of involving in still greater obscurity the significance of the term, to define it clearly with reference to the actual work of civil engineers, and not, by implication, with reference to the work of other classes of engineers? Are some members of the Society of Civil Engineers ashamed of the ancient and honorable occupations of transit squinting, ditch digging and track laying?

BELT TRANSMISSION OF POWER AS AN ANALOGUE OF ELECTRIC TRANSMISSION.

There is a fascination about the electric transmission of power which is attributable to its invisibility. When power is transmitted by a rope or belt drive, we see the moving parts, we can feel the tension, and we can readily apprehend the process. When power is transmitted by a moving fluid, as in pneumatic or hydraulic systems, our senses again come to aid our imagination and we can form an adequate mental picture of the process. When, however, we contemplate the electric transmission of power, our senses are unresponsive and powerless to suggest. We enter an electric generating station. If it be a steam plant, we see the coal fed steadily into the hungry furnaces. The boilers are hard at work producing steam under pressure. This compressed steam rushes in a swift stream to the admission valves of the engines, carrying the energy with it, and the transmission of power from boilers to engines is perfectly plain. We see the engines, be they reciprocating or rotary, transforming the exhaustive power of steam into the power of moving machinery. Moving stresses in gaseous media exchange into moving stresses in the solid media. Or, if the generating plant be hydraulic, we can see the moving water falling through the turbines and delivering its power into the electric generators. But by whatever path we reach the generators, the process seems to end there mysteriously, like a river that loses itself in an underground passage to the sea. The dynamos are tugging at their load, and beyond them are the quiet line conductors, apparently carrying all this power without disturbance, save a slight rise in temperature. Nothing is to be seen, felt, smelled or heard of the transmitted power till we come to the motors at the distant end of the line. There seems to be no electrical wear and tear, or depreciation, in the conductors. Insulators may be fractured, but the copper or aluminum bids fair to outlive time, save for the erosion of the elements. Curiously enough, in spite of our inability to form an adequate mental portrait of the process of electric power by mechanical means we understand practically how to control and carry on the process. It is an open question whether we should be better enabled to transmit power electrically if we thoroughly understood the process. It is questionable if our plants would be any cheaper, or more durable, or more convenient. In the ante-Galileo days, it was supposed that a pump sucked up and raised water because Nature abhorred a vacuum, although it was a hard task to find why the abhorrence should cease at a depth of thirty-two feet. The significant fact was rather that men are distressed at not comprehending a well known phenomenon, and will often invent a fictitious reason rather than admit total ignorance. Thus, we in this age, pending the full elucidation of the phenomena of electric power transmission, seek to allay the pangs of mental hunger by bridging the gap of emptiness with analogies.

The article by Prof. Brackett on page 986 of this number draws attention to the difficulty which is presented by the various analogues of electric power transmission in current use. The hydraulic theory which pictures the electric conductor as a water-pipe is shown to be very defective, as indeed all admit. Prof. Brackett goes on to develop an analogy between the electric transmission and the belt drive. This has been suggested before in outline, but Prof. Brackett carries the analogy to a degree of detail that probably has not been hitherto attempted. The inertia of the belt and of the mechanical parts connected thereto is considered as analogous to the electromagnetic inertia. The elasticity of the belt is considered as analogous to the electrostatic capacity of the electric system. It is shown that the fundamental electric and magnetic equations of the electric transmission system may be read upon the mechanical properties of the belt transmission system when the meaning of the symbols is changed from electromagnetic to mechanical quantities. Interesting and remarkable as this analogy is when carried into detail, doubt exists as to the benefit to be derived from pursuing it. To one not acquainted with all the mechanical principles involved, it would perhaps be quite as simple to study the phenomena direct instead of by analogy. As indicated in the article, it can only remain an analogy and can no more become a real working theory of the electric transmission circuit than the hydraulic analogy. This is evident when we consider that in the belt transmission, the power is carried in the belt substance and not in the surrounding air. Whatever power wanders into the air, or the space surrounding the belt, is lost for the purposes of transmission and is frittered away in heat. On the other hand, in the electric transmission, the power is carried in the ether, or space surrounding the conductor, and not in the substance of the conductor. Whatever power wanders into the conductor is lost for the purposes of transmission and is frittered away in heat. Consequently, the belt drive and the electric drive, although in many details analogous, are actually antithetical as regards the location and space distribution of the moving energy.

While, therefore, mechanical analogies of the electric drive may be very interesting to examine, and while they may temporarily fill an aching void in our understanding of the immediately surrounding universe, we must hope for permanent satisfaction from a closer physical development of the actual phenomenon. The better we understand any working of Nature, the simpler it appears, and we have a right to hope, if not to believe, that the true inwardness of the electric transmission circuit would be extremely simple if we could only gain an insight into it. We already know that the energy in an electric drive is carried half by electric flux and half by magnetic flux, the two fluxes being inseparably associated and moving together crabwise at right angles to their directions, with the speed of light in the medium considered. We know that the electric and magnetic fluxes contain energy as a necessary property, this energy per unit volume varying as the square of the flux density. Where the fluxes are, there, too, are the flux energies, and when the fluxes skim over a wire at light speed they carry their energy with them. It is not yet known whether the ether itself moves, or whether the ether is steady but the fluxes move through it. It is not yet known what change is needed to produce a flux in the ether; whether it be a hydrostatic stress, or a movement like that of a vortex filament. But it is known that whatever the nature of one flux is, the other will be its curl. It would seem, therefore, as though we might receive experimental demonstration on these moot points before long. When such demonstration is completed we expect to claim an understanding of the electric drive; but even then, it may be difficult for us to form a mental picture of it, so based are all our mental pictures upon sensation memories. Perhaps we may need an analogy to think about, even then.

The Zambesi Power Scheme.

As we have recently noted, the great scheme for the utilization of Victoria Falls is again before the public with perhaps some prospect of being pushed to a finish. A species of prospectus published in *South Africa,* of London, has just reached us, and though somewhat flamboyant in its contents still bears witness that something may be accomplished. The best evidence we have yet seen is that the promoters have taken counsel with an American electrical transmission engineer regarding the matter instead of relying, as in the previous incarnation of the project, upon the somewhat theoretical advice of academic gentlemen whose chief acquaintance with dynamos had been gained in distribution at about 100 volts. The Victoria Falls project is certainly a notable one. The great cataract of the Zambesi is one of the very few really enormous hydraulic powers of the world. Perhaps the only others in the same class are Niagara and that tremendous fall on the Parana which has recently been reported. But, unlike Niagara, Victoria Falls has at present no market within several hundred miles, and the Rand, the objective of the present scheme, is 700 miles away across the African wilderness. The concrete proposition is the feasibility of competing at the end of such a transmission with power generated by steam or gas engines on the spot or within the scope of an easy distribution. As a mere engineering feat the transmission of the power presents no forbidding difficulties. Half of this distance has actually been covered in California, and with only 50,000 volts pressure at that. But the probability of dividends is quite another matter, and one of far more dubious issue.

The long and short of the matter is that good financial returns are quite out of the question at or near any voltage yet attempted. This is by no means a damnatory judgment—it merely indicates that the engineers must be prepared to invade and conquer territory hitherto unexplored. Even at 100,000 volts working pressure and 20 per cent loss the project from the financial standpoint has a rather sorry aspect, but it is fair to presume that the engineers do not intend to halt at that figure any more than they propose to rest content with transmitting 20,000 hp. It must be remembered, however, that increase of output without increase of voltage does not help the matter much since the capital cost increases nearly *pro rata* in cases where so large a proportion of expense is in the line. An almost fantastic touch is given the project by the serious consideration of Thury's direct-current system as a possible method in the case. We have great respect for M. Thury's skill and ingenuity in working out the troublesome problems of direct-current series transmission, but in view of the enormous voltage required to make a success commercially on a 700-mile line, and the small output of even the largest dynamos yet constructed for series transmission, we may be forgiven for refusing to take the direct-current proposition very seriously. We are quite willing to concede that the Thury system has a useful field and possesses some very meritorious features. Since, however, the experience already gained on the Pacific Coast shows clearly that the difficulties inherent in alternating-current transmission over big distances have been greatly overestimated, and since lightning, the most formidable enemy of transmission lines, is no respecter of systems, we fail to see the usefulness of going to a direct-current transmission. Undoubtedly the alternating current has for a given effective voltage to struggle against a higher normal voltage at the sine-curve peak, but on the other hand, it has to face no greater maximum strains since a direct-current line is immune as regards neither lightning nor surging. Perhaps the most important advantage which the advocates of the Thury system would claim for the series direct-current transmission scheme is not to be found in the initial saving in conducting material, but in the relative ease with which the current can be maintained constant as compared with the difficulty that is encountered with the voltage regulation of the so-called constant-potential circuits. To what extent this latter characteristic of the system may have been the determining factor in the selection of the several Thury systems now installed is difficult to surmise.

We understand that M. Blondel is looking into the question of respective insulation limits of alternating and direct-current systems, and shall await with interest his conclusions, not unmindful, however, of a certain probability that by the time they are available similar tests on a commercial scale will probably have been successfully concluded here. To make a successful commercial enterprise of a 700-mile transmission, a working pressure of 150,000 to 200,000 volts should be available in order to keep the investment in lines down to a point where it will not be in the long run prohibitive. A great transmission plant is not an investment for to-day or to-morrow, but for many years, and it cannot afford to run so close to costs by steam power as to incur the risk of disastrous competition at an early date. Working on a scale commensurate with the proposed transmission from Victoria Falls and with cheap coal as a fuel, it is possible to generate and distribute electric power at a figure much lower than is generally supposed. The actual fuel cost in a big plant of the kind that would be installed to-day is a very small item, something like 0.2 cent to 0.3 cent per kw-hour, and much less if the plant is at the mine's mouth. This cost stops when the output stops, save for the small fraction required for banking fires, while the interest, depreciation and maintenance charges on a line go remorselessly on for every hour in the year. And this takes no account of gas-engine working on a large scale, such as is about to be tried by the California Gas & Electric Co.

We believe in electric power transmission and have no desire to pose as a "Devil's Advocate," but this Victoria Falls proposition certainly needs the services of such a functionary, and we hope that one has already been retained. We fully realize the splendid possibilities of Victoria Falls, and we realize too that Africa is to be the center some day of an immense civilization. In Africa and in South America some of the great world struggles of the next few centuries will doubtless find their stage, but in our own generation Rhodesia is not likely to become a great industrial center. So far as present hopes of dividends are concerned, the Victoria Falls project must depend almost wholly upon a great mining camp 700 miles away, at a point where there may be somewhat sharp competition from fuel. Its promoters must take all this into consideration and move cautiously. They have secured good advisers on the engineering side of the problem, who can carry the technical part of the enterprise to a finish. It is a scheme magnificent in its proportions and its possibilities, and should not incur the risk of failure from too precipitate action. Its sponsors could do no better than to devote the next year or two to experiments by its corps of engineers on a large scale. Fifty thousand pounds would be well invested if thereby the practicable limit of voltage could be pushed upwards 25,000 or 50,000 volts. For commercial success is here merely a question of voltage which can be successfully worked. A certain upper figure which can be predicted within fairly close limits means economic failure in spite of operative success; a certain other limit means success, and money spent in reaching the latter is spent in a profitable cause. We earnestly hope that the project will succeed. Its very boldness demands appreciation, and it may prove to be the forerunner of achievements far more notable than any which the world has yet seen. But to win anything more than a barren victory demands the annexation of an electrical region little known and seemingly inhospitable. It is a case for progress *à la* Kitchener with the line of communication well fortified, the commissariat ample and scouts investigating every kopje in sight.

Proposed 700-Mile Direct-Current Transmission.

A recent issue of [illegible] (London) prints a lengthy interview with Mr. H. Wilson Fox, of the Africa Concessions Syndicate, relating to the project for transmitting power from the Victoria Falls, on the Zambesi, to the Rand, a distance of 700 miles. The available head at the falls is about 330 ft. and the flow is sufficient for the development of 300,000 hp. Mr. Fox stated that probably 150,000 hp. would amply suffice for all the requirements of the Rand district. The present plans provide for an initial delivery of 20,000 hp., and as the demand for power becomes greater than this further independent lines will be provided.

The striking feature of the interview is the announcement that the Thury system of direct-current power transmission will be employed. Mr. Fox stated that the relative merits of the alternating and direct current systems of power transmission had been very carefully studied. Opinions were secured from Dr. E. Tissot, of Basle, Switzerland; Prof. Gisbert Kapp, of Birmingham, and Prof. A. Blondel, of Paris, all of whom pronounced the use of direct-current transmission to be commercially feasible. Later a conference was held in London at which Prof. Kapp, Dr. Tissot and M. Thury were present, the meeting extending over three days. Conclusions arrived at favorable to direct current were formulated and subsequently endorsed by Prof. Blondel, who had been unable to attend the conference owing to illness. Mr. Ralph D. Mershon was also called on for an opinion, and upon his arrival in Europe visited with Mr. Fox the various Thury installations in Switzerland and Italy. Mr. Mershon also had lengthy consultations with Profs. Blondel and Kapp. Mr. Fox states that as a result of Mr. Mershon's visit his views relating to methods to be adopted for insulation of the lines have been accepted in a large measure; he also stated that Mr. Mershon endorsed the use of direct current for the main transmission plant.

The reasons given for the adoption of the direct-current system are, first, that at equal voltages the same power can be sent over smaller and consequently less expensive conductors; and second, that M. Thury claims that higher voltages can be employed with direct current than is practicable with the alternating-current system. It is expected that the most economic loss in transmission will, under normal conditions, be from 25 to 30 per cent. At the end of the transmission the direct current will be transformed to alternating current for distribution.

Gas Situation in Chicago.

The gas situation in Chicago is of interest to central station men all over the country, both on account of its possible influence on attempts at reduction of gas and electric light rates in other cities, and because of the campaign of education, which the gas company in Chicago is now carrying on, as a result of the attempt to reduce rates. It will be remembered the last Illinois Legislature passed a bill which gave to cities the right to regulate rates for gas and electric light. While the legality of this bill is yet to be tested, the city of Chicago, whence originated the cry for the bill, is now attempting to lower the rates, although no definite action has been taken. The gas company evidently believes that many of the complaints about poor gas and excessive bills are due to faults of the apparatus in which gas is used, and is buying large advertising space in the daily papers, in which attention is called to the fact that the gas company maintains a "special order department," for the express purpose of giving its customers, free of charge, expert service in maintaining gas ranges and other appliances at their best point of efficiency. For example, the burners in a gas stove frequently get clogged, or otherwise out of adjustment, so that it does not work properly, and the user of the stove may blame the gas company for poor gas rather than putting the blame where it belongs. The gas company will have its experts overhaul and put in proper shape any appliances in use by its customers that need such attention. It has undoubtedly been the case in Chicago that the majority of the customers have not known that such service was given free by the gas company, and have sought relief from the plumber or the maker of the gas stove, without success. The company probably believes that once the public is well acquainted with the fact that this special order department exists a great number of the complaints about poor gas and excessive rates will be done away with. The lesson this teaches the electric light companies is obvious; the customer of the central station is interested in results and he judges the company solely by the results, as he sees them, in the shape of light or power. A company should not wait until agitation for lower rates or municipal ownership or a competing company forces it to make such a move, but should as a regular practice advertise the fact that it is at all times ready to inspect customers' lighting and other appliances, to see that customers are getting what they should for the money they are paying in bills for current. It is not enough that companies should deliver current at the customer's service switch and pay no more attention to what happens beyond that switch.

National Conference on Standard Electrical Rules.

At the annual meeting of the National Conference on Standard Electrical Rules, held in the Auditorium of the New York Edison Company on Monday, December 4, Mr. W. H. Blood, Jr., was elected president, and Mr. C. J. Woodbury, secretary-treasurer. Resolutions were passed requesting the National Board of Fire Underwriters to make the grounding of the secondary of low-tension, alternating-current circuits mandatory, and in the case of three-wire, direct-current systems with grounded neutrals, to make the omission of the neutral fuse permissible. It was also suggested that the present method of publishing the reports of electrical fires by the Underwriters was unfair to electric lighting interests, in that undue prominence was given to fires of electrical origin as compared with fires from other causes. Resolutions were adopted requesting the Underwriters to give all causes of fires equal prominence. It was the consensus of opinion of the conference that where alternating-current systems were grounded to gas or water pipes in dwellings near the wall and beyond the meter, no damage from electrolysis was to be apprehended. A committee was appointed to draft suitable resolutions to present to the retiring president, W. J. Hammer. A new constitution was also adopted.

The National Conference on Standard Electrical Rules was organized and held its original meeting at the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York, March 18 and 19, 1896. Subsequent meetings have been held by the Code Committee of the conference, but no regular meeting of the conference as a body was held until the meeting at Boston, April 21, 1905. The new constitution provides that a yearly meeting of the conference shall be held contemporaneous with the meeting of the Underwriters' National Electric Association. The list of societies forming the present National Conference on Standard Electrical Rules is as follows: American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street and Interurban Railway Association, American Institute of Architects, American Institute of Mining Engineers, Associated Factory Mutual Insurance Companies, Association of Edison Illuminating Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, Underwriters' National Electric Association, National Contractors' Association, International Association of Municipal Electricians. These societies alone may vote on changes and recommendations to the Underwriters' National Electrical Code. Associate members are made up of corporate interests such as the American Telephone & Telegraph Company, Western Union Telegraph Company, Postal Telegraph Company, General Electric Company, Westinghouse Electric & Manufacturing Company, etc.

Some Municipal Data Comparisons from England.

A study of English electrical statistics brings out some interesting points that bear upon the municipal ownership agitation. In England there are no cities of over 300,000 population supplied by private plants, except London, where the city is divided into districts. In cities of from 150,000 to 300,000 population, all except one are supplied by municipal plants.

The figures in the attached table have been obtained as follows: Population, connected load of private lights (8 cp), connected load of private motors (hp), number of consumers, and miles of main, from the London *Electrician* sheet for 1904-5. Kilowatt-hours sold to private customers and average price to private customers from Garcke's manual; "private" customers excludes trams and street lighting.

Newcastle is the only one of these towns supplied by private enterprise, and it should be noted that in 1900 Newcastle was largely freed from the tax involved by the purchase clause, i. e., the purchase clause corresponds in its effect to the right claimed by the legislatures to regulate prices.

	Population.	Thousands of private lights, 8 cp.	Private motor H.P.	No. of consumers.	Price to public (excluding tram and street lighting).	Thousands of K.W.H.	No. miles of mains.
Dublin . .	[illegible]	[illegible]	220	850	3.58	1,450	[illegible]
West Ham	[illegible]	[illegible]	670	1,007	3.13	1,827	-
Dundee .	163,[illegible]	[illegible]	715	1,030	3.52	1,106	[illegible]
Leicester . .	[illegible]	156	167	[illegible]	3.83	1,710	[illegible]
Salford . . .	[illegible]	122	2,685	[illegible]	[illegible]	2,051	150
Aberdeen .	[illegible]	[illegible]	1,871	1,321	3.05	1,581	61
Newcastle* . .	[illegible]	288	6,050	4,100	[illegible]	1,684	[illegible]
Cardiff	164,000	62	607	1,070	2.80	2,385	[illegible]
Cardiff	164,000	62	607	1,070	2.80	2,385	[illegible]
Nottingham. . .	230,000	[illegible]	1,913	2,704	3.86	4,168	

* Two companies in separate district, i. e., without competition.

It will be noted that when freed from the purchase clause, private enterprise has given the lowest prices, the municipal price averaging nearly 75 per cent higher. In proportion to population private enterprise supplies nearly double the number of consumers reached by the most enterprising municipality, and fully three times as many as the average municipality. Private enterprise supplies nearly as much electric energy to motors as all the eight municipalities put together; in other words, it is private enterprise that is moving to get the steam and smoke of factories away from the cities.

In the only place in England where private enterprise has been freed from the shackles of the purchase clause it has kept so far ahead of municipal enterprise that comparison is almost ludicrous. Of course one single instance does not prove a case, but it is curious that when every English municipality has had for twenty-two years all the advantages that the Newcastle Company has had for only four years, not one of them can show as good a record for the public.

◆

Natural Gas Under Steam Boilers.

Mr. Jay M. Whitman presented at the recent New York meeting of the American Society of Mechanical Engineers an interesting paper giving the results of investigations regarding the commercial value of natural gas and coal as fuel for steam boilers. Assuming that a boiler hp-hour requires 3.5 pounds of wet coal or 45 cu. ft. of natural gas, the author finds that fuel costs are the same under best conditions with natural gas at 10 cents per 1,000 cu. ft. and semi-bituminous coal at $2.87 per 2,240 lb. Expressed otherwise, a long ton of semi-bituminous coal is the equivalent of 28,700 cu. ft. of natural gas, while a short ton of such coal is the commercial equivalent of 25.625 cu. ft. As compared with the costs for coal in a hand-fired plant having an output of 1,500 boiler hp, coal being at $2.00 per 2,240 lb., considering the saving in labor due to the use of gas, natural gas should sell for about 10 cents per 1,000 cu. ft.

The author states that it is not justifiable to expect in good commercial practice to obtain a boiler hp-hour on less than from 43 to 45 cu. ft. of natural gas, referred to 60° Fahr. and four ounces pressure above a barometric pressure of 29.2 in. The "air for dilution" is greater with gas than with coal, so that efficiencies that are possible with coal are impossible with gas. An efficiency as high as 75 per cent in the use of gas is seldom obtained even under the best conditions.

◆

Books Relating to Benjamin Franklin.

That part of the library of Governor Pennypacker, of Pennsylvania, which consists of Franklin imprints and books relating to Franklin, will be sold by auction in Philadelphia on December 14 by Davis & Harvey. The collection is very rich in Franklin imprints, but contains only three items relating to the scientific career of Franklin.

Four pamphlets bound in one volume are as follows: "Conjecture on the Cause of Thunder"; Paris, 1750. "Lettre electrique pur le Mort de M. Richmann," by A. Rabiqueau; N. P. Stukeley's "Philosophy of Earthquakes"; London, 1750. Lovett's "Newton's Aether Realized"; London, N. P. The two last-mentioned books are in the Library of the American Institute of Electrical Engineers, the date of Stukeley being 1750. On the fly-leaf of the volume the contents are written in the hand of Franklin.

Franklin's "Experiments and Observations on Electricity" is represented by the 1769 edition. The A. I. E. E. Library has four editions in English—1751, 1754, 1769 and 1774—and two editions in French—1752 and 1756.

The title of the third item is "A Poem addressed to Benjamin Franklin of Philadelphia, on his Experiments and Discoveries in Electricity." By C. W. Extracted from the *Gentleman's Magazine*, 1754.

◆

Some Suggestive Lighting Arguments.

The excellent bulletin, "The Electric City," published in the interests of the Chicago Edison Company, prints the following list of "Don'ts for People Who Don't Use Electric Light." They may be suggestive to central station managers who are conducting active new business campaigns elsewhere:

Don't blow out the gas.
Don't sputter if the curling tongs singe.
Don't expect ironing to be a pleasure.
Don't expect hot water bags to stay hot.
Don't throw burning matches any old place.
Don't expect to keep your walls clean.
Don't knock the kerosene lamp over.
Don't complain of the odor it can't help.
Don't think your home looks modern.
Don't imagine you're enjoying life fully.
Don't let your fire insurance lapse.
Don't move into an "unwired" building.
Don't have an illuminated Christmas tree.
Don't fall down the cellar stairs in the dark.
Don't chafe at the alcohol chafing-dish.
Don't cut your throat shaving in a poor light.
Don't answer the door-bell carelessly at night without a porch light.
Don't blame some one else for all this.
Don't fail to 'phone Main 1280 about it.

◆

Electrical Development in South Africa.

United States Consul Snodgrass, at Pretoria, Transvaal Colony, South Africa, makes an interesting report on electrical development and possibilities. He says: "Africa, both north and south, is an important customer for electrical supplies of every description, and although the British firms have been capturing the majority of contracts, due to their being on the ground floor, it is evident that the United States can come in for a larger share of the trade by the prosecution of an energetic campaign and by having competent and forcible men in the field.

"The great activity in the electrical trade is not by any means confined to South Africa, for in Egypt and other northern provinces large electrical problems are under consideration. As an instance the Soudan government is considering the introduction of an extensive electric tramway system into Khartoum. Neither cables nor overhead wires will be used, the intention being to store the electric power in the cars. It is expected that the system will be extended to Omdurman.

"In South Africa, especially in the Transvaal, the demands on electrical engineers are multiplying to an enormous extent, as the mines are running as never before since the introduction of Chinese labor. There appears to be a feeling of optimism among the little cities as well as among the larger ones, which is bringing about a large expenditure for utilities. Electrical hoists are being installed in nearly all the mines; electrical elevators are being placed in many of the business houses and in the tall buildings of Johannesburg, and in nearly every town of any importance some large electrical project is either in hand or in contemplation.

"In the city of Pretoria, a place of 30,000 people, which has come to the front since the conclusion of the war like a boom town of the West, the citizens have been worrying along with a horse car line which penetrates the center of the city and has perhaps three miles of track. The town council is arranging to convert it into an electrical system, at an outlay of several millions, it being the intention to lay fifteen or more miles of track throughout the municipality and also to connect the numerous suburbs lying within a radius of five or six miles.

"At Johannesburg several millions were spent in installing an electric tram system, but practically all the contracts were captured by representatives from Scotland and England. At Volksrust and Klerksdorp it has been decided to erect lamps, and I might go on multiplying instances in which electrical developments are being carried on.

"If Americans care for this trade they will have to wage a war for it against the Britishers, who are on the ground and are in possession of the country. It will be difficult to wrest it from them. However, as America has captured the mining machinery trade on the Rand from all competitors, even under British rule, it can do likewise in the electrical field if the same amount of energy, concerted effort and brains are expended as were laid out by the pioneers in the gold fields."

The Proposed Manhattan Municipal Lighting Plant.

In these pages last week a very full abstract was given of the paper read by Prof. G. F. Sever before the Municipal Engineers' Society, of New York, on the proposed municipal lighting plant for Greater New York. The paper was followed by an interesting discussion, the chief points in which are noted below.

Mr. J. W. Young remarked that it would be of interest to the members to know how the data were collated for the reports of the commission. In order to design the system of distribution necessary to supply the street and building lights, the location of these had first to be obtained. The available records of the Department of Water Supply, Gas and Electricity of this city were checked and brought up to date. Inspectors were then sent through every public building, in regard to which additional information was required, and a tabulated list made of the number and character of the gas, electric lights and power equipment, in each room. Men also covered the streets to locate the different kinds of lamps, where necessary. This work took several months. The street and building lights and the location of the buildings were then plotted on large scale maps for each borough, the building lights being reduced to 16-cp incandescent equivalents.

From the number of lights thus shown on the map, the distribution of the load was evident, and the location of the main power house was obtained, and the number and economical location of the sub-stations determined; due consideration being given to the probable development of the territory.

Street circuits were laid out and their cost estimated, each being designed to carry the equivalent of fifty 2,000-cp arc lamps and two mains placed on each highway, the lamps being connected alternately on these conductors, so that if one circuit should be in trouble half of the street lights would continue to burn. The size of conductors, transformers, etc., were then calculated for the building lights, each group of buildings being carefully considered, and the economical center of distribution located in one of the larger installations, which point was fed from the main sub-station by 2,200-volt, single-phase feeders, the smaller bunches of lights being connected to a center by three-wire, single-phase conductors. All the building lights were thus connected to distributing points, except those in the immediate vicinity of the sub-station. Street lights were fed from the sub-station proper.

It was decided to place the 11,000-volt, three-phase feeders, the 2,200-volt feeders, where on the same street, and all wires in public parks, underground; in all other places, except in Manhattan and the "restricted area" of Brooklyn, overhead construction was decided upon. Pole lines were, therefore, required and a complete conduit system in the "restricted area" and also for the main feeders. It was assumed that existing overhead equipment could be attached to by the city after proper rebuilding, at its expense, and upon payment of a yearly rental.

Every street was gone over and a record made of the overhead lines. A map was made for showing in detail the location as to side of street and ownership of all the underground conduits in Brooklyn. A large amount of data on the cost of conduit construction was obtained independently from two of the principal contractors in the United States, which checked very closely, and this was utilized as a basis for calculating the conduit plant. The record of existing underground was especially valuable in placing the proposed heavy runs so as to avoid existing systems.

The cost of reconstructing the pole lines was then worked out and the rental charge; also the expenses of building new lines where none existed. On the principal streets of Manhattan the present iron poles were duplicated. On the other streets of Manhattan and the other boroughs, poles of a somewhat different character were provided, equipped with mast arms, to bring the lights more out in the streets and away from the sidewalks. This is particularly desirable in the Bronx and places where the foliage interferes with the illumination from lights placed along the curb. Where lamps would be attached to pole lines a mast arm was used. Prices for this material were obtained from a number of manufacturers and the total cost calculated. The cost of making service connections from the streets to the centers of distribution and other buildings, both underground and overhead, was worked out, together with the cost of connecting the street lamps to the underground conduits and pole lines.

The next problem taken up was the calculation of the size of the load for which it would be requisite to provide equipment in the power house. In order to obtain the proportion of the maximum load to the total connected capacity, recording wattmeters were installed in a number of public buildings and calculations made from the bills for the entire lighting of the city, in every borough from which were derived the average number of hours burned by gas and electric lamps. The maximum equipment necessary in the main power house was thus derived and after a thorough comparison of the different types of power houses now in use, and the collection of a large amount of data as to the cost of machinery, the cost of a generating system was estimated.

To compare the cost of lighting in the various boroughs, under the municipal plant with the rates charged the city, the cost of lighting was estimated partly from meter readings, where bills had not been rendered, and partly from bills made out according to the rates charged up to December 31, 1904. An estimate was made of the cost of city lighting under the recent act of the Legislature. The exact number of lamps on a certain day was taken and a comparison between the above prices and unit prices made for each report of the commission.

Mr. Arthur Williams, of the New York Edison Company, discussed the paper from a number of points of view, and started with the observation that good service was of even greater vital interest than the cost. No street lighting was ever subjected to a severer test than that of New York on the day and night of the blizzard, occurring in the early part of this year. It will be remembered that such trains as succeeded in getting through (very few did) consumed from ten to fifteen hours between New York and Albany. The street car system was compelled to suspend operations, and cars were abandoned on every hand. Yet not a single street lamp failed to give the usual service. During the storm a prominent city official made a personal inspection of a great many streets and reported every lamp burning brilliantly.

Still another question may enter into the problem—assurances against interruption from transportation troubles, the weather or other causes. Would such assurances be of a more substantial nature were the city itself to manufacture the light it requires? The Engineering Commission failed to include anything like the coal storage capacity of the private companies. The New York Edison Company, in addition to carrying many thousands of tons in each of its generating stations—the bunkers of one station containing 15,000 tons—has provided a storage on the New Jersey shore of the North River of from [illegible] to 300,000 tons. From there coal can be taken in barges and delivered directly into the company's principal generating station. The supply is sufficient for two-thirds of a year, a period much beyond the possible duration of any interruption in the source of supply.

The commission was composed of engineers of the highest technical standing and one should, therefore, hesitate in criticising the plans adopted. Yet the system proposed was not equal to and does not give the assurances of the present system. It was understood that the proposed change would be made to secure a cheaper method than that used by the private companies. For example, it would not be possible to use storage bateries, without the aid of which the best service cannot be maintained—and in fact without which no system supplied from a high-tension generating station can be operated without constant probability of interruption. It did not seem fair to compare a system, which at enormous cost has been developed to provide these advantages with one which to obtain cheapness omits them. The comparison is not "on all fours."

The cost of illuminating the streets is extremely low. For such illumination of an average unequalled in any other city, the per capita cost for each resident of Manhattan Island is less than $1 yearly. It is about two-tenths of a cent daily. A one-cent tallow candle burned nightly for each resident, would increase the present cost of municipal lighting fully five times.

Mr. Williams disagreed also with the views of the commission that the loss of taxes should be omitted from the operating cost of this plant. Almost without exception, curiously, taxes lost are omitted from all municipal ownership calculations. Advocates of municipal ownership, basing their premises largely, if not entirely, upon the expected, and in practice imaginary, profits to be derived from the enterprise, give little heed to the value of the taxes paid by private corporations.

The commission estimated that the mere operating costs of an arc lamp, including labor and fuel, are approximately $35 annually—not including interest or depreciation. For labor alone the cost of operating the municipal lighting plant which now supplies the old Brooklyn Bridge is in excess of $50 annually for each arc lamp supplied.

The commission stated that the nine small electrical plants now operated by the municipality in the Borough of Brooklyn cost annually $100,000. But the same, or better, service would be rendered to the city by the local electric light company at a cost not exceeding $70,000.

The largest municipal street lighting plant in the world is that of the city of Chicago. For a long time the city authorities have claimed that it is operated with great economy, and yet the report for 1904 states that the operating costs of an arc lamp were $54.36, or $20 more than the Engineering Commission allows for operating costs in this city. The Chicago figures do not include water, amounting to approximately $4 annually for each arc lamp. Furthermore, relative expenses are much greater in New York than in Chicago.

Another point at issue is the allowance for depreciation. This was originally placed at 7½ per cent by the distinguished chairman of the commission. But more recently the commission has reduced the figure to 6 per cent. Within twenty years the New York Edison Company has changed its generating system several times and another change is now in sight. The lowest expenditure estimate of the commission is now $7,567,000 and the annual difference between these percentages—6 per cent and 7.5 per cent—amounts to $113,505.

Mr. Williams then discussed the alternative plans of the commission, and showed that some of the plans admitted a heavy loss to the city if adopted. He contended that the loss thus bluntly admitted would indeed be much larger, because of the omission of sundry items. Such plans might, therefore, be dismissed from consideration. Special attention should be given, however, to the plan for an investment of $7,567,000 with an annual saving claimed of $434,000.

But the report did not include the cost of subways, which would be not less than $3,750,000; it does not provide for the equipment with wires and fixtures of the buildings now using gas; nor for the changing of the present electrical apparatus, including elevator and other motors. On a conservative basis this equipment would cost, including, properly, engineering expenses, not less than $2,750,000. Thus the ultimate investment by the city through the introduction of a municipal generating plant would be $14,067,000 to obtain a so-called "profit" of $434,000—about 3 per cent. But there would be no such differences as $434,000. The entire cost of lighting the city last year was $1,703,000. It was upon this basis that the hypothetical "profit" was obtained by the commission. The legislative reduction in the price of street arc lamps lessens this sum by $204,000; the reduction in incandescent lighting will lessen it from $15,000 to $20,000 more, and there has also been a reduction in the price of public gas lighting. But allowing only for the change in the cost of arc lighting the total margin claimed by the commission becomes reduced to $230,000, hardly more than 1½ per cent on the ultimate investment.

Moreover, there was no allowance for taxes lost, which amount to approximately $80,000 annually; no allowance for general expenses, executive and administrative, which for a plant of this size would amount annually to not less than $75,000; there were no changes incidental to the installation expenditure $2,750,000—upon which must be allowed 10 per cent annually, or $275,000; likewise, all subway costs were omitted, which, on the basis of 10 per cent for interest, depreciation and taxes, would be $375,000; there was no allowance for the upkeep of the underground cable system, which would average not less than $2 annually an arc lamp or $30,000 altogether; the commission allowed the absurdly low figure of $8 annually for upkeep, maintenance, repairs and attendance for each arc lamp, yet no private company can render this service for as little as $12 annually. Adding the additional $4 they must again increase the expenses of operating the municipal plant by $60,000.

The aggregate of these additional items is $895,000, making an annual net loss to our taxpayers of $665,000, instead of a gain, as reported by the commission of $434,000. This loss would be made up by additional taxation.

Dr. Cary T. Hutchinson replied briefly to some of Mr. Williams' criticisms, disputing their accuracy. As to underground costs he repeated the claim of the city to enjoy free access to the ducts it needed.

First Ganz Three-Phase Railway in America.

The first electric railway to use three-phase, alternating currents on this continent will run between London and Port Stanley, Ontario, Canada, and it is expected to open one part of the line for service in about two months. This railway, besides being the first exponent here of the three-phase system, has another feature of special interest. The length of line now under construction is 27 miles, split into two sections of 18 miles and 9 miles, to be run with three-phase currents. Between these two sections there is a third one of about 2 miles, belonging to the St. Thomas City Railway, and run by direct current. The cars of the interurban road will run over the direct-current section, too, being furnished with a special equipment permitting this. The motor stator has a three-phase winding arranged in such a way that it may be fed with 1,000 volts alternating current or 500 volts direct current. The rotor has a commutator and four sliding contact rings, it being a two-phase armature when running with alternating current. Each car will have two of these motors, of an aggregate rated horse-power of 130. The series parallel control will be used for direct-current work, and the single-cascade control for alternating-current running. The trains to be hauled will weigh 35 tons and run at a maximum speed of 30 m.p.h. The line has several very heavy and long grades up to 5 per cent. The transmission and distribution e.m.f. is 10,000 volts, three-phase. This railway represents a novel application of the Ganz system, as it is a combination of alternating current and direct current that will enable the interurban road to enter the cities and its cars to pass over the street railway lines. It is expected that the railway company will soon extend its line east as far as Hamilton, a distance of 85 miles, using the same system. The Ganz system is exploited in Canada by Bruce Peebles & Co., Limited, of Edinburgh, and in the United States, Mexico, etc., by the Railway Electric Power Company, of New York.

The Chicago Electrical Show.

The management of the Chicago Electrical Show, which is to be held Jan. 15 to 27, announces that "College Row" is to be a feature of the exhibition. Three thousand square feet have been allotted to the schools and colleges of the middle west which have technical departments, where each school will display every day some novel tests and demonstrations. This department will be in charge of Dr. Henry Crew, professor of physics of the Northwestern University; Clarence E. Freeman, professor of electrical engineering at Armour Institute of Technology; Charles H. Smith, editor of School Science and Mathematics; Professor R. A. Milliken, of the University of Chicago, and Professor P. B. Woodworth, head of the technical department of Lewis Institute. The Northwestern Electrical Association and the National Electrical Salesmen's Association will hold conventions in Chicago during the time of the exhibition. January 17 being the two hundredth anniversary of the birth of Franklin, the directors are preparing a notable celebration programme for that day.

Electrical Engineers of the Times.—XXXIX.

MR. KEMPSTER B. MILLER.

Kempster Blanchard Miller was born in Boston, Mass., August 13, 1870, and received his preparatory education in the public schools and in the high school at Washington, D. C. He entered Cornell University in 1886, from which he was graduated with the degree of M.E. in 1890.

Immediately after graduation Mr. Miller entered the United States Patent Office, where he occupied the position of assistant examiner for one year. Resigning from that service, he entered practical work in the field of telephony, becoming chief engineer of the Western Telephone Construction Company, Chicago, with which company he remained until 1898. During one year following he was connected with the International Correspondence Schools of Scranton, Pa., being text-book writer in telephony, telegraphy and other branches of electrical engineering. From 1899 to 1904 he was superintendent and engineer for the Kellogg Switchboard & Supply Company, Chicago. In May, 1904, he began professional engineering and expert work in partnership with Samuel G. McMeen, under the firm name of McMeen & Miller, in Chicago.

By far the most of Mr. Miller's adult activity has been in connection with telephone and similar intelligence transmission interests, and inventions resulting from his study of telephone problems have been a considerable portion of his contributions to that art. Most largely these relate to telephone equipment, particularly central office switching mechanisms. Of the inventions so made, more than 30 already have been subject of applications for patents in the United States and foreign countries. At intervals, however, he has made contribution by invention to other arts, an early example being an invention in the regulation of prime movers, in which the basis is that of frequency, and the link between speed and power is electrical.

KEMPSTER B. MILLER.

Mr. Miller's contribution to technical literature has been of a general character, and among the papers presented to engineering and scientific societies have been the following: "Irregularities in Alternating-Current Waves," prepared in collaboration with Frederick Bedell and G. F. Wagner, and presented before the American Association for the Advancement of Science, 1893. "Hedgehog Transformers and Condensers," prepared in collaboration with Frederick Bedell and G. F. Wagner, and presented before the American Institute of Electrical Engineers, 1893. "Practical Aspects of Electrical Resonance," presented before the Chicago Electrical Association, 1897. "Modern Telephone Engineering," presented before the New York Electrical Society, 1900.

Among readers Mr. Miller is best known by his work "American Telephone Practice," of which the first edition was issued in 1899, the second in the same year, the first speedily having been exhausted, the third in 1902, and the fourth in 1905. This book is quite generally referred to as a standard work on telephony, and has been continually revised and enlarged in the editions succeeding the first. The revision resulting in the current edition brings the volume to a size of about 900 pages, with over 800 illustrations, treating the history and present status of both science and art. The method of treatment chosen by the author is one effecting a compromise between the popular and didactic. Such a selection seems almost obligatory in handling one of the newer arts in a writing intended for [illegible] ic variously interested in scientific, industrial, legal and professional phases.

During the current year Mr. Miller has made a protracted and exhaustive examination of the fire alarm telegraph system of New York City, reporting in detail on its condition. Accompanying the report are his conclusions and recommendations as to the action necessary properly to protect the life and property interests of the Borough of Manhattan against fire damage.

Mr. Miller is a member of the Western Society of Engineers and of the American Institute of Electrical Engineers, of the Chicago branch of the latter he is member of the executive committee for a fourth term, and chairman of that committee for a second term.

CURRENT NEWS AND NOTES.

MEDAL FOR AMERICAN.—The Royal Society of Arts has awarded a silver medal to the Hon. Robert P. Porter, former head of the U. S. Census Office, for his valuable paper read before the Society, session 1904-5, on "London Electric Railways."

NORTHWESTERN ELECTRICAL ASSOCIATION.—It has been decided to hold the Convention of the Northwestern Electrical Association at Chicago January 17 and 18, 1906, at the time of the Electrical Show, to be held at the Coliseum in that city.

NEW YORK ELECTRICAL SOCIETY has just issued its year book for 1905 containing the constitution and by-laws and the names and addresses of 638 members. The society maintains a steady rate of growth from year to year, and fills to perfection the place for which it was organized.

RAILWAY SIGNALS.—The Proceedings of the Railway Signal Association are to be issued December 12. They are full of interesting text and data pertaining to signals. The various committee reports and papers written during the year are reprinted, together with all the discussions on them, such topics being dealt with as lights, rubber covered wire, storage batteries, standard mechanical specifications, etc. Mr. H. S. Balliet, 335 Madison avenue, New York City, is the secretary-treasurer.

A. I. E. E. MEETING.—The two hundred and second meeting of the American Institute of Electrical Engineers will be held in the assembly room of the New York Edison Company, 44 West Twenty-seventh Street, New York, on Friday, December 15, at 8.15 p.m. The following papers will be presented and discussed: (1) "Some Considerations Governing the Location of Railway Sub-stations," by C. W. Ricker, electrical superintendent of power stations, Interborough Rapid Transit Company, of New York; (2) "The Relation of Railway Sub-station Design to Its Operation," by Sidney W. Ashe, associate professor of physics and electrical engineering, Brooklyn Polytechnic Institute, Brooklyn, N. Y.

GETTING BUSINESS AT DUBUQUE.—Mr. L. D. Mathes, general manager of the Union Electric Company, at Dubuque, Iowa, in response to a recent request from the editors for information on the business getting methods employed there recently, says: "We have not yet used any original advertising matter during the past few months. The trade has been very kind in supplying us with artistic illustrated matter, which are of a higher character than we could ordinarily afford to turn out on our own account. Our business has not been standing still, however, as the connected load has enjoyed a very healthy growth. We find that actual results are obtained only by personal solicitation. We have two energetic young men who canvass the town and are constantly endeavoring to impress prospective customers with the superiority and desirability of the electric service. Undoubtedly a certain amount of advertising assists the solicitor, as it introduces our representative in advance of his call. Our experience has been, however, that good live men will go out and get more business in a week than will come as a result of the most ingenious advertising in a year. We have been quite successful in introducing the new high efficiency, high candle-power [illegible] of the G. E. Company. We have about 75 of the large units out and they are now beginning to attract attention to the extent that is desired for them." It may be stated that Dubuque [illegible]

BELGIAN TELEGRAPHS.—Government telegraphs and telephones in Belgium this year show better results, the receipts for the first four months of 1905 amounting to $749,129, against $692,649, an increase of $56,481.

WIRELESS 1,200 *MILES OVERLAND.*—The Atlantic De Forest Wireless Telegraph Company makes the announcement that on the night of November 30 its Manhattan Beach (Coney Island) station was in communication with the company's stations in Galveston, Tex., and New Orleans, La. The distance between the Manhattan Beach station and the others is over 1,200 miles.

NOT QUITE RIGHT.—The London *Electrical Times* remarks: "It is a popular superstition that Americans do everything electric quite right. Mr. Kempster B. Miller and Mr. J. J. Carty have just had to report on the fire alarm service in New York. The report is that it is fundamentally wrong in engineering design, and, moreover, in so bad a condition as to be liable to become wholly useless just when it is wanted. In fact, the only thing to be done with it would seem to be to tear it out and put in something fresh." There is no indication yet that this scathing report will be acted upon or any improvement made.

ELECTRICAL STIMULATION.—Prof. Frank W. Bancroft, of the department of physiology at the University of California, has completed some important experiments dealing with the effects of electrical currents on sea life, and has issued the results in a bulletin entitled "On the Validity of Pluger's Law for the Galvanotropic Reactions of Parameclum." Dr. Bancroft has succeeded in demonstrating that the cilia covering the body of the parameclum and the cause of its locomotion respond to electrical stimulation by changing the direction of their movement. When an electric current passing through water containing the paramensis is interrupted, the cilia reverse their beat on that end of the animal which is nearer the anode, or positive pole. When the current is made again, and during its flow, only cilia on the end nearer the cathode, or negative pole, reverse. These results are in strict accord with the law formulated by Pluger for the phenomena of muscular contraction under electrical stimulation.

VARIABLE-SPEED GENERATOR.—A patent issued November 28 to Moritz von Hoor, Friedrich Reinitz and Leopold Stark, of Austria-Hungary, relates to a variable-speed generator intended particularly for use with a storage battery in connection with the lighting of a train. The main generator is provided with two field coils. One of the coils is supplied with a current of constant strength from the storage battery, while the other is supplied with an opposing current, the strength of which varies directly with the speed. The source of this latter field current is a separate exciting dynamo, which is mounted on the same shaft with the main generator, its field coil receiving current directly from the storage battery. As showing the regulation obtained by this system it is stated that a certain equipment for railway train lighting supplied 5 kw at 33 volts at a speed of 50 miles per hour and furnished 800 watts at 31 volts when the speed decreased to 22.5 miles per hour, without necessitating any change or adjustment of the brushes or the rheostats in the field circuits.

THE SIMPLON TUNNEL.—We are advised from Europe that the Swiss Government has decided to open the operation of the Simplon tunnel with electric traction. The Simplon line is the longest railway tunnel existing, being about 20 km., and is the last link of an international railway line connecting Switzerland with Italy. The system to be applied is that of Ganz & Co., viz.: the high tension, three-phase, which uses current at 15 cycles and 3,000 volts in the contact wires. The initiative to apply electric traction in the Simplon tunnel has been taken by the Italian Government, which for this purpose invited the Swiss Government to inspect the Valtellina line constructed by the Ganz firm. The Swiss Government commissioners have made careful studies of the installations of the Valtellina line with which they were so favorably impressed as now to decide on the application of that system to the Simplon line. The Swiss Government has also accepted the proposition of the Italian Government to place five Ganz electric locomotives used for the Valtellina line at their disposal for the operation in the Simplon tunnel. The line will be opened for public traffic on the first of May proximo.

GREAT TELEPHONIC EXPANSION.—The present enormous growth of telephony is emphasized by the raising of large sums of money for telephonic development. The stockholders of the American Telephone & Telegraph Company will meet on December 21 to authorize the issue from time to time of no less than $150,000,000 of convertible bonds. At the present time it has $131,551,400 of capital stock outstanding and paying dividends, and about $88,000,000 of bonds. According to the circular which has been sent to the stockholders, the bonds will be issued from time to time as business may require, with the right to convert them into stock after two and not more than twelve years at a price no less than par. The circular says that the company has sufficient cash in its treasury to meet all needs until well into 1906, but that the directors believe it advisable to have authority to issue bonds in order to act quickly in case favorable opportunities arise. Heretofore the capital required by the company has been provided either by the issue of stock or by the issue of its 4 per cent collateral trust bonds, payable in 1929, except that in the spring of 1904 there were issued debenture notes of the company to the amount of $20,000,000, payable May 1, 1907, and secured by 4 per cent bonds of the issue above described to the amount of $25,000,000.

TELEPHONIC COMPETITION.—Although the Atlantic Telephone Company holds that it is not required to meet all the conditions laid down by Harry P. Nichols, head of the Franchise Bureau of Comptroller Grout's office, and submitted to the Board of Estimate and Apportionment on October 12, officials of the company have submitted to Mayor McClellan a counter proposition, in which they express a willingness to pay the city $7,750,000 in cash for a franchise, and to provide the city with the use of 1,000 telephones for 25 years without charge. In his letter to the Mayor, Joshua D. Powers, president of the company, said the recommendations of Mr. Nichols, if adopted by the board, would make it impossible for the Atlantic or any other independent telephone company to undertake to do business in this city, principally because the present company has a monopoly of duct and conduit systems by which wires are carried underground. He objected also to a recommendation that the term of the new franchise be limited to 25 years, and that at the end of this term the city, if it desired, should take over the property for municipal operation. "It will be seen," Mr. Powers wrote, "that the Atlantic Telephone Company, which is to compete with the Bell Telephone Company at half its rates, is asked to give the city in 25 years $75,000,000, while the Bell Company pays nothing to the city except a franchise tax, which equally bears on the Atlantic Telephone Company."

THE PIONEER PERIOD.—In his paper on "Economic Waste and Competition," read recently before the Empire State Gas and Electric Association, Mr. W. S. Barstow said: "The industry of electricity supply might be stated to have its beginning on a commercial scale in the early '80's. Prior to that time the development of the science (as it was not a recognized industry) was more or less experimental and interesting only from this standpoint. The first electricity supply companies were, from a financial standpoint, decidedly speculative. Only those who could afford to part with their investment without inconvenience would consider lending their aid, and as often happens in the development of a branch of science into an industry, many of the early promoters and inventors fell in the struggle, their own enthusiasm causing their downfall. Since the early '80's the industry has passed through successive stages of construction and reconstruction, reaching not more than fifteen years ago a degree of permanency and beginning to attract the attention of the capitalist in general. Up to that time no more errors had been made in the development of the science than are made in the development of any art. All attention and efforts were devoted to the first principle of any industry—'to make it work'; this was the foundation of its existence. No one ever inquired into the expense 'of making it work,' not even the capitalist himself. It was recognized that a certain service was being performed and the charge was made accordingly. After this constructive period there came the necessary refinements; the capitalist having overcome the practical engineering difficulties began to realize that he never knew whether he was operating his business at a profit or a loss until sometime after either had actually taken place."

TELEPHONES IN A BARBER SHOP.—An enterprising barber in Paterson, N. J., has attached a telephone to each chair in his shop to enable customers to keep in touch with the telephone world while in the hands of the "tonsorial artist." In these days of strenuosity the telephone precedes a man wherever he may go.

CANADIAN TARIFF.—One of the requests made to the Canadian Tariff Commission is that of electric switch companies in the Dominion who desired "as they were subjected to severe competition from American manufacturers, that slate and fibre to be used in the manufacture of electrical goods, should be admitted free."

WIRELESS TO COLON.—Commander Beehler, commandant of the naval station at Key West, has reported to the Navy Department that the wireless telegraph station at Key West has received an eight word message by De Forest wireless telegraphy from the station at Colon. The distance is about 1,000 nautical miles, and the Island of Cuba lies directly across the line between the two points.

BACK SEATS PREFERABLE.—It is stated that members of the congregation of the Munn Avenue Presbyterian Church, East Orange, N. J., occupying pews remote from the pulpit, now have neat little telephone receivers which are connected with a powerful transmitter located in the pulpit directly in line with the sound waves as they issue from the pastor's mouth. All that is necessary to do is to set a little switch lever when the occupant of the pew wants to hear the speaker in the pulpit more plainly, and the necessary connection is made. If the pew occupants do not wish to be disturbed they can stay cut out, but without attracting attention.

THE TROUBLES IN RUSSIA continue down to date, and have been intensified by the frequent interruption of telegraphic and telephonic service. This week the telegraph operators at Moscow have struck again and their strike may lead to a general strike in the postal and telegraph service throughout the empire and involve the railways and other trades and professions. The telegraphers' strike is due to the dismissal of men who, contrary to the orders of the government, formed a union of postal and telegraph employes. This week also the soldiers attached to the Military School of Electricity have been arrested by four battalions of the Pavlovsky Regiment and taken to the fortress of St. Peter and St. Paul.

A BADLY HUNG FIXTURE.—A cable dispatch from London of December 2 says: "The official visit of the Mayor of Grimsby to the George Street Wesleyan Chapel was characterized by a remarkable accident. The Rev. W. J. Boote, the Mayor's chaplain, was engaged in prayer when one of the electroliers stationed right above the pulpit fell from the roof. The electrolier first struck the choir rail, the shock causing the incandescent electric lamps to burst with a loud report which startled the whole congregation. Rebounding, the electrolier struck the clergyman, cutting deeply one of his hands which were extended in supplication. Several members of the congregation rose from their seats in alarm, but the courageous minister did not even pause in his prayer, but finished it with the blood dripping from his hand."

ENERGY AND MATTER.—In a recent address before the Twentieth Century Club, of Boston, Prof. Wilhelm Ostwald, of the University of Leipzig, said that phenomena like electricity and heat, while they cannot be elucidated by the notion of matter, can be explained or set in order through the idea of energy In other words, the idea of energy is wider than the idea of matter. The greater part of physics and of chemistry can usually be taught without resort to the atomic hypothesis of the constitution of matter, and this is possible even in the elementary branches of the subject. The conception of the atom may be called symbolical, but it is not a useful conception We can make our ideas in chemistry much clearer if we leave out the atomic hypothesis altogether Prof Ostwald said that in his work he always tries to handle and deal with measurable and tangible things without going beyond what can be shown measured or proven.

CANADIAN INTERURBAN ROADS.—United States Consul Culver, of London, Ont., thinks there is a good field in his district for the sale of material for electric tramways. He writes: "In this active, enterprising, thickly populated part of the Dominion, where factories flourish and where the best of local markets exist, there is an important feature of modern commercial and industrial life which is noticeably lacking, and that is interurban electric roads. The towns and cities are supplied with good electric lines, but there are few interurban lines in Ontario. In this consular district there is one completed road, some 12 miles in length, between the towns of Woodstock and Ingersoll, and a line some 30 miles in length under construction, running from this city to Port Stanley, on Lake Erie, but I know of no other lines in western Ontario, except the line from Windsor to Amherstburg; and yet the entire country in every direction is thickly populated and filled with thriving towns and villages. London is the industrial center, the market for all this territory, extending for some 60 to 100 miles in every direction."

RUSSIAN TELEGRAPH STRIKE.—A good opportunity is being afforded in the present paralysis in Russia due to the strike of operators, to witness the results obtained from government telegraphs. It would not appear that the telegraphers are at all happy, contented or prosperous under governmental régime, but go to extremities to secure even ordinary rights. Count Witte continues to refuse to deal with the telegraphers, declaring that for the government to yield would be equivalent to its abdication at their order. Nevertheless, the surrender of the government to their demand for the dismissal of M. Durnovo, acting Minister of the Interior, is regarded as inevitable. The striking telegraphers declare that they have ample funds and that they will not yield, even at the risk of dismissal. Telegraph officials on the railroads refuse to forward government or private dispatches, but are willing for the present to send and receive telegrams relating to the railroad service. Meantime, telegraphy within Russia has practically ceased, and owing to the cutting of the Danish cable it is difficult for people inside the empire to communicate with their friends outside.

EDUCATED ENGINEERS.—An article by Prof. V. Dwelshauvers-Dery, of Liege, Belgium, cited in the *Sibley Journal of Engineering*, quotes some interesting letters from its subject, the late Dr. R. H. Thurston, in regard to the growing appreciation of educated engineers. One of these dated in 1902 says: "Even the railway companies are asking me for engineers, whereas a short time ago it was very difficult to place a college man with them. . . . We are also entering shipbuilding, textile establishments, cement plants and all industries employing electricity. . . . The educated engineer, trained in the college, is now replacing everywhere the routine workman, the ignorant rule of thumb, and the man who called himself practical in the last generation. Our new generation of engineers adds to the ingenuity, to the spirit of enterprise and of energy, to the observation of the old-time workman, scientific skill and technical, theoretical knowledge, in such a way as to realize ideally the perfect engineer. Doubtless only a small number attain this degree of perfection, but the least successful is still worth far more than the best of the old type, and the most successful is incomparably superior. The proof is in the statistics of the situations held by our graduates."

MOTORS FOR ARGENTINA.—Special Agent Hutchinson of the Bureau of Manufactures, U. S. Department of Commerce and Labor, in a letter from Buenos Ayres, discusses the use of small motors in the Argentine Republic, and says: "The motors wanted are of all kinds, from electric fan motors up to 4 or 5-hp gasoline engines for use on the estancias. In the towns there is steadily increasing use of electric power for small industries. Not only is Buenos Ayres well supplied with electric service, but many of the interior towns have their electric lighting plants, and wherever persistent efforts have been made to introduce small motors they have met with success. The Germans are particularly active in the matter and there are recent instances in which their goods have been pushed so energetically in new fields as almost to exclude the American. The moment a concession is made for the erection of an electric plant in a new place, German agents are to be found on the spot getting contracts for the installation of motors, thus gaining the advantage which comes from being first in possession of the field. There are openings at present at many interior points, notably Rosario, Santa Fe, Parana, Concordia and Corrientes. At the last-named town an electric plant is now in process of construction and will be completed in a few months. It is being built by a German company."

Hydraulic Station at Cusset, near Lyons, France.

By F. M. Bryan.

ONE of the largest hydraulic plants in France is the station which is controlled by the Société des Forces Motrices du Rhone. This station has been erected in order to utilize the power of the Rhone for operating lamps and motors in the city of Lyons. The fall which is employed for the turbines is obtained by the large canal which runs from Jonage to Cusset, and the station is located at the latter point. The volume of water which is obtained from the Rhone is some 100 cubic metres per second in times of low water and increases with the level of the stream so as to reach 150 cubic metres per second during the high water period.

The difference of level between the intake point and the outlet of the canal varies from 13.25 to 14.50 metres. During 300 days of the year it is in the neighborhood of 14.00 metres. The head of water at the station varies between 11 and 13 metres net, with a supply equal to 100 cubic metres of water per second. During the 60 days of high water in the Rhone, the fall may be below 11 metres, but the increased flow more than makes up for the difference in the fall. At all times the station disposes of a water supply which affords more than 14,500 hp.

Figs. 1 and 2.—Views of Dynamo Room.

The load upon the machines in the station is quite variable during the different hours of the day. During the night at certain hours the load may be almost zero, and it may reach its maximum point in winter at 5 o'clock p. m. Taking into account the losses of all kinds, from the canal, the turbine and the machine, about 12,000 hp on the shaft of the turbines has been allowed for, and the plant has been laid out so that at certain hours of the day a maximum of 20,000 hp could be distributed.

The main station which contains the turbines and dynamos is built across the canal, and in addition to the repair shops and attendants' quarters, it contains a main dynamo room having a length of about 600 ft. and a width of 60 ft. Underneath the main floor are lodged the turbines, each in a separate chamber. Figs. 1 and 2 show the general appearance of the main dynamo room. It contains 19 machines, each driven by a separate turbine. Sixteen of the machines form the principal units, and produce three-phase current at high tension, while the three other machines serve as exciters. The latter are placed in the center of the dynamo room, and on either side are placed eight alternators.

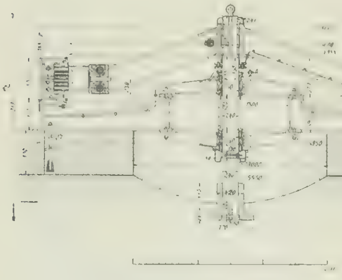
Against the side wall and near the middle of the dynamo room is mounted the main switchboard containing the apparatus for handling the alternators and the exciters. A second switchboard plant in an elevated gallery in one end of the hall is used for the different feeders which start from the station. The mechanism for operating the turbine gates is placed on the opposite side of the room from the machine switchboard, and each set of apparatus is mounted near the turbine for which it is used. The water is brought to the turbines by horizontal conduits, and these are arranged so that each turbine can have the water supply cut off from the interior of the dynamo room without affecting the working of the others.

The principal turbines of the station, which, as already stated, are 16 in number, are of an improved type which is built by the well-known Swiss firm Escher, Wyss & Company. These wheels, each of which is direct coupled to one of the large alternators in the dynamo room, are of the reaction type and have vertical shafts. Of the total number of 16 main turbines which form the outfit of the station, 10 of the wheels are built to operate under the following conditions: The head of water in this case is from 10.1 to 12 metres. The water supply to the wheel varies in like manner between 12,500 and 10,500 litres per second. The normal speed of the turbines is 120 revolutions per minute. Under these conditions of working, each of the 10 turbines can develop 1,250 hp. In the case of the six turbines, whose construction presents some differences from the above and which are designed to give a somewhat higher power, the head of water varies between the limits of 8 and 10 metres, with a corresponding variation in flow of 15,000 to 17,200 litres per second. The average speed of the second class of turbines is about the same as in the preceding group, or 120 revolutions per minute, while the six turbines are capable of supplying from 1,350 to 1,500 hp in regular working.

The sectional view in Fig. 4 indicates very clearly the method which has been adopted in the Cusset plant for mounting the high-capacity and low-pressure turbines. The section has been taken in this case through the 1,500-hp turbine which has just been mentioned. These latter wheels are of the type which is known as the "Francis turbine," and this wheel has proved a favorite in the Swiss and in a large proportion of the French hydraulic plants of recent construction. The arrangement of the intake conduit, the position of the turbine in the special chamber which has been built for it, also the method of mounting the alternators on the top of the turbine shafts will be observed in the sectional view, as well as the position of the regulating mechanism of the turbine, which works upon a set of movable vanes within the wheel for controlling the water supply and thus keeping the speed constant. The control of the feed to the wheel can thus be carried out automatically by means of the governor, which causes an oil-pressure apparatus to act upon the vanes, or when desired the regulation can be carried out from a hand wheel which is placed in the station near the machines. The oil pressure apparatus, which has the form of a differential hydraulic piston with oil admitted to either side of it and moving it in, the forward or back direction, is operated from the shaft of the turbine in each case, and the shaft of the apparatus is connected by belt with the turbine shaft. Oil under pressure is supplied to the piston by a set of differential pumps. Part of the regulating apparatus is located in the main dynamo room of the building, and this part of the device, as also the pressure gauges, will be observed in Figs. 1 and 2, mounted beside each of the alternators.

In addition to the 16 large turbines which are used with the alternators, there are three turbines of smaller capacity, also furnished by Escher, Wyss & Company, which are used to operate the exciter groups. The method of mounting the smaller wheels is practically the same as above shown, and they also have the inlet vanes controlled by an automatic speed governor. The three turbines for the exciters are all of the same pattern and have been designed according to the following data: For a head of water varying from 10.1 to 12 metres, the output is from 2,300 to 2,500 litres per second. The turbines operate at 250 revolutions per minute on the average. Each has a capacity of 250 hp.

During the preliminary work of the Cusset plant there were five different projects for the electrical equipment presented by a number of the leading European electrical firms. The system which was finally decided upon corresponded to the project which was furnished by the Swiss firm, the Société Anonyme Brown, Boveri & Cie., of Baden, using the three-phase system of distribution, with the high voltage for the line supplied directly from the alternators without the use of step-up transformers. All the electrical equipment of the station has, therefore, been furnished by the Brown-Boveri firm. It was at first desired to use a voltage of 5,500 on the machines for supplying the feeder cables, but it was afterwards found necessary to adopt a reduced voltage of 3,500, due to the fact that the company which operates the Cusset-Lyons system wished to use a form of underground cable for the high-voltage feeders which had a paper insulation, and at the time of laying out the system the constructors of the cable could not give a guarantee for a higher voltage. A frequency of 50 cycles per second was decided upon, and it was found the most suitable for operating the motors on the line as well as for the arc and incandescent lamps.



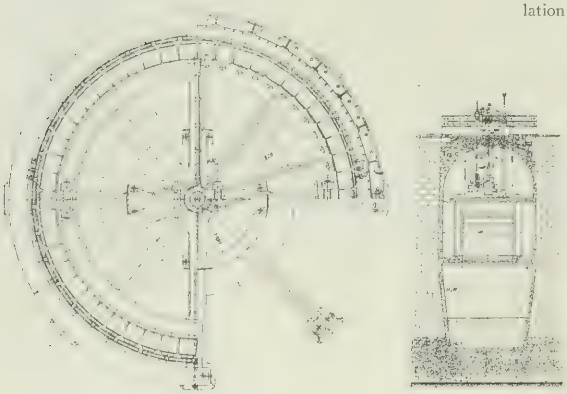


FIG. 3.—SECTION AND PLAN OF 1000-KW ALTERNATOR.

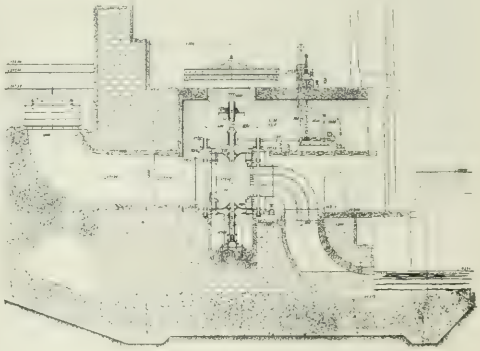


FIG. 4.—ARRANGEMENT OF 1500-HP FRANCIS TURBINE.

The alternators are of the vertical-shaft pattern with an outer circular casting which contains the armature ring, and an inner revolving field, supported on the top of the turbine shaft by a series of radial arms. Space has been left in the station for adding other alternator groups as the demand for power increases. Each of the 16 three-phase alternators has a capacity of 900 to 1,000 kilowatts. Fig. 6, which was taken in the shops of the company at the time of building the alternators, shows the manner of constructing the revolving field. This form of field is the one which the company has recently brought out and which is preferred to the other types for the reason that the conical shape of the piece with the point of attachment placed high up on the shaft has the effect of lowering the center of gravity of the rotating part, and in practice this has been found a decided advantage in increasing the steadiness of running. This form is known as the "umbrella" pattern, from the shape of the upper part, which is formed of a set of arms connecting the main hub with the outer ring forming the field.

The section and the plan view of the alternator gives a very good idea of the method of construction. The revolving field structure of the machine consists of an outer ring of cast-iron which is used to support the pole-pieces. The profile of the ring is of a U form, and it is connected by the radial arms of double T section with a hub which fits upon the upper end of the turbine shaft. The field frame, as a whole, is formed of two halves which are bolted together, as is noticed in the plan view. The total diameter of the casting which forms the field ring is 4,400 millimetres. Around the periphery is mounted a series of 50 pole pieces which are formed of cylindrical cores of good magnetic steel having a diameter of 225 millimetres. On the end of the core is fixed a pole-piece of rectangular form, having the length about twice the width. The core and the polar projection form in this case a single piece, and the core is bolted on to the main ring from the inside. Each of the cores is provided with a field coil which is made up of 61 turns of insulated copper strip. The section of the strip is 3.5 by 20 millimetres, and it is insulated by paper, which is found to be quite sufficient in this case, because the difference of potential between the turns of the field is only 0.04 volt. The exciting current is brought to the field coils as usual by a two-ring collector which is mounted upon the shaft of the machine.

The outer casting of the alternator, which is stationary, is bolted down to the foundation and forms the support for the armature ring. The main circular casting of the armature, which lies on the upper part, is formed of two portions having a common diameter of 5.82 metres on the exterior. When bolted together, the ring which is formed by the two halves has a double U section. It is provided with a set of holes around the periphery which afford a good ventilation to the armature iron. The crown of the armature is bolted down to a series of foundation castings. The foundation plates are placed radially, and are joined near the center to a drum-shaped casting which forms a support for the two upper bearings of the turbine shaft. This construction will be seen in the section and the plan view. The two upper bearings are spaced 520 millimetres between their inner edges, and the top of the lower bearing of the pair lies about on a level with the flooring. It will be noticed that the use of the "umbrella" type of armature allows the upper bearings of the machine to be spaced wide apart, as is necessary in order to secure the best conditions of running, and at the same time the field ring of the alternator is sufficiently low to bring the center of gravity of the revolving part down to the proper point and thus give a great steadiness to this portion of the machine.

The working part of the fixed armature is formed of thin laminated iron which is insulated by sheets of paper. The laminated iron ring is strongly compressed between the two halves of the circular casting which serves to hold it in place. The armature winding is placed in a series of 150 holes of circular section, having a diameter of 50 millimetres. In each of the holes are placed 7 copper cables which are contained in an insulating tube of micanite. Each of the cables is made up of 37 wires of 1.5 millimetre gauge. The total section of the cable is, therefore, 65.5 square millimetres.

In each phase the conductors are joined in series and the circuits of the three phases are coupled in star connection.

When the station was first set running, the alternators were put through a trial test, in which it was found that the increase of tension which results in the passage from full load at the normal voltage to no-load (the value of the field and the speed of the machine remaining constant) has the following values: For $\cos \phi = 1$, the rise of voltage equals 2.8 per cent. For $\cos \phi = 0.74$, the rise is 13.7 per cent. As to the efficiencies, there were found to be the following: 94.6 per cent for a power factor equal to 1, and 93.3 per cent where the power factor equals 0.74. As to the exciters which are used in the station, each machine has its armature mounted upon the upper end of the turbine shaft in the same way as the alternators. Each exciter has a capacity of 1,500 amperes, and delivers a voltage of 120, and operates at a speed of 250 revolutions per minute. These machines are of the Brown-Boveri pattern, and are of the four-pole type. The exterior field frame is formed of a circular casting of soft steel. Each core has a circular section of 450 millimetres diameter, and on the outer end is fixed a pole-piece of elliptical section. The field winding which is placed on each pole consists of 603 turns of a 4.8 millimetre copper wire. To the upper part of the main casting are bolted a series of curved arms which join at the top and hold the upper bearing of the turbine shaft. In like manner the lower part of the casting supports the second bearing at the central part. The armature, which is mounted between the two bearings, is of the drum type. The core consists of a cylindrical ring having 900 millimetres diameter and 470 millimetres length of iron. It is formed as usual of laminated plates. The drum winding, which is placed upon it, consists of two parallel circuits. The wires are lodged in a series of slots upon the armature face, using one wire per slot and per circuit. An insulated copper strip of rectangular section, 4.5 by 1.6 millimetres, is used here. In the armature there is a total of 344 conductors, and the commutator has 172 segments. The latter has two pairs of copper brushes. Of these exciters there are three at present in the station; one of them acts as a reserve.

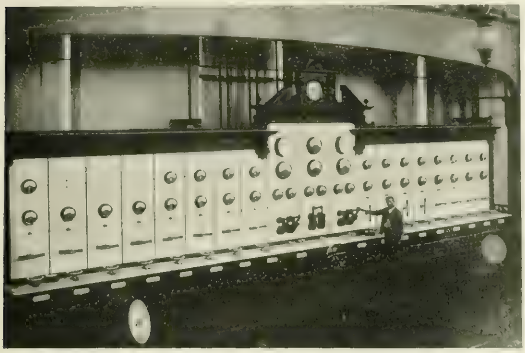


FIG. 5.—SWITCHBOARD.

The current from the alternators is brought to the main switchboard by cables which are laid in conduits underneath the flooring. In the same conduits are placed the cables for the exciting current, above the main cables. A view of the principal switchboard of the station is shown in Fig. 5. The apparatus are disposed in three main parts. The central part is used for the totalizing instruments, and the apparatus and instruments for handling the exciters.

The three middle panels carry two wattmeters and a voltmeter for the main three-phase current, also an ammeter for each of the phases. At the lower part of the panels are an ammeter, a voltmeter and a double pole switch for each of the exciters. The current which is needed to excite the fields of the direct-current machines is taken from the bus-bars of the exciter circuit. The hand regulators for the exciter fields are placed under the projection in the lower part of the board which forms a casing to contain the mechanism.

The high tension, three-phase current from the machines is brought to three bus-bars which correspond to the three phases. These bars are divided into four sections, each of which can be separately connected to a system of bus-bars for the main current. Four of the alternators work upon each of the sections, and it is thus possible to carry out the cleaning or overhauling of any one of the sections, cutting it out of circuit without interfering with the working of the plant. Each alternator panel carries an ammeter, a voltmeter, a hand lever for operating the three pole switch, which is placed behind the panel, and the phase-indicating lamps. The switch levers are placed so as to lie in the vertical position when the machine is connected in circuit, and this shows at once how many of the alternators are in operation.

The exciting current for the alternators, which is taken from the exciter bus-bars, is regulated by the rheostats placed in the circuit. The hand-wheels of the rheostats, like the set which has been already mentioned, project above the casing which contains the mechanism for operating the resistance coils. The whole set of rheostat boxes forms a continuous casing below the main panels, and a marble shelf covers it. The three middle hand-wheels are used for the exciter fields, and the remaining ones, which are of somewhat larger size, serve for the alternator fields. The hand-wheels are provided with stop-points and are connected together so as to allow of operating all the rheostats by means of a large central hand-wheel, which is placed in the middle part of the switchboard; at the same time the rheostats retain their individual operation. The resistance coils are placed at a point back of the switchboard and underneath the flooring of the gallery, which is formed of an iron grating.

The grating has been found necessary in order to secure a good ventilation of the resistance coils, which are further cooled by two air fans, each of which is run by a 10-hp motor. Both air fans and motors are likewise mounted underneath the flooring. To provide for the handling of the resistance coils, which have a considerable weight, a traveling crane is placed in the space back of the switchboard. The main switches are placed in small recesses of marble and are thus kept well separated from each other. Under the switches the transformers for the measuring instruments are lodged in somewhat the same way, and are closed over by wire gauze.

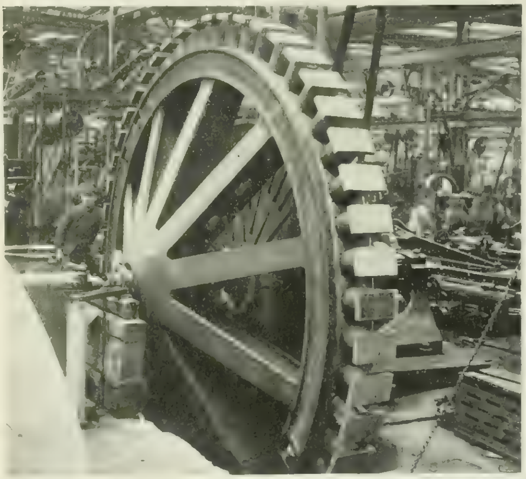


FIG. 6.—REVOLVING FIELD.

The main current passes through the totalizing apparatus mentioned above, and is then taken into the main bars which rise to an elevated point and pass along a gallery protected by wire gauze, reaching the feeder switchboard, which is a second board placed against the front wall of the building. The high-tension current is received in the feeder switchboard by a series of bars which supply the 12 feeders starting from the station. In each of the 12 feeder circuits are placed a three pole high-tension switch, an ammeter and a set of fuse blocks. In the center of the switchboard is located the ground-detector.

The hydraulic plant at Cusset has now been running for several years and supplies a large amount of power to the city of Lyons. The turbines and alternators have given good satisfaction ever since the station was started up. The present station is to be reckoned among the most important of the European hydraulic plants.

Belt Transmission of Power as an Analogue of Electric Transmission.

By Byron B. Brackett.

THE use of analogues to explain the various phenomena of current electricity is open to serious objection, yet the use of such analogues continues. Why these should be studied rather than the phenomena itself, is difficult to explain. It may be that certain minds can thereby remember two related facts more persistently than either one of them alone, and can likewise comprehend two similar reasons better than either of them without some mutual relation to the other. Or, it may be due to the inability of some persons to understand methods of explaining natural phenomena which go to the point direct, while indirect methods often lead those with this type of mind to the desired end. True it is that all analogues require comprehension of two subjects. Such devices cannot possibly reduce the amount of intellectual effort required to understand the phenomena which it is sought to explain by the analogy, unless the subject chosen to illustrate be thoroughly understood in advance.

Hydraulic analogies are often used to explain the phenomena of current electricity to students who themselves do not entirely comprehend the laws of hydraulics involved. This is well known. That the hydraulic phenomena usually employed, or the assumptions frequently made, illustrate only the more simple electrical phenomena and lead to absurd conclusions, if carried very far by way of analogy, is also beyond question. Such analogies continue to be used, in all probability, not because the student is thought to be familiar with the principles of hydraulics, nor yet because this class of phenomena is peculiarly suitable; but for the reason that the fiction of an electric fluid persists and permeates so thoroughly all of our electrical language.

The subtle, imaginary fluid, phlogiston, is no longer needed to explain our chemical theories. The fluid, caloric, has been abandoned in the treatment of heat phenomena; nevertheless, we still have our imaginary electric fluid to represent a condition or state of some portion of ether, probably as unlike the presence or flow of a fluid as anything could be. Why need we cling to such a fiction? If we admit its unreality, yet consider it merely a convenient assumption to bind together well-known facts, why illustrate it by hydraulic phenomena, actual or modified, and in a way that tends to make the assumption seem a reality?

If there is any necessity for illustrating, by phenomena connected with ordinary matter, the more general laws that govern the transmission of electric power, then the simple machine belt or rope drive will serve the purpose quite as well as water forced through a closed pipe system. No further modification or variation from the usual conditions of operation will be required, in the case of the belt drive, than it is necessary to make or assume in the common hydraulic analogy.

Imagine, for a moment, an endless belt passing as a wrapping connector in the regular way around two pulleys, or wheels, one driving, the other driven. The tension in this belt at any point may be assumed, for illustration, to represent an e.m.f. The velocity of the belt will then represent, by analogy, the phenomena of an electric current. The tension multiplied by the velocity of the belt gives, with due respect to the units of measurement, the energy transmitted in the unit of time represented by the speed, just as e.m.f. multiplied by current gives the electric energy, with similar respect to the units involved and the time considered.

To illustrate the effects of resistance and resistance losses in the electric circuit we must assume the somewhat unusual conditions of a driving belt operating in a perfectly viscous fluid, where the pull necessary to keep the belt moving through the fluid increases in direct proportion to the speed of the belt. This is not so exceptional a condition, nor so difficult to attain, experimentally, as the modification of actual resistance to the flow of liquids through pipes, which of course must be made in order to fit the hydraulic analogies to the phenomena they are supposed to illustrate.

The force required to pull the belt through such a viscous liquid as we have assumed would represent the portion of the tension lost, or rendered useless, before reaching the driven wheel. Hence, it represents quite satisfactorily the e.m.f. lost in the transmitting lines. This assumption makes the numerical value of the resistance to be the tension required simply to keep the belt moving at unit velocity. The actual properties of the electrical circuit will be illustrated by those of the medium surrounding the belt; but how these modify the resistance to motion need not now be considered. Given any resisting medium we may say by analogy that the belt tension divided by its velocity will equal the resistance. Change the resistance and the speed of the belt corresponding to any tension will change in an inverse relation; or, the tension required to produce a given speed will be modified, varying directly as the resistance of the medium in which the belt moves, all of which will be seen to be in accord with the relations of Ohm's law.

This law was stated by Ohm thus: "The strength of the current varies directly as the e.m.f., and inversely as the resistance of the circuit." But when applied to a portion of the whole circuit only, as, for example, to the transmitting line without including the motors, lamps or other receiving apparatus, the same relation may be more conveniently expressed, thus: the e.m.f. (needed for the portion of the circuit considered) varies directly as the product of the current and the resistance (of the part of the circuit under consideration).

It is further evident that the power consumed along the belt between the driving and driven wheels, would be proportional to the square of the velocity of the belt, illustrating, in this case, Joule's law.

According to this law, the heat developed in an electrical conductor, during any definite interval of time, is proportional to the square of the current and to the resistance of the conductor. Since the belt we are considering moves faster and pulls harder, at higher velocities, it illustrates most perfectly a conversion of another form of energy, into heat energy at a rate proportional to the square of the velocity of the belt, which is analogous to the electric current.

To grip this belt at any point of its motion and hold it in a position of rest would be similar to opening an electric circuit. The effect of the action, in either case, would be like inserting an infinite resistance at that point. When the belt is so held the driving wheel produces the full tension on the belt, at its point of application (or contact with the driving wheel), without causing any movement of the belt, just as the open-circuited dynamo develops an e.m.f. without delivering any current.

Starting and stopping conditions may now be considered. If the belt is without mass, or as is often said, without weight, its movements at once respond to the tensions produced at and by the driving wheel. The speed instantly reaches such a value that the resistance (the resisting forces) exactly equals the moving tension.

If the belt has any perceptible mass some of the moving or driving tension will be required to overcome the belt's inertia, as long as any change in speed is in evidence. Hence, a heavy belt would start slowly. It would keep or maintain itself in motion more persistently, so to say, when once set moving. This phenomenon represents the behavior of the so-called electric current in a circuit having self-induction. Since self-induction is a property not of the current but of the circuit, one might infer that it should not be represented by any analogous property of the belt, since that or its velocity has been assumed to represent the electric current. It may be recalled that such an inconsistency is committed by those who use hydraulic analogies; and, further, if one wishes, he may imagine the belt, which we are considering, to set into rotation any number of flywheels in the space about the belt by simply running over them. There may be many of them, and each one assumed to possess small inertia, to represent distributed self-induction; or, large and definitely located, to represent an inductance coil or some similar apparatus.

Moreover, if desired, one may find in the mass, radius of gyration, etc., of these inertia wheels, analogies for the magnetic flux, convolutions, etc., of an inductance coil. But it is not our purpose to examine these in detail. If there is mass inertia, directly connected with the changes in the speed of the belt in question, whether derived from the mass of the belt itself, or, from masses that are moved whenever the belt moves, there may be observed in either case phenomena analogous to those connected with a circuit having self-induction.

Should we attempt suddenly to stop such a belt as we have just considered, serious damage might result to the mechanism. The belt may break loose from the grip or other device which was introduced to stop it, and thence continue in motion for a time. This may ensue in spite of the efforts to check it, just as the electric current in a circuit with large self-inductance arcs across the switch, and maintains the so-called flow for an interval that is more or less brief, depending upon the circumstances. Again, the momentum of the belt in such a condition might actually wreck some portion of the mechanism from the stresses caused by an attempt quickly to bring it to rest, just as an effort to stop, in too short a time, the electric current in a circuit with self-inductance may result in a puncture of the insulation of the conductor.

In fact, the actual equations that apply to the building up or dying down of the electric current in a circuit with self-induction, apply without change to starting or stopping a heavy belt. In which case, also, the mass or mass equivalent of the belt, and of all masses moved by it, take the place of the inductance of the electric circuit. The velocity of the belt is used for current strength, and the driving tension in the belt represents the applied e.m.f.

This may be proved as follows:

Let T = tension in the belt.
R = frictional resistance to movement of the belt, as previously explained.
S = velocity of the belt.
a = acceleration of the belt.
m = mass equivalent of the belt.
t = time from application of T.

Then, at any instant, we have

$$T - S R = a m = \frac{d S}{d t} m,$$

or

$$d t = \frac{d S}{T - S R} m,$$

which may be written in the form

$$d t = - \frac{m}{R} \left(- \frac{R \, d S}{T - S R} \right)$$

Integrating between the limits t = 0 and t', and S = 0 and S', we have

$$t' = - \frac{m}{R} [\log (T - S'R) - \log T],$$

or

$$- \frac{R t'}{m} = \log \left(\frac{T - S'R}{T} \right)$$

hence,

$$\epsilon^{-\frac{Rt'}{m}} = \frac{T - S'R}{T}.$$

and finally

$$S' = \frac{T}{R} - \frac{T}{R} \epsilon^{-\frac{Rt'}{m}} = \frac{T}{R} \left(1 - \epsilon^{-\frac{Rt'}{m}} \right)$$

Thus, the velocity or speed of the belt, at any instant t' after a constant driving force, T, has been applied, is found by a formula which is identical with that for the electric current at a time t' after a constant e.m.f., E, has been impressed. The correspondence of the other quantities involved has already been noted.

The term $\epsilon^{-\frac{Rt'}{m}}$ in parenthesis in the above expression, becoming negligible when t' has a large value, the ultimate speed of the belt becomes constant at a value equal to T/R; and the time required for any fraction of this ultimate speed to be attained, will depend upon m/R, which is the *time constant* of the system.

By a like method, the stopping conditions, after the driving tension has been removed, may be shown to be given by the equation:

$$S' = \frac{T}{R} \epsilon^{-\frac{Rt'}{m}}$$

This may be considered in every sense analogous to the decay of the current value in an electric circuit with self-induction, after the impressed e.m.f. ceases to act.

We may now suppose the belt to be elastic so as to stretch when any tension is applied to it, till the elastic forces are sufficient to cause a steady movement of all parts of the belt; or, better still, we may imagine to exist between the surface of the belt and the medium or mechanism surrounding it, an elastic connection such that to establish any given speed of the belt a definite amount of stretching must occur, and remain operative so long as the same conditions of speed continue. In either case the initial speed of the belt at the driving wheel, resulting from the application of any constant driving tension, will be larger than would exist, if all other things were the same, and the belt with all of its connections had no elasticity. But, when the belt has been sufficiently stretched all phenomena will go on, while the driving tension remains constant, as if there were no elasticity to any part of the mechanism under consideration. When, however, the driving tension is removed, this elastic stretch will tend to move the belt backwards, for an instant. This is in all respects similar to starting an electric current in a circuit having capacity. For, when a constant e.m.f. is applied to such a circuit, there is a temporary rush of current into the circuit, larger than would flow over the same circuit if it had no capacity, or larger than the ultimate value of the current which is determined by Ohm's law. Again, when the e.m.f. is removed and the circuit kept closed there is a temporary back current which soon dies out.

To express the extra speed of the belt mathematically, we must consider a belt with unit elasticity to be one which will stretch a unit distance under a tension of unit value. Hence, one which stretches n units under unit tension will have an elasticity of n. Such a belt, if held firmly at the driven wheel, would move at the driving wheel, under the influence of a moving tension T, a distance, $D = Tn$, or $T = D/n$. These represent the ultimate conditions or those when rest ensues.

In general, after a definite interval of time, before the conditions of rest have been reached, a portion of the total tension (applied to the belt at the driving wheel) would be balanced by the elastic forces from the stretch already attained; and the remainder would be consumed in moving the belt against friction at the velocity then existing. Represent the tension required to balance the elastic force by T_1, corresponding to a stretch D_1. Then, $T_1 = D_1/n$. The other portion of the force will be equal to $R S'$.

Hence,

$$T = R S' + \frac{D_1}{n}$$

or

$$Tn = R n S' + D_1.$$

But

$$D_1 = \int S' \, d t,$$

or

$$Tn = R n S' + \int S' \, d t.$$

And differentiating, we obtain:

$$0 = R n \, d S' + S' \, d t,$$

$$d t = - Rn \frac{d S'}{S'}.$$

Integrating this between the limits of 0 and t'; S_0 and S', we have

$$t = - Rn \left(\log S' - \log \frac{T}{R} \right)$$

since S_0 must be equal to T/R, all of T at that instant being available against frictional resistances. Solving the above for S' we now obtain

$$S' = \frac{T}{R} \epsilon^{\frac{t}{Rn}}$$

This is entirely similar to the case of an electric circuit with a condenser inserted directly in series with it. The condenser puts in an infinite resistance at one point, but gives an effect of elasticity to the circuit.

We might consider the stopping conditions, and develop their formula when the belt is held, as above. Or we might develop the more important relations that apply when the belt is not held stationary at one point. This would be analogous to a closed electric circuit with capacity between different parts of the circuit. Here there is the current value which would exist without capacity, and, an additional current, at the start, obeying the laws above explained.

It is not necessary to multiply details. All of the interesting relations may be developed through using the analogy of the belt drive. Mechanical elasticity, in the sense that we have defined it above, is more nearly a perfect analogy of electric capacity than is shown in almost all illustrations used. It must be here remembered, however, as in the case of self-induction, that capacity is distinctly a property of the circuit itself and not of the current. If any one should think that elasticity of the belt is not a proper analogy let him bear in mind that the elasticity may be applied to the regions near the belt and in contact with it, without making any changes in the relations which we have considered.

For the purpose of establishing a comparison with the possible operation of the belt transmission, the alternating current of electricity may, for the moment, be conceived of as starting and stopping continuously, first in one direction and then in the other. Now, if we rock the driving wheel back and forth, so to speak, the motion of the belt may be treated as an analogue of the alternating current. It is self-evident that any considerable inertia, or elasticity of the belt, would affect its motion, under such conditions, much more than when driven in one direction. Inertia and elasticity, as already defined, will modify the velocity of such a driving belt, moved first in one direction and then the other, in exactly the same way and to the same extent that self induction and capacity are known to modify the alternating electric current. Moreover, formulæ showing these relations may be developed from the properties of the mechanism of the belt transmission; that is, the behavior or phenomena of the ether medium as affected by the transmission of an alternating current of electricity, may be illustrated by the well-known properties of ordinary matter.

◆

Temperature Effects in Spans.

By C. P. Nachod.

THE purpose of this article is to show the relation between the sag and tension in a span of wire where there is a temperature variation. It is the result of some investigations for an overhead trolley construction where a knowledge of the variation of sag with the weather is necessary; and the conclusions have been substantially verified by measurements on an experimental span.

In order to simplify the calculations certain approximations have been made. For the flat curves in which wire usually hangs in practice these involve an entirely negligible error.

Ignoring at first any elongation of the wire under the stress produced by hanging, and supposing the temperature constant, all the desired relations can be expressed by two well-known equations, viz.:

$$l = y + \frac{8d^2}{3y} \qquad (1)$$

$$p = \frac{wy^2}{8d} \qquad (2)$$

The first is an approximate formula for the rectification of the parabola, a curve which, when flat, does not sensibly differ from the catenary, the true curve. The quantities involved are l, the length of wire in the span; y, the length of the span itself; d, the deflection of the middle point from the horizontal line through the supports, or sag, all being conveniently expressed in feet.

The second equation gives the relation between p, the tension in pounds; w, the weight of the wire in pounds per foot, and the span and sag. The tension, p, is that at the lowest point of the span. For any other point it is increased by the weight of a length of wire equal to the height of that point above the lowest—an ordinarily negligible increase.

If to the foregoing statements there is added that the wire elongates uniformly under heat at a rate dependent upon its coefficient of expansion, and that it elongates uniformly under tensile stress up to its elastic limit at a rate governed by the elastic modulus, E, all data are at hand for the investigation of the problem.

Assuming an unstretched wire of length l_c when cold and l_h when hot, a the linear coefficient of expansion of the material composing the wire, t the temperature range, the relations governing a temperature change may be expressed as

$$l_{ho} = l_{co}\,(1 + a\,t). \qquad (3)$$

If s is the unit fibre stress, β the reciprocal of the elastic modulus, l_o the length of the unstretched wire, l_s its length under the unit fibre stress, s, the analogous relations governing a change of stress are

$$l_s = l_o\,(1 + \beta s). \qquad (4)$$

or more conveniently,

$$l_s = l_o \left(1 + \frac{p_s}{aE}\right) \qquad (5)$$

where p_s is the total tension over the area a, the resisting section of the wire.

If the dimensions in the hot condition of the wire as stressed by hanging be denoted by subscripts $h\,s$, equation (1) being general, is true for any temperature, and may be written more particularly

$$l_{hs} = y + \frac{8d^2_{hs}}{3y}. \qquad (6)$$

Also for the cold condition under the stress s' by subscripts $c\,s'$,

$$l_{cs'} = y + \frac{8d^2_{cs'}}{3y}. \qquad (7)$$

In a similar manner equation (2) for the hot stressed condition of the wire may be written as

$$p_{hs} = \frac{wy^2}{8d_{hs}}. \qquad (8)$$

And for the cold condition under stress s' produced by it,

$$p_{cs'} = \frac{wy^2}{8d_{cs'}}. \qquad (9)$$

Proceeding thus for equation (5) there results

$$l_{hs} = l_{ho}\left(1 + \frac{p_{hs}}{aE}\right) \qquad (10)$$

$$l_{cs'} = l_{co}\left(1 + \frac{p_{cs'}}{aE}\right) \qquad (11)$$

where l_{ho} and l_{co} represent the lengths in the hot and cold unstressed conditions, respectively.

Eliminating l_{hs} between equations (10) and (6), and p_{hs} between equations (10) and (8) there results

$$d^3_{hs} + \frac{3}{8}\,y\,(y - l_{ho})\,d_{hs} = \frac{3wy^2}{64\,aE}\,l_{ho} \qquad (12)$$

as the first important equation. To find the value of l_{ho}, this requires to be supplemented by another deduced by eliminating l_{co} between equations (3) and (11), and $l_{cs'}$ between equations (11) and (7), which gives

$$l_{ho} = \frac{\left(y + \frac{8d^2_{cs'}}{3y}\right)(1 + a\,t)}{1 + \frac{p_{cs'}}{aE}}. \qquad (13)$$

By multiplying out the numerator and omitting the product of the two right-hand terms as being negligible in comparison with y, a form is produced in which the numerator is calculable by the slide rule, viz.:

$$l_{ho} = \frac{y + y\,a\,t + \frac{8d^2_{cs'}}{3y}}{1 + \frac{p_{cs'}}{aE}}. \qquad (14)$$

In the case of a 300-ft. span consisting of a ⅝-in. steel messenger cable having a section of .2355 sq. in., and which, together with an inert load that it carries, weighs 1.43 pounds per foot, if a tension of 6,000 pounds is assumed for cold weather, the resulting sag may be found from equation (9):

$$6{,}000 = \frac{1.43 \times \overline{300}^2}{8 \times d_{cs'}}.$$

which gives 2.68 ft.

To find the sag and corresponding tension in weather 100° F. warmer, it is necessary to find the length at that temperature and without stress from equation (14) as follows:

Assuming for steel $E = 30{,}000{,}000$ pounds per sq. in., $a = .0000068$ for Fahrenheit scale,

$$lho = \frac{300 + 300 \times .0000068 \times 100 + \dfrac{8 \times \overline{2.68}^2}{3 \times 300}}{1 + \dfrac{6,000}{.2355 \times 30,000,000}}$$

$$\frac{300 + .204 + .0638}{1.00085} = \frac{300.2678}{1.00085} = 300.01278 \text{ ft}$$

The last operation cannot be performed on the slide rule since four or five significant figures are requisite.

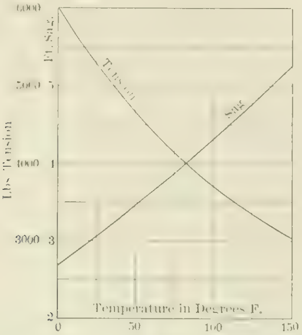


FIG. 1.—CURVES FOR VARIATION OF TEMPERATURE.

This value is required for substitution in equation (12):

$$d^3hs + \frac{3}{8} \times 300\ (300 - 300.01278)\ dhs = \frac{3 \times 1.43 \times \overline{300}^2 \times 300.01278}{64 \times .2355 \times 30,000,000}$$

or

$$d^3hs - 1.437\ dhs = 76.8.$$

Solving this by trial approximations on the slide rule gives the sag in hot weather as 4.36 ft., an increase of 1.68 ft., or 63 per cent over that in cold weather.

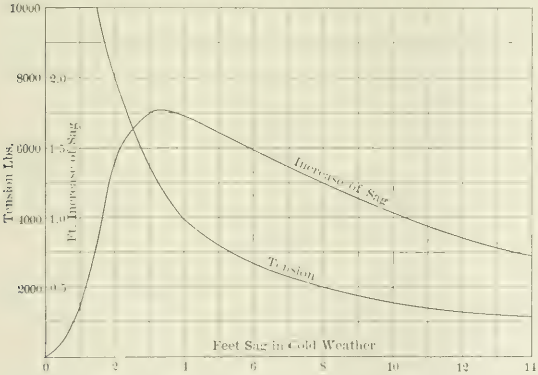


FIG. 2.—CURVES FOR VARIATION OF SAG DUE TO 100° F. TEMPERATURE RISE.

For the corresponding tension, substitute in equation (8):

$$Phs' = \frac{1.43 \times \overline{300}^2}{8 \times 4.36} = 3,690 \text{ lbs.,}$$

which is a decrease of 2,310 pounds, or about 39 per cent.

Fig. 1 shows in a graphical manner the variation of sag and corresponding tension with temperature for this span. Within the limits shown the sag increases almost directly with the rise in temperature. For an increase of 150° F. the tension is reduced to about one-half.

In Fig. 2, which applies to the same span, there is shown the effect of suspending the cable with various initial sags in cold weather and the resulting increase of sag for 100° warmer weather. The tension for each sag is also shown. It will be noted that there is a certain initial sag for which the increase in warm weather is a maximum. This is that value of the initial sag that will make the hot length without stress equal to the span, i. e., that value of dcs' that will make $(y - lho)$, the parenthesis in the coefficient of dhs in equation (12) equal to zero. In this case it is about 3.4 ft., for which the increase would be 1.77 ft.

This would be the condition to be avoided in practice, as it is usually not desirable that the sag should change much from winter to summer. There will be seen to be two initial sags giving the same increase in warm weather, the lower sags to the left of the maximum implying, however, abnormally high tensions.

In actual service a succession of spans would not be subject to as great changes in tension during the seasons as the curves show, since a very slight yielding of the support, as would happen, especially at curves, greatly diminishes the maximum tension in cold weather.

◆

London's Power Supply.

By T. H. Minshall.

At present there are in London over 70 bodies engaged in the supply of electrical energy. In 1889 an attempt was made to concentrate production at Deptford, but this scheme, though sound in principle, was unsuccessful, because it was before its time. Since then the number of independent authorities has steadily increased, and it was with the object of putting a stop to further increase in the construction of comparatively small and costly stations, and gradually introduce a policy of concentration, so far as production goes, that the bill of the Administrative Power Company and a number of other schemes of a somewhat similar nature were brought before Parliament last year.

Of these the Administrative Power Company scheme was the one which attracted the most attention. This measure had two principal objects: First, the wholesale or bulk supply of electricity to railway companies and to existing lighting authorities for distribution by the latter; and, second, the retail supply of electricity to individuals for power purposes in certain cases, and under conditions, approved by the Board of Trade.

The bill was so framed that the existing authorities in each district had the first option of supplying the consumers themselves. If unable to supply from their own stations as cheaply as the power company, which would generally be the case, they had the option of purchasing power wholesale and retailing it themselves. Only in the event of their being unable to supply the consumer by either of these two means as cheaply as the company was prepared to do, was the latter allowed to give a retail supply for power. But the bill conferred no powers for competing with the ordinary lighting supply, which forms nine-tenths of the present authorities' business; neither did it in any way affect the control of the various undertakings. The object of the company was, and is, to produce current on a larger scale, and hence at a lower cost than is possible in the present stations, and to sell energy wholesale to the existing authorities for them to retail. As was said at the time, the only change which this need involve would be that the existing authorities would purchase *energy* in place of *fuel*, and cease to enlarge their existing stations.

The following table, which was given in evidence, shows the relative cost of production in the existing stations of the borough councils, and the prices at which they could demand an equivalent supply from the power company; i. e., at the maximum prices the power company is authorized to charge:

	Total cost of production, 1904.	Cost of bulk supply delivered.
Battersea	$54,225	$38,800
Bermondsey	20,890	12,580
Fulham	49,580	35,890
Hackney	71,155	56,270
Hammersmith	91,060	59,617
Hampstead	155,730	99,350
Islington	145,060	83,485
Poplar	56,020	30,350
Shoreditch	140,500	77,520
Southwark	40,090	20,310
Stepney	63,180	54,340
St. Pancras	175,005	122,085
Total	$1,064,725	$710,685

The right to distribute the energy so purchased for light or power will be left in their hands, if they choose to exercise it, but if not, the Board of Trade is empowered to allow the consumer to obtain a supply direct from the power company. It is, obviously, a matter of indifference to the generating company whether it deals with the distributing company or with the individual user direct, provided always that there is some guarantee that the consumer obtains the full benefit resulting from cheap production; for without this the demand for electricity will not grow at a sufficient rate to make this scheme commercially feasible.

The bill was heard at great length by committees of both Houses and passed, together with the bills of the Metropolitan and North Metropolitan Power Co., thereby dividing London among three power companies. This has been somewhat overlooked, the belief having been general that one company covered the whole area. As the scope of the scheme became better understood, the opposition of the existing companies, and of a number of local authorities was withdrawn, and many agreements for bulk supply come to, but a number of boroughs, including Poplar, West Ham, Woolwich, etc., together with the London County Council, maintained their opposition to the end, with the result of delaying the proceedings to such an extent that there was no time for the bill to go to third reading. It has thus to be brought forward again, but it is not expected that it will involve such a lengthy struggle as it did last year now that the majority of the points have been threshed out and the modifications suggested by Parliament inserted.

The opponents, of whom the principal was the London County Council, maintained that the existing authorities were in a position to supply all London's power requirements, and that, in any case, to compete with them would endanger the security upon which the Council has advanced large sums of money for electrical purposes to the borough councils. At a later stage of the Proceedings the Council agreed that concentration was desirable, but that the Council itself was the proper body for providing such a supply to the existing authorities, for which purpose, in fact, it had already, unsuccessfully, promoted two bills before Parliament.

The following table gives some particulars of the systems in the original area proposed by the bill, from which Hertfordshire and half of Middlesex was excluded:

Total number of stations	62
Average size of stations in kilowatts	2,920
Total number of engines	537
Average size of engines in kilowatts	338
Number of different voltages	25
Number of different systems of generation	35
Number of different systems of supply	27
Number of different voltages of supply	24

There are thus no less than 62 stations of an average size of only 3,000 kilowatts, or less than one-fifth of the size of the individual turbines which the power company proposed to use. This, of course, excludes the innumerable private installations in large works, some of which contain several thousand horse power. The variety of systems at present in vogue not only prevents amalgamation, but also necessitates manufacturers of electric motors carrying a very much larger stock of motors than would be required in the case of a uniform system.

The following table gives particulars of the capital outlay, etc., in the Metropolitan stations:

Total capital expenditure	$82,993,575
Kilowatts of plan installed in lighting stations	181,034
Capital extended on stations	$46,219,910
Capital expended per kilowatt installed	$255
Kw hours units generated	150,154,144
Plant costs	$3,051,000
Plant costs per kw hour generated	2.2 cts.
Capital charges on stations	$2,728,335
Capital charges on stations per unit generated	1.64 cts.
Total generating costs	$6,379,995
Total generating costs per kw-hour generated	3.84 cts.
Gross revenue	$11,725,145
Gross revenue per kw hour generated	7.08 cts.

In view of these figures it is not surprising that London is very much behind other cities in its consumption of electric power, and the following table gives particulars of this:

Name of city	Population.	Horse-power connected per 1,000 head of population. All purposes.	Power only.
Boston	600,029	164.6	41.3
Tyneside	223,241	122.8	30
Frankfort	306,000	80.1	28.7
Berlin	2,288,000	82.1	22.0
New York	3,732,903	52.6	13.9
Hamburg	706,000	76.7	12.7
Glasgow	786,897	43.9	8.26
London	6,565,390	48.0	5.4
London ("industrial area")	3,812,283	25.8	4.8

It will be seen that London as a whole uses more power per head than the industrial area, due to the fact that in some of the western districts, such as the Strand, etc., space is so valuable that electric power has to be used by the printers, etc., at any cost.

The fact was very clearly brought out before the committee by various manufacturers that, hitherto, the purchase and general use of electric power in ordinary works was—except in special cases, where space, etc., made it necessary—the exception rather than the rule, and this is shown by the following table, from which it will be seen that only about 4 per cent of the power used in the factories of the industrial area was electric power supplied by the present plants:

	"Industrial" area.	Proposed area of supply.
Total number of hands employed:		
1898	458,856	600,894
1911	534,458	700,227
Total horse-power installed of all kinds in factories, etc.		
1904	456,415	592,992
1911	484,148	636,695
Horsepower of motors supplied by present lighting authorities:		
1904	18,316	34,236

Both opponents and promoters were quite in agreement as to the advantages possessed by electric power over other forms; where they differed was as to the best means of bringing about its general adoption. During the first part of the proceedings the companies' and the existing local authorities' contention was that the present methods, if allowed to develop, would, in time, suffice to meet the needs of the metropolis, and to provide a supply of power at such rates as would insure its general adoption.

The promoters, however, contended that the present methods were radically wrong, and that the longer they went on the worse it would become, and that the only correct way to deal with the problem was at once to inaugurate a policy of concentration in place of the continual addition to the number of stations supplying London.

To show the economy of concentration the following table was prepared, in which the figures of the Administrative Company's stations in London, as furnished by their owners, are contrasted:

Causes to which Economy is Attributed.	Adm. Co. 90,000 kilowatts.	Existing stations. 3,000-kw. average size.
Reduced capital outlay, due to—		
(a) Lower cost of large turbines	$42 per kw.	$252.50 per kw.
(b) Lower cost of iron buildings		
(c) Lower cost of sites		
Reduced coal costs, due to—		
(a) Greater efficiency of large machines	.304 cent per kw hour.	1.26 cents per kw-hour.
(b) Better sites for coal delivery and condensing water		
Reduced cost of operation, labor charges, etc., due to—		
(a) Use of turbines	.106 cent per kw hour.	1.08 cents per kw-hour.
(b) Use of larger units of plant		
(c) Use of coal handling and other automatic appliances		
Reduced capital charges per unit, due to—		
The greater number and variety of demands for power in a large area supplied by one station, enabling the machinery to be employed for a longer period each day and hence yielding a greater output with the same capital thereby reducing the capital charge per unit of output.	.218 cent per kw-hour.	2.58 cents per kw-hour.

The Administrative Company proposed three stations, one at Greenwich, one at West Ham, and a peak station at Fulham, though they did not undertake to construct this at first. The extraordinary reduction in the cost of large stations is clearly shown by the above table, and that these figures were by no means fanciful was shown by the fact that tenders had been received to supply all the apparatus for the figures therein mentioned, while the cost of the station already built on Tyneside was only some $10 per kilowatt higher.

Apart from the advantages of uniformity and of economy, it would, obviously, be an advantage to London if it were possible to remove the various generating stations from out of the congested central area. This cannot be done under the present conditions. The Administrative Company proposed a solution of the difficulty; the existing companies at first proposed alternatives, while the County Council proposed further delay.

After an extremely lengthy hearing the committees of both Houses decided that the best method of solving the problem was to create a new company for the purpose of supplying power, in order to insure the principle of competition being maintained, which would have been difficult had the existing authorities been endowed with these powers. But the interests of the existing authorities were very carefully safeguarded against injury by clauses specially framed for this purpose by the House of Lords. It is understood that next session the promoters will ask Parliament to confirm this decision.

Reflectors, Shades and Globes.—III.

By J. R. Cravath and V. R. Lansingh.

The two previous articles on this subject dealt mainly with the older and more familiar types of reflectors and globes. This and the following articles will take up mainly some of the newer and special types, patented and unpatented, which have been coming into prominence in the past few years.

Fig. 14 shows the distribution about a 16-cp lamp equipped with what is known to the trade as a 10-in. X-ray desk shade. This shade is shown in Fig. 15A. The light distribution from a 32-cp lamp with the same reflector is shown in Fig. 15. This is a shade with a corrugated mirror reflecting surface, the reflecting surface being applied under the paint which covers the outer surface. As seen by Fig. 14, this reflector has a tremendous concentrating power, giving over 108 cp at the tip of the 16-cp lamp. With a 32-cp lamp, the maximum candle power covers a much larger angle than with the 16-cp. Streaks of light which are likely to be present with mirror reflectors are in this case partially wiped out by the corrugations, so that, except when the work is very near to the lamp, this reflector can be used without a frosted bulb lamp, although the latter is recommended. This reflector is an excellent one to use wherever good, powerful, concentrated light is desired and where an opaque reflector is not objectionable. It is well suited to show-window lighting, office desk lighting and billiard table lighting wherever other lights are present for the general illumination of a room. It is considerably more expensive, heavier and more likely to be injured than the frosted aluminum cone, Fig. 8, but it gives a much more powerful light and is more easily kept clean on account of its smooth inner surface.

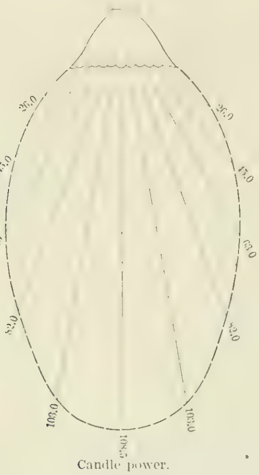
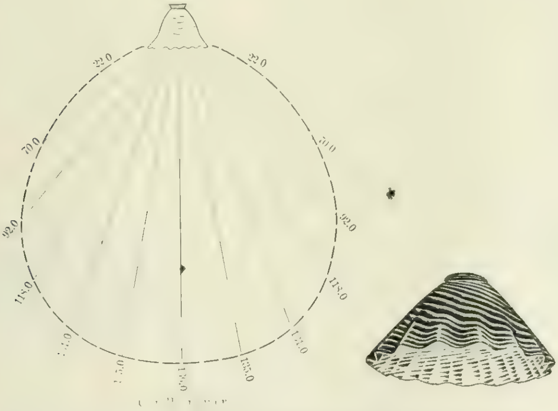
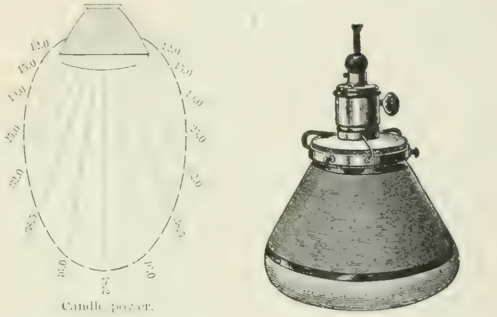


FIG. 14.—DISTRIBUTION OF LIGHT FROM X-RAY DESK SHADE.



FIGS. 15 AND 15A.—DISTRIBUTION FROM 32-CP LAMP WITH X-RAY SHADE.

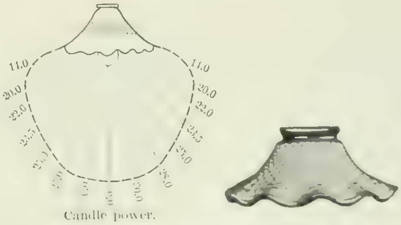
Fig. 16 shows the light distribution about a 7-in. McCreary desk shade, shown in Fig. 16A. This is a shade which has a silvered mirror reflecting surface, but instead of being open, as are most reflectors, it has a ground-glass bottom through which the lignt must pass and which eliminates the streaks. It is, of course, intended to give a concentrated light for desk use and draughting. The maximum candle-power below the lamp is about 48. Its performance on the whole is very similar to that of the frosted aluminum cone, but this type of reflector has the advantage that no matter what angle it may be placed at, the bare lamp is not visible, as all the light comes through ground glass. For desk work, where it is almost always desirable to place the reflector at an angle, this is a good feature. This shade should never be used without a mica or asbestos gasket in the shade holder to prevent dirt collecting inside of the shade.



FIGS. 16 AND 16A. DISTRIBUTION OF LIGHT ABOUT A M'CREARY SHADE.

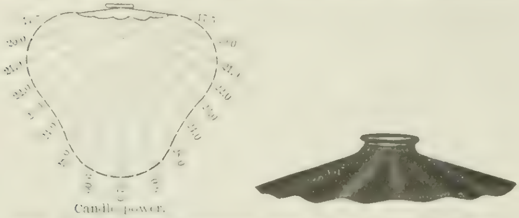
The "McFadden" shade is similar to the "McCreary," except that its reflecting surface is opal with green backing like the common desk shade. It is, in fact, the common desk shade with a ground glass bottom. It is not subject to deterioration of the reflecting surface like the "McCreary" and "X-Ray," which depend on mirrors for their reflecting value.

Fig. 17 shows the distribution of light about a 6-in. ornamental X-Ray reflector, illustrated in Fig. 17A. This gives a candle-power of from 20 to 30 at the most useful angles below the horizontal. The principal application of this reflector is in connection with clusters and on ceilings, where the fact that the reflector is opaque is not a drawback. It is sometimes used by mistake where the more concentrating type of X-Ray reflector shown in Fig. 15A should be used. The use of this or any other reflector on a chandelier or cluster at an angle and hung low enough to be in the ordinary line of vision is objectionable on account of the glare received in the eyes. The remedy is the use of frosted bulbs or the placing of the cluster high.



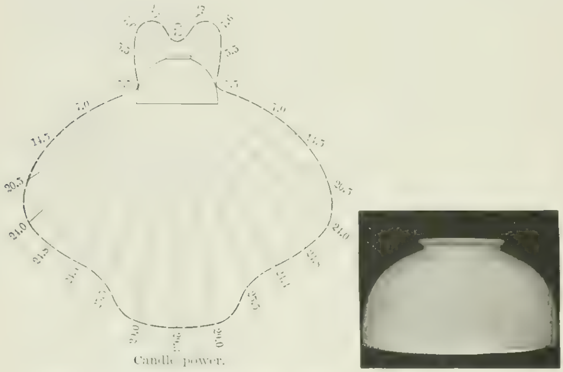
FIGS. 17 AND 17A. DISTRIBUTION FROM X-RAY REFLECTOR.

Fig. 18 shows the distribution of light about a 16-cp incandescent lamp in a 10-in. flat fluted X-Ray reflector. Although a reflector of this form would naturally be expected to give a rather wide distribution of light below the horizontal, it will be seen that the candle power directly below the lamp is considerably higher than with other flat reflectors shown in this series of tests, while the candle power a little below the horizontal is nearly as great as with some of the other flat reflectors. The shape of this reflector is shown in Fig. 18A. The proper place to use a reflector of this kind would be where it was desired to illuminate a considerable area and at the same time to obtain much light immediately under the reflector. Like all opaque reflectors it cannot be used where darkening of the ceiling is objectionable.



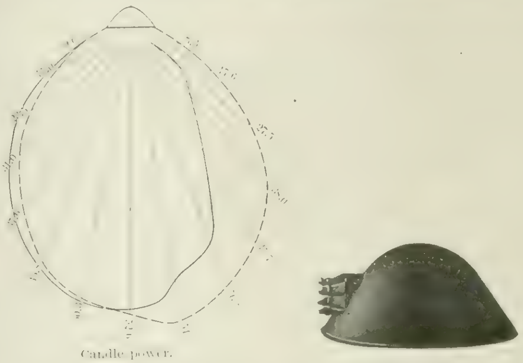
FIGS. 18 AND 18A.—DISTRIBUTION FROM FLUTED X-RAY REFLECTOR.

Fig. 19 shows the distribution of light about a 16-cp power incandescent lamp in a white opal dome reflector, the form of which is shown in Fig. 19A. This is an excellent reflector for many common uses. Being 3¾ in. deep, and 7 in. in diameter, it covers the lamp so as to act as a diffusing globe to a certain extent, while at the same time it gives an excellent distribution of light in all downward directions, the maximum being somewhat over 29 cp. It is a good type of reflector to place pointing straight downward over the center of a dining-room table, one lamp giving illumination over the entire top of a fairly large table. It can also be used on chandeliers for the general lighting of all classes of rooms. When so used it should be pointed straight down, because if placed at an angle it will give more light than is necessary on the high side walls. It is interesting to compare this with the opal reflectors, Figs. 3 and 4. The maximum candle-power of this opal dome reflector is considerably greater than from the fluted opal cone, shown in Fig. 3. This candle power extends about 10 degrees each side of the vertical, and the balance of the distribution is very similar to that of the fluted opal cone. This would be a good reflector for reading and desk use, but for the fact that having a smooth reflecting surface, the light is somewhat streaked. The streaks can be overcome by the use of a frosted bulb lamp, as in other types of smooth reflectors. Although not specially ornamental in its usual form, as found on the market, it could easily be made so. It is another good example illustrating how little attention is commonly paid to combining the useful and the artistic in glassware and how much room there is for improvement and development along this line.



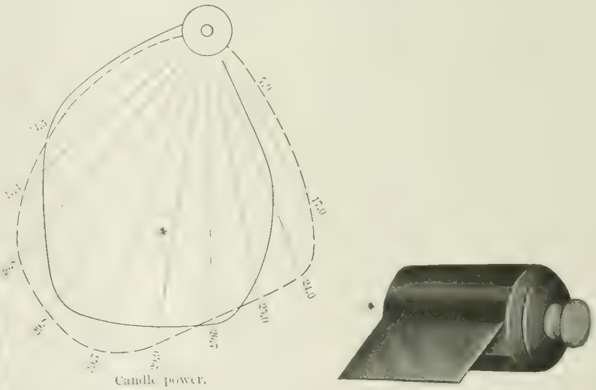
FIGS. 19 AND 19A.—DISTRIBUTION FROM WHITE OPAL DOME REFLECTOR.

Fig. 20 shows the distribution of light in two planes about a 16-cp incandescent lamp in a parabolic aluminum reflector with frosted aluminum finish inside. This reflector is shown in Fig. 20A. The candle-power in the vertical plane of the lamp axis is shown by dotted lines, as in the other diagrams, while the candle power in a vertical plane at right angles to the lamp axis, technically known as normal to the lamp axis, is indicated by a heavy line on the same diagram. This is a reflector which is coming into common use for desk and office work, as well as for shops and all places where a light, easily adjusted, opaque reflector is needed. This test shows the reflector to be an excellent one for this purpose. It gives over 50 cp at the angles where the light is most wanted in desk lighting, and gives over 40 cp through an angle of about 70 degrees. The reflector is light and is usually made so that it can be quickly turned at any desired angle. The easy way in which it can be adjusted, as well as the excellent distribution of light from this reflector, are strong points in its favor. Reflectors of this kind can be obtained with various outside finishes so that they will harmonize with almost any surroundings. Not being patented articles, they are low in price. For use in dirty machine shops, it may be advisable to purchase them with smooth polished finish instead of the frosted finish inside. For most cases, the streaked light from the polished aluminum will be objectionable. Generally, the frosted aluminum finish is the one to be chosen.



FIGS. 20 AND 20A.—DISTRIBUTION IN TWO PLANES FROM PARABOLIC ALUMINUM REFLECTOR.

Fig. 21 shows the distribution of light in two planes about a 16-cp incandescent lamp placed in a cylindrical desk reflector with aluminum paint finish inside. This reflector is shown in Fig. 21A. The solid line shows the light given in the plane of the lamp axis, while the dotted line shows the light given in the plane at right angles or normal to the lamp axis. Cylindrical desk shades of this kind are in common use, and may be compared with the parabolic shade shown in Figs. 20 and 20A. The light obtained from the cylindrical desk shade is considerably less than from the parabolic reflector. Not only is the maximum candle power approximately half that of the parabolic shade, but it does not extend over as great an angle. The cylindrical form of shade with aluminum paint finish is, however, much to be preferred to the same shade with white paint finish, as the latter causes streaks in the light which are extremely objectionable and necessitate the use of frosted lamps.



FIGS. 21 AND 21A.—DISTRIBUTION IN TWO PLANES FROM CYLINDRICAL DESK REFLECTOR.

Fig. 22 shows the distribution of light about a trough reflector, in which the reflecting surfaces are glass mirrors. Such trough reflectors are made for store window lighting purposes, being placed at the top of the window out of sight from the street. This reflector is shown in Fig. 22A. Fig. 22 shows the light on vertical plane normal or at right angles to the reflector. This can be compared with the light thrown from the X-Ray reflector, shown in Figs. 15 and 15A. Both of these types of reflectors are much used for window lighting. The X-Ray reflector apparently has much the best of it in this test, not so much in maximum candle power as in the wide angle over which this maximum candle power is distributed. It is conceivable, however, that there might be some locations where the 60-cp thrown by the window trough reflector in a direction slightly below the horizontal might be of use in lighting the upper part of the window. This is a matter to be determined by the conditions under which the reflector is to be used.

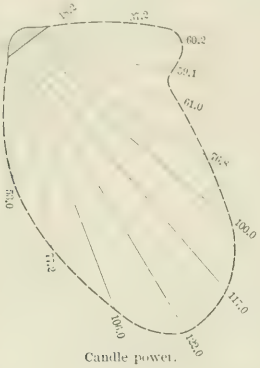


FIG. 22.—DISTRIBUTION FROM TROUGH REFLECTOR.

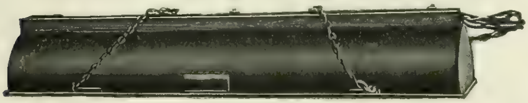


FIG. 22A.—TROUGH REFLECTOR.

Electrically-Operated Pillar Cranes.

By Chas. Smith.

In the operation of factories and shops as well as iron and steel works, the application of electricity has been of special value as a motive power for hoists and cranes of both the traveling and fixed types. Where electric power is available and is used for other purposes as well, it is generally conceded that such power is preferable for this service, flexible cables being more desirable than the rigid piping formerly used for pneumatic and hydraulic cranes, while those operated by steam have still more serious drawbacks, each crane requiring a separate steam engine and boiler which continually wastes fuel for long periods in order to keep steam up even when not in use. The electric crane, therefore, is utilized more extensively than the other forms, which are only employed when certain conditions require it.

It may be of interest to consider some of the details of construction and methods of operation of that form of electric crane known as the pillar crane. Fig. 1 shows an electric pillar crane of American construction with covered trolley for out-of-door service. The current is conducted to the hoisting and traveling motors by four horizontal wires on the top of the crane through trolley wheels, as shown in the illustration. The controlling apparatus is mounted in the cab noted at the side of the pillar, the whole apparatus being protected from the weather as the crane is designed for yard service for large manufacturing plants.

Fig. 2 shows a pillar crane employed for indoor service, which was constructed in Berlin, Germany, by Becker, and electrically equipped by the Elektricitäts Actien Gesellschaft, of Frankfort. It has a lifting capacity of 7.5 tons, and is utilized in the boiler shop of Henschel & Son, of Cassel, Germany. The controlling mechanism is mounted near the base of the pillar within easy reach of the operator. The driving motor is mounted on the top of one arm of the pillar crane, from which point it drives by gearing and chains the swinging and hoisting motion employed in the regular service of the mechanism. The hoisting hook is suspended from a carriage on a long arm of the pillar crane, the hoisting of the hook and movement of the carriage on the arm being controlled by the wheels shown at the base of the pillar.

Pillar cranes are very largely used in iron and steel works as well as in machine shops, boiler houses and yards of manufacturing plants, where the fixed types of pillar cranes are more largely employed. Fig. 3 shows the construction and indicates the methods of operation of an interesting type of German movable pillar crane as utilized for removing ingots from the soaking pits of modern European steel works. This crane was constructed by the Gesellschaft für Elektrische Industrie, of Karlsruhe, I. B., Germany. This "velocipedkran" or gantry traveler has a capacity of 3.5 tons, with a hoisting speed of 15 meters per minute. The carriage mounted on the swinging arm of the pillar crane, as noted in the illustration, is operated by a three-phase motor. The carriage operates at a speed of 17 meters per minute, while the arm swings with the pillar, 2.1 rotations being the maximum per minute, this motion being supplied by another motor geared to the pillar at its base. A third three-phase motor of 7 hp capacity is utilized for moving the pillar crane on its track, the travel being at the rate of 35 meters per minute. All of the movements of the pillar crane are controlled from the operator's stand on the base of the crane. The hoisting hook is operated by a 20-hp motor mounted on the carriage, the greatest radius of action being 12.9 meters and the shortest radius of action being 3.4 meters. The total height of this pillar crane is 6.078 meters, while the height to the top of the swinging arm is 5.048 meters, and the maximum height to which the hook may be raised is 4.05 meters.

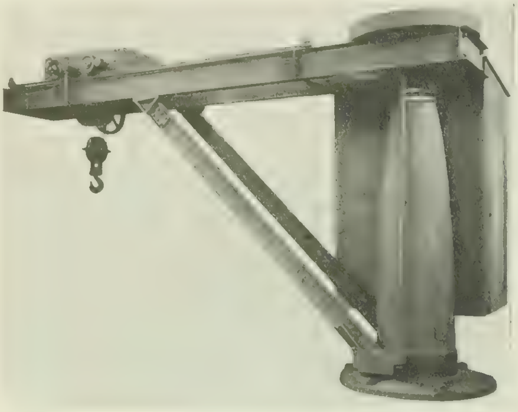


FIG. 1.—AMERICAN ELECTRIC PILLAR CRANE.

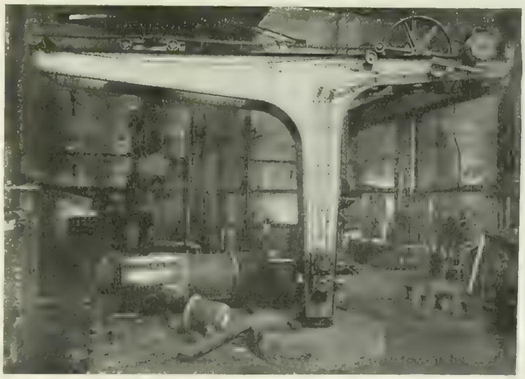


FIG. 2.—GERMAN ELECTRIC PILLAR CRANE.

The universal controller employed is so designed that by the movement of a single lever the hoisting and swinging motions are controlled in harmony with the movement of the lever. The three chief movements are effected by means of three reversing regulators by applying a universal crane controller which permits the performing of two movements of the crane with one single steering lever. The zero position of this lever is the horizontal one; when moved upward the load is raised; if turned to right or left the load follows the same direction; if turned in an upward direction and to the right, the load follows a corresponding movement; if a circle be described by the lever the load performs a circular movement.

This steering apparatus differs from an ordinary street railway controller only in that it is constructed with two cylinders, which, through the medium of cog wheels, may be turned by the lever either singly or both at the same time. The resistance is mounted separately in each case. In some special cases the universal steering apparatus is provided with a third cylinder for the third movement, which is set in motion by means of a separate small lever. But in a general way the use of a special reversing regulator quite suffices for the third movement. In this way the man in charge of the crane can, by the aid of his two hands alone, direct the three movements of the crane simultaneously. All the movements are thus centralized and are directed by a single man. In the case of traveling cranes, and more particularly where very rapid running is required, the steering apparatus is kept in the bunk immediately below the crane bearer. The elevated position of the man in charge affords him an extensive view of the whole field of operation, thus enabling him to work rapidly and with distinct aim. It goes without saying that good quality and durability of the steering apparatus on the one hand, and, on the other hand, its exact adaptation to the requirements of each individual case, are most important factors in the successful handling of cranes on a large scale.

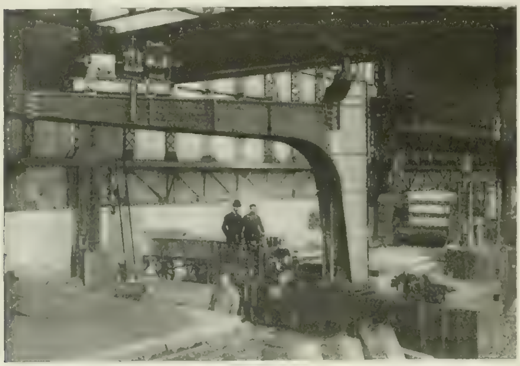


FIG. 3.—GERMAN ELECTRIC PILLAR CRANE AT STEEL WORKS.

It is a necessary condition of rapid manipulation that the steering apparatus be graduated to a fine scale. Well constructed cranes must deposit their loads upon the desired spots to within half an inch straightaway and without any prior uncertain attempts. In order to more fully insure this result the starting gear of cranes is provided with automatic electromagnetic brakes.

New Telephone Patents.

CENTRAL OFFICE APPLIANCES

Mr. Frank B. Cook, of Chicago, has brought out one more form of sneak current protector, this being a modification of one of his earlier types designed upon the self-soldering plan. With this present design a high-resistance carbon conductor of cylindrical shape is included in the circuit to be protected. This cylinder is held in a spring holder restrained against rotation about its axis. Near the middle of the cylinder is a groove into which there is sprung a metallic ring having a serrated surface. This ring will rotate freely on the cylinder, except when secured in position by a fusible wax or solder. The actuating spring catches in one of the teeth of the ring and through it completes the electric circuit. If sufficient current flows to heat the fusible material it lets go, the ring slips and the operating spring snaps off and opens the circuit. As the cylinder cools the adhesive sets, securing the ring in a new position ready for re-use.

With lamp switchboards, the lamp cap and lamp cap symbol have always been a study. Some use an opalescent bull's eye cap which can be seen from any direction. Such a cap is difficult to mark, however. Internal markings have failed, while external ones must be cut in the glass and filled in. Another type of cap carries a plane window, and T. V. Davis, of Kansas City, has invented a plane cap with changeable markings. These markings are upon thin templates, which fit over the face cap of the cap proper, being secured in position by a guard ring which slips on over the extremity of the lamp cap holder. Mr. Davis has assigned his patent to the Stromberg-Carlson Company.

The Western Electric Company has obtained by assignment a patent recently issued to F. R. McBerty, of Evanston, Ill., for a special type of switchboard signal. The vane is controlled by two armatures. The weight of one of these, the upper one, as shown in Fig. 1, normally holds the vane obscured. When this armature is attached into the forward position the vane falls by its own weight. When the lower armature is actuated the vane is again obscured, being raised by a stud on the second armature.

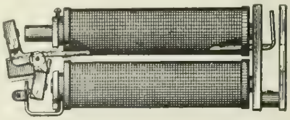


FIG. 1.—M'BERTY SIGNAL.

SWITCHBOARD CIRCUIT.

In Fig. 2 is shown a switchboard circuit for a common battery two-wire system. It is worked out with an auxiliary intermediate potential to give a suitable busy test. In this arrangement of circuits a differential cut-off relay is used, which fails to operate until a plug is put in a line jack. It may readily be traced how this unbalances the two relay windings and how the relay in operating completely shunts out one of its windings and thus remains locked as long as a plug is in its jack. The general principle of operation of both cord and line circuits and the design of the former are well understood. H. G. Webster, of Chicago, is the inventor of this circuit, the Stromberg-Carlson Company having been assigned the patent.

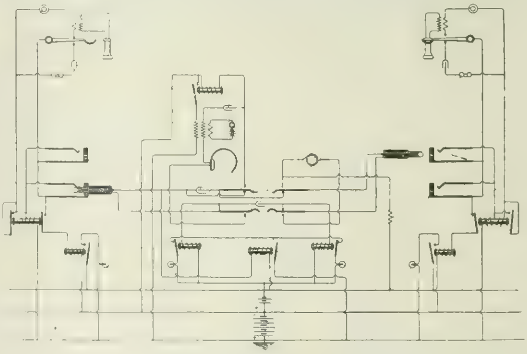


FIG. 2.—WEBSTER SWITCHBOARD CIRCUIT.

BINDING POST.

Still another patent assigned to the above company is that of William Kaisling for a binding post of improved construction. This post has a brass base threaded to receive the clamping screw. This latter is a screw with a shank of reduced size upon which is placed a washer, too small to pass over either head or thread. It is at once seen that as the screw is slacked off the washer travels with it, leaving a clear space between the washer and base within which to insert a wire. The troublesome tendency of a washer to stick to the base is effectively overcome.

SUBSCRIBER'S CIRCUIT.

It is a well-recognized fact that with common battery systems to obtain the maximum of uniformity of transmission with lines varying widely in resistance, the constant part of the resistance must be as high as possible. On the other hand, as this rises the total resistance rises to the detriment of the average transmission. In order to avoid the latter while retaining the former effect, F. W. Dunbar has invented a subscriber's circuit adapted for use with a very high resistance transmitter—in fact one with a normal resistance of several hundred ohms. Such a transmitter will, of course, have a proportionate variable resistance. Mr. Dunbar has arranged his circuits in many different ways, but always includes his receiving and transmitting apparatus in two parallel branches of approximately equal impedance.

INTERCOMMUNICATING SYSTEM.

Mr. Edward J. Hall, of New York City, has patented an intercommunicating system to be operated upon the common battery plan. This is worked out, using two common wires, one battery and one return wire, to which both sides of the telephone circuits are connected. The switch wires are concerned in the signalling only and thus introduce no interference with the talking circuits.

Letters to the Editors.

"London's Telephones."

To the Editors of Electrical World and Engineer:

Sirs:—The remarks published as passed by Postmaster W. R. Wilcox, of New York City, in which it is stated he tells Londoners "their telephone service is the worst he ever saw in any place," deserve comment, as to say what is further stated, that "there is not a Londoner who can say a good word for the telephone service," is very far fetched. As is known to many, in some parts of London the service is as prompt as can be desired. That there is great room for improvement is a sure thing, but look into some of the causes of these remarks, not very complimentary to the telephone authorities of the world's greatest city, when it will be frankly acknowledged, the fault of bad service is not altogether with the telephone authorities. At present, telephonically speaking, London may be said to be undergoing gradual conversion into standard working. The engineering features of its equipment are at present very mixed, there being about five different systems in use, which as every telephone man knows, involves a great deal of complication due to inter-communication details, an absolute necessity for efficient service. These details are unavoidably all such as tend to cut down the rapidity of connecting through, an item which has a large effect on the handling of traffic at centers where the local calls are a very low percentage of the total. In a few years the whole of London's systems will probably be working on the well known "common battery" principle, being on lines much similar to those existent in New York City, which is, without much room for doubt, the city "par excellence" in telephonic matters throughout the world. All of the large exchange centers in the Post Office and several of the National Telephone Company's are on this principle. Thus, in common to the evolution of things, as time goes on, the factor of differing systems with its attendant evils will be eliminated.

The great feature that needs attention by the British telephone user and one that has a great effect on the service is the necessary knowledge of how to handle and transact business through the telephone. What is there to know? may be asked. It is simple, yet very important. Study the instructions issued, act up to the spirit of them, and above all pay attention to your telephone immediately on being rung up. In general, the British public do not seem to take unkindly to the telephone, but certainly as yet do not realize its business value as the American does. Compare the fact that New York City possesses four times the number of telephones that London does. At present the education of the telephone user is a feature much neglected, and where proper instructions are issued, it is common to have them entirely disregarded, to the user's own disadvantage.

However, it seems safe to affirm that the British Post Office in matters telephonic is surely if slowly coming ahead with modern progress, so the time should not be very distant when Londoners may be able to say their telephone system is second to none, and by that time doubtless the public will have fully grasped the necessity of paying as much attention to the proper use of the telephone, as they would when in ill-health to their physician's advice, enhancing the efficiency, while enabling them to realize the true value of the service, a matter never so forcibly brought home as when a serious dislocation occurs, suspending its operation.

New York City. A. L Stanton.

Belgian Single-Phase Railway.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of October 21, 1905, there appears at the foot of page 697 a note stating that you have been informed by Mr. Latour that the motors of the Borinage Railway in Belgium are of the Latour type. The letter from Mr. Latour which appears on page 701 conveys a wrong impression as to the true state of the case.

We beg to inform you that the motors in question were built by our company as the result of experience gained on our experimental lines in our factory and at Spindlersfeld. They are of precisely the same Winter-Eichberg type as used on the Stubaitalbahn line.

Some of our patents for the Winter-Eichberg system were not secured in Belgium soon enough. The reason for the ambiguity in the patent situation is that Germany was not in the International Patent Union at the time when Mr. Latour's French patents were applied for, France and Belgium having at that time a mutual agreement to acknowledge each other's patents. As the result of this state of affairs the Allgemeine Elektricitäts-Gesellschaft preferred to control the Belgian Latour patents. This is the whole influence which Mr. Latour had on the Borinage motors.

As these Belgian Latour patents cover at most only some details of our system it cannot be said that the Borinage motors are of the Latour type.

Berlin, Germany. Allgemeine Elektricitäts-Gesellschaft.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Machines at Liege Exposition (Single-Phase Motor).—Reyval.—An illustrated description of various machines exhibited by the Société Parisienne pour l'Industrie des Chemins de Fer. Most of the machines are for traction service. There is a 34-kw, 225-volt, direct-current generator, various traction motors of different capacities and three-phase and single-phase motors. A single-phase induction motor exhibited is designed by Heyland and starts without any condenser or special external starting device. Its construction is similar to ordinary polyphase induction motors and the special feature rests entirely in the construction of the stator. The same comprises two windings arranged like the phases of a two-phase motor. Their reactances are made as different as possible and at starting the two windings are connected in parallel. The one winding, which is the principal one, is placed in numerous open slots, while the second auxiliary winding, which is used only at starting, has only a single slot per pole and the slot is entirely closed. This construction results in differences of self-induction in the winding, resulting again in different phase differences between the e.m.f. and the current in the two windings. This results in the revolving flux which turns the motor. The motor gives at starting a torque equal to that corresponding to normal running. At that moment the sum of the current absorbed by each of the two phases is not more than double the normal current at full load, if the frequency is not more than 60 periods, and about 2½ times that value if the frequency is 100 periods per second. When the motor starts without load, the starting current is not more than the normal current in the first case; it becomes 1½ times this value in the second case. The starting rheostat is of the normal type as far as the insertion of resistances in the rotor circuit during starting is concerned, but it also comprises another device operated by the same handle, which cuts out automatically the auxiliary phase when the speed of rotation of the motor has become sufficiently high.—*L'Eclairage Elec.*, October 28.

Alternator.—Hopkins.—An illustrated article showing how to build a small alternating current dynamo without castings. *Scien. Am. Sup.*, November 11.

LIGHTS AND LIGHTING.

Flame Arc Lamp.—An illustrated description of the "Oriflamme" arc lamp exhibited by Oliver & Co. at the Olympia Exposition in London. The chief difficulty of flame arc lamps is the rapid consumption of the carbons. Within certain limits the greater the relative size of the flame producing core, the greater the efficiency of the arc; but at the same time, the greater the proportion of the core the more rapid is the consumption of carbon. In the present lamp a "magazine" is used holding eight or nine pairs of carbon, each twelve inches long. These are of exceptionally small diameter, but the proportion of the total section taken up by the core is greater than in ordinary flame lamps. Since the carbons are of smaller size, it is possible to use carbon of comparatively poor quality without impairing the steadiness of the arc, and it is claimed that the cost of carbons does not exceed 0.18 cent per lamp-hour in a 9-amp. lamp. Each pair of carbons burns five hours. The carbons are placed in two boxes, inclined at an angle of 22°. They are put in at the back and pressed forward by a pair of arms controlled by a spiral spring. The right-hand diagram of Fig. 1 is a sketch of one of the magazines, the arms, *AA*, pressing against the carbons, *C*. The front carbon emerges from the magazine as seen, and is pressed forward by the stud, *S*, fixed on a chain, *B*. It is this chain that feeds the lamp, being turned by the sprocket wheel, *D*. There are two studs, *S* and *T*, on this chain. In the position seen in the sketch the stud, *S*, is pressing down the carbon as the lamp feeds by the travel of the chain. When the stud reaches the bottom the carbon is ejected and the next one takes its place, and the second stud, *T*, has at that moment reached the top of the carbon and presses it down as the chain travels. In the left-hand diagram the general arrangement of the lamp is shown. *R* is a reflector which is designed to prevent the deposit of the products of combustion on the globe of the lamp. It is of porcelain in a copper spinning, and rests on the rim of the globe on three distance pieces. By this arrangement there is an upward draught of air through the hole in the reflector and the products of combustion are deposited above. An ash tray, *G*, catches the short ends of carbon.—Lond. *Elec.*, October 20; *L'Industrie Elec.*, November 10.

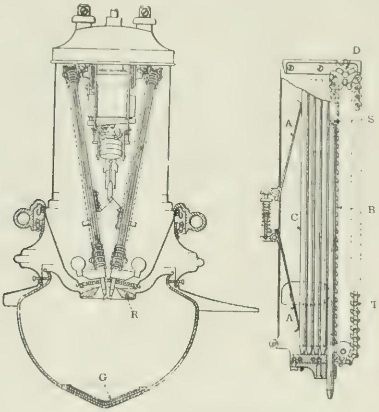


FIG. 1.—FLAME ARC LAMP.

Arc Carbons.—Solomon.—An abstract of a paper on the manufacture of arc carbons. The arc lamp carbon of the day differs very little from the early forms and the process of manufacture is also practically the same. Nearly all carbons then contained about 75 per cent of gas carbon and 25 per cent of soot, gas tar being employed at present, instead of syrup as formerly. The author described the various processes of grinding the retort carbon to pebbles, and finally to dust, by means of an octagonal box containing heavy steel spheres. Tar of the correct quality, although not treated in any way, is exceedingly difficult to obtain. The mixing process is carried out by means of a dough-mixing machine, and the mixture subsequently passed between rollers, so as to distribute the tar evenly. Finally, the material is moulded into large cylinders, forced through a nozzle by means of hydraulic pressure, cut off into lengths of a little over a meter, and then baked. After baking the rods are cut up into pieces of any desired length, sorted, ground to length and pointed. The author mentioned that carbons for use in open-type lamps out of doors have a large proportion of retort carbon; those for use in the same lamps indoors are composed of about equal parts of carbon and soot, while a third class for enclosed lamps is nearly all soot. The materials have to be very pure and clean, and the soot has to be specially made. The author gave some results of tests of carbons made by the British General Electric Company and by firms in Continental Europe.—Lond. *Elec.*, November 17.

Electric Candle.—Among notes on the recent Olympia Exposition in London a new candle fitting of Bonnella & Son is mentioned. This lamp has been designed to meet a demand for a correct and effective initiation of an ordinary wax candle. The lamp, as shown in Fig. 2, consists of three parts, viz.: the interior, the lamp and the opal tube, all of which are renewable at a small cost. The interior is formed of an inner and outer metal case, insulated from each other by a glass tube, and connected at one end to the two terminals of an ordinary S.B.C. cap. On the upper end of the outer tube is screwed a spring clamp, which makes contact with the outer contact of the lamp, the inner tube receiving the pin or second contact of the lamp. It will be seen that the light passes for only a short distance down the opal covering, thus giving it the appearance of a lighted wax candle when a shade is fixed over the lamp. A special spring socket or holder is supplied for fitting into the sconces of pianos, etc., three springs projecting from the outside and holding the socket tight when pushed into the sconce.—Lond. *Elec.*, November 10.

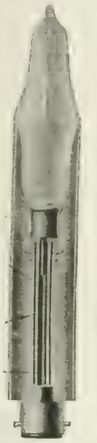


FIG. 2.—ELECTRIC CANDLE.

POWER.

Hydraulic Station.—Herzog.—A well-illustrated description of the water power plant utilizing the falls of the Morobbia mountain stream and supplying power to the city of Bellinzona. There are three three-phase, 660-hp alternators. The voltage is 5,500 and the frequency 50. The results of the tests of the alternators are given in detail.—*L'Eclairage Elec.*, October 28 and November 4.

High-Tension Transmission.—Scott.—Some notes on new extensions of the system of the Missouri Power Company in Montana. The most interesting feature is the use of 70,000 volts for transmission. A brief description of the insulators and pole construction is given.—*Elec. Jour.*, November.

Electricity for Mines.—Randolph.—An illustrated article on colliery and mining switchgear for high and low-tension, alternating-current service.—Lond. *Elec. Rev.*, November 3 and 10.

Turbo-Generator.—Reyval.—A description of a generating set, exhibited at Liege. It consists of a Union steam turbine of 300 hp, running at the speed of 3,000 r.p.m., and a Helios direct-current dynamo. Only the steam turbine is described.—*L'Eclairage Elec.*, November 4.

Steam Turbine Plant.—An illustrated description of the new plant at the Port Dundas generating station in Glasgow. The present plant comprises two Parsons steam turbines directly coupled to 3,000-kw. three-phase alternators.—Lond. *Elec. Rev.*, November 3.

Cleaning Blast Furnace Gases.—Krull.—An illustrated description of a new apparatus devised by Bian for cleaning and cooling blast furnace gases.—*Glueckauf.*—October 28.

Work of Windmills.—Ringelmann.—An account of determinations of the relation between velocity of wind and speed of revolution of windmills employed for raising water. The experiments extended over two years and were made with a pump having 72 vanes, 1.3 meters long, with a total surface of 9.4 square meters. The pump was left to its own working all the time, being self-turning and self-regulating and going out of gear with a wind velocity exceeding 10 meters per second. The ratio between the velocity of the vane rim and the wind varied from 0.82 at 4 meters per second to 0.75 at 10 meters. The volume of water raised 10 meters was 1,566 liters per hour at the former speed and 3,527 liters at the latter speed.—Lond. *Elec.*, November 17; from *Comptes Rendus*, October 30.

Traction.

Heavy Electric Traction.—An article referring to a recent communication of Parshall to the engineering supplement of the London *Times,* of November 1. He is a supporter of the three-wire, direct-current system for the electrification of suburban railways. For the lighter class of railways working over considerable distance with moderate acceleration and moderate tonnage, he thinks that a single-phase system has certain advantages. "As regards first cost third-rail is much cheaper than the ordinary overhead system; as regards reliability, experience is in favor of the third rail." Parshall claims as disadvantages of the single-phase system the drop in the return circuit if not insulated; disturbances to telegraphic and telephonic apparatus and such a low power factor and low efficiency which must counterbalance the energy losses in transformation of polyphase to direct current, in the system at present generally adopted for traction purposes. Parshall suggests that for rapid acceleration and for short runs the direct-current is preferable to the single-phase. Reference is made to Sprague's stand taken with respect to the New York, New Haven & Hartford Railway's decision to install single-phase locomotives. The editorial writer does not seem to agree with these views of Sprague and Parshall. He states that a single-phase system, if properly installed, will have over its whole range of operation a power factor which should not fall below that obtainable with the direct-current system, and rotary converters. Further, alternating currents are much less liable to cause electrolytic and similar damages. The overhead system is not more costly than third-rail or fourth-rail installations, if applied to suburban lines and around large towns. As regards rapid acceleration, where the motors have been scientifically designed with the primary object of making them satisfactory alternating-current motors, and not merely good direct-current motors, which can work more or less efficiently on alternating-current lines, the average acceleration during the whole period of acceleration is at least as favorable, if not more so, with the single-phase as with the direct-current. Fig. 3 gives the results of tests of the Allgem. Elek. Ges., made to compare single-phase and direct-current traction. The train in each case consisted of six coaches, each train being equipped with eight motors, and the run was one of 775 meters (847.5 yards) on the level. The dotted curve refers to direct current, the drawn-out curve to single-phase. It will be seen that whereas with a single-phase motor the accelerating line is practically straight, giving an even acceleration throughout the whole period of acceleration, in the case of the direct-current motor a little after half the period of acceleration, the latter rapidly falls; the result, as far as short-distance journeys are concerned, therefore, being all in favor of the single-phase motor.

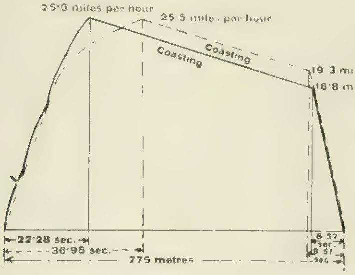


FIG. 3.—DIAGRAM OF TESTS.

	Direct current.	Single phase.
Watt hours per ton km	42.2	39.3
Average efficiency	73.6	74.2
Average power factor.....................	..	.816

With direct current supplied from a high-tension polyphase station through rotary converters, the average power factor over the whole system would not appreciably exceed 82 per cent.—Lond. *Elec. Rev.,* November 17.

New York Central Electrification.—A very well-illustrated article describing the proposed track lay-outs on the new Grand Central Station of the New York Central Railroad in New York. This station will not only be the largest and most complete of any in the world, but will also be unique in that it is designed exclusively for electric trains. Following the description of this station is a full account of the power distribution system to be used in the electric zone of the New York Central Railroad.—*St. R'y Jour.,* November 18.

Three-Phase Versus Direct-Current Traction for Trunk Railroads.—Koromozay.—A comparison of the relative advantages of the three-phase and direct-current systems for electric traction on main railroads. The author compares first cost, working cost, security of service and elasticity of service. He is in favor of the three-phase system. Some comparative figures for first cost are given for the Valtellina three-phase line and the Milan-Gallarate-Porto-Ceresio direct-current road. For the former the first cost was 12,000 francs per kilometer; for the latter 27,380 francs. The first cost of the three-phase line is, therefore, less than 50 per cent of that of the direct-current line.—*L'Eclairage Elec.,* October 28.

Brakes.—Two reports on brakes presented before the Association of German Street Railway & Light Railway Companies. The first report by Scholtes is in favor of the electric brake and some of his conclusions are as follows: The first cost of the electric brake is less than that of the air brake, and its maintenance cost is lower than even the hand brake. This is due to the less wear of the brake shoes, which are used only after the car has already been braked electrically. Electric braking requires simply a somewhat larger controller and more closely graduated resistances. On trail cars the solenoid brake is now considered preferable to the disc type. The second report is written by Bjorkegren and is rather in favor of air brakes. The proper operation of the electric brake is said to demand a certain degree of skill. The air brake has given the better results on low city speeds and the electric brake on high city speeds. It appears also that the stops are smoother and the jolts less marked with the air brake than with the electric brake. Judging from the experience on the Berlin railway Bjorkegren asserted that on similar systems either brake was equally reliable, as proved from the collision statistics. It was his opinion, however, that for lines with long severe grades, electric brakes should not be recommended, owing to the severe strain put upon the apparatus in trying to stop a runaway car. The use of air brakes on such lines makes it possible to have independent braking for the trailers. Air brakes should also be preferred on high-speed interurban runs with heavy cars. Consequently it may be concluded with regard to reliability that the air brake satisfies all operating conditions and the electric brake only a limited set of conditions. Both authors give some interesting statistics on first cost, maintenance and extra current required on account of power braking.—*St. R'y Jour.,* November 18.

Combined Electric and Steam Traction in Hungary.—A note stating that the railway which is at present being built between Miskolez and Diosgyör will normally be operated electrically, but the traction peaks (which are very pronounced) will be dealt with by three steam motor cars besides. This arrangement has been adopted to reduce the cost of electrical plant, especially in connection with the distributing system. Ganz & Co., who are the contractors for the electrical portion, will also supply the three 80-hp steam motor cars, which are to haul several trailers.—Lond. *Elec.,* October 27.

Freight Tunnel in Chicago.—An illustrated article giving some information concerning recent developments on the elaborate system of freight tunnels underlying the central business district of Chicago. The purpose is to relieve the congested streets above of a great deal of teaming by conveying coal, ashes, earth from buildings and excavations, freight, merchandise and mail matter by means of narrow-gauge electric railways in the system of tunnels. Thirty-nine miles have so far been completed. As yet the tunnels are in use only to a limited extent.—*Western Elec.,* November 18.

Block Signals.—Kohlfuerst.—An illustrated description of Grassman's block signal system for single-track railroads.—*Dingler's Polyt. Jour.,* November 11.

Trolley Wire Suspension. An illustrated description of a new flexible suspension for grooved trolley wire.—Lond. *Elec.,* November 10.

Railway Motors.—Schoepf.—An illustrated article of a general nature on the installation and care of railway motors.—*Elec. Age,* November.

Installations. Systems and Appliances.

Automatic Voltage Regulator.—In notes on the recent Olympia Exposition in London the Chapman regulator is described. The principle on which this regulator works is the automatic adjustment of a resistance placed in the field magnet circuit of the generator.

The regulator consists essentially of three parts: a rheostat, a working solenoid to operate the rheostat, and a relay to detect any slight variation in voltage. According to the size of the generator to be governed, the rheostat is composed of from one to four sets of coils, each being connected to a set of segments numbering from 41 to 61 in a set. German silver is the material used for the coils, which are stretched between slate plates. The segments of the rheostat are made of rolled copper and are arranged on top of the working solenoid side by side, insulated by mica, and resemble a flat commutator. A German silver brush moves over the upper surface of the segments, and is operatively connected to the core of the working solenoid. The working solenoid (Fig. 4) consists of two differentially wound coils of wire mounted on a brass tube. Inside the tube is placed an iron core, cone-shaped at either end, and adapted to serve a double purpose: that of a magnetic movable core, and that of a piston in a cylinder. The ends of the tube are closed, and the space inside the tube at each end is filled with oil. It is clear that the core can move only as it displaces the oil. A passageway is provided for the oil to pass from one end to the other, and a valve is arranged in the passage for adjusting the freedom of flow of the oil. As may be gathered from the illustration, the vertical plunger is controlled by a small thumb nut. By this means the rapidity of movement of the core may be checked to any desired extent to adapt the movements of the regulator to the characteristics of the particular generator to which it may be connected. The valve should be set just tight enough to prevent "hunting." Each of the two coils composing the working solenoid is made up of three sections of wire; an inside section, an outside section and a middle section. The inside section and outside section are connected as one, and the number of turns of wire in the two together is exactly equal to the number of turns of wire in the middle section. Under normal conditions, with the relay balanced, there is a current flowing only through the middle section of each coil. This magnetizes the core strongly and pulls it equally in opposite directions, so that it remains indifferently in any position where it happens to be. The relay has two platinum contacts. Should the voltage rise 1 per cent, the relay armature abuts against one of the platinum contacts, thus admitting current to the inner and outer sections of the coil at the right-hand side of the regulator; this exactly neutralizes the magnetic effect of the current already in the middle section of that coil, and the core then moves in response to the pull of the middle section of the left-hand coil. If the voltage drops 1 per cent below normal, the relay makes contact on the other side and the core is pulled the other way; and since the sections of the large solenoid are exactly balanced against each other, the effects of self-induction are entirely neutralized, and there is no spark at the platinum contact points. The diagram of the connections is shown in Fig. 5.—Lond. *Elec.*, November 3.

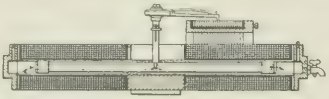


FIG. 4.—VOLTAGE REGULATOR.

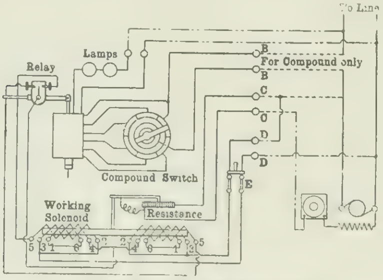


FIG. 5.—DIAGRAM OF CONNECTIONS.

Central Stations in Australasia.—A statistical list giving detailed information on the management and equipment of electric supply stations in Australasia, corrected to August, 1905. Fifty-two stations are mentioned. The largest one is the Melbourne municipal plant of 3,854 kw capacity.—*Australian Hardware and Mach.*, September 1; Lond. *Elec. Rev.*, November 3.

Lightning Arresters.—A report of a committee of the Franklin Institute on the Shaw lightning arrester.—*Jour. Franklin Inst.*, November.

ELECTROPHYSICS AND MAGNETISM.

Congress of Radiology.—An account of the proceedings of the first International Congress of Radiology and Ionization, held in Liege from September 11 to 16, 1905, with abstracts of the following papers presented: Riecke, on the absorption of the rays from radium and polonium; Angstrom, on the heat given off by radium; Himsted and Meyer, on spectrum analysis of the light emitted from radium bromide crystals; Wiedemann and Wehnelt, on an easy method of investigating the metallic vapor spectra of discharge tubes; Mathies, on potential measurements in tubes without electrodes; Mache and Meyer, on the radioactivity of Austrian thermal spring waters; Blanc, on the radioactive elements contained in the sediments of the thermal springs in Echaillon and Salins-Montiers (Savoie); Tommasina, on the radioactivity of the lava of the 1904 eruption of the Vesuvius; Sarasin, on the radioactivity of air from springs; Sarasin, Tommasina and Micheli, on an investigation of the Elstea and Geitel phenomenon of induced radioactivity; Brunhes and Baldit, on the dissipation of both electricities on tops of certain mountains; Barus, on the properties of condensation nuclei and their distribution in the atmosphere; Lewis, on the velocity of ions in the gases of colored flames.—*Phys. Zeit.*, October 26. Paper by Righi on the electrification of bodies subjected to radium rays.—*Phys. Zeit.*, November 9.

Excited Activity.—Makower and Jackson.—Two papers, in the first of which Mackower gives a result of an experimental investigation of the method for transmission of the excited activity of radium to the cathode. He arrives at the hypothesis that the molecules of excited activity, initially uncharged, are projected from radium emanation with velocities large compared with those of gas molecules, and at a certain percentage of encounters with the gas molecules a negative electron is shot off, leaving the activity positively charged. The paper by Jackson is chiefly mathematical.—*Phil. Mag.*, November.

Electric Wind.—Schaffers.—An account of an experimental investigation of the complex nature of what is generally called electric wind. In most cases it is due to three different causes. The first is the change of form of a liquid conductor under the action of influence and of the ordinary attraction. The second is the repulsion of the point to the charge of equal sign given to this conductor. The third is the effect of the air being carried along with the moving electric charges, i. e., the ions. The last cause is generally considered exclusively, but it is not the main cause. The second cause always appears to be predominant.—*Phys. Zeit.*, October 1.

Path of Cathode Rays.—Wehnelt.—If a cathode is passed through a homogeneous electrostatic field the theory requires that the path of the ray is a parabola. The author shows how this may be easily demonstrated by experiments.—*Phys. Zeit.*, October 1.

ELECTROCHEMISTRY AND BATTERIES.

Traction Storage Cell.—Some notes on the Girard and Fiedler lead storage cell for which some remarkable claims are made, although not vouched for by the editorial writer. It is claimed that 1 hp-hour can be obtained from a cell weighing only 16 kg., an output equivalent to more than 21 watt-hours per pound. The battery is charged in a period not exceeding 2 hours. A battery which when discharged in 10 hours gives 360 amp.-hours, is claimed to give 180 amp.-hours when discharged in one hour. The amp.-hour efficiency is claimed to be practically constant, no matter what rate of charge or discharge is adopted. The plates are of the pasted type.—Lond. *Elec. Rev.*, November 10.

Metallic Calcium.—Goodwin.—An account of experiments in which he obtained metallic calcium by electrolysis of fused calcium chloride with a hollow cylindrical anode vessel of graphite. As cathode he used an iron rod on which the calcium is deposited; this rod is gradually raised during electrolysis in order to prevent the calcium from redissolving in the electrolyte.—*Jour. Am. Chem. Soc.*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Modified Braun Tube.—Wehnelt.—An illustrated description of a highly sensitive modification of the well-known Braun cathode-ray tube. He uses the "soft" rays which are given off from incandescent metallic oxides (CaO, BaO, SrO) as cathodes in discharge tubes. The new Braun tube is designed for magnetic and electrostatic deviation and its construction is shown in Fig. 6. *K* is the cathode consisting of a narrow strip of platinum foil which is brought to incandescence by the current from a few storage cells, *B*. On the platinum strip there is a spot of CaO of several square millimeters. The anode, *A*, has a very small opening in the center. If *K* is heated and *A* is connected with the positive and *K* with the negative pole of a source of current of several hundred volts with suitable resistances in series, the CaO spot on *K* sends out an intense bundle of cathode rays. The perforation, *A*, allows only a well-defined ray to pass. C_1 and C_2 are condenser plates. The ray produces a well-defined bright fluorescent spot on the screen, *S*. This spot is the brighter the greater the difference of voltage used for producing the cathode rays. The author recommends voltages between 200 and 1,000. Corresponding to the relatively low voltages used, the rays can be easily deviated magnetically as well as electrostatically. The vacuum of the tube must be as perfect as possible since the rays ionize strongly; the gas and the ionization is the greater the greater the density. This new type of Braun tube is recommended as useful in all cases in which the high electrostatic potentials of the ordinary Braun tube are a disadvantage; moreover, the velocity of the cathode rays and the sensitiveness of the tube may be easily varied within wide limits by regulating the temperature of the cathode and by properly selecting the voltages applied.—*Phys. Zeit.*, November 1.

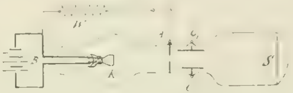


FIG. 6.—CATHODE-RAY TUBE.

Equipment of Meter Testing Departments.—Gerhardi.—In the continuation of his long illustrated serial on electricity meters the author deals with instruments, apparatus, accessories for meter testing departments. He first refers briefly to the Kelvin balances, voltmeters, potentiometers and standards of time, and then deals at greater length with frequency meters and apparatus for measuring the torque.—Lond. *Elec.*, November 10.

Transformer Tests.—Drucbert.—A discussion of various transformer tests. He first deals with the determination of the variation of tension and describes the method of Kapp and the construction of the diagrams of Kapp and Arnold. He then discusses the determination of the increase of current. Diagrams are given and numerical applications are made.—*L'Eclairage Elec.*, November 4.

Testing Converters.—Bercovitz.—An illustrated note on tests of converters.—*Elek. Anz.*, November 9.

Telegraphy, Telephony and Signals.

Telegraphy and Telephony.—Gavey.—The conclusion of his presidential address to the British Institution of Electrical Engineers. The first part of the address was mentioned in the Digest last week. In the second part the author gave a review of the development of wireless telegraphy; he believes that wireless telegraphy is not under any circumstances to supplant or even to compete seriously with inland methods of communication. But there is an important sphere of utility for communication from ship to shore and from ship to ship. For communication between neighboring coasts there is also a possible future, but this depends almost wholly on the further development of the methods of syntony or tuning. The speaker then discussed developments in overground and underground telegraph line construction and gave a review of the enormous increase of the telephone industry. He spoke up strongly for the "milliampere man" and pointed out how wrong the occasional tendency is to look upon telegraphs and telephones as a little apart from serious engineering undertakings. "When modern telephone practice is considered it will be found that in the complexity of the system the amount of electrical energy used for the purpose of signaling and the extent of the works undertaken, a telephone system regarded from the engineering standpoint is in no degree behind any other electrical enterprise." The author gave a review of the development of long-distance telephony with special reference to Pupin's system. He also gave the results of interesting experiments made by the British Post Office, exhibiting graphically the attenuation which in practice takes place under varying conditions. Two circuits were selected, one of one mile and the second of 20 miles of the same cable. An oscillograph was used for observing simultaneously the curves due to the action of the induction coil at the transmitting end and the corresponding curves at the receiving ends of the circuits. A number of letters, both vowels and consonants, were rapidly spoken into the transmitter and the respective transmitted and received curves for each were recorded in the usual photographic manner. Fig. 7 gives the results for the letter *E*. It will be seen that on the one-mile length the difference of amplitude at the transmitting and receiving ends is almost inappreciable; and all the irregularities of each transmitted curve are faithfully reproduced at the distant end. With the 20-mile cable the difference of amplitudes at the two ends is most marked, and although it is perhaps somewhat more difficult to compare the shapes of the two curves, they still bear a substantial resemblance one to the other. Of unsolved problems the author mentioned the following: A means whereby telegraphic messages can be received at high rates of speed in type or written character, ready for immediate issue to the public or the press; in wireless telegraphy the problem of perfect tuning; in telephony the invention of an effective telephone relay or repeater and secondly a method of extending the range of communication in submarine cables.—Lond. *Elec.*, November 17.

FIG. 7.—TELEPHONE SPEECH CURVES OF LETTER E.

Speed of Different Telegraph Systems.—Luginbaehl.—The author gives the following table on the speed of various telegraph systems:

	Words per hour and per line.	Wires.	Words per wire.	No. of operators at the two ends of wire.	Words per operator.
1. Morse	700	1	700	2	350
2. Sounder	1000	1	1000	2	500
" duplex ..	2000	1	2000	4	500
" quadruplex	4000	1	4000	8	500
3. Hughes	1440	1	1440	2	720
" duplex . .	2880	1	2880	4	720
4. Beaudot triple ..	4320	1	4320	6	720
5. Baudot Dubreuil double . .	4800	1	4800	4	1200
6. Wheatsone automatic q'druplex	12000	1	12000	18	666
7. Murray, simple...	2880	1	2880	4	720
" duplex..	5760	1	5760	6	960
8. Rowland, octuplex.	13440	1	13440	12	1120
9. Mercadier, 2×12 posts	12000	2	6000	24	500
Mercadier, dplex.	24000	2	12000	48	500
10. Pollak & Virag ..	[illegible]	[illegible]	[illegible]	-	more than 1000
11. Siemens . ..	17866	1	17866	13	1374

The data for the systems 1 to 6 are based on observations of the author; the data given for systems 7 to 11 are taken from statements in engineering journals.—*Jour. Telegraphique*, October 25.

Statistics.—Statistical notes on telegraphy and telephony in Great Britain in 1904-5; in Denmark, 1903-4; in the Dutch Indies, in 1902 and 1903; in Switzerland, in 1904. A description of the new Bureau des Telegraphes, in Berne is also given.—*Jour. Telegraphique*, October.

German Cables in the Far East.—Meyer.—Notes on some German cables in the Far East. The section between Shanghai and Tschifu offered considerable difficulties since it contained a portion of 110 kilometers with a depth of the ocean of 7,300 meters. The construction of the cables made by a German company is described.—*Elek. Zeit.*, November 9.

Miscellaneous.

Calculating Temperature Rises with a Slide Rule.—Walker.—An article showing how a simple and accurate method for calculating changes of resistance of copper with changes of temperature, and vice versa, can be employed by using a slide rule fitted with a suit able sliding scale. The method described takes into account the changes of the temperature coefficient with temperature.—*Elec. Jour.*, November.

Electric Furnace Hoist.

By L. Ramakers.

BELOW is given a description of a very interesting electrically-operated furnace hoist, which was constructed recently by the Elektricitats Aktiengesellschaft vorm W. Lahmeyer & Co., of Frankfurt:

The hoist shown in Fig. 1 is a double hoist sloping hoist, so that while the contents of one truck is being dicharged into the furnace the other is being filled below in the pit. For this purpose two lines are provided at the loading pit, a coke line and an ore line, so that ore and coke can be handled alternately. With double-lead transmission the hoist is capable of lifting about 2,500 tons in 24 hours, it being assumed that the weight taken by each truck is, say, four tons of ore and two tons of coke or lime, the weight of the truck itself being two tons. The duration of travel of the truck, with a vertical lifting height of 40 m., amounts to about 75 seconds, so that the duration of a loading journey amounts to say 100 seconds, if 25 seconds be allowed for filling the trucks. The driving mechanism is so calculated, however, that the hoist is capable of lifting the quantity stated with only one lead, provided the trucks are large enough to hold a load of six tons.

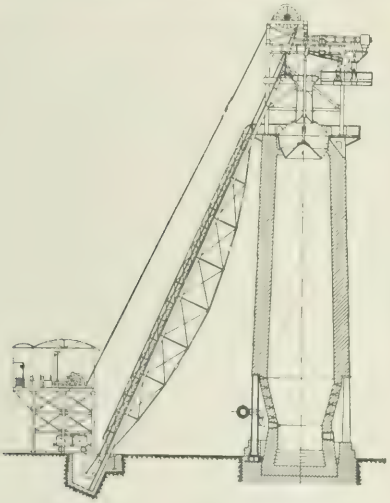


FIG. 1.—VIEW OF HOISTING INSTALLATION.

The control of the hoist is perfectly automatic, so that all that is required is to start the ascent and descent, the actual running, stopping and braking being effected automatically and positively by the hoist itself. The driving apparatus is made double, and the connecting up of the whole plant is such that not only can the two motors be used alternately with their corresponding starters, but it is also possible to have an intermittent driving of motors and starters, and likewise a simultaneous driving or working of the motors. The mutual interchangeability of the motors and their distribution or valve motion admits of a continuation of work, even should one of the two parts become defective. The possibility of letting the motors work simultaneously on one countershaft is of special use when, owing to breakage of a rope or damage to the second countershaft the then not counterbalanced weight of the furnace truck and the somewhat greater loading thereof requires a greater power of the driving engine. Of course all precautions are taken against overdriving, slack rope, stoppage of current or breakage of a wire

The two driving motors are arranged right and left of the rope drums, and their base plates are screwed on to the foundation frame of the winch. The tripartite frame is strongly made of hollow cast iron and held together by flange screws and nuts. Each of the motors has a capacity of 100 hp with a speed of 290 r.p.m., with direct current at 550 volts. In order to obtain as uniform running as possible, even under variable load, and also to secure prompt and exact braking, when the motor supplies return current as a dynamo, the motors are counter compounded.

Clutches inserted in the countershaft enable each of the countershaft halves to be uncoupled with the corresponding motor. The ordinary brake and the emergency brake are made double, so as to render the two halves of the driving mechanism completely independent of each other. The brake discs of the former bear upon the motor axles, while the discs of the emergency brake are cast on to the rope discs direct. The mechanism for the working brakes is fastened with the brake cheeks to the base plate of the winch and, being at the same time dependent upon the driving mechanism, is operated by means of magnets which are mounted upon special cast-iron brackets behind the motors and are intended for a tensile strain of 220 lbs. with a lift of 4 in. The braking magnets are provided with air dash-pots, so as to prevent jolting in switching them on and off. As soon as the motor receives current the brake is taken off, but falls into position again directly the motor is cut out of circuit or when current is stopped for any other reason.

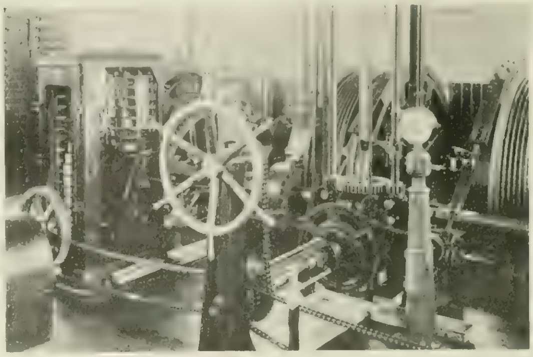


FIG. 2.—VIEW OF DRIVING MECHANISM.

The emergency brake consists of two steel bands lined with wood, which are tightened up by means of a mutual brake lever with weight. It comes into operation directly the truck runs too high for any reason whatsoever. In this case the chucks of the depth indicator lift a rod which draws away a plug from beneath the brake lever, thus causing it to fall and apply the emergency brake. Furthermore, the emergency brake can also be applied by the engineer by hand by the aid of a lever which is placed close to the guiding wheel. The fallen brake weight can be raised again by means of a hand winch, the crank of which can be taken away in the usual manner, and the arrangement is such that the release mechanism automatically snaps into position again.

[illegible] OF CONTROLLER

The depth indicator is located immediately in front of the driver's seat, and, [illegible] trucks, is provided with two screw spindles having indicator chucks which show exactly the position at any [illegible] and descending truck. It is driven by means of conic wheels from off the countershaft. Two bells serve as a warning signal when the trucks are approaching the terminal position. In the central axis of the driving mechanism, and permitting of an easy view of the whole mechanism, there is the engineer's platform with the guiding and controlling wheel. The double starters, mounted right and left of the drivers' platform, are connected by means of chain gearing to the guiding wheel and to the driving mechanism.

As mentioned above, the arrangement is such that the driver has only to make the introductory regulating movements, all the others being automatically effected by the hoist itself. The whole of the driving mechanism is shown in Fig. 2, while two views are given of one of the starters in Figs. 3 and 4. It has two contact rollers, one of which is moved by the steam steering wheel and serves as a connecting up roller, while the second is rotated from off the countershaft by means of chain gearing. The first one, by means of its contacts, inserts resistance so that the motor is just able to start. The second starting roller, driven by the driving mechanism itself, then comes into play and automatically and successively short-circuits the several grades of resistances. The stopping of the lift is effected by a retarding device driven off the countershaft by means of conic wheels; this retarder consists of a powerful screw spindle with nuts held in a guide frame. The small friction of the nuts is not sufficient to turn the guide frame, so that the nut travels on the spindle and its position corresponds at any minute to the position of one or both of the trucks. As soon, however, as the hoist has reached its terminal positions the nut is firmly coupled to an adjustable stop attached to the frame, so that the frame, guiding wheel and putting in circuit roller connected thereto, can now be turned back. Brake contacts arranged thereon cause the braking of the motor as a dynamo, whereby a gentle but positive stoppage of the driving mechanism and of the trucks is effected.

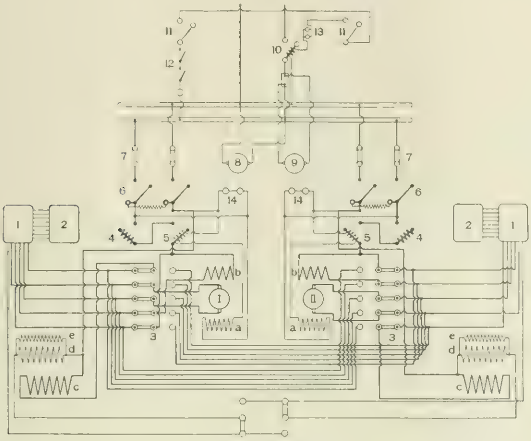


FIG. 5.—DIAGRAM OF CIRCUITS.

Simultaneously with the aforesaid electric braking of the motor the brake magnets, which are deprived of current on being cut out, throw the mechanical brake upon the motor shaft. Due to the use of both kinds of brakes double safety is obtained. Furthermore, as already remarked, a third brake is formed by the emergency brake acting upon the rope drum, this being released purely mechanically by the nuts of the depth indicator, but it can also be operated from the driver's platform.

The whole of the scheme of connections for the hoist is shown in Fig. 5, where the following notation is used: 1, controller; 2, resistances; 3, reversing bars; 4, maximum switch; 5, minimum switch; 6, cut-out; 7, fuses; 8, voltmeter; 9, amperemeter; 10, minimum cut out; 11, terminal cut out; 12, switch against sagging rope; 13, incandescent lamps as resistances; 14, incandescent lamps as resistances; *I* and *II*, motors; *a*, shunt field coils of motors; *b*, main current winding of motors; *C*, brake magnet, main current winding; *d*, brake magnet, shunt winding; *e*, guard resistance. In this connection the following brief remarks may be made: In the current conductor to the bus-bars there is inserted a minimum cut-out switch, which in the event of a return or stoppage of the potential supplied from the central station, breaks the circuit and thus brings the hoist to a standstill by depriving the brake magnets of current.

To the winding of the minimum switch there are connected the anti-sagging switches and the terminal switches provided at the end of the transport path, so that the whole system is also deprived of current and comes to a standstill should the retarding device refuse to act contrary to expectation or should sagging of the rope occur. A second minimum switch is placed immediately in front of the motor, and its winding is laid in the shunt exciting circuit of the motors. These switches also bring the mechanism automatically to a standstill should the excitation of the motors be interrupted by any chance.

Portable Test Set.

By Chas. H. Coar.

During the installation of telephone cables it is highly desirable to have some convenient method for selecting and testing the various conductors prior to permanently connecting them to terminals. Quite a portion of the time required for installing cables is expended while making the necessary tests, and for this reason any means which would tend to facilitate this testing should commend itself. A test set adapted for use during the installation of cables in order to be convenient must, first of all, be compact and portable so that it may be readily taken from place to place.

The accompanying illustrations show a set of this description applicable for use about central energy systems, the set in most instances being used from the line side of the terminal rack in the exchange building. The set is self-contained and can readily be arranged for operation in any exchange, or in fact at any point where the proper currents are available.

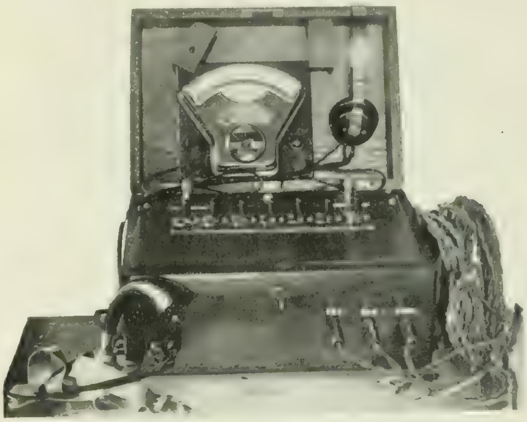


FIG. 1.—GENERAL VIEW OF SET.

This set consists of the following apparatus: First, a reversing key (*Rev*) by means of which the terminals of the testing apparatus in the set can be reversed with regards to the circuit under test. Second, a ringing key (*Gen*) arranged in series with an 80-ohm buzzer, the ringing circuit being connected by means of a plug and jack, as shown in Fig. 3. Third, an operator's key (*Oper*) to connect the operator's talking set to the circuit. Fourth, a battery cut-off key (*BC*) which is arranged in conjunction with the balanced relay and battery feed circuits in such manner that its operation affects the relay and battery supply to the circuit. Fifth, a buzz key (*Buz*) which is arranged in such manner that it controls the operation of the relay. Sixth, two testing keys (*VG* and *VK*) for connecting the voltmeter to the circuit. Seventh, four double connecting cords and plugs for connecting the set up through the jacks provided; the cords in this instance are provided with snap clips. Eighth, a balance relay having 250-ohm windings, used as a buzzer in addition to other factors. Ninth, the operator's equipment, condensers, lamp and other accessories which will be described later.

The usual method of testing cables which extend into the exchange building is to connect the various conductors permanently to the terminal rack clips at the exchange, after which the terminal clip numbers are assigned in any subsequent testing. This method aids matters in most instances, for the cable man can connect his set to a conductor and the man at the exchange rack would locate this conductor by running the test clamp along the terminal clips of the cable under test. One can more readily select the conductors when they are permanently connected.

In describing some of the tests it will be assumed that this method is adopted. The test set is placed at a convenient point on the terminal rack, preferably as near as possible to the cable in question, and connected up as follows: The generator cord and plug is connected to the source of the exchange ringing current, and the plug is inserted in the proper jack. The battery cord and plug is similarly connected, the current being obtained from the exchange battery. The operator's set is plugged into circuit, and the line terminals connected up by means of the plug and cord shown in Fig. 1. The line terminals are connected to the cable clips by means of snap connectors, and the balance relay is operated by throwing the buzzer key. A peculiarly sounding interrupted current is transmitted over the tip and ring conductors of the test set to the cable conductors.

The cable man at the distant end searches for this pair of conductors with one side of his test set. When he makes connection with the pair, the relay in the rack test set ceases to operate as a buzzer and attracts its armature permanently, thus closing the lamp circuit and lighting the lamp, and giving notification that the pair has been found. The two men testing can then converse with each other.

Ordinarily when the lamp lights during tests, the operator in charge of the set places the talking set in service by means of the operator's key (*Oper.*), thus extinguishing the lamp, after which conversation can be held over the conductors selected.

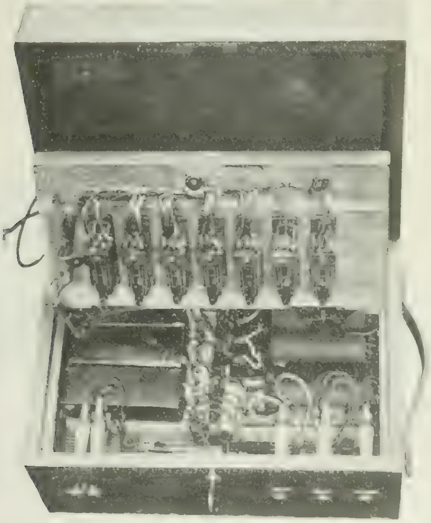


FIG. 2.—VIEW SHOWING INTERIOR ARRANGEMENT.

At times it is more desirable to test in another manner, and the man at the distant end of the cable connects his set to a certain pair of conductors while the operator at the exchange set locates this pair by running the test snaps along the cable terminals until this pair is found.

This latter method is much quicker, but can be adopted to good advantage only under limited conditions. As in instances where there is a large number of conductors to be tested in one cable, a pair of conductors can be utilized to talk over at all times, regardless of the condition of the remaining apparatus in the set. The talking plug and cord (*Tal.*) in the diagram is provided for this purpose, and it will be seen that this is directly connected to the operator's set.

By arranging this set to a pair of conductors in connection with a talking set at the distant end the two men testing can talk at all times during the testing. Under this arrangement the test for the conductors is identical, except, of course, the manner of communication. This method is quick, insomuch as no time is lost in arranging the sets for talking.

It is possible to test out a live cable with this set without interference, but the lamp operation cannot then be obtained because it is necessary to operate through a condenser placed in the circuit by means of the battery cut-off key (*BC*), as shown in the diagram. The man at the distant end would also have to place a condenser in series with his set so as not to short-circuit or ground the circuits during the tests. In this method the switchboard signals are not interfered with, but paths are provided for the ringing current in case an operator rang on a line under test, as this current readily passes through a condenser.

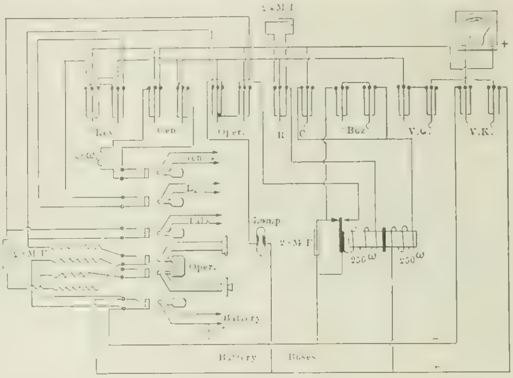


FIG. 3.—DIAGRAM OF CIRCUITS.

A faulty unused conductor would give notice of the defect by a relay operation during the buzz test, unless the trouble be due to an "open" conductor, in which case no test could be secured ordinarily.

When it is desirable to test a conductor by means of the voltmeter the voltmeter key (*VK*) is thrown over, thus giving a metallic circuit measurement by the series method. By operating the voltmeter ground key (*VG*) in conjunction with the voltmeter key (*VK*), a single conductor is tested to ground by the series method. Both conductors can be tested in this manner by using the above combination in addition to the reversing key (*Rev*). At times it is necessary to ring out over cable conductors in order to ascertain if any telephones are connected to them, and for this reason the ringing key (*Gen*) is provided.

A test set similar to the one herein described will be found convenient about common battery exchanges, particularly during the installation of cables, as has been fully demonstrated in actual practice.

◆

Danger of Christmas Decorations.

Special attention has been called in a timely manner by the National Fire Protection Association to the hazard of Christmas decorations and displays. Mr. W. H. Merrill, Jr., secretary, has reissued the Philadelphia circular on the subject quoted below:

The executive committee of the Philadelphia Fire Underwriters' Association feels compelled to call the attention of the public to the dangers to life and property from Christmas displays, decorations, signs, etc., in churches, public buildings, mercantile establishments and especially department stores. The use of Christmas greens, harvest specimens and other inflammable materials, such as draperies, scenery, cotton to represent snow, and the like (especially in connection with electric and other lighting systems), is decidedly an increase of hazard, it being impossible to make displays of that nature perfectly safe. One of the conditions of the insurance policy is that:

"This entire policy, unless otherwise provided by agreement endorsed hereon or added thereto, shall be void if the hazard be increased by any means within the control or knowledge of the insured."

The making of such displays would, therefore, under a strict interpretation of the conditions of the policy render the contract of insurance void unless the policy is endorsed with a special permission for the increased hazard, which will generally be granted only in consideration of an additional premium commensurate with the hazard.

If electricity is used in the building the permit for same in the insurance policy is subject to the following conditions, viz:

"No additions, alternations or repairs shall be made in the system of wiring, lamps or any portion of the system of wires or appliances for conducting, creating or controlling the electric current until written noticé has been given to the Philadelphia Fire Underwriters' Association and an additional permit granted for such."

Therefore, any such changes made in violation of the above condition will affect the insurance.

In addition to the danger to property from displays referred to, the danger to life in crowded stores or places of meeting by reason of a panic occasioned by a fire, even though it be small and easily controlled, is so great that the Underwriters, who have made a study of such hazards, would only be partly fulfilling their duty should they fail to give this warning.

The Proposed Washington Plant.

Bids were opened November 20 on the amended specifications for the power plant for the Capitol at Washington, as follows:

Westinghouse Electric & Mfg. Company, Pittsburg, Pa., proposition 2, $1,084,369; deduction, $596,002, leaving the bid $488.367; proposition 3, $901,736; deduction, $471,929, leaving the bid $429,807.

J. G. White & Co., New York, proposition 1, $1,189,250; deduction, $595,034, leaving bid $594,216; proposition 2, $1,059,299; deduction, $540.377, leaving bid $500.062.

Carl Leonard de Muralt, New York, proposition 1, reciprocating engines, $1,164,700; deduction, $395.500, leaving bid $769.200; proposition 2, turbines, $1,119,800; deduction, $372,500, leaving bid $747.300.

Lynch & Woodward, Boston, Mass., proposition 1, reciprocating engines, $862,726; deduction, $486,957, leaving bid $375,769.

Hanley-Casey Company, Chicago, Ill., proposition 1, $1,047,277.85; deduction, $548,495.65, Babcock & Wilcox boilers, leaving bid $498,782.20; proposition 2, $1,047,277.85; deduction, $556.495.65, leaving bid $490.782.20; proposition 3, $1,047,277.85; deduction, $583,495.65, Atlas boilers, leaving bid $463,782.20.

McIntosh & Seymour Company, New York, proposition 1, $903,730, horizontal compound engines; deduction, $481,054, leaving bid $422,676; proposition 2, $918,500, vertical engines; deduction, $488,052, leaving bid $430,448.

The Schofield Company, Philadelphia, Pa., proposition 1, $1,015,450; deduction, $453.647, leaving bid $561,803; proposition 2, $974,100; deduction, $423,844, leaving bid $550,256.

The original bids were given recently in these columns

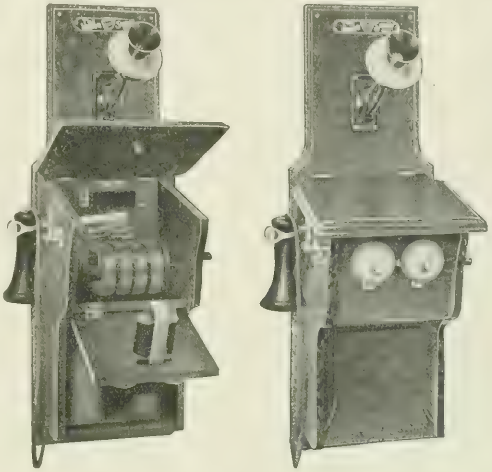
Cabinet Telephones.

A few years ago it was quite the thing among "independents" to boast of the ownership of an ornate tandem cabinet magneto telephone, and the longer the battery box and the more material used in its construction the greater was the pride of its owner. Then came the more practical wide battery box cabinet, so extensively used by the Bell Company interests, and which still has a strong hold upon the fancy of a goodly share of operators and subscribers. Later the compact style of cabinet made its appearance, the original design for which is claimed by half a dozen manufacturers, and is to-day by far more generally used in the independent field than all other styles combined.

This convenient, economical and practical style of telephone now finds a rival in the "Ideal" cabinet. It was originally designed and placed on the market by the Wesco Supply Company, of St. Louis. several years ago, but it proved to be a "snow flower" born before its time "to blush unseen" by but a very small portion of the trade. Since that time, however, several manufacturers have recognized the commercial value of this cabinet design and have made efforts to introduce it to the trade, with the result that a very general demand is springing up for this style of instrument.

The accompanying illustration shows the "Ideal" magneto telephone as now placed on the market by the Wesco Supply Company. Among its advantages are the facts that the line terminals are inside of the cabinet, entering from the rear of the backboard, thus placing these binding posts out of the reach of the user and avoiding the trouble so often experienced by patrons tampering with the line terminals.

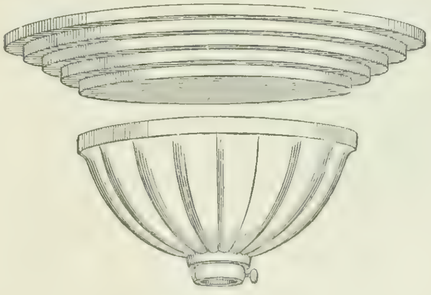
In this instrument all the wiring is done from the rear of the board and all the parts are firmly secured to the backboard, no shelves being used. Another point in its favor is that the transmitter arm is attached to the backboard, which gives it a solid base and avoids the tendency to vibration experienced in the compact style of instruments, where the cabinet itself acts in the manner of a sounding board to the transmitter.



FIGS. 1 AND 2.—CABINET TELEPHONES

Ceiling Fixture Block.

The fixture block illustrated herewith has been introduced by the H. C. Roberts Electric Supply Company, 905 Arch Street, Philadelphia, and bears the name of that concern. As will be seen from the engraving, it is made with steps so as to fit different sizes of standard canopies and will thus accommodate no fewer than four sizes, namely, those of 3, $3\frac{1}{2}$, 4 and $4\frac{1}{2}$ in. diameter. Having this ability to meet the necessities of four sizes, the Roberts block obviously takes the place of four sizes of the old-fashioned block. When a canopy has been put in position on this block it cannot "side slip," but is fixed firmly in the proper central position around the fixture stem. It is, moreover, neat in appearance and should appeal alike to the central station company, the isolated plant or the individual user. The prices are moderate whether for the plain unfinished type or for that in highly polished oak.



CEILING FIXTURE BLOCK

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Jobbers and manufacturers are busily engaged on holiday goods, some lines of which are already reported oversold. In many wholesale lines, on the other hand, seasonable quiet prevails. Manufacturing plants make very satisfactory returns, despite the high level of prices for raw materials and inadequate transporting facilities. Taken as a whole, the reports as to the traffic situation show a small improvement. Railway earnings thus far available for November were 6.5 per cent larger than a year ago and foreign commerce at the port of New York for the week shows gains of $4,280,535 in exports and $2,874,007 in imports, as compared with last year's figures. Reports from the various industries are still highly favorable, iron and steel leading with unprecedented demand and consumption for this season, the highest prices of the year being freely paid, and premiums are eagerly offered for prompt deliveries of finished products. The labor situation is rather more restless, notably in the New York building and shipping trades. Prices of speculative staples all show great strength. Spot cotton sold at 12c., which is the highest price of the year. The cotton goods market was very strong and active in nearly all departments. In the metal market, copper is selling at the highest price in six years. Sensational advances were made, the net gain being about 9/16c. This represents a rise of 2c. in about two months. It is considered in some quarters that this advance has not been justified by commercial conditions and that it has been due largely to manipulation by producers. The closing quotations were 17⅞c. for Lake and electrolytic and 17⅝c. for casting stock. There is great activity in the coal trade, the output and shipments being limited only by car capacity. Commercial failures during the month of November numbered 817, with liabilities of $8,866,798, which compares with 864 in the corresponding month last year, when defaulted indebtedness aggregated $8,535,459. Manufacturing insolvencies were 197 in number and $4,317,443 in amount, against 217 for $3,540,983 in November, 1904. In trading occupations there were 591 defaults involving $4,256,184 compared with 618 failures and $3,929,143 liabilities. In banking and other fiduciary undertakings there were 4 suspensions, with liabilities of $111,200, comparing most favorably with 9 defaults for $761,724 last year. Increased losses in the two chief classes are largely due to the abnormally small failures last year, which were lighter than in any recent November. *Bradstreet's* reports 188 business failures during the week ending November 30, against 224 the week previous and 184 in the corresponding week last year.

BOWRING & CO., 17 State Street, New York, recognizing the opportunities for trade in the Far East, sent Mr. E. R. Duer, the head of their export and import commission department, to the Orient to make investigations and establish business connections in that field. Mr. Duer was in Japan before the war closed and was able to put himself in very close touch with the leading individuals and firms carrying on business in that country. After a thorough investigation he arranged with Messrs. Cornes & Co., one of the oldest English houses in Japan, having establishments in both Yokohama and Kobe, to act as Japanese representatives, Bowring & Co., at the same time, caring for their interests in this market. The business of Messrs. Cornes & Co., covers a widely diversified field. They have an office in London, and are the Japanese correspondents of such firms as J. P. Morgan & Co., Lloyds of London, the Lancashire Insurance Co., the Drexels of Philadelphia, etc. They are in touch with the highest officials of the Japanese Government. Messrs. Cornes & Co. also maintain fully equipped engineering and electrical departments, both of which are under the supervision of competent engineers. Since making the arrangements above referred to Bowring & Co. have succeeded in obtaining several agencies for them from prominent American manufacturers, and now have specifications in hand and prices on various machinery and appliances required for the remodeling of the Imperial Japanese Naval Arsenals. According to the latest advices, Mr. Duer was last in China. After covering that field he will visit the Philippines and possibly Australia, where Bowring & Co. are represented by Robert Little & Co., of Sydney. The firm have also an agency in Buenos Aires, Argentine Republic.

BROKEN STEEL RAIL.—In a decision by I. F. Fischer, the Board of United States General Appraisers have sustained a claim filed by P. McGettrick, of Burlington, Vt., against the action of the Collector of Customs [illegible] duty on pieces of old street railway steel girder rails. It appears from the testimony laid before the board that the rails had been laid down and used in the streets of Canadian cities; that they were welded together end to end, and that after being torn up they were broken into pieces of irregular lengths. They were broken in the middle section of the rails and not at the welds, the majority of the pieces being from three to ten feet long. Another point brought out was that in many instances the "lip" of the rail was broken, thereby rendering it absolutely unserviceable for use. The collector demanded the full duty applicable to T rails at the rate of seven-twentieths of 1 cent per pound, whereas the importer maintained that the merchandise should properly be assessed as scrap steel at the rate of $4 per ton. The importer's claim was upheld, and the collector instructed to return the overcharge.

SOUTHERN LUMBER.—The Frost Cross Arm & Lumber Mfg. Co., Inc., of Cleveland, O., has purchased over 12,000 acres of long leaf yellow pine lumber land, near Ocala, Fla., on the Atlantic Coast Line Railroad, and is now erecting a new and modern mill which will have over five times the capacity of its present plant at Chesterfield, S. C. This new plant will be divided into three departments, viz., rough lumber, dressed and kiln-dried lumber, such as dimension stock, car sills, etc.; and the cross arm factory. The concern will deal only in long leaf, all heart yellow pine cross arms, of the highest grade only, and expects to be in a position to accept orders soon after the first of the year, when its present plants will have been disposed of. It will have one southern office, viz., that in Florida, and will move its general offices, north, from Cleveland to some point near Philadelphia. It will also in all probability change the name of the concern to the Lake Yale Lumber Co., as the timber is on that lake; but the management of the company will remain exactly the same as at present, under Mr. A. S. Ward, president and general manager.

THE OSWEGO BOILER WORKS at Oswego, N. Y., have been purchased by New York parties understood to be associated with the A. D. Granger Co., the machinery house at 95 Liberty St., New York, with branches at Philadelphia and Pittsburg. The plant, which occupies about twenty acres on the lake front, was established some twelve years ago, and will be placed in active operation at once. Steel plate work in all branches, including boilers, tanks, and stacks, will be manufactured. The new company will be known as the Oswego Boiler & Engine Co., with the main office at Oswego, N. Y.

THE LINDSLEY-BAUMAN COMPANY has recently been formed as the successor to the Lindsley Brothers Company. It has offices at Menominee, Mich., and Alfred, Mich., and in the Tribune Bldg., Chicago. H. A. Bauman is the president, G. L. Lindsley, vice-president, and E. A. Lindsley, secretary and treasurer. The capital stock has been increased to $50,000, and the company will carry at all times a complete stock of poles, posts and ties, as was done by its predecessor.

WESTINGHOUSE TURBINES FOR LOS ANGELES.—The Edison Electric Company has closed contracts for a 7,500-kw Westinghouse-Parsons turbo-generator, including condensing plant for its new No. 3 station. The overload capacity will be over 30 per cent, making this one of the largest steam-turbine generating sets ever built. The generator is to be three-phase, 16,500 volts, 50 cycles. The present equipment of the Los Angeles No. 3 power house consists of two 2,000-kw Curtis steam turbines.

JAPANESE PROGRESSIVENESS.—The Calculagraph Co. is distributing with proper pride examples of the time checks employed by the Japanese Porcelain Co., of Noritaka, Japan, in its factory there, as records for its workmen. We doubt whether any American, French or English porcelain factory has yet reached the point of using calculagraphs to record the hours of work, like the brainy, progressive Japs.

DEMAND FOR COPPER.—It is stated that the General Electric Co. will consume between 55,000,000 and 60,000,000 pounds of copper this year, as compared with about 40,000,000 in the preceding year. This will be the largest amount of copper ever consumed by the [illegible] year.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Robinson, Ill.; Lakewood, Ill.; Holt, Mo.; Houlton, Me.; Bingham, Utah, and Harrisonville, M

STEAM TURBINES AS RESERVE POWER.—The Missouri River Power Transmission Company, operating in the vicinity of Helena, Mont., and notable as owning one of the highest voltage transmissions in the world, has begun the erection of a steam turbine power plant to operate as a reserve to its present water power plant. A large part of the output of the Missouri River system is transmitted to the city of Butte, and the Anaconda district mining properties, and the service has grown to such an extent as to warrant the erection of a reserve plant as a protection against serious fluctuations in the available water power. Turbines of the Westinghouse-Parsons type will be installed, the initial equipment, consisting of two units of 2000 kw. capacity each, operating at 1200 r.p.m., with 150 pounds pressure, 28 in. vacuum, 100 degrees superheat. They will be capable of delivering continuous overload of at least 50 per cent condensing, or full load without the assistance of a condenser. The generators will be of the revolving field type, and completely enclosed, with forced ventilation. This feature will entirely eliminate the peculiar hum of the high speed turbine generator of the open type. The generators will operate at 1,200 r.p.m. and deliver 60 cycle, 3-phase current at 2400 volts. The motor-generator exciter and complete switchboard equipment accompanies the turbine plant. The Westinghouse Machine Company, builders of the turbines, will also equip the boiler plant with their mechanical stokers.

AMERICAN ARC LAMP CO.—A whole page is devoted by the Kalamazoo, Mich., *Gazette* to the announcement of the fact that the American Arc Lamp Co. has located there and has a handsome new factory in which to continue the production of its Lea lamp. This enclosed arc is already well known to the industry and has been illustrated and described in these pages. The new factory is a two-story building of brick, well equipped and admirably situated in the heart of the manufacturing district. One of the men identified with the Messrs. Dewings in the concern is Mr. Walter Ramsey, formerly of Indianapolis. He is a man of wide experience and excellent business training and has had charge of the business for several years. Under his management the concern and the lamp have taken a place as leaders among enclosed arc lamps on the market. He expects to become a permanent resident of Kalamazoo and is delighted with his new surroundings. Mr. Charles M. Rose, superintendent of the factory, served ten years with the company, beginning with Mr. Lea. He is well fitted for the position he holds, being a thoroughly practical electrician and familiar with every detail of the manufacture of the lamps. During his service with Mr. Lea, he was of great assistance to the inventor and many of his ideas are embodied in the improved Lea lamp now being vigorously pushed.

WESTINGHOUSE ACTIVITY.—One hears no talk of dull times among the workers in Turtle Creek Valley, locally known as "Westinghouse Valley," owing to the territory being practically covered by the various Westinghouse factories, which extend from East Pittsburg to Wilmerding and Trafford City on the main line of the Pennsylvania Railroad. The largest of these is the Westinghouse Electric & Manufacturing Company, covering over 47 acres at East Pittsburg, where everything electrical is manufactured. Some idea of the magnitude of the business handled at this plant can be formed when it is stated that during the month of October the shipment of electrical apparatus from this factory, exclusive of a large number of local freight and express orders, amounted to approximately 17,000,000 lbs., consisting of over 5,000 individual consignments. Among the more interesting recent shipments was one to the Hawaiian Electric Company, Honolulu, consisting of a 1,200 kw. alternating current generator, and three 500 kw. oil transformers with the necessary auxiliary apparatus. This material is intended for their power station on Kauia Island, the most northern of the Hawaiian group. The shipment goes direct from New York on the S. S. Arizonian, and is the second of a series of similar shipments, the first having gone forward some thirty days ago.

CROPS AND PROSPERITY.—The annual report for 1905 of James Wilson, Secretary of Agriculture, says: "Farm crops have never been harvested at such a high general level of production and value. Corn has reached its highest production, over 2,700,000,000 bushels, of a total estimated value of $1,216,000,000. Hay comes second, with a value of $605,000,000. Cotton is expected to yield $575,000,000. The short wheat crop of last year is followed by one of 684,000,000 bushels, and its value, $525,000,000, overtops the highest value ever before reached. While only one crop, corn, reached its highest production this year, four crops—corn, hay, wheat and rice—reached their highest value. The wealth production on farms in 1905 has reached the highest amount ever attained by the farmer of this or any other country, 'a stupendous aggregate of results of brain and muscle and machine,' amounting in value to $6,415,000,000, an excess over last year of $256,000,000. The wealth produced on farms in 1906 exceed that of 1904 by 4 per cent, that of 1903 by 8 per cent, and that shown by the census figures for 1899 by 36 per cent."

PRICE OF COPPER.—Mr. John Stanton, the copper expert, says: "I have been offered as high as 18 cents a pound for high grade copper, but have not been able to make any contracts at this figure for the reason that I have no copper to sell. Of course we do not expect copper to remain around 18 cents for all time to come. It will eventually decline, but before there is any decline it is likely to go up to 20 cents. I am not in favor of a further sharp upward movement, but when consumers offer fancy figures those who have the copper are likely to satisfy these demands. No heavy sales of copper are being made at the prices now prevailing, one of the reasons being that the big consumers have covered their wants for sometime ahead, and producers are busy fulfilling these contracts. Developments indicate that the market is not "rigged." The prices are very tempting to sellers, but they haven't got the copper to sell. Exports will be very small this month, perhaps 15,000 tons, notwithstanding the copper abroad is very scarce. Home consumption is responsible for the falling off in exports."

ENORMOUS ORDERS FOR CARS.—The New York Central Railroad has placed orders with several manufacturing companies for a total of 25,000 freight cars, calling for the expenditure of about $25,000,000. The order exceeds that placed recently by the Pennsylvania Railroad for 21,000 cars, which until a few days ago was the largest order for equipment ever placed by a railroad in this country. The tremendous scale on which the railroads are now providing equipment indicates the pressure under which they are working to care for the traffic that is being offered to them. The orders placed by the Central are for delivery all through the year 1906. The head of one of the companies which are to manufacture the cars said, however, that it was doubtful if the whole number could be turned out on time, owing to the great demands being made upon the equipment companies. This, however, in view of the electrical requirements, etc., does not represent the full extent of the New York Central car requirements.

TELEFUNKEN WIRELESS.—Ostheimer Bros., of the Burd Building, Philadelphia, writes as follows: "We hereby beg to inform you that the Wireless Telegraphy Company, Limited, Telefunken system, will, on and after December 1, 1905, be represented in the United States by the Telefunken Wireless Telegraph Company of the United States. The entire business heretofore transacted by Messrs. Ostheimer Brothers, as United States agents of the abovementioned company, will be taken over by the Telefunken Company of the United States, which corporation now assumes all the liabilities and contracts entered into by Messrs. Ostheimer Brothers as agents of the aforesaid system."

WASHINGTON, D. C.—Bids will be received until Dec. 12 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., electrical wire and supplies, poles, generating sets, etc; also on Dec. 26 to furnish at the navy yards at Mare Island, Cal., and Puget Sound, Wash., searchlights, etc. H. T. B. Harris, Paymaster-General, U. S. N.

J. G. WHITE & CO.—A steam railroad running from MacKey's Ferry to Beaufort, N. C., will be built for the Virginia and Carolina Coast Railway Co. This road will extend a total length of approximately 120 miles. The contract has been awarded to J. G. White & Co., 43 Exchange Place, New York, who will do all the clearing, grading and track laying work, as well as the building of steel bridges and viaducts.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was subjected to manipulation on a large scale, the prominent feature being the southern iron stocks, although Union Pacific and other standard railroad shares also received similar attention. Toward the close of the week the trading developed weakness, due to a renewed hardening of call loans. While iron and steel stocks, including the United States Steel shares showed strength, they were subordinated entirely to the demonstration in the southern group. Some of the other industrials were very strong. Amalgamated Copper was another strong feature at times, but, on the other hand, the traction shares were less prominent; and the manipulation of Brooklyn Rapid Transit has temporarily subsided. There was active trading in the latter stock, 213,550 shares having been sold at prices ranging between 85½ and 89⅜, the former figure being also the closing quotation. The net result for the week is a decline of 2½ points. Metropolitan Street Railway closed at 118¾, which is a net loss of 1¼ points, and Interborough Rapid Transit closed at 210. Allis-Chalmers common is down ½ point, the closing quotation being 19½; preferred closed at 62. General Electric was on the downward turn and closed at 184, a net loss of 4 points. Westinghouse common and preferred closed at 171⅛ and 190, respectively, the former being a net gain of [illegible] point. American Locomotive common is [illegible] points higher, closing at 71; preferred closed at 117. Western Union declined [illegible] and Mackay Companies gained 1 point, the closing price being [illegible] and [illegible], respectively. The curb market was irregular, with early firmness, followed by easing off in most stocks in sympathy with the Stock Exchange list. The volume of business was smaller. The closing quotations on the Stock Exchange Dec. 5 were as follows:

NEW YORK

	Nov. 28	Dec. 5		Nov. 28	Dec. 5
Allis Chalmers Co.	20⅜	22¼	General Electric	186	185½
Allis-Chalmers Co. pfd.	62	64	Hudson River Tel.		
American Dist. Tel.	37	37	Interborough Rap. Tran.	210¾	211
American Locomotive	71	72⅜	Mackay Cos.	52⅞	50½
American Locomotive pfd.	118½	118	Mackay Cos. pfd.	72¾	71
American Tel. & Cable	91	90	Marconi Tel.		
American Tel. & Tel.	135	132	Metropolitan St. Ry.	120⅜	117¾
Brooklyn Rapid Transit	87¾	85	N. Y. & N. J. Tel.		
Electric Boat	32	32	Western Union Tel.	92½	92½
Electric Boat pfd.	70	70	Westinghouse com.	170	170
Electric Vehicle	14	14	Westinghouse pfd.		
Electric Vehicle pfd.	20	20			

BOSTON

	Nov. 21	Dec. 5		Nov. 28	Dec. 5
American Tel. & Tel.	136	132⅞	Mass. Elec. Ry. pfd.	59½	59½
Cumberland Telephone	121½		Mexican Telephone.	1½	1½
Edison Elec. Illum.			New England Telephone.		
General Electric			Western Tel. & Tel.	13	12
Mass. Elec. Ry.	14½		Western Tel. & Tel. pfd.		

PHILADELPHIA

	Nov. 28	Dec. 5		Nov. 28	Dec. 5
American Railways.	53	52	Phila. Electric.	8½	8⅜
Elec. Co. of America.	11⅛	11¼	Phila. Rapid Trans.	32⅛	34¾
Elec. Storage Battery	80	80½	Phila. Traction.		
Elec. Storage Battery pfd.					

CHICAGO

	Nov. 28	Dec. 5		Nov. 28	Dec. 5
Chicago City Ry.	200	200	National Carbon	75	76½
Chicago Edison	162	161	National Carbon pfd.	114½	*120
Chicago Subway	49¼	53	Union Traction.		
Chicago Tel. Co.		137	Union Traction pfd.		
Metropolitan Elev. com.	27½	27			

* Asked.

BELL TELEPHONE BONDS.—President Fish, of the American Telephone Company, says that while no plans have been made for issuing further securities of the American Telephone & Telegraph Company, and the company is now seeking only to place itself in a position to issue any form of security that may be most advantageous, the officials of the company believe that there might be great advantage in the issue of convertible bonds to the extent of $150,000,000 to be used from time to time. This form of security is attractive to investors for obvious reasons, and would be likely to be readily taken in a broader market than that to which the present issues of Telephone securities have been to some extent confined. There would be no difficulty in securing the capital required for the development of the business in other way, but at the present time a convertible bond seems to be generally regarded as the form of security that can be issued to the best advantage of the company and with the greatest satisfaction to investors.

SAN FRANCISCO UNITED.—Brown Brothers & Company have disposed of all their interest in the United Railways Investment Company of San Francisco, and Ladenburg, Thalmann & Company with their associates and clients now hold a controlling interest in the property. With the change of control Arthur Hollins, who has been president of the company, has resigned, and his successor will be named by the new controlling interests. The United Railways Investment Company controls the street railway system of San Francisco. The company is capitalized at $25,000,000, divided into $10,000,000 common and $15,000,000 preferred stock. Brown Brothers & Company were the managers of the underwriting syndicate which organized the present company. The earnings of the property have increased steadily from the time of the settlement of the strike of the employees, which came soon after the organization of the new holding company. The preferred is now paying 4 per cent. This dividend, it is said, will soon be increased to 5 per cent, which is the full rate to which the stock is entitled.

LONG ISLAND TROLLEYS.—The Belmont syndicate and the Long Island Railroad Company have jointly become owners of the trolley line which runs from Queens, L. I., through Jamaica to Far Rockaway. The property was purchased to extend the street electric system in Queens and Nassau counties controlled by the two interests. The recent purchase has about fifteen miles of track and is said to be a profitable line. It owns valuable franchises besides its own power house and electrical equipment. The Belmont syndicate and the Long Island Railroad have a franchise for a trolley line on the Jericho Turnpike, and it is reported that they are getting ready to build the road. They own all the trolley lines in Nassau County. The Belmont syndicate owns the New York & Queens County Railway Company, which owns all the trolley roads in Queens, with the exception of two lines of the Brooklyn Rapid Transit Company.

U. S. TELEPHONE DEAL.—Stockholders of the Rochester Telephone Company have received circulars from the United States Independent Telephone Company, of which Thomas W. Finucane is the president, withdrawing in effect the former offer to take over the stock of the Rochester company for cash. While the circular does not make explicit mention of any withdrawal, it releases the Rochester company stockholders from existing option agreements, but allows them to exchange Rochester telephone stock for United States Independent stock if they so desire, thus putting all compensation in stock instead of in cash. The United States Company also announces that it has filed its $25,000,000 property mortgage to secure bonds. This is done although the local company has not yet been taken over.

NORTHERN NEW YORK TRACTION.—The new company which is to take over the trolley system of the United Traction Co., of Albany, in the interests of the Delaware & Hudson will probably be known as the Northern New York Traction Co. So far, 94 per cent of the stock of the United Traction Co. has been deposited with the National Commercial Bank of Albany under the terms of the purchase. The preferred stock and debentures of the new company, both of which are guaranteed by the Delaware & Hudson, are offered to the public, while the Delaware & Hudson will hold the common stock. The preferred stock, which is entitled to a dividend of 4 per cent, is offered at 104½, and the 3¾ per cent debentures at 97½.

STANISLAUS POWER.—Messrs. Tucker, Anthony & Co. of Boston, in conjunction with F. L. Eldridge of the Knickerbocker Trust Co., N. Y., and C. C. Cuyler of Cuyler, Morgan & Co., N. Y., have successfully placed the underwriting of $5,500,000 of 5 per cent bonds and $2,750,000 of preferred stock of the Stanislaus Electric Power Co., organized under the laws of California for the purpose of developing water power in the Middle Fork of the Stanislaus River in California. It is planned to develop 25,000 electrical horse-power and in addition thereto water power equivalent to 16,000 horse-power.

KEYSTONE TELEPHONE.—The Keystone Telephone Company, of Philadelphia, has earned about $657,000 gross in the ten months ended Oct. 31, 1905, and $256,000 net applicable to bond interest, after deducting renewal reserve in addition to the ordinary operating expenses. The interest charges on the entire bonded debt for a full year are only $200,000 or 5 per cent on $4,000,000 bonds. November and December should add at least $15,000 to the net applicable to fixed charges, which would give a surplus of $75,000 for the twelve months of 1905, over a full year's interest on the new bonds.

REPORT OF WORCESTER ELEC. LIGHT CO.—The Worcester Electric Light Co., Worcester, Mass., has filed with the State Board of Gas and Electric Light Commissioners its annual report for the current fiscal year, showing total assets of $1,081,049.75, of which $601,663.51 is for electric lines, $110,559.19 for electric plant, and $97,007.97 for real estate, with total liabilities amounting to $786,335.90, of which $600,000 is for capital stock. The profit and loss balance is $294,713.85 on its capitalization.

GENERAL ELECTRIC STOCK.—At Schenectady on December 5, a special meeting of the stockholders was held at the company's office at 2 o'clock p. m., for the purpose of voting upon a proposition to increase the capital stock of the company by the amount of $11,674,500, consisting of 116,745 shares of the par value of $100 each, so that the capital stock shall be increased from the present amount, viz: $48,325,500, consisting of 483,255 shares of the par value of $100 each, to $60,000,000, consisting of 600,000 shares, of the par value of $100 each. The increase was duly voted.

SOUTHERN BELL INCREASE OF CAPITAL.—A special meeting of the stockholders of the Southern Bell Telephone & Telegraph Company has been called for December 13, to vote on a proposition to increase the capital stock of the company from $1,000,000 to $30,000,000.

NEW YORK CONNECTING R. R.—Terms for the franchise for the New York Connecting Railroad as fixed by Comptroller Grout are $250,000 cash in advance, $50,000 per annum for the first ten years, and $100,000 per annum for the next fifteen years for every 25-year contract.

DIVIDENDS.—The Ashton Valve Co. has declared an extra dividend of 1 per cent, payable Dec. 15, 1905. Directors of General Electric Co. have declared the regular quarterly dividend of 2 per cent, payable January 15.

PHILADELPHIA TRANSIT COAL.—The Philadelphia Rapid Transit Company has built a 65,000-ton storage plant for coal, and has ordered the Reading Coal & Iron Company to fill it at a cost of $168,75[illegible]

General News of the Week

The Telephone.

PINE BLUFFS, ARK.—The City Council has granted a franchise to the Southwestern Telephone & Telegraph Company to place its wires underground in the business section of the city.

HOLLISTER, CAL.—George Burg has been granted a franchise to build a telephone line from Panoche to New Idria.

SAN FRANCISCO, CAL.—Dr. Hugh Cumming, Federal quarantine officer at this port, has called for bids for laying a telephone cable from the city to the Angel Island station. An independent telephone system will be installed, connecting the station with the city lines of the Pacific States Telephone & Telegraph Company.

SAN FRANCISCO, CAL.—The Home Telephone Company, of San Francisco, is showing much activity, now that the municipal election is over and it is hoped that the present Board of Supervisors will pass an ordinance advertising the telephone franchise for sale. The company is willing to take the chances on the new Board's harmonious action next year. Under the ordinary course of procedure in advertising and selling a franchise it would take until about the middle of May next to comply with the legal requirements, including the 90 days' advertising. So, unless the Supervisors expedite matters by waiving preliminaries and advertising a franchise promptly, work will not be commenced on the new system much before June 1, 1906. F. F. Graves, of Los Angeles, is in San Francisco. Favorable progress is reported by the Home Telephone Company of Alameda County, in Oakland, Cal., where a franchise sale has been authorized. The United Long Distance Telephone Company, which operates interurban telephone lines connecting with the exchanges of the several "Home" companies, now connects with 115 towns in California south of Santa Barbara. Business has been opened in twelve new towns between Santa Ana and Los Angeles, as follows: El Toro, Myford, Capistrano, Oceanside, Encinitas, Del Mar, San Diego, El Cajon, Coronado, Pacific Beach, La Jolla and National City. The San Diego Home Telephone & Telegraph Company has secured an exclusive right to build telephone lines for a distance of 160 miles into Mexico from the American boundary.

DOVER, DEL.—The Central Home Telephone Company, with a capital stock of $5,000,000, has been granted a certificate of incorporation. The new company will conduct extensive operations, especially in the Middle West, both in constructing new lines and consolidating existing local lines. The incorporators are Edward L. Barber, Wauseon, O.; John C. Monteith, Louisville, Ky.; John C. Monteith, Bloomington, Ind., and James E. Bergen, Nanticoke, Pa.

McLEANSBORO, ILL.—The new telephone line from Springerton to McLeansboro is completed.

MT. CARROLL, ILL.—The Mt. Carroll Mutual Telephone Company has been formed. Capital, $5,000.

PEORIA, ILL.—A new cable is being laid across the river at the foot of Bridge street. It is being placed by the Central Union Telegraph Company.

AUBURN, IND.—The Bell Telephone Company has finished rebuilding the exchange in this city, at a cost of $50,000.

GOSHEN, IND.—The new switchboard at the central office of the Home Telephone Company is in operation. An addition to the board will be necessary in the near future.

WALDRON, IND.—The Moore Telephone Company has been organized. Arrangements have been made with the Central Union Telephone Company for toll line service. Elmer E. Moore is president.

MARION, IND.—C. L. Barger is heading a telephone company which proposes to use automatic telephones and has applied to the City Council for a franchise to operate in this city. It is thought the franchise will be granted.

INDIANAPOLIS, IND.—The Board of Public Works and the Indianapolis Telephone Company have agreed upon plans for putting the company's wires underground throughout the park and boulevard territory on the north side.

SOUTH BEND, IND.—The St. Joseph Valley Telephone Company has incorporated to build independent exchanges and local lines throughout Northern Indiana. Theodore Thorward, president of the South Bend Home Telephone Company, is president of new company.

RUSHVILLE, IND.—At a meeting of the independent telephone men of the eighth telephone district, held in Rushville, a resolution was passed pledging all independent telephone companies of the district to refrain from any further service connection with any company that has a connection, direct or indirect, with any sublicensee of the Bell company.

INDIANAPOLIS, IND.—The first meeting of the executive committee of the Indiana Independent Telephone Association was held in Indianapolis on November 3. Mr. G. W. Beers, of the committee, said the Indiana Association was carrying out every purpose for which it was organized and had done much to encourage development and stimulate the growth of the telephone business in Indiana.

WINCHESTER, IND.—The Eastern Indiana Telephone Company, with headquarters in this city, has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The directors are B. S. Hunt, J. S. Engle, A. L. Nichols, J. A. Browne, J. M. Fletcher and Robert Letschert. The first act of the stockholders and directors was to absorb the Parker City plant with full lines to Albany and Losantville. It is now believed this is a part of the policy of the Indiana Independents to organize strong companies in different parts of the State to absorb and merge a large number of small companies and save them from falling into the hands of the Bell Company.

PRESTON, IA.—A new telephone line is being built between Preston and Miles.

WATKINS, IA.—The North St. Clair Township Company has begun to build a new telephone line.

COLUMBUS JUNCTION, IA.—The Muscatine-Louisa County Telephone Company will establish an exchange here.

OTTUMWA, IA.—The Hamilton County Telephone Company now has a toll line direct to Boone and with connections from there on direct to Des Moines and intermediate points.

MANCHESTER, IA.—The Bell Telephone Company has been at work in this city erecting new 30-foot poles with 3 cross arms and 10 pins, between here and Delaware. This additional 30-wire service means more accommodations between towns and farmers.

BOSTON, MASS.—The New England Telephone & Telegraph Company has discontinued the bankers' private line which connected the banking and brokerage offices in the State Street district. This bankers' private line was inaugurated several years ago, but telephones were connected with it for firms not members of the New York Stock Exchange, and the New York Stock Exchange has recently ordered all its Boston members to discontinue this wire connection. This edict so reduced the number of subscribers for the service that the line was discontinued.

ATLANTIC CITY, N. J.—The National Grange Patrons of Husbandry at its recent meeting here unanimously favored a proposal to have the farmers organize independent telephone companies in their various localities as a means of securing more reasonable rates and better service through competition.

NIOBE, N. Y.—The Niobe Telephone Company has been formed with a capital of $1,000. Incorporators: L. L. Warner, L. C. Way and others, all of this city.

MIDDLE BASS, OHIO.—A telephone line is to be strung from this place to North Bass by the new Ottawa County Telephone Company during the winter months.

JEFFERSON, OHIO.—The inability of the Jefferson and Warren Company and the new Lyme Company to come to terms may result in another company being organized.

CHARDON, OHIO.—The Geauga County Telephone Company, of Chardon, has been incorporated with a capital stock of $10,000 by R. C. Carter, W. R. Nutt, H. S. Brown, James Niven and J. T. Daniels.

MARIETTA, OHIO.—The Washington & Monroe Telephone Company, of Marietta, has been incorporated with a capital stock of $5,000 by E. D. Amos, William Kette, Cyrus McHugh, W. J. Moore, C. A. Amos, B. C. Cline and J. O. Swallow.

LOWELL, OHIO.—Contracts have been signed between the Lowell Farmers' Telephone Exchange Company, of Lowell, O., and the Central District and Printing Telegraph Company, by which the independent company adopts the Bell instruments and connections and will interchange business with the Bell company.

COLUMBUS, OHIO.—A syndicate composed of Toledo and Columbus men has purchased the majority of stock in the Gallipolis Telephone Company and steps will be taken at once to improve and extend the system. The new owners will build exchanges in Pomeroy and Middleport and a long-distance line will be constructed to Athens, which will give the company good service to Columbus. Those who have purchased the controlling interest are Cyrus Huling, Columbus; Dwight Sapp and Frank Beam, Mt. Vernon; W. E. Morrison and J. E. Gardner, Toledo, and E. N. Coen, Vermillion.

GUTHRIE, OKLA.—The case of Oklahoma City vs. the Pioneer Telephone & Telegraph Company has been appealed to the Supreme Court. The plaintiff is seeking an injunction to prevent the company from increasing its rates. The injunction was granted by the probate judge of Oklahoma City, but when the appeal was taken to the district court the injunction was reversed.

JENKINTOWN, PA.—John R. Wiggins & Co. will take estimates upon plans for a new exchange at Jenkintown for the Bell Telephone Company.

WASHINGTON, PA.—The Greene County Telephone Company, an independent concern, will, by the purchase of the Carmichaels Telephone Company, enter the Greene County field, and begin active competition with the Bell and other interests. The Carmichaels company had franchises on the principal streets of Waynesburg and lines will be built into the Greene County capital at once. By working arrangements with other lines, the new concern will be able to reach Uniontown, Greeling, Pittsburg, Allegheny, Johnstown, Harrisburg, Philadelphia and Baltimore. It is stated that Mr. J. G. Splane, president of the Pittsburg & Allegheny Telephone Company, is interested in the new concern.

DREWRYVILLE, VA.—The Courtland Emporia Telephone Company, of Drewryville, has been incorporated by D. B. Drewry, president; T. P. Pope, secretary and treasurer, of Drewryville. The capital stock is, maximum, $5,000; minimum, $1,000.

MARSHFIELD, WIS.—The Badger State Telephone Company, in which Hon. J. C. Marsh of this city is interested, has completed a new metallic line which gives independent connections from Marshfield direct to Merrillan. This is an important connection, as it gives the local exchange excellent facilities for reaching the Central Wisconsin line comprising a number of towns not heretofore reached direct. By next summer a metallic line will reach La Crosse and complete the network.

Electric Light and Power.

OZARK, ARK.—E. H. Adams has petitioned for a franchise to establish an electric plant.

REDDING, CAL.—The Board of Supervisors has granted a franchise to the Shasta Power Company.

RED BLUFF, CAL.—The California Gas & Electric Corporation, acting through its engineer, James H. Wise, has filed two notices of appropriation of water from Mill Creek, covering about 15,000 inches of water, ostensibly for the purpose of erecting an electric power plant. The location is about six miles from Morgan's Springs, and has been already located by the Tehama Transportation Company, composed of local and San Francisco capitalists, who have already done considerable work, building roads and surveying ditches. It is stated that the Tehama Transportation Company's rights have lapsed, as it has not done the amount of work required by law. This power site is considered by experts to be one of the best in Northern California, and, with the building of the electric railway from Chico to this point and the proposed electric railway from Red Bluff to Redding, this particular location is a very valuable one.

SANTA CRUZ, CAL.—The Santa Cruz Electric Light and Power Company has been sold by James McNeil, of this city, to John Martin and L. P. Lowe, of the California Gas & Electric Corporation. Messrs. Martin and Lowe are large stockholders in the Bay Counties Power Company of Oakland. The latter company has a contract to furnish power for the Santa Cruz Portland Cement Company, which is building an immense plant at Davenports, 14 miles up the coast. It is believed to be the intention of the new owners of the local company to extend the power line from Davenports to this city and use that power instead of its present supply.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation is rushing work on the new power house at Walbridge and Schwerin Streets, for it is to begin early in the new year supplying the United Railroads Company with electric power. The contract becomes effective next February, and is to run for twenty years. The new power house will contain three of the largest gas engines in the world, driving 400-kw alternators. About $1,000,000 is being spent on the new power house and its equipment. President Holland and General Manager Chapman, of the United Railroads Company, count on a large annual saving when the company does not have to supply its own electric power. The shops are to be equipped with the most modern facilities for repair work, and it is expected that many economies not possible under the present system, where the repair work-shops are scattered throughout the city, will be realized.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation has been receiving bids for three additional 5,500-kw, 3-phase, 60-cycle generators, and three direct-connected water wheels which are to be installed at various power plants on its system of transmission lines. Two new pipe lines and one power canal are to be constructed in connection with these improvements. While the company has experienced considerable inconvenience at some points on its lines from the long dry season, the shortage did not reach 50 per cent at any time, and it is now reported that nearly all of the plants are running on the normal flow of water without further depleting the storage reservoirs. After a period of 192 days without measurable rainfall in Northern California the drouth was broken on Nov. 19, and there were several days of rain during the following week. It will probably take but a few weeks to increase the flow of streams enough to greatly improve the conditions of nearly all of the power companies depending upon a water supply. The California Gas & Electric Corporation made good use of its steam reserve plants at Sacramento, San Jose and Oakland during the drouth. The steam plant of the San Francisco Gas & Electric Company in the city also contributed quite an amount of power to help take care of the load on the transmission lines of the corporation with which it is soon to be consolidated. The gas engine reserve plant south of San Francisco is being completed as rapidly as possible. One of the two frequency changers which have been installed has had a test run and current from the transmission lines of California Gas & Electric Corporation can be supplied for the use of the United Railroads system in February, although some further time will be required for the erection of the three large gas engines, owing to a delay at the manufactory.

WINDSOR LOCKS, CONN.—Burdett Loomis and others, of Hartford, Conn., have bought control of the Windsor Locks Electric Light Company and the Enfield Gas Company, and will combine the interests. The new company will add to the electric plant new water wheels and gas engines and will erect a new gas plant.

THOMASVILLE, GA.—Thomasville citizens have voted to incur a debt of $30,000 for the purchase of a municipal light and power plant. The plant to be purchased is that of the Thomasville Electric Light Company.

BELLEVILLE, ILL.—The Belleville Gas & Electric Company has decided to expend about $[illegible] in improvements, including a new engine and generator.

LITCHFIELD, ILL.—The Litchfield Heating Company, with a capital stock of $15,000, has been incorporated here by Judge Paul McWilliams, E. F. Sweeney and Dr. G. A. Sahler.

ZIONSVILLE, IND.—The Zionsville Water & Electric Light Company, recently incorporated, is in the market for a full equipment for a water works and electric lighting plant for this city. M. E. [illegible] is president.

BICKNELL, IND.—Electric light is now being furnished to the city by the [illegible] Coal Mining Company, which has installed a large dynamo at its plant near the town. There are [illegible] streets lamps and many residences and business houses are supplied.

NOBLESVILLE, IND.—The Noblesville Hydraulic Company is preparing to negotiate the sale of bonds, the proceeds to be used in completing the dam across White River, which will furnish power to Noblesville and nearby towns for electric light, etc. The plant when completed will represent an investment of $150,000.

CORNING, IA.—The Corning Light & Heat Company has been incorporated, with a capital of $30,000 by C. R. Munns and others.

AUGUSTA, KY.—Sealed proposals will be received until Dec. 8 for the installation of an electric light plant, as per specifications on file with the clerk of the committee, Mr. J. P. Reese, Augusta, Ky.

ARCADIA, LA.—The plant of the Arcadia Electric Lighting Company was destroyed by fire on Nov. [illegible].

PORTLAND, ME.—The Portland Lighting & Power Company is having plans prepared for a power plant to be built in this city or the suburbs. The General Electric Company is to furnish the machinery.

BALTIMORE, MD.—At the annual meeting of the Hamilton Water, Light & Power Company the following named officers were elected: President, William McCallister; vice-president, A. G. Struven; secretary, J. Neidhardt; financial secretary, J. C. Toland; treasurer, J. T. Carter.

WOBURN, MASS.—An ordinance has passed first reading in the Board of Aldermen, authorizing the establishment of a municipal lighting plant.

WELLESLEY, MASS.—The town of Wellesley has voted to make a contract with the Edison Electric Illuminating Company for a term of seven years for all the power required for municipal and commercial lighting delivered at the switchboard at the town line. The situation in Wellesley at the present time is peculiar in that the town owns the poles and street wires and the Edison Company owns the commercial wires. The town and the company have agreed upon a valuation of $14,000 for the commercial wires and fixtures which are now the property of the company, and the town has appropriated $32,000 to buy the commercial wires of the Edison Company and to erect a distributing station at the town line. This is the first town to buy its power of the Edison Company, as a municipality, and the contract made is the same as that between the Edison Company and any other wholesale customer.

CROSWELL, MICH.—The taxpayers of the city have voted in favor of bonding for $5,500 for electric lights.

ELK RAPIDS, MICH.—A. E. French has been awarded the contract of erecting the power house for the Elk Rapids Power & Electric Lighting Company.

FLINT, MICH.—Detroit people have purchased the water power rights at Argentine, owned by Derham Bros., W. B. Stiles and L. C. Sutherland. It is stated that the new owners will expend about $200,000 in developing 3,000 horse-power. A new concrete dam and suitable buildings will be erected. One of several objects in view in developing this power will be the furnishing of electric lights and power to Fenton, Durand and also to other towns in the vicinity.

GRANITE FALLS, MINN.—The Council is considering the enlargement of the electric light plant.

LITTLE FALLS, MINN.—The Little Falls Water Power Company contemplates making improvements to its plant.

CROOKSTON, MINN.—The County Board is considering the installing of an independent electric plant for the purpose of lighting the county buildings.

RED WING, MINN.—P. C. Thompson and others, of Detroit, Mich., have purchased the gas and electric light plant here, and will make extensive improvements.

ST. LOUIS, MO.—Surveyors completed the preliminary work preparatory to the construction of a canal connecting Missouri River with Meramac River, for the development of electric power for use in St. Louis. Westinghouse, Chuch, Kerr & Co., of New York, N. Y., are preparing a report on this project.

YERINGTON, NEV.—C. W. Fancher, T. Harris and T. B. Gambel, all of San Jose, intend to erect a large electric power station at Yerington, and if they can secure necessary capital will build an electric railway from Wabuska, near this city, to Mono County, Cal.

DOVER, N. H.—Extensive improvements are to be made to the plant of the Electric Light Company so that concern will be able to supply the increasing demand for light and power.

PASSAIC, N. J.—The question of constructing a municipal electric light plant is reported under consideration here.

NEWARK, N. J.—The City Hall Commission is considering the installation of a lighting plant in the new city hall, at a cost of about $41,000.

PATERSON, N. J.—The Parral Power Company, of Paterson, has been incorporated, with a capital of $500,000 by John L. and Harry E. Griggs and Wm. L. Berdan.

SOCORRO, N. M.—The Socorro Water & Light Company, recently incorporated, has made preliminary surveys. The plan is to install a lighting plant, to be operated by water power furnished by hot springs 288 feet above the power site. The water will afterwards be used to supply the city of Socorro. Frank Owen, of Santa Fe, is general manager.

ARCADIA, N. Y.—The Town Board has granted a franchise to the Niagara, Lockport & Ontario Power Company to furnish electric light, heat and power in this town. This company has also applied for franchises in Lyons and Newark.

FOREST, OHIO.—The Council has awarded a contract to a Sandusky firm to light the city by electricity. The contract is for ten years and provides for 29 arc lights to burn all night, for which the town will pay $2,500 per year. It is stated that the same firm has received the contract to supply Dunkirk with electric lights. Twenty-six arc lights will be furnished in Dunkirk at an annual cost of $[illegible] per light per year on moonlight schedule. The Dunkirk system will be supplied by power from the Forest plant.

WATONGO, OKLA. TER.—The citizens have voted in favor of issuing $6,000 bonds for an electric plant.

HAINES, ORE.—The Hot Springs Electric Light Company has been incorporated, with a capital of $5,000, by W. J. Mays, of Baker City, and J. F. O'Bryan, of Haines.

SCRANTON, PA.—It is stated that the West Scranton Light, Heat & Power Company is preparing to build a new power plant.

PITTSBURG, PA.—Both branches of the Councils have adopted a resolution authorizing the appointing of a committee of seven to inquire into the cost of installing a municipal electric lighting plant, the committee to report at the second meeting of the Councils in January.

BAMBERG, S. C.—The Board of Public Works wants prices on a 90-kw generator, two 100-hp boilers and a 125-hp engine; the plant to consist of 40 arcs and at least 1,000 incandescents. G. M. Dickinson is manager.

SOUTH PITTSBURG, TENN.—This city is negotiating for the purchase of the electric light and water plant. An engineer is estimating the cost of improvements to the same.

JASPER, TEX.—An electric light plant is to be installed at Jasper. Local citizens are interested in the project.

UVALDE, TEX.—The City Council of Uvalde has granted a franchise to J. F. Simpson, W. D. Kincaid and Gus Muller for the installation of an electric light plant at Uvalde.

EL CAMPO, TEX. It is announced that a company is soon to be organized for the purpose of installing an electric light and power plant at El Campo. The proposed plant is to furnish power for operating irrigation pumps on rice plantations and to operate the machinery of rice mills and other industries as well as to provide lights for the town.

AUSTIN, TEX.—The rebuilding of the great dam across the Colorado River at this place is practically assured. The project is to be undertaken by the Stone & Webster syndicate, of Boston, Mass., under the auspices of the Old Colony Trust Company, of that city. Stone & Webster sent expert hydraulic and electrical engineers here to investigate the feasibilty and practicability of the proposed enterprise. These engineers have made favorable reports. They estimate that the cost of rebuilding the structure will be about $538,000. This dam was built about ten years ago at a cost of $1,000,000. The electric light plant and power house, and water works plant which were erected at a point on the bank of the river just below the dam, cost an additional $600,000. In the spring of 1900 an unprecedented flood in the river swept away a part of the dam and wrecked the power house. In rebuilding the dam it is proposed to utilize the portions of the structure that are still standing. The power house can also be repaired and put in condition for use at comparatively small cost. The ruins of the dam and power house are owned by the city of Austin, but they will be either sold outright or leased to Stone & Webster. There are certain legal matters to be straightened out in connection with the enterprise before the formal transfer of the property can be made.

VERNAL, UTAH.—E. H. Wilson, of Vernal, has filed application at Salt Lake City, for a water right on the Uintah reservation, the purpose being to establish a power plant.

PROVO, UTAH.—Bonds amounting to $91,000 have been sold, the proceeds to be used for an electric light plant and water works. Frank C. Kelsey, Salt Lake City is the engineer.

PRICE, UTAH.—Incorporation papers have been filed by the Grand Canyon Power Company, of Salt Lake City. The capital stock is $100,000, and the officers are: O. S. Buel, secretary and president; H. M. Bowers, vice-president; Geo. Havercamp, treasurer. The company proposes to build a large power plant on Green River.

SALT LAKE CITY, UTAH.—The Inter-Mountain Power Company proposes to construct during the spring three hydro-electric power stations about 17 miles from Salt Lake City. The probable cost of the work proposed is $500,000. Frank C. Kelsey, of Salt Lake City, is the engineer.

BARRE, VT.—An explosion on Nov. 26 practically wrecked the plant of the People's Lighting, Heating & Power Company.

READSBORO, VT.—A number of Readsboro business men have organized a co-operative electric light service and expect to have the lights running soon. F. L. Allen, Dr. Cole, Valentino DaRin, George M. Bemis, H. A. Parsons and H. T. Goodell have formed a stock company and taken out incorporation papers under the laws of the State of Vermont, the title being the Readsboro Electric Light Company.

ODESSA, WASH.—Jas. Shaw, of Harrington, has petitioned for a franchise for an electric light plant at Odessa.

RITZVILLE, WASH.—Articles of incorporation have been filed by the Ritzville Electric Company of Ritzville, with a capital of $50,000. Incorporators: Philip Rowe, W. V. Reinhart, Jr., Geo. H. Tilden, and others.

MADISON, WIS.—It is reported that a $250,000 heating and power plant is to be constructed by the University of Wisconsin.

LA CROSSE, WIS.—The new plant of the Wisconsin Light & Power Company, in this city, was started on Nov. 23. The generators are of the revolving field, turbo-alternator type and were furnished by the Westinghouse Company. Mr Jacob Closs, of Milwaukee, was the contractor and constructing engineer.

BAHIA, BRAZIL.—The Bahia Gas & Electric Company has been incorporated in Maine, with authorized capital stock of $3,500,000, to operate systems of gas and electric lights in Bahia, Brazil. The officers given are: President, James S. Hernan, and treasurer, J. L. Brophy, both of Portland, Maine.

TORONTO, ONT.—At a meeting of the shareholders of the Toronto & Niagara Power Company, just held, the agreement between this company and the Toronto & Hamilton Electric Railway was confirmed, granting the Toronto & Hamilton Railway power to build and operate its line between Toronto and Niagara Falls on the Power Company's right of way. The Railway Company, by its agreement, undertakes to construct the line and pay the interest on half the cost of the right of way of the power company. By the arrangement, the development company, among other advantages, has secured the construction of a line which will enable it to control the right of way on its line. Difficulties at present are the gaps at the Humber River, Port Credit, Brotte and Burlington in the feed lines.

VERA CRUZ, MEX.—Alberto Schuler will install a hydro-electric plant on the Minas River, in the Jalacingo district, State of Vera Cruz. The plant will furnish power for mines.

MAZATLAN, MEX.—A hydro-electric plant is to be installed on the Piaxtla River by the Campania Minera Guadaloupe de los Reyes. The plant will cost about $500,000 and will have a capacity of 5,000 horse-power.

SANTA EULALIA, MEX.—Ezequiel Salazar Enriquez, of Chihuahua, will establish an electric light and power plant at Santa Eulalia. In addition to furnishing lights and power for the town and mines at Santa Eulalia, he proposes to convey power to the city of Chihuahua and provide that city with lights.

PARRAL, MEX.—Eugene Davis, of Chihuahua, is at the head of a company which has been granted a concession by the federal government to install an electric power plant 51 miles from Parral. The plant will consist of six units of 500-horse-power each. The power will be transmitted to mines and reduction works of that section.

PARRAL, MEX.—The organization of a company, which will have a capital stock of $10,000,000 is now being perfected for the purpose of installing in this district one of the largest electric power and transmission plants in Mexico. Leopoldo Iwonskey, the general representative of the firm of Stallforth Hermanos, Sucs., of Parral, is promoting the enterprise. American and German capitalists are interested in the project. Mr. Iwonskey has gone to New York and Germany to confer with the interested parties in regard to the details of the project. The contract will soon be let for installing the plant. It will be located between Parral and Minas Nuevas. The power will be generated by mountain streams. A survey has already been made for the proposed plant. Transmission lines will be built to Parral and the numerous mines of the district. The company has just closed a deal for the purchase of an extensive tract of timber land situated adjacent to the site of the proposed plant.

The Electric Railway.

SAN FRANCISCO, CAL.—At a meeting of the directors of the United Railroads of San Francisco, held on Nov. 23, President Holland announced that the control of the United Railways Investment Company, which owns the stock of the United Railroads of San Francisco, having been acquired by other interests, he and Brown Bros. & Company will retire from participation in the management of the company January 1.

CHICAGO, ILL.—The last link in the chain of interurban roads connecting Chicago and Milwaukee was completed Dec. 2 by the opening of the Chicago & Milwaukee Electric Railroad Company's line between Zion City, Ill., and Kenosha, Wis. The trip from Chicago to Milwaukee can now be made over the electric roads for $1.25 and the round trip for $2.15, or less than half the steam railroad fare. The time required from the center of one city to the center of the other is about five hours. A sub-station has been built at Kenosha to supply power at the north end of the line. A new power house, designed to contain 25,000 horse-power in steam turbines is to be built on the beach at Waukegan, replacing the present power house at Highwood. The opening of the line was celebrated by a banquet at Kenosha, Dec. 2, at which the company entertained the mayors and aldermen of the villages through which the road passes, and county officials. The guests were taken to Kenosha by three special trains.

INDIANAPOLIS, IND.—The stockholders of the Columbus, Greensburg & Richmond Traction Company held a meeting in this city on Nov. 24, and elected the following board of directors: H. F. Holland, A. M. Kulin, Indianapolis; Walter McConaha, Richmond; J. T. Clapp, Hartsville; C. M. Brooks and J. G. Barrett, Indianapolis.

NEW ALBANY, IND.—Work has been commenced by the Louisville & Northern Railway and Light Company, to build a system of electric railways in southern Indiana, to reach Louisville over the line of the Louisville & Southern Indiana Traction Company.

VERSAILLES, IND. A meeting was held in this city last week by the promoters of a traction line from Greensburg to Madison via Versailles. Among those who attended were: C. L. Henry, president of the Indianapolis & Cincinnati Traction line; ex-Governor W. T. Durbin, George A. Ball and others. There is every indication that the road will be built next year.

MADISONVILLE, KY. The interurban train service between Earlington and this city, and Earlington and Nortonville, which was forecasted some weeks ago, is to be inaugurated as soon as the necessary arrangements can be made.

DETROIT, MICH.—H. A. Everett, of the Everett-Moore Syndicate, states that a proposition is on foot to run cars from Detroit City Hall to Cleveland, via Toledo, and that they will probably be in operation by spring.

NEW YORK, N. Y.—At the annual meeting on Dec. 4 of the Metropolitan Street Railway and the Twenty-eighth and Twenty-ninth Street Railroad the retiring boards of directors were reelected.

GENEVA, N. Y.—The Geneva, Phelps & Newark Railroad Company has been formed to operate an electric railway 15 miles long, from Geneva to Newark, Wayne County, with a capital stock of $400,000. The directors are S. W. Hayes, Geneva; S. S. Partridge, Phelps, and E. K. Burnham, Newark.

CINCINNATI, OHIO.—The Interurban Railway & Terminal Company has re-elected the present officers with the exception that L. T. Anderson was chosen a director in place of J. M. Kennedy, Jr., who has retired. The company has decided to abandon its generating station at South Lebanon and move the two [illegible]-hp units in that station to the station at Coney Island, increasing the capacity of that plant to [illegible] hp, thus centralizing the power equipment for its three roads, embracing [illegible] miles of track. To accomplish this, the company will build a transmission line [illegible] miles across country to take care of its Rapid Railway division, formerly supplied by the South Lebanon station.

ROOSEVELT, OKLA.—The Wichita Mountain Traction Company, with headquarters at Roosevelt and Hobart, has been chartered with a capital of $[illegible] for the purpose of building an electric railway from Roosevelt to Apache, a distance of 50 miles, and costing $[illegible]. The incorporators are: W. R. McKnight, F. A. Coulter, C. L. Johnson and Guy H. Parker, of Roosevelt; John A. McKeene, of Hobart.

CORPUS CHRISTI, TEX.—Steps have been taken to organize a company to build and operate an electric railway to connect Corpus Christi with the Alta Vista resort, situated about three miles from town.

SAN MARCOS, TEX.—Bids are being received for the construction of the interurban electric railway between the towns of San Marcos and Luling by the San Marcos Valley Interurban Railway Company. Judge B. G. Neighbors, of San Marcos, is secretary of the company.

HOUSTON, TEX.—The project of building an interurban electric railway between Houston and Galveston, a distance of about 51 miles, has been revived. A number of wealthy business men and bankers of the two cities are interested in the matter and it is believed that the consummation of the project is now assured. Among those interested are J. O. Russ, H. C. House, O. T. Holt, H. Masterson, Hyman Levy, all of Houston; W. J. Moore, of San Antonio and I. L. Dana, of Galveston.

TORREON, MEX.—The Torreon & Lerdo Electric Railway Company has purchased the electric light plant at Torreon. It is reported that the same company is negotiating for the purchase of the electric street railway system in Torreon. The owners of the latter company recently announced that they would soon increase its capital stock from $100,000 to $250,000, the additional capital to be used in extending the system.

New Industrial Companies.

THE GREENWICH ELECTRIC COMPANY, of New York, has been incorporated with a capital stock of $5,000 by J. T. Ramsay, W. C. Ward and E. Tobieson, New York.

THE DARCHE ELECTRIC CLOCK COMPANY, of Chicago, has been formed, with a capital stock of $40,000. The incorporators are Frank W. Jansen, Augusta Y. Jansen and C. D. Fahrney.

THE BABCOCK ELECTRIC CARRIAGE COMPANY, of Buffalo, N. Y., has been formed with a capital stock of $100,000. The directors are F. A. Babcock, F. L. Bapst and Harry Yates, of Buffalo.

THE FRANCO-AMERICAN ELECTRIC COMPANY, of New York, has been incorporated with a capital stock of $[illegible]. The directors are B. Baunstein, Hoboken, and Simon Baunstein and J. Ochs, New York.

THE L. W. GILLESPIE COMPANY has been incorporated at Marion, Ind., with $15,000 capital stock, to manufacture gasoline engines and electrical supplies. The directors are Arthur F., Leonard W., and Ella M. Gillespie.

THE BLACKALL & BALDWIN COMPANY, of New York, has been incorporated to manufacture electric motors. The capital stock is $50,000 and the directors are A. S. Adams, W. H. C. Lee and F. S. Blackall.

THE H. P. METER COMPANY, of New York, has been incorporated to manufacture electric meters. The capital stock is $100,000, and the directors are H. [illegible] and W. P. Snyder, of Brooklyn, and H. I. Bernard, of New York.

THE NORTHERN TEXAS ELECTRIC COMPANY has been formed at Portland, Me.; capital, $3,000,000. President, L. [illegible]; treasurer, J. H. Rider. Directors as above and E. L. [illegible], A. W. Tolman, J. H. Pierce, Scott Wilson and W. K. Neal, all of Portland.

THE OAKMAN MANUFACTURING COMPANY, of New York, has been incorporated to manufacture gas and electrical apparatus. The capital stock is $[illegible], and the directors are L. N. Oakman and W. S. [illegible], New York, and [illegible], Mass.

◆

Legal.

MARKET QUOTATIONS AND BUCKET SHOPS.—In the case of the Hammond Elevator Company vs. the Western Union Telegraph Company, the Indiana Supreme Court reverses the judgment of the lower court and decides that bucket shops cannot compel telegraph companies to deliver market quotations to them.

NO TELEPHONE OPPOSITION IN CINCINNATI.—By a recent decision of the Ohio Supreme Court the case of the Queen City Telephone Company against the City of Cincinnati was unfavorable to the Queen City Company. The company attempted to get a franchise through the Probate Court, the City Council failing to act in the matter. The Supreme Court affirms the judgment of the Circuit Court, which was against the Queen City company.

CONDEMNING LANDS FOR CENTRAL STATIONS.—Justice Wright, of the Supreme Court of New York, according to a decision from Utica, has rendered a decision upholding the constitutionality of the law which gives to electric light and power companies the right to condemn lands which may be required in the business of furnishing municipalities with light and power. The East Creek Electric Light & Power Company sought to acquire the lands of Norman Loucks and asked for the appointment of a commission to assess the damages. Loucks resisted, and attacked the constitutionality of the statute. Justice Wright holds that the Legislature has the power to invest in companies providing municipalities with a supply of electricity for power and lighting the same rights that are held by companies engaged in furnishing cities and towns with water.

STEAM PIPE COVERING.—An important patent suit over steam pipe covering has been begun in the United States Circuit Court. The complaint charges conspiracy in connection with the alleged infringement and the amount of damages aasked, $600,000, is unusually large. Edward K. Jones, the attorney acting for the Keasby & Mattison Company, of Ambler, Pa., has filed the complaint. The defendants, six in number, are also manufacturers. They are Jacob F. Schoellkopf, Jr., of Buffalo, William S. Gray, of New York City; William T. Mayer, of Albany; C. P. Hugo Schoellkopf, of Buffalo; and Henry T. Pierce and Thomas Keeney, of Hancock, N. Y. Jacob F. Schoellkopf, Jr., is a member of a corporation capitalized at $3,000,000 and doing business at 100 William Street. It is alleged that the six firms entered into a conspiracy whereby the plaintiff lost many customers and was deterred from increasing his business. The Keasby & Mattison Company is a manufacturer of a patented covering for steam pipes. It is alleged that the defendants conspired to infringe the patent prior to its expiration and that they made and sold an infringing product of the plaintiff's patent, greatly to the damage of the Keasby & Mattison Company. Usually infringement cases are tried in equity, but because conspiracy is alleged in this case and a definite amount of damage named it will be tried before a judge and jury.

Obituary.

W. H. EDGAR.

MR. W. H. EDGAR.—The death is noted on November 26 of Mr. William H. Edgar, president of the Dearborn Drug and Chemical Works, of Chicago, and residing at 4642 Drexel Boulevard, who died at the Arlington hotel, Hot Springs, Ark., Sunday night, after an illness of six weeks. Mr. Edgar was born in Chicago Nov. 25, 1865. He was a member of the Chicago Athletic Association of Chicago, and the Bohemian Club of San Francisco. He belonged to Dearborn Lodge A. F. and A. M., Apollo consistory, Oriental consistory and Medinah Shrine. He was also a member of Los Angeles Lodge of the Benevolent and Protective Order of Elks. He was married to Miss Elizabeth Winthrop, of Davenport, Iowa, four years ago. He leaves a widow and two sisters, Mrs. Carrie Edgar Wallace and Miss Catherine J. Edgar, and his mother, Mrs. Lucy M. Edgar, all of [illegible] Champlain Avenue, Chicago. Mr. Edgar, through the energetic pushing of and large demand for his boiler compounds, and his active interest in electrical work, has become very widely known among electric light and street railway managers. He and his company participated in the various conventions, and in the course of years he had built up a circle of friendship and acquaintance far beyond the ordinary. He was a typically successful western business man. The funeral took place at Chicago on November 29.

Personal.

MR. CHARLES T. YERKES has arrived in New York from London, but has been confined to the Waldorf by a severe cold. His condition has greatly improved this week.

MR. HORACE ANDREWS.—It is reported that Mr. Charles T. Yerkes, who is now in this country, has offered the presidency and management of the London Underground Railways to Mr. Horace Andrews, president of the Cleveland Electric Railway.

MR. JOHN A. HILL, president of the Hill Publishing Company, publisher of the *[illegible]* and *Power*, has been elected president of the American Trade Press Association, in succession to Mr. James H. McGraw. The annual dinner was given on December 1 at the Hardware Club, New York, when Mr. Hill made a valuable address on aspects of technical journalism.

MR. W. B. GRAHAM.—Inspectors and officials of the Brooklyn Rapid Transit Company have been notified that the post of Superintendent of Surface Lines has been abolished, and that W. B. Graham has given up his connection with the company. A new place has been created, that of Assistant General Superintendent. The official selected is Mr. Dow S. Smith, with W. O. [illegible], formerly of the elevated lines, to assist him, with Mr. L. V. [illegible] to be superintendent of the elevated division of the service.

MR. W. L. SHERWOOD, who has served as chief clerk of the general superintendent's office of the Brooklyn Rapid Transit Company under three general superintendents, has accepted a place as assistant to the general manager of the Mexico City Tramways. Mr. Sherwood will leave for Mexico on December 14. Beginning his railroad work in the office of the train dispatcher of the New York Central Railroad, some twelve years ago, Mr. Sherwood became connected with the Brooklyn Rapid Transit Company in 1895, and has been with that corporation continuously, with the exception of a short period with the Public Service Corporation of New Jersey.

MR. W. W. WHEATLY, president of the Mexico City Electric Tramways, Ltd., accompanied by Mr. Paul H. Evans, the chief engineer and purchasing agent, is visiting New York City for a brief holiday and to look up some business matters. Mr. Wheatly states that the Mexican Electric Tramways has made a contract to receive hydraulic power from the Mexican Light & Power Company's hydraulic plant at Necaxa, where there are about 40,000 hp under process of development, with an additional 40,000 hp held in reserve. The amount contracted for at first is about 5000 kw, but this must be increased during the next few years to 8000 kw. According to Mr. Wheatly, one special mission here at this time is to purchase the electric apparatus for the installation of the four new sub-stations which are to receive the alternating current from the Necaxa Company's plant. At the same time he is taking advantage of his presence in New York to make purchases of a large quantity of other materials.

MR. G. W. LAWRENCE.—The Greenfield (Mass.) Electric Light and Power Company has secured as its superintendent Geo. W. Lawrence, a thoroughly trained electrical engineer. A. J. Doolittle, who has been superintendent and treasurer, has resigned the former position, but retains the latter. The change is purely voluntary on Mr. Doolittle's part, he feeling that a younger man should come into the business and relieve him of a part of his duties. Mr. Doolittle continues in the employ of the company. Mr. Lawrence is 30 years old. He is a graduate of the University of Maine, and was for three years with the General Electric Company at its Schenectady plant. After that he became superintendent of the electric and steam plant of a large mining company that was operating in Mexico. Since that time he has been with the General Electric Company at Boston, and was for the past two years the foreman of construction with the General Electric Company's Boston office, having charge of the setting up and installation of the machinery sent out from that office. He set up for the General Electric Company the new machinery at Gardner Falls, so that he is familiar with its operation.

Trade Publications.

WINDOW LIGHTING.—The H. T. Paiste Company, Philadelphia, Pa., has issued bulletin No. 27, dealing with Fielding receptacles, rosettes and weather-proof socket plugs for window lighting and general decorative effects.

CRUSHING ROLLS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued catalogue No. 128, treating of crushing rolls for crushing rock, coal, salt and ores of all descriptions. The catalogue contains 56 pages, which are devoted to a detailed description of the various machines.

PLUG CUT-OUTS.—Flyer No. 2167 of the General Electric Company, Schenectady, N. Y., illustrates a complete line of plug cut-outs for 125 and 250-volt circuits. The cut-outs are compact in construction and present a neat appearance. They are equipped with substantial porcelain covers which protect all metal parts and remove the possibility of accidental short circuits.

ELECTRIC POWER IN FACTORIES.—The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has issued as bulletin No. 144 a reprint of an article by Mr. A. W. Henshaw on "Electric Power in Factories," which appeared in the ELECTRICAL WORLD AND ENGINEER, March 18, 1905. The bulletin is well illustrated, numerous views being given of machines built according to the S. K. C. system.

ELECTRIC ELEVATORS.—The Otis Elevator Company has issued a well-illustrated catalogue dealing with elevators for all services. In addition to describing the various devices which serve to make up a complete elevator equipment, the catalogue gives views of numerous elevators now in use of both the electric and hydraulic types. Views are also given of special elevator equipments such as inclined railways and escalators.

POLYPHASE WATT-HOUR METERS.—Bulletin No. 1074 of the Fort Wayne Electric Works, Fort Wayne, Ind., describes a complete line of polyphase induction watt-hour meters. Each meter might be considered as two single-phase meter fields operating upon a single rotating element in such a manner as to record upon a single register the combined energy in watt-hours which is being used in all the phases of the multiphase circuit to which the meter is connected.

ELECTRIC BOTTLE WASHER.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued bulletin No. 3,953, devoted to motor-driven bottle washers for cleaning bottles and arc lamp globes. This device is adapted for the use of small dairies and carbonating and bottling establishments which have a considerable number of bottles to clean, but where the volume of work is not sufficient to warrant the installation of an expensive automatic bottle washer.

STEAM TURBINES.—The General Electric Company, Schenectady, N. Y., has issued a well-executed catalogue designated as No. 9137-2, showing numerous views of Curtis steam turbines now installed. It is stated that the first machine was put into commercial service in the power house of the General Electric Company, on October 1, 1902. Curtis turbines now in daily commercial service have a rated capacity of over 135,000 kilowatts, and an overload capacity of over 202,500 kilowatts.

POLYPHASE INDUCTION MOTORS.—Bulletin No. 359, of the National Electric Company, Milwaukee, Wis., describes a complete line of polyphase induction motors in capacities from 1 hp to 75 hp. Each motor is provided with distributed primary windings on the stator, and squirrel-cage secondary windings on the rotor. The frame is so constructed as to afford ample ventilation. The motor is placed in operation by means of variable ratio transformers which supply reduced e.m.f.s. to the motor circuit.

MOTOR-DRIVEN AIR COMPRESSORS.—The National Electric Company, Milwaukee, Wis., has issued bulletin No. 363, dealing with stationary and portable motor-driven air compressors for continuous and intermittent service. The motors driving these compressors are of the series type, and are mounted directly on the frame of the compressors which they drive through herring-bone gears and pinions. It is stated that the noise of the gearing is unnoticeable. These compressors have been designed particularly for use with portable pneumatic tools.

THE COMFORTS OF ELECTRICITY AND GAS.—The Denver Gas and Electric Company has issued some attractive advertising matter in the form of two booklets dealing with the comforts to be derived from gas and electricity, respectively. Descriptions are given of cooking ranges, water heaters, room heaters, grates and water stills operated by gas, and numerous electric devices, including call bells, heaters, laundry irons, chafing dishes, motors, elevators, telephones, fans, telegraphs, lamps, automobiles and electric signs. These booklets are well illustrated and should prove effective business getters.

COAL HANDLING MACHINERY FOR MINES.—The Jeffery Mfg. Company, Columbus, Ohio, has issued Catalogue No. 20 illustrating machinery specially designed for handling coal at the mines. Views are given of direct-current generators, electric locomotives of the single-unit and double-unit types, and of the single-end and center control and also electric gathering locomotives, which operate beyond the range of the trolley wire. Illustrations are also shown of electric coal cutters of the long-wall, chain and shearing types. The major portion of the catalogue is devoted to mechanical coal conveying devices.

THE LIVING AGE occupies a field peculiarly its own. It gives sixty-four pages every Saturday of selections from the best and most popular English periodicals, and is almost indispensable to any one who wishes to keep informed upon public affairs and current discussion. The sources from which its material is taken represent an annual cost price of nearly two hundred dollars. The magazine serves an exceedingly useful purpose by sifting out from week to week whatever in English periodicals an intelligent American reader cares most for, and reproducing these articles without abridgment. Fiction, essays, travel sketches, poetry, critical and biographical papers, literary and art articles, and much else besides, will be found in the magazine. The subscription price is six dollars a year, but a trial subscription of three months, thirteen numbers, may be had for one dollar.

INDUCTION MOTORS.—Bulletin No. 1072 of the Fort Wayne Electric Works, Fort Wayne, Ind., is devoted to single-phase induction motors. In the three forms of motors described in this bulletin, three distinct principles are involved in the starting operation. Form A motors, which are furnished only in the one-fourth and one-half horse-power sizes, are of the hand-starting type. Form B motors are supplied with an auxiliary starting winding so proportioned in resistance and reactance as to allow a current to flow through its coils which is sufficiently displaced in phase from that of the main winding to produce an adequate starting torque. The principle of operation of Form C motors, which are produced in capacities from one to 15 hp. inclusive, is entirely different from either of the two previously mentioned. The winding upon these motors is similar to that of a polyphase motor, but in addition a condenser is connected between a given point of the winding and one of the terminals so as to throw the current in one portion of the winding out of phase with that in the other portion. The condenser provided with this motor is sealed in an air-tight and moisture-proof case, and is assembled within the sub-base of the motor. It is permanently connected with the motor circuits. Instruction book No. 3022 of the same firm gives much practical information concerning the installation, operation and care of induction motors, treating particularly motors of the polyphase type.

News of the Trade.

THE LOWE ELECTRIC COMPANY has removed its store to 54 Vesey Street, New York City. It is located between Church and Greenwich Streets.

TO ENLARGE PLANT.—The High Voltage Porcelain Company of New Lexington, O., is doubling the capacity of its plant in order to keep pace with its rapidly increasing business.

THE WESTINGHOUSE ELECTRIC & MFG. COMPANY has perfected a new line of three-phase core-type transformers for 60-cycle circuits. One of these transformers may be used where three-phase transformation is to be made, instead of two or three of the single-phase type. They are self-contained units of compact construction, and are generally easier to install, and reduce the complexity of wiring between the transformer and the apparatus which they are to supply.

PRINTING PRESSES.—Because of the fact that the Westinghouse Electric & Mfg. Company make the largest units required for the production and transmission of electricity, comparatively few people know that in the same works at East Pittsburg are manufactured also the smallest units to meet the needs of printing establishments and similar lines of industry. It is a matter of considerable gratification to the company to see the favor with which its motors for the printing industry have been received. There have very recently been closed three contracts aggregating in the neighborhood of 400 motors, and the company is in position to undertake the equipment of printing establishments with machines from the smallest to the largest sizes.

WIRELESS AT THE SHOW.—Among the features of the Electrical Show, to be held in Madison Square Garden from December 12 to 23, will be a wireless bulletin service which will be maintained in the Garden through the exhibition. News items and happenings on the various steamships equipped with the De Forest wireless apparatus will be transmitted from the exhjbit to the surrounding cities and to vessels at sea. Among the wireless apparatus to be shown will be the instruments used in the Japanese-Russian war and demonstrations will be made of the apparatus now in use on the American merchantmen and battleships. The exhibit will include a wireless automobile which is an electrically propelled motor car equipped with sending and receiving apparatus. These cars have been used for reporting sporting events and are intended for this purpose as well as for army use. The machine to be exhibited has been successfully used in reporting the curb brokers' sales and other items of news interest in New York City.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 28, 1905.

[Conducted by [illegible] & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

805,439. LIGHTNING ARRESTER; Arthur J. Berry, Marion, Ohio. App. filed Feb. 23, 1905. Two metal tubes are adapted to be supported in co-axial relation and parallel to the usual telephone wire, and are respectively connected to the wire and to ground so as to produce a spark gap between them.

805,448. MAGNETIC SEPARATOR FOR ORES; Henry F. Campbell, Melrose, Mass. App. filed Jan. 26, 1904. An inclined table has a plurality of magnets rigidly supported above its surface and has a hammer or knocker for jarring the ore beneath the magnets. The entire table and magnets are adjustable to vary the inclination.

805,4[illegible]. ELECTRIC DRILL; Stephen D. Stoycheff, Toledo, O. App. filed June 26, 1905. The drill has a cylindrical metal casing with motor coils mounted therein and operating a train of gears including a friction clutch for rotating the drill.

805,501. METHOD OF PRODUCING CHEMICALS IN ELECTRIC FURNACES; Edward R. Taylor, Penn Yan, N. Y. App. filed Jan. 25, 1902.

805,502. METHOD OF PRODUCING CHEMICALS IN ELECTRIC FURNACES; Edward R. Taylor, Penn Yan, N. Y. App. filed June 9, 1902.

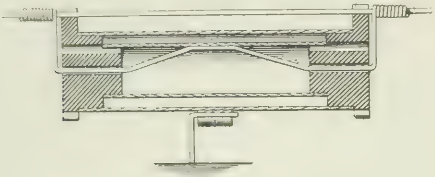
805,505. AUTOMATIC REGULATOR FOR ELECTRIC CIRCUITS; Montgomery Waddell, New York, N. Y. App. filed June 28, 1904. A system of regulating dynamos in which the fields thereof have a principal and a reverse wound section in series with each other and together in shunt with the armature. An automatic regulator comprising a variable resistance device is placed in shunt with the principal field magnet coil.

805,509. ELECTRIC CUT-OUT; Willes P. Wright, Blandinsville, Ill. App. filed June 13, 1904. Details of construction of a cut-out adapted to an ordinary gas chandelier. A porcelain casing has four swinging metal arms therein, the outer ends of which are joined by fuse wires, and the inner ends of which are respectively connected to the lamps and to the supply mains.

805,547. ARMATURE FOR ELECTRICAL MACHINES; William T. Hensley, Bound Brook, N. J. App. filed Mar. 25, 1905. In order to secure more efficient ventilation of the armature coils, the patentee provides small flat strips which lie upon the surface of the usual coils and have shoulders for maintaining the discs in spaced apart relation.

805,557. ELECTRIC CURRENT GENERATOR; William Kaisling, Chicago, Ill. App. filed May 31, 1904. The magneto has a two-part commutator with end plates electrically connected to the respective segments. Separate binding posts are provided for obtaining a rectified current from the commutator or an alternating current from the end plates.

805,568. TROLLEY BASE; Henry R. Lockhart, Westmount, Canada. App. filed July 13, 1905. The trolley pole is hinged to a horizontal arm swiveled upon the car and which has mounted on it a spring with link connections to the pole for holding the latter against the usual conductor.



805,439.—Lighting Arrester.

805,572. TROLLEY WHEEL; Alexander H. Mathesius, Brooklyn, N. Y. App. filed May 24, 1905. The tread portion of the trolley wheel is rotatable separately from the side flanges so that the different surface speeds of the tread and flange in running upon the wire will be avoided.

805,5[illegible]. ELECTRIC GAS LIGHTER; [illegible], Wis. App. filed [illegible]. The tube neck for a Welsbach burner is directly [illegible] and has an arm adapted to make electrical contact [illegible] gas is turned on.

805,598. TELESCOPIC RAMMER MOTOR; Alfred A. Thresher, Dayton, O. App. filed [illegible]. Details of construction of a telescopic rammer [illegible] chain connection [illegible].

[illegible]. ELECTRIC SIGNALING SYSTEM; William S. [illegible] and Arthur S. [illegible]. A system for [illegible]. When the fire [illegible] so that the telephone [illegible].

[illegible]. PANEL BOARD; [illegible], New York, N. Y. App. filed [illegible].

[illegible]. CONTROLLER; [illegible], Ind. App. filed [illegible].

805,714. VISIBLE AND AUDIBLE SIGNAL; John L. Creveling, New York, N. Y. App. filed Oct. 27, 1900. A fog signal apparatus in which a lamp [illegible].

805,725. CONTROLLING DEVICE FOR ELECTRIC GENERATORS; [illegible].

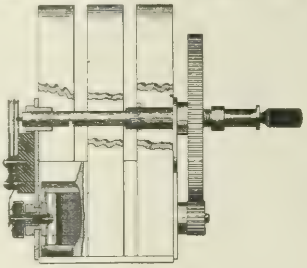
[illegible] CONTACT TELEGRAPH KEY; Samuel B. Lefley, Flori-[illegible].

[illegible]. ELECTRIC FURNACE; John S. Dorian, Niagara Falls, N. Y. App. filed March 27, 1905.

[illegible]. ELECTRIC STRAIN INSULATOR; [illegible] connections is made, while the other strain connection passes through an axial hole in the insulating block having a nut within the casing to engage the same.

805,795. X-RAY TUBE; John O. Heinze, Jr., Lowell, Mass. App. filed Mar. 16, 1905. In order to avoid injury to the operator by X-rays the anode plate within the vacuum tube is enclosed within an iron hood which permits passage of the rays only in the desired direction.

805,827. RAILROAD SIGNAL CIRCUIT; Eugene W. Vogel, Chicago, Ill. App. filed Sept. 26, 1904. The track rails are divided into insulated sections and are energized by direct currents which operate local magnets for the usual signal circuits.



805,557.—Electric Current Generator.

805,854. MAGNETIC ORE SEPARATOR; Eric Hedburg, Joplin, Mo. App. filed Jan. 15, 1904. The ore is led through a vertical annular passage in which are successively presented annular pole faces of varying strength to which adhere the magnetic particles. The magnets are continuously rotated so as to scrape off and remove the adhering particles.

805,856. BLOCK SYSTEM FOR RAILROADS; Albert N. Ireland and John T. Reese, Sioux City, Ia. App. filed Apr. 6, 1905. Details of a block signal system in which springs are placed along the roadway and make electrical connection with a pivoted arm upon the locomotive fender so as to ring an alarm circuit within the cab in case the semaphores are at danger position.

805,874. AUTOMATIC FIRE EXTINGUISHER SYSTEM; James G. and John D. Nolen, Toledo, O. App. filed Sept. 11, 1902. All the fire plugs in an office building have an attachment for transmitting a signal to the underwriter's office when the water is turned off. Each signal operates like an ordinary messenger call so as to indicate the particular plug shut off.

805,879. ILLUMINATING DEVICE; Adolph Richter, New York, N. Y. App. filed Feb. 24, 1905. The lamps are supported on a frame adapted to rotate on a vertical axis. A motor is provided for rotating the axis so as to give a more diffused illumination.

805,901. TELEPHONE-EXCHANGE SYSTEM; Henrik Thore Cedergren, Stockholm, Sweden. App. filed Jany. 28, 1902.

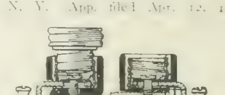
805,952. ELECTRICAL MUSCULAR EXERCISING MACHINE; Robert O. Hammond, Buffalo, N. Y. App. filed May 23, 1905. The usual exercising straps are led around the driving pulley of a magneto generator which imposes the necessary resistance and at the same time gives the operator an electrical treatment.

805,968. JUNCTION BOX; Edwin T. Greenfield, Monticello, N. Y. App. filed Oct. 24, 1904. The junction box has conical openings for the usual terminals and corresponding plugs are adapted to be clamped therein so as to secure the wires in place.

806,006. PROCESS OF MANUFACTURING CALCIUM; Otto Ruff, Berlin, and Wilhelm Plato, Colberg, Germany. App. filed Jan. 20, 1903.

806,009. AUTOMATIC MOTOR STARTING RESISTANCE; Ralph Scott, Wilkesbarre, Pa. App. filed June 15, 1904. The starting arm is guided to move longitudinally with a cylindrical casing under the influence of a solenoid magnet, and a dash pot is provided for limiting the speed of the movement.

806,018. ELECTROMAGNETIC RELAY OR SOUNDER; Thomas M. St. John, New York, N. Y. App. filed Apr. 12, 1905. The magnet is held [illegible] a resilient board upon which is an armature extending [illegible] to the pole piece of the magnet.



806,018.—Relay Base.

806,035. ELECTRIC SIGNALING AND ELECTROPNEUMATIC TRAIN CONTROL SYSTEM; John A. Whyte, Toronto, Canada. App. filed Sept. 2, 1904. Trolleys are laid adjacent to the usual track rails and in case another train is upon the same block, an electro-pneumatic system within the engine cab serves to notify the engineers.

806,039. ELECTRIC HEATER FOR OIL WELLS. James E. Williamson and Charles E. Collins, Allegheny, Pa. App. filed Jan. 23, 1896. Comprises a cylindrical box having a heat coil inside which is attached to the [illegible] and lowered into the hole to heat the same for any desired purpose.

806,052. RECEIVER FOR WIRELESS TELEGRAPHY; Henry S. Blackmore, Mt. Vernon, N. Y. App. filed May 8, 1901. A detector comprising [illegible] is enclosed within a casing of aluminum which forms one terminal of the detector. The aluminum will not permit the passage of light [illegible] affect the selenium, but only the invisible rays of the wireless emanations.

806,067. ELECTRICAL SIGNALING MECHANISM; David H. Coker, Piedmont, Ala. App. filed Dec. 13, 1904. A lever is pivoted within a box and has at one end a screen which makes a signal through an opening in the box, and at the other end an operating magnet.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, DECEMBER 16, 1905. No. 25.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................................1139 Monadnock Block
PHILADELPHIA OFFICE..............................929 Chestnut Street
CLEVELAND OFFICE.................................402 Cuyahoga Building
EUROPEAN OFFICE..........Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for* 1905 *to date,* **686,500.**

NEW YORK, SATURDAY, DECEMBER 16, 1905.

CONTENTS.

Editorial 1013
Struggle for Independent Telephony in New York.......... 1016
Allowance for Plant Depreciation 1016
Changes in National Electrical Code.......... 1017
Analyzing the Brooklyn Municipal Plant Report.......... 1017
The Allis-Chalmers Steam Turbine 1017
United Engineering Building 1018
Power and the Water Ways.......... 1020
Work of the U. S. Bureau of the Census.......... 1020
Three-Phase Traction for the Simplon Tunnel.......... 1020
The Cunard Turbine Steamer "Carmania".......... 1021
Opening of the New York Electrical Show.......... 1021
Electrical Engineers of the Times.—XI. Mr. William L. Waters.......... 1021
Current News and Notes 1022
Electricity and Sewage Disposal 1025
Commutation Theory. By A. Press.......... 1027
A New Type of Frequency Meter. By A. S. Langsdorf.......... 1029
A Short Single-Phase Railway on Long Island.......... 1029
Some Obstacles to Electrical Development in Great Britain. By W. Valentine Ball 1032
Reflectors, Shades and Globes.—IV. By J. R. Cravath and V. R. Lansingh. 1033
The Approximate Calculation of Plunger Electromagnets. By Charles R. Underhill 1035
Recent Electrochemical Developments.......... 1036
LETTER TO THE EDITORS:
  Saturation Expressed in Percent. By H. S. Baker.......... 1037
Digest of Current Electrical Literature.......... 1037
Book Review 1042
The Allis-Chalmers Steam Turbine 1042
Pneumatic Brush-holders for Turbo Generators 1044
Electric Pipe-Thawing Outfit 1045
1000-HP Induction Motor in a Paper Mill.......... 1045
Motor-Driven Hand Miller 1045
Industrial and Commercial News 1046
General News of the Week 1049

LIGHTING "UNITS."

We have referred several times in the past few months to the somewhat chaotic condition of the rating of different electric illuminants, and the importance of reducing all these to the common basis of mean spherical candle-power. We have advocated this in common with the majority of those who have given this matter much thought, because the mean spherical candle-power basis seems to be the nearest to a satisfactory one that can be obtained, and not because it is the final criterion from which the expert illuminating engineer is to draw his conclusions in selecting an illuminant for any specific purpose. The watts consumed per mean spherical candle-power by any bare illuminant indicate roughly to the designer of illumination what may be expected from the illuminant when properly equipped for any particular piece of lighting. The final test which should always be applied by the illuminating engineer on important work is that of calculating the intensity of light delivered where it is wanted from the source of illumination properly equipped with shades, globes or reflectors. In other words, we are coming rightly to consider more and more the source of illumination, together with globes or reflectors, as lighting "units" rather than simply as sources of illumination without regard to the means which are taken to direct and diffuse the light. Indeed, so important has this point become that many manufacturers have within the past few years brought out lamps which are in reality lighting units, in which in order that there may be the least possible opportunity for users to equip wrongly the source of light, there is provided as a regular equipment a reflector and a diffusing globe. It is to be hoped that the day will come when manufacturers will not be obliged in self-defense to put out such lighting units, and that those responsible for the installation of electric lighting arrangements will be able to combine intelligently the source of light with the means used to direct and diffuse the rays, or in other words, to assemble their own lighting units from standard material on the market so as best to suit the conditions to be met. The series of articles by Messrs. Cravath and Lansingh which have been running in these columns for several weeks give much information which will enable this to be done in connection with incandescent lamps, for which the immense variety of shades, globes and reflectors is available.

An equal amount of attention has not been given by glassware and electrical manufacturers to the proper equipment of other electric illuminants. The matter has not been entirely neglected by any means, but should be more generally considered than it is. As pointed out by the authors, manufacturers of this kind of glassware might well give attention to combining the useful and the artistic to a greater extent than is usually done. That is, there are many very plain and homely shades and globes which are very useful on account of the way in which they alter the distribution of light about the lamp and which could be made easily decorative as well as useful. On the other hand, there are some purely decorative shades which could be redesigned so as to make them useful in altering the distribution of light as well. Such attempts to combine the useful and the artistic of the past have been confined mainly to manufacturers of certain patented types, but there is no good reason why this should continue to be the case, nor has there apparently been any good reason in the past save the indifference of both manufacturers and users. As more attention is now being given to the engineering of illumination, these points must be more considered in the future by manufacturers than in the past.

ELECTRICITY AND THE FARM.

It is both a surprising and disturbing fact that while electrical engineering has in recent years greatly benefited all classes of citizens, it has hardly done anything for the farmer. Dwellers in towns and cities receive the advantages of electric light, electric power distribution, electric traction, and electric transmission of intelligence. The only advantages that have been extended to agricultural districts and isolated farms have been in the direction of electric trolley roads and electric telephones. Even these advantages extend to only a small percentage of farms in the United States, and they hardly enter into the real activities of the farm. A considerable amount of energy is required annually in farming. It is not supplied by electric motors. It is supplied mainly by the dirigible quadruped, and partly by the itinerant steam-engine. Vast aggregate quantities of fertilizers are prepared and applied to farm lands, but electrochemical industries have not yet even entered the field. We live at the bottom of an ocean of nitrogen, containing a relatively small quantity of oxygen. The nitrogen in this aerial ocean is about 4 billion million tons (4×10^{15} tons) in total weight, and yet it is so difficult to fix a single ton of it in fertilizing form, that we have to depend upon bacteria to do most of the work in a slow and tedious process.

It is earnestly to be hoped that electrical processes may be developed to aid in some one of the manifold industries that find their home on the farm. The commercial value of any such successful processes might become enormous. The recently published report of the Secretary of Agriculture shows that the total money value of United States farm products for the year covered by the report was nearly 6½ billions of dollars, representing an average daily output of 17½ millions of dollars. The United States farms thus produced wealth at an average rate of not far from a million dollars each hour. Fifty-six per cent, or more than half of the total money value of the annual products of the country are farm products. Since the farming population is only about one-third of the total population of the country, this third produced more than half the total produce value of the country. During the past five years the total money value of United States farms has increased on the average by a hundred millions of dollars per month. Chemistry, botany, biology, meteorology and mechanical engineering are doing splendid work for the farmers. It is greatly to be desired that electricity should be enlisted in the same service.

MODERNIZING STORE LIGHTING IN SMALL TOWNS.

The owner or manager of the central station in a small town who thinks there are no more fields to conquer in electric store lighting because he has secured as customers all the stores in the town, can profitably set to work to broaden his view. Electric lighting, and especially incandescent lighting, in the stores in many small towns is undeniably crude and very far behind the times; in fact, is but a step in advance of the kerosene lamps it replaces, and the average electric light company has plenty of scope for a campaign toward modernizing and making attractive this branch of lighting. While the modernizing of the lighting of any particular store will not necessarily require much if any more power than formerly, it does mean that the rendering of the lighting attractive as well as useful in a few stores in a town will stimulate interest in electric lighting generally among merchants, and in the end be sure to result in greater consumption of power for store lighting. Furthermore, if there are some merchants in a village (and there usually are) who still stick to kerosene lamps, the difference between their lamps and the stores with modern electric lighting arrangements will be so much more marked than between kerosene and crude electric lighting as almost to force the adoption of electric lighting by the slower members of the mercantile community who have before held back from having their stores wired. The conventional method of electrically lighting stores by incandescent lamps in small country towns is now, as it was fifteen years ago, to hang a row of bare incandescent lamps on drop cords over the counter on each side of the store. The windows in which goods are displayed are illuminated with similar bare drop lights hung low in the window, rather than with lamps in reflectors concealed at the top of the window. So far as the illumination of the counters and shelves is concerned, the rows of bare lights give fairly good distribution of light, with perhaps more at and above the horizontal than necessary. The effect of the rows of bare lamps hung low is, however, not only crude, but detrimental to the general effect of the lighting.

The general effect can be improved immensely in such stores simply by the use of shades of frosted or other diffusing glass placed over each lamp. Even frosted bulb lamps alone would be a great improvement, both in artistic and illuminating effect. Going a step farther, the merchant, by spending a little more money to modernize his lighting, can substitute one-light pendant fixtures for drop cords, place the lights considerably higher above the counter, and use frosted lamps with any of the several artistic and efficient types of reflectors now on the market, thus throwing plenty of light down to illuminate counters and shelves and permit the sources of light to be placed high enough to be well out of the line of vision. If the merchant can be induced to spend a little more money on power for illumination in order to secure very much better effects, a good plan is to go almost to the ceiling with the incandescent lights, either grouping them on ceiling fixtures or studding the ceiling with them. In this case the use of reflectors which will give a downward distribution similar to that from a Nernst lamp is advisable. In modernizing store lighting, a change frequently made is to bunch incandescent lamps in clusters or groups. This should be done with much care, remembering that the bunching of lights in this way does not give as good and even a distribution of light over the store as the arranging of single lamps at frequent intervals. To have the illumination on the counters as satisfactory as it was before, when a few clusters or chandeliers are substituted for scattered lights either the total amount of light must be increased or the clusters must be equipped with lamps in reflectors mounted at such an angle that the lamps in the cluster will cast the maximum light in directions that will bring up the illumination midway between clusters to nearly that under each cluster.

SATURATION EXPRESSED IN PERCENT.

A suggestion is made by Mr. H. S. Baker, in our correspondence columns on page 1037, to define the percentage of saturation as the ratio of the intercept on the y-axis, by a tangent drawn at any point of the saturation-curve, to the ordinate through that point. Thus, if the tangent should cut the y-axis at half the height of the ordinate, the percentage of saturation would be 50 per cent. or 0.5. The advantage of this plan would be, as the communication points out, that if we subtract this ratio from unity we have the ratio of any small percentage increase in voltage to the percentage of additional exciting current producing it. If this method of expressing saturation were generally understood, it would be convenient on account of the above advantage. An objection is that it is very difficult to secure unanimity of usage in phraseology of this character. Consequently, ambiguity and misunderstanding are likely to follow such usage, because the engineer, not acquainted with the definition, is likely to suppose that the "percentage of saturation" means the ratio of the voltage actually attained to the maximum attainable with full-field excitation, either as permitted by the field-rheostat, or as attainable with large super-excitation. Possibly all danger of ambiguity might be avoided, and the definiteness of the suggestion secured, by inverse method. Thus, it is possible to define the degree of saturation in the sense above defined, by stating that one per cent more exciting current will produce *x* per cent more generated voltage. Thus if one per cent more excitation produces, say, 0.4 per cent more voltage, the position of the tangent to the saturation curve is defined for the point considered, no matter what the scales of excitation and voltage may severally be.

Single-Phase Railway on Long Island.

A description of a short urban railway system which possesses the distinguishing characteristic of being operated exclusively by alternating-current, although covering the exact route formerly occupied by a direct-current railway, is given on page 1029 of this issue. The railway described may be taken as an example of an alternating-current traction system in its simplest form. A portion of the simplicity may be attributed to the fact that with the exception of the oil switches, no automatic devices are used on the cars, and no moving machinery is installed in the sub-station. The absence of automatic brakes with their magnetic or pneumatic devices renders the apparatus on each car only slightly more bulky than that necessary with direct-current equipments; for the accelerating rheostat there have been substituted a one-coil transformer, a preventive resistance and a preventive reactance. In comparison with the controller circuits used with a two-motor equipment operated on the series-parallel method using a variable resistance in series with the armatures, the controller circuits of the plain single-phase equipment are much simpler. The weight of the auxiliary devices on the single-phase car is somewhat greater than that of those used on the direct-current car, but that no trouble is experienced in finding room for these devices, even on small urban cars, is evidenced by the fact that the complete equipment for two 50-hp single-phase motors has been placed on a 14-ton single-truck car without any appearance whatever of crowding.

As viewed by a passenger familiar with direct-current railways, the system as a whole possesses few points to attract his attention. The cars are in general appearance similar throughout to those frequently seen upon city streets. The trolley-wire with its suspending catenary, and the trolley pole with its supporting porcelain insulators, give to the conducting system an appearance of stability never found in direct-current work, and these are the only features which serve to distinguish this railway from the usual urban systems. A study of the overhead work of this railway soon convinces one that, independent entirely of the extra expense involved in the insulation to withstand the higher voltage, the cost of the catenary cable, cross-span wires and substantial side poles renders the investment in the completed distributing circuits quite comparable with that necessary with the usual low-voltage direct-current trolley wire equipments. It is evident, however, that nothing less severe than a falling tree, a hurricane or an earthquake could disturb the overhead work, and that the expense for maintenance will be reduced to an insignificant figure.

Multiple-Unit Control for Single-Phase Equipments.

The advantage of the multiple system of control of motor cars with respect to rapid acceleration, and the incidental advantage of the motor car method of operating trains through the ease with which the individual cars can be handled in switching and the assurance that a train will not be rendered non-operative by the derangement of a single unit, have proved so great in direct-current practice that the absence of a similar system for use with alternating-current has been adduced as a grave defect of the latter system; and it has rather strangely been assumed by some that the multiple-unit system could not be applied to alternating-current equipments. The problem of producing a multiple-unit system for the control of cars driven by single-phase series motors does not, however, seem to possess any difficulties greater than those involved in direct-current equipments.

It can be taken as self-evident that all cars on which it will be desirable to use the multiple-unit control will be equipped with air brakes. No difficulty has been experienced in constructing single-phase motors for operating air compressors, and it can be assumed that a supply of compressed air will be available to operate multiple-control gear. It is probable also that pneumatically-operated and magnetically-controlled switches are as well adapted for alternating-current as for direct-current equipments, and even in direct-current practice the electromagnets for opening the air valves are supplied with current from an isolated storage battery circuit. It thus does not appear why the slight modifications which would be introduced in standard direct-current multiple-switch controllers in order to render them serviceable for alternating-current equipments should present any unsurmountable difficulties.

Frequency Meters.

An interesting type of frequency meter for alternating current circuits is described on page 1,029 of this issue. It depends upon the well known fact that the alternating-current strength which will flow through a given condenser under a given impressed voltage, increases directly with the frequency. Thus, at 2,653 volts, a one-microfarad condenser will take one ampere of current, if the frequency be just 60 cycles per second; whereas if we double this frequency, leaving the voltage unchanged in magnitude, the current in the condenser will be two amperes. Consequently, an ordinary ammeter in circuit with a condenser is a frequency-meter, if allowance be made for variations of voltage. Variations of voltage may, of course, mask and suppress the utility of such a device for indicating changes in frequency. The plan adopted in the article referred to compensates for changes of voltage by employing a separate dynamometer voltmeter coil to carry the scale; while the ammeter dynamometer coil carries the pointer. If the voltage remains stationary, the scale will thus remain stationary and the ammeter pointer will indicate changes of frequency in the ordinary way; but if only the voltage changes, the scale and pointer will each move in the same direction through the same angle, thus leaving the pointer over the same mark on the scale. By a simple union of these functions, the one moving coil points off changes in voltage, thus making a voltmeter and a frequency-meter out of the same instrument, and utilizing both moving coils.

A well known form of frequency measurer employs the principle of electro-mechanical resonance in such a manner that one out of a number of appropriately loaded springs, placed side by side, is electromagnetically excited into visible resonance. As the frequency changes, the resonance is shifted from one spring to another, in successive steps. Such a method does not permit of strictly continuous indications from one step to the next. The apparatus described in the article should, however, be capable of continuous indication throughout a considerable range. In a large distribution system, the measurement of frequency is not of great importance, because it is determined by the engine-governors in the central station or stations supplying the system. It is in experimental plants where the frequency is under control, and has to be adjusted, that a knowledge of the frequency becomes important and a special frequency-meter will be useful. The frequency is always to be had by determining the speed of the alternating-current generator; but a constant running tachometer is not easy to maintain and it is inconvenient to make frequent observations with a speed counter.

Struggle for Independent Telephony in New York.

The recent struggle to establish one or more independent telephone systems in New York city has led to some interesting developments. The proposal to use the old burglar alarm franchise of the Mercantile Electric Company, now owned by the United States Independent Telephone Company of Rochester, is said to have impelled Controller Grout and Corporation Counsel Delany to ask Charles E. Hughes, counsel for the Insurance Investigation Committee, to investigate the facts concerning the reported sale of the franchise by interests identified with the Equitable Life and the Mercantile Trust Company. For some time the Controller's office and the Corporation Counsel's office have been looking into this franchise, which was granted by the old Board of Electrical Control to enable the Mercantile Safe Deposit Company to perfect a burglar alarm service. The city officials were informed that the Mercantile Trust Company had disposed of the Mercantile Electric Company for $5,000 to the New York Independent Telephone Company, which in turn is owned by the United States Independent Company. Then they received bankers' circulars announcing that the United States Company was floating a $25,000,000 bond issue largely on the strength of this franchise, which the company valued at $12,500,000.

Controller Grout at once set to work to find out whether the Mercantile Trust Company interests had sold the franchise for $5,000, or whether the United States Company was placing an absurd value on the franchise when it estimated it to be worth $12,500,000. President Paul Morton of the Equitable was appealed to to investigate the sale of the franchise because of the fact that the Equitable Life owns the Mercantile Trust Company, and, therefore, would be a heavy loser if the company had sold for $5,000 a franchise worth in reality $12,500,000.

President Morton issued the following statement last week concerning the franchise sale: "The Mercantile Electric Company was incorporated some years ago, with a special charter or franchise which gave it permission to lay wires in the Subway of New York, and to do a general burglar alarm and telephone business. The stock is entirely owned by the Mercantile Safe Deposit Company." The fact that President Morton asserted that the franchise gave the right to do a general telephone business attracted general interest. The Controller and the Corporation Counsel also were interested in President Morton's statement that the stock of the Mercantile Electric Company is owned entirely by the Mercantile Safe Deposit Company. The New York Independent Telephone Company, on October 7 filed with the Secretary of State and also with the County Clerk a certificate of merger with the Mercantile Electric Company. The papers on file state that the merger was effected September 27 of this year, and that at that time the New York Independent Telephone Company owned all the stock of the Mercantile Electric Company.

Allowance for Plant Depreciation.

A number of interesting decisions by the Massachusetts Gas & Electric Commission were quoted recently in these pages. Hon. F. E. Barker, chairman, has now given out another, in the unanimous decision of the board upon the petition of the city of Holyoke for a change in the method of reckoning the annual depreciation of its plant so that the city will not have to charge off 5 per cent a year. The board dismisses the petition. The decision is in part as follows: On December 15, 1902, the city of Holyoke took possession, under the general law, of its gas and electric light plant. The total initial expenditure for this purpose was $829,252.21. Since that time the city has expended for additions and improvements $267,722.94, making a total investment in the business up to the present time of $1,096,975.15. Nearly all the cost of the original purchase and of the subsequent additions and improvements has been defrayed out of the proceeds of bonds issued by the city. Of these bonds $98,200 have already been paid, $36,600 become payable in 1906, and the same sum annually for the seven years following, with a smaller amount annually thereafter until 1932. The interest payments for the year 1906 amount to $28,185.50, the demand for this purpose obviously decreasing steadily with the payment of the bonds as they mature. Interest upon practically the entire debt is at 3½ per cent per annum. During the year covered by the last return the income derived from private consumers exceeded the operating expenses, not including interest or depreciation, by about $40,000. The estimates for the year 1906, as submitted at a hearing at Holyoke, gave:

Operating expenses	$230,781
Bond payments	36,600
Interest charges	28,185
Depreciation at 5 per cent	54,849
Amount to be provided	$350,415
Deducting estimated income, not including anything for city lights	$228,000
To be raised by taxation	$122,415
Bond payments	36,600
To be raised by taxation for maintenance	$85,815

It was urged at the hearing that to include the last-named amount in the tax levy would impose upon the taxpayers an unreasonable and unnecessary burden and that the city was entitled to relief accordingly.

In the conduct of a business of this character the municipality and the taxpayers seem to stand clearly in the place of a private company and its shareholders, while the relation of the consumers to the owners of the property is not changed. The consumers must bear the full burden of carrying on the business, including the cost of depreciation. The consumers, however, as such are not to be assessed to pay for the plant, and they are not interested in the time or manner in which the money representing the original investment is called for from the taxpayers. Whether the city's debt on account of the plant is large or small does not concern them.

As a fair depreciation charge is for the proper protection of the owner's interest, he is primarily interested that its amount should be ample. The fact that the owner is obliged to expend at the same time a large sum on his investment can be no reason for reducing it; it may rather emphasize the importance of keeping it at a proper amount. It seems clear to us, therefore, that the amount of the bond payments ought not to be considered as material to the question of the fair amount of the depreciation charge.

Included in the total investment of $1,096,975 is approximately $110,000 paid for the expense of litigation and $45,000 paid for plant, which was shortly after abandoned and replaced by appliances of a modern and more efficient type. These two items indicate an impairment of the investment already incurred of about $155,000, and constitute an obvious depreciation for which provision should at some time be made. In any well-regulated business law expense is an operating and not a capital charge. Some additional amount is annually accruing from causes common to all enterprises of this character. The sum already named is so large, however, that if the statutory rate of 5 per cent be required and the depreciation now going on be taken at no more than the 2 per cent suggested by the city, it will require five years from this date, or eight years from the purchase of the plant, to restore the amount already lost. Nor will the 5 per cent requirement be unreasonably burdensome upon the city. It will, in fact, require the inclusion in the tax levy of a somewhat less sum for maintenance than is involved in the suggestions originally presented by the city, as the following figures will show:

Suggested by the city—	
For operating expenses	$230,781
Interest on bonds outstanding	28,185
For operating and interest	$258,966
Deduct receipts not including city lights	228,000
Leaving a balance of	$30,966
Depreciation at 2 per cent	21,099
Making a total to be put in the tax levy for maintenance	$52,905

Since the hearing the estimate for operating expenses has been materially reduced and the figures resulting from this and the board's finding will be as follows:

For operating expenses	$196,281
Interest on the entire investment at 3½ per cent, as required by law	38,394
For operating and interest	$234,675
Deducting receipts not including city lights	228,000
Leaves	$6,675
Add depreciation at 5 per cent	54,849
Net for operating and depreciation	$61,524
Deduct from this the difference between the interest to be collected $38,395 and $28,185 the interest to be paid on	10,209
	$51,315

That is to say, with a continuance of the present prices to private consumers the city, as a consumer sharing with them the consumers' obligations, will pay for its lights in the public buildings and streets the sum named.

Changes in National Electrical Code.

The fourteenth annual meeting of the Underwriters' National Electric Association was held in New York on December 6 and 7 to consider changes and additions to the National Electric Code. The recommendations of the committees on car wiring, double and single-pole switches, high-tension motors, switches and cut-outs, rheostat specifications, wiring and construction of fan motors and flexible tubing, were all adopted. The committee on double and single-pole switches adversely reported to the suggestion that no single-pole switches be allowed and that double-pole switches be used in every instance. The committee on switches and cut-outs recommended only one change, and that was in connection with switches designed for use on Edison three-wire systems, which must hereafter be marked with both voltages, followed by the ampere rating and the words "3-wire," as for example, "125-250 v., 30 a., 3-wire." The recommendations made by the committee on high-tension motors were mainly relative to the proper insulation of the machines and wires leading to them. The suggestions for the proper rating of variable-speed motors were referred to a committee.

Among the decisions were that the casings of all transformers in central or sub-stations must be permanently and effectively grounded through conductors having a carrying capacity not less than No. 4 B. & S. gauge, except in the case of series transformers for instruments; a committee was appointed with power to provide rules relative to these latter instruments. Transformer secondaries of distribution systems may be grounded at the transformer or on the individual service, as provided in the Code. When transformers feed systems with a neutral wire, the neutral must also be grounded at least every 250 ft. for overhead systems and every 500 ft. for underground systems. Mr. Dow, of the Detroit Edison Electric Company, cited cases in which this rule would be unfair, and a committee was appointed to consider his suggestions. The ground wire in direct-current, three-wire systems and alternating-current systems must hereafter never be less than No. 4 B. & S. gauge. Over especially inflammable stuff water-proof sockets must be used. This provision is not made because of the water-proof quality of the socket, but rather on account of the superior and special construction of this socket.

The rule providing that the insulation of transformers when heated shall withstand continuously for five minutes a difference of potential of 10,000 volts alternating between primary and secondary coils and between the primary coils and core, has been changed so that the time now is one minute in order to agree with the rule of the American Institute of Electrical Engineers. The suggestion that the rule for switches, cut-outs and circuit-breakers should be modified so as to require no protective devices on the switch in the neutral of three-wire systems, and the resolution passed by the National Conference that "in cases of three-wire systems with ground neutral a solid connection without fuse be permitted on the neutral wire," were referred to a special committee for action. It was felt that this suggestion was so important and would make such a radical change in all rules in force to-day that the change should not be made except after mature consideration. The suggestion emanating from Mr. Willcox, of the General Electric Company, to amend the rules so as to allow the use of series lamps was referred to a committee who were instructed to report as soon as possible.

Hereafter under the head of "General Suggestions," as printed before the Code proper, will appear a suggestion urging upon architects the necessity for properly providing for signaling system wires in modern buildings, with suggestions also as to the proper methods of accomplishing this. The suggestion that a committee be appointed to consider special rules for the equipment of electric cranes was approved. No action was taken on the suggestion that outlet boxes be required at all outlets, and the recommendation that the grounding of secondaries be made mandatory met a similar fate.

Analyzing the Brooklyn Municipal Plant Report.

Considerable space has been given in the last two issues of this journal to the report of the experts of the city on the proposed municipal lighting plants for Greater New York and the discussion of the subject at the meeting of the Municipal Engineers. A novel and excellent way of bringing the data home to the public at large has been hit upon by the Edison Electric Illuminating Company, of Brooklyn, in regard to that part of the report which relates to Brooklyn Borough. A full-page advertisement has been inserted in the *Brooklyn Eagle*, giving all the figures of the report, and then analyzing and discussing them. It is a good piece of work, and as a means of appealing to the intelligence and sound common sense of the community, its value cannot be overstated. As will be remembered, two plans are proposed, one more ambitious and comprehensive than the other, each, however, involving, on the actual figures presented, a loss to the borough, as compared with the cost of the service from private companies. The estimated losses are $27,000 and $68,000, but it is claimed that the real losses to the city would be much greater, in one case being $257,390, and in the other $525,820.

Moreover, the first plan is discussed as follows: "The plan proposes running lines through 494 miles of streets, of which 156 miles will be supplied from underground and 338 miles from overhead construction. The average distance between poles in overhead construction of this character is 90 ft., which makes it necessary to place not less than 58 poles to the mile. This will involve, therefore, for the overhead construction, the erection of not less than 19,604 additional poles throughout the various streets of the Boroughs of Brooklyn and Queens. At a time when private companies are, in co-operation with the city authorities, taking down thousands of poles annually and removing many miles of overhead wires, the erection by the city itself of 20,000 additional poles can hardly be regarded as a public benefit." As to the second, large plan, it is pointed out that it proposes running lines through 1,004 miles of streets, of which 256 miles would be supplied from underground construction and 748 miles from overhead. This would involve, for the overhead construction, the erection of not less than 43,384 additional poles throughout the various streets of the Boroughs of Brooklyn and Queens.

The Allis-Chalmers Steam Turbine.

On Tuesday a large party of engineers inspected, by invitation, the 5,500-kw Allis-Chalmers turbine in course of installation in the Williamsburg power station of the Brooklyn Rapid Transit Company. Mr. A. M. Mattice, chief engineer of the Allis-Chalmers Company, was present to explain to the visitors the special features of the turbine, the upper casing of which was removed to facilitate inspection. An account of the Williamsburg station appeared in the issue of September 23, and on another page of the present issue the new turbine is described in detail.

The points which interested visitors in particular were the details of securing the blades, the shroud rings protecting and stiffening the outer ends of the blades, the low-pressure water packing arrangement, and especially the low-pressure balancing arrangement with its ingenious labyrinth or baffling packing. All of these details are described in the article on page 1042.

Not far from 100 engineers and other invited guests were present, among whom were the following: General Manager Frank Hedley, Chief Engineer George H. Pegram, Mechanical Engineer John Van Vleck, and Mr. George E. Thomas, Interborough Rapid Transit Company; Superintendent of Motive Power H. G. Stott, Interborough Rapid Transit Company; Chief Engineer M. G. Starrett, New York City Railway Company; Mr. Willis Lawrence, Manhattan Street Railway Company; President Edwin W. Winter, Vice-President and General Manager J. F. Calderwood, Electrical Engineer C. E. Roehl, Superintendent Motive Power C. F. Baker, Mr. A. Wolff and Mr. Geo. H. Howard, Brooklyn Rapid Transit Company; Constructing Engineer George A. Orrok and Chief Engineer J. D. Andrew, New York Edison Company; General Manager W. F. Wells, Brooklyn Edison Company; Mr. D. S. Kohler and Mr. W. A. Donkin, Allegheny County Light Company, Pittsburg, Pa.; Mr. Herbert W. York, chief engineer, American Smelting & Refining Company; Mr. H. A. Lardner, J. G. White & Co.; Mr. Geo. H. Throop, Mr. Martin H. Kilgour, London, England. The Allis-Chalmers Company was represented by Mr. W. W. Nichols, vice-president and secretary; Mr. A. M. Mattice, chief engineer; Mr. F. C. Randall, manager New York office, and Messrs. John S. Lord, C. J. Larson, A. G. Christie, Harry Byrne, A. F. Rolf, Frederic D. Herbert, C. A. Hoppin, S. G. Stone, H. W. Rowley, L. C Marburg and Samuel Moore.

United Engineering Building.

The accompanying illustrations give a perspective view and floor plans of the United Engineering Building, New York City, the gift of Mr. Andrew Carnegie to the American Institute of Electrical Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers. The construction of the building is proceeding satisfactorily, having reached the third floor, and in the absence of labor troubles it should be ready for occupancy next fall. The building is on West Thirty-ninth Street, in the rear of the Engineers' Club Building (which is now constructed to the sixth floor), and covers five city lots, with a front of 125 ft. and a depth of 100 ft. Only 85 per cent of this area is, however, covered by the building, or 115 ft. frontage and 90 ft. depth.

The first floor (Fig. 2) is devoted to general purposes. Fig. 6 is the plan of the floors containing the working offices of the representatives of the founder societies. The reception room, board and committee rooms are on the desirable south front and are favored by the windows which look to the eastward. Other floors (Figs. 3, 4 and 5) contain a number of meeting rooms and auditoriums. The largest of these, primarily designed for the meetings of national societies and for those of other large bodies, has been made to accommodate 1,000 persons (Fig. 3). The location of this large auditorium is on the first floor above the street, so as to make elevator service for it unnecessary. A large foyer and generous corridors give ample space for withdrawal from the large assembly hall. To enable those in the back of the auditorium to see clearly such diagrams and illustrations as may be on the stage, the seats are arranged on a grade, which arrangement enables coat rooms to be provided, opening from the outer corridors. The large auditorium floor is reached from the great central rotunda on the street floor (Fig. 2) by generous stairways, and can also be reached from carriages entering the driveway and moving continuously as they receive or discharge their passengers. The room for preparing apparatus and exhibits for the stage is conveniently served by a large freight elevator, so that heavy machinery and apparatus can be easily handled.

On the floor above the large auditorium are two assembly rooms (Fig. 4) occupying the principal portion of the area. These assembly rooms may be used independently for lecture purposes, or one may be made auxiliary to the other and used as a foyer or conversation room. Two rooms adjoining may be used in common when desired, as, for instance, for purposes of general reception or conversazione. Auxiliary smaller rooms on this floor are provided and provision is made for the service necessary for light refreshments or luncheon.

On the next floor above (Fig. 5) several small lecture halls are provided suitable for ordinary meetings of scientific and engineering societies, and for meeting of sections at the time of general conventions of national organizations. It is expected that there will be a great demand, especially for the small meeting rooms, for scientific purposes. They will be supplied with electric current, with compressed air and with gas and water. The meeting rooms of all sizes will be fitted for the use of the projection lantern. The board rooms of the society floors will be large enough for the holding of small professional meetings when occasion may require.

A crowning detail, in the planning of the building, has been the provision on the two upper floors for the libraries of the various societies (Fig. 7). The consolidation libraries of the several societies will form a working and reference library of the highest possible value as respects engineering science and practice. The top floor is to be devoted to working alcoves, to rooms for photographic reproduction and for drawing and similar library work. The roof will be specially constructed to secure the best illumination. The floor below the library reading rooms will be devoted to the book stacks, although when first the societies enter the building the alcove construction in the floor above will probably take care of the greater part of the nucleus of the future library which the societies will bring with them. This will leave the book stack floor to provide for future accessions. It is believed that, by the co-operation of the New York Public Library on the adjoining block, and with the interest and strength which the societies can add, the library in the Engineering Building can in time be made the most important engineering library of the country.

The building is also to furnish office accommodation for a large and continually increasing number of societies which have engineering or some other department of science as their principal object, such, for example, as the New York Electrical Society, Society of Naval Architects and Marine Engineers, Heating and Ventilating Engineers, American Gas Light Association, National Electric Light Association, Society of Chemical Engineers, Association of Edison Illuminating Companies, etc. For these organizations the building will offer office areas of varying sizes, the arrangement of which will be adjusted to the requirements of the tenants. Such participants will have use of the auditoriums.

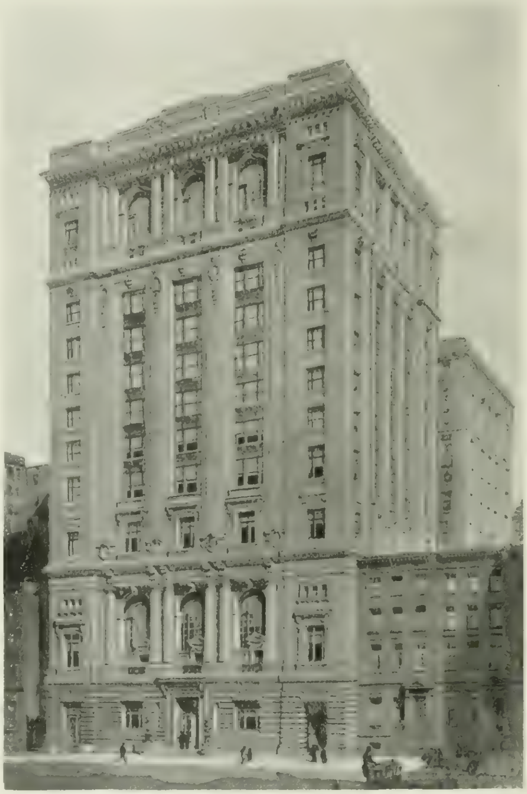


FIG. 1. PERSPECTIVE VIEW OF UNITED ENGINEERING BUILDING.

A driveway (Fig. 2) gives access on the street level and under cover to the freight elevator, for boxes of books and other merchandise moving inward, and for mail sacks moving outward. This driveway also serves for carriage access to the auditorium and passenger elevators, and affords facilities for unloading by gravity to the coal pockets of the heating plant without handling. The general convenience of the building is also served by a receiving and shipping office at the rear, through which all goods in and out will be handled. There will be a bureau of information, at the right of the main entrance, where general questions can be answered, visitors directed, and some routine business transacted. This office will also be the location for the telephone exchange, the telegraph and the sub-postoffice.

By a business arrangement formed under legal advice and forming part of the deed to the property to the east of the building, a restriction has been placed which prevents the erection on that lot of a building more than 60 ft. high. This restriction runs with the land and secures light and air for the building on its eastern front above the third floor. The westerly wall is built 10 ft. within the property line, so that openings for light and air will always be left on that side and on the rear, even if high buildings should be hereafter built on adjoining property to the west and the north. The building will be given a finished appearance on all four sides and not merely on the south façade, in order that its monumental character may be seen and recognized from every point of view.

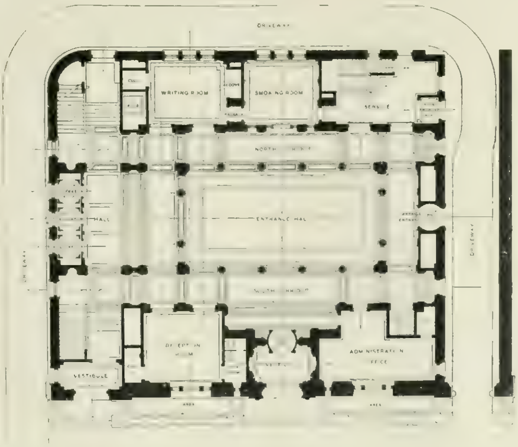


FIG. 2.—PLAN OF ENTRANCE OR FIRST FLOOR.

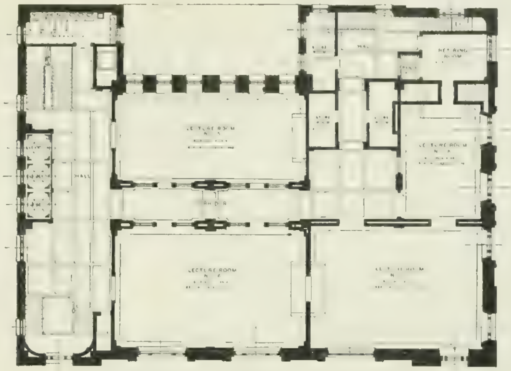


FIG. 5.—PLAN OF LECTURE HALLS OR SIXTH FLOOR.

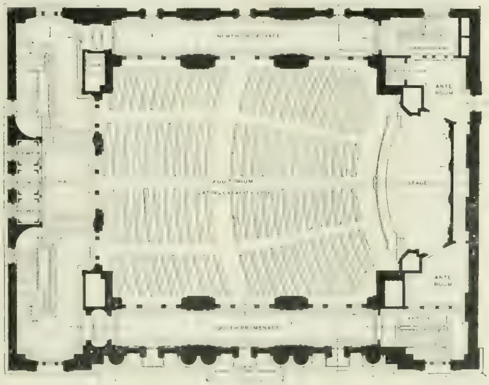


FIG. 3.—PLAN OF AUDITORIUM OR THIRD FLOOR.

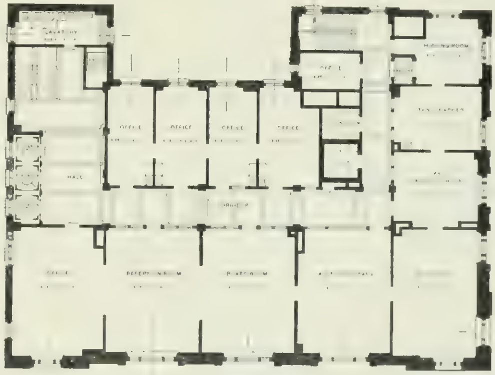


FIG. 6.—PLAN OF ELECTRICAL ENGINEERS OR TENTH FLOOR.

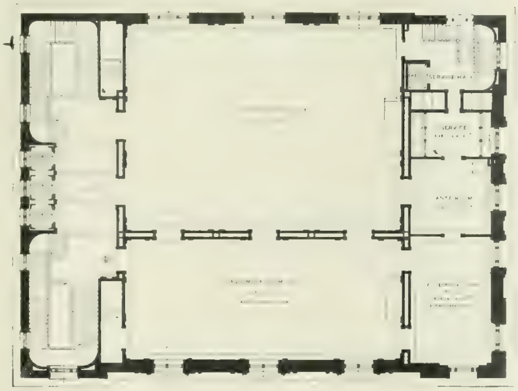


FIG. 4.—PLAN OF ASSEMBLY OR FIFTH FLOOR.

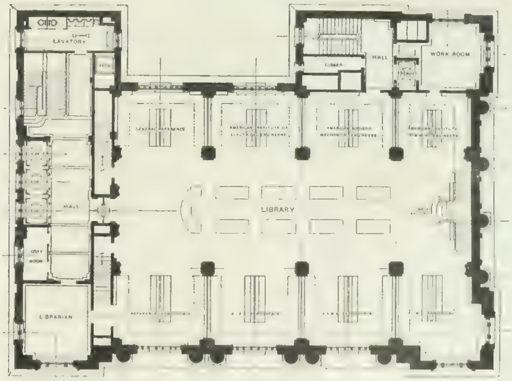


FIG. 7.—PLAN OF LIBRARY OR THIRTEENTH FLOOR.

UNITED ENGINEERING BUILDING.

Power and the Waterways.

The American section of the International Waterways Commission, consisting of Col. O. H. Ernst, U. S. A., chairman; George Clinton and George Y. Wisner, in its annual report to the Secretary of War on the progress of the work devolving on the commission, calls attention to a number of questions, which have been brought before it, and asks for an expression of the wishes of Congress for its future guidance. Among the questions referred to are the following:

The uses of waters at Sault Ste. Marie for power purposes and their regulation necessary to insure an equitable division of the waters between the two countries and the protection of the navigation interests.

The uses of the waters in the Niagara River for power purposes and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of Niagara Falls as a scenic spectacle.

The advisability of building controlling works at the outlet of Lake Erie, including the effect upon the levels of the lakes and upon their shores, and upon the River St. Lawrence.

The effect of the Chicago Drainage Canal upon the levels of Lakes Michigan, Huron, Erie and Ontario and upon the River St. Lawrence.

Since it completed its organization in September last the commission has made progress in the collection of data bearing upon some of these questions, particularly those relating to the use of water at Niagara Falls, and to the regulation of the level of Lake Erie by works near its outlet. The commission on October 28 adopted the following resolution:

"Resolved, That this commission recommends to the Government of the United States and Canada that such steps as they may regard as necessary be taken to prevent any corporate rights or franchises being granted or renewed by either Federal, State or Provincial authority for the use of the waters of the Niagara River for power or other purposes until this commission is able to collect the information necessary to enable it to report fully upon the "conditions and uses" of those waters to the respective Governments of the United States and Canada."

The most pressing question, according to the report, related to the use of water at Sault Ste. Marie, where the traffic through the canals constructed at the Rapids, is said to be larger this year than ever before, it being estimated that the tonnage will exceed 40,000,000 for the year. The quantity of water which will be required in the operation of the canals will be greater in the future, and in granting privileges the respective Governments should not forfeit the right to increase the amount indefinitely. In this connection the commission has adopted the following resolution: "Resolved, That in the opinion of this commission, no further rights or privileges should be granted or conferred regarding the uses or diversions of the water flowing out of Lake Superior, by either the Government of the United States or Canada, until all data and information are in the hands of the commission that may be necessary to enable it to make suggestions for regulating the excess of these waters, or that, if such rights or privileges be granted, they be subject to any regulations that may be adopted by both Governments." The use of water for power purposes, the report points out, must be so regulated as not to affect injuriously the level of Lake Superior, and the level must not be allowed to fall so low as to injure navigation or raised so high as to submerge the shores."

Referring to the authority granted a certain power company to divert water from St. Mary's River above the rapids, and calling attention to the conditions imposed, one of which is that the company shall operate "in accordance with any rules and regulations that may hereafter be recommended by any international commission," the report points to the regulations prescribed by the Secretary of War in granting permission under the act for the diversion of the water, with the statement that these regulations probably will be used by the commission as a basis for regulations to be recommended. Their fundamental principles, which the commission believes to be sound, are that levels must be maintained, that navigation must be protected and that the public must reserve the right to use any portion or all of the [illegible]. After a public hearing given to the parties in interest in this connection, the commission tentatively adopted certain rules [illegible] and the report adds: "The enforcement of these rules and regulations calls for the executive action from time to [illegible] established hereafter at other places or upon the subjects will probably likewise require joint executive action. It is not clear from the language of the law creating this commission that Congress intended to provide for a permanent international board. It is desirable that the status of the present commission as a permanent executive board be defined, or a new board be created."

Work of the U.S. Bureau of the Census.

The annual report of the United States Department of Commerce and Labor recommends that the Bureau of the Census be given authority to take up the following subjects:

1. A five-year report on the electrical services, street railways, public power stations, telephones and telegraphs, etc., in lieu of the ten-year reports now authorized.
2. A report on savings banks, co-operative savings institutions, home-building associations, and similar fiduciary organizations for the promotion of individual thrift.
3. A report on life, fire and marine insurance.
4. A report on the fisheries industry, in co-operation with the Bureau of Fisheries.
5. A compilation of the results of the several State censuses of population taken in 1905.
6. A report covering the judicial statistics of the several States, covering the indictable offenses recorded in the court dockets and the disposal of these cases.

The director of the census also calls attention to the popular desire for a continuation of the Eleventh Census report on mortgage indebtedness, but he hesitates to recommend it on account of the large expense for field work. He refers also to the demand of the agricultural interests for a five-year census of live stock, a report which is urgently recommended by the secretary of agriculture. This report also, if authorized, will involve a large increase in the regular appropriation for the continuance of census work.

The electrical reports of the Bureau are at present on a ten-year basis, except that on electrical manufacturing, which is included in general manufacturing, the statistics for which are required, by act of Congress every five years.

Three-phase Traction for the Simplon Tunnel.

Confirmation has been received in this country of the report published in our last issue that the Swiss Government has adopted the Ganz three-phase system for the Simplon tunnel and that the installation will be ready for service May 1, 1906. To provide the necessary equipment the Italian Government has agreed to furnish temporarily five electric locomotives made for the Valtellina line. It has been found that these locomotives are large enough for the conveyance of the heaviest trains.

This decision is a result of an investigation of the working of the Valtellina line by a commission of officials representing the Swiss Post and Railway Federate Department, the General Director of Federate Railways and the Federal Commission for the study of Electric Traction; Engineers Boveri and Thormann were also members of the commission.

The commissioners, twelve in number, traveled on a special train hauled by an electric locomotive at a speed of 20 miles per hour on the line Lecco-Lierna. The weight of the train was 400 tons. At Lierna a transformer-substation was inspected. From Lierna to Colico the speed with a train weighing 250 tons was 40 miles per hour. Then, on the line of Colico Morbegno and back the multiple-unit system with two electric motor-cars each at the ends of the train with a total weight of 300 tons, was tested with load differences of a maximum of 10 per cent between the two motor [illegible]

From Colico to Chiavenna, on the long line with steel gradients, starting tests were made with a train standing still with a total weight of [illegible] tons which train was dragged by an electric locomotive. On the following day the commissioners ascertained on the same gradient and [illegible] by means of a directly reading wattmeter the power [illegible] from recuperation, which with a train of 247 tons gave a mean value of 273 kw and a maximum value of 450 kw. On the [illegible] the Adda bridge and the hydro-electric central station of Morbegno were inspected, which terminated the visit of the Valteliina line. On the next day a run with a special train was made on the line Milano-Porto Ceresio, with motor-cars on the multiple-unit system, and a visit was made to the sub-station of Gallarato and the central station of Tornavento. The shops at Lecco were inspected for the purpose of examining the motors dismounted and in order to judge about repairs and operating expenses incurring.

The Swiss engineers examined into every detail and during the trial runs ascertained personally the loads of the trains, the operation of the motors and apparatus, and the taking of records in the dynamometric car, thereby satisfying themselves as to the accuracy of the traction tests which were a complete success.

The Cunard Turbine Steamer "Carmania."

Great interest has naturally been aroused by the arrival in New York harbor of the new Cunard liner *Carmania,* fitted with Parsons steam turbines for the propulsion of her three screws. She is in general respects a sister ship to the *Caronia,* whose arrival here in the spring was noted in these columns. She is 672 ft. 6 in. over all, with a gross register of 19,524 tons and a displacement of 30,918 tons. Her boilers have a capacity of 21,000 indicated horse-power, and the steam pressure is 195 pounds per square inch, the turbines taking steam at an initial pressure of 150 pounds. There is a general saving in weight by the adoption of the turbines of about 5 per cent. The high-pressure turbine is on the center of the three shafts, and one combined low-pressure and astern turbine on each of the two wing shafts. The appearance or effect is curious. It is apparently an engineless engine room; but there are many elements that help fill up the space. All the auxiliaries are driven by reciprocating engines, except where one or two electric motors are used. There are about 1,115,000 blades on the turbines; the longer blades of the low-pressure turbines are bound together by two circumferential strips laced with copper wire and soldered. The screw shaft speed is 185 r.p.m.

The electrical equipment, in the orlop deck aft of the engine room is occupied by four generating sets, each of 75 kw capacity, running at 450 r.p.m. There are about 3,000 incandescent lamps. From the main switchboard run 36 circuits, 16 for ship lighting, 10 to the thermo tanks and ventilating fans, three to the electric heaters, three for the motors on the turbine lifting gear in the engine room, two for the boat hoists and one to the searchlight projector. The lavish use of electric heaters is quite noticeable. There are 4 in the main saloon, of 20 amp. each; 2 in the writing room, 2 in each of six staterooms, and 1 in each of the first-class bathrooms. The second size take 7 amp. and the smallest 5 amp.

Motors are to be seen all over the ship. In the engine room there are three, each of 18 brake hp, for lifting the turbine cases and rotors. On the boat deck are two electric winches with warping drums for lifting the ship's boats. In the storerooms on the lower deck three electric hoists handle supplies for the galleys and pantries. One 500-pound hoist of 3.5 brake hp, and one 300-pound hoist of 1.56 hp supplies the first-class galley, while a similar one is located in the third-class galley and pantry. These motors with their controllers are all on the lower deck. A 200-pound coal hoist is placed in one of the vent shafts from the stokehold, to raise coal for the first-class galley. In the mail sorting room, aft on the upper deck, a 4-hp motor, lifting 500 pounds at 150 ft. per minute, is employed for delivering the mails to the mail room on the orlop deck.

The electrical equipment of the galleys and pantries includes one dough-mixer for the bakehouse, one roaster for the first-class galley, one dish-washer for the first, second and third-class pantries, one grid in the first and second-class pantries, the bridge deck service pantry, the promenade deck service pantry, the first-class smoke-room bar, and the officers' pantry. In addition to these there are three knife cleaners. The first and second-class barbers' shops are provided with an electric hair brusher and a one-gallon electrically-heated hot water urn. Small fans are provided for the chief engineer's cabin, engineers' mess, doctor's and first-class barber's shops and at other points. There is also a very complete telephone system and a submarine signaling equipment, as well as a regular Marconi wireless outfit. The turbine outfit had a severe test on the outward trip, and underwent the ordeal splendidly. The storms encountered were tremendous, but the usual vibration was reduced to a minimum.

Opening of New York Electrical Show.

The Electrical Show, which is to continue until December 23, was opened in Madison Square Garden on December 12. Temporary Chairman George A. Miller, Jr., secretary of the exposition company, introduced Prof. G. F. Sever, of Columbia University, Director of Exhibits, who delivered a short address of welcome. President Roosevelt, in Washington, opened the show. The moment Prof. Sever finished his address the news was flashed to Washington over a special wire, and Mr. Roosevelt pressed a golden key, placed for the occasion in the White House. The Presidential pressure completed the circuit, which started the machinery of the exhibits and turned on the numberless lights in the Garden. The golden key, which is the property of Gen. E. S. Greeley, of New Haven, Conn., has been used before on several similar occasions, and is highly prized by its owner, who was present at the Garden.

As a matter of fact the show, while interesting, is not greatly of technical interest, but is intended rather for "popular consumption." Between forty and fifty exhibitors have spaces, the most conspicuous and beautiful of which is that occupied by the Bell Telephone local and long-distance companies. This in reality is the only telephone display. The General Electric, Westinghouse, Crocker-Wheeler, Sprague, C. & C., Stanley and other large corporations are conspicuous by their absence. But there is enough to amuse and dazzle the public for a couple of weeks, and some of the more technical exhibits are worth inspection by engineers, such as those of the "Inter-pole" motors, the long Moore vacuum tubes, the electric heating and refrigeration displays, the Gray telautograph and the Poulsen telegraphone, the De Forest wireless telegraph system and the Ovington lecture experiments in the concert hall on high frequency. We shall return to the subject in our next issue.

Electrical Engineers of the Times.—XL.

MR. WILLIAM L. WATERS.

William Lawrence Waters was born in London, England, on September 7, 1876. He was educated at St. Dunstan's School, London, and entering the London University, in 1893, was graduated in electrical engineering at the head of his class in 1896, and in mechanical engineering in 1897. During his course at the London University Mr. Waters did considerable research work in pure physics, and the results of which were embodied in papers on "Variations in the E.M.F. of a Standard Clark Cell," "Absolute Determination of the Ohm," "A Mathematical Investigation of the Cooling of a Short, Hollow, Poorly Conducting Cylindrical Shell with Walls of Appreciable Thickness." These papers were presented before the London Physical Society, the British Association for the Advancement of Science, and the Royal Society.

MR. WILLIAM L. WATERS.

After leaving the University, Mr. Waters spent one year in the shops of Hosking Brothers, marine engineers, London, which he left to enter the engineering department of Siemens Bros., Woolwich. Here he spent three years, having charge of alternating current design during the last year.

In January, 1901, Mr. Waters came to the United States and entered the engineering department of the Bullock Company, Cincinnati, as assistant to Mr. B. A. Behrend. In February, 1902, he became connected with the National Electric Company, of Milwaukee, at that time the Christensen Engineering Company, as chief engineer. In this capacity Mr. Waters has designed a large number of direct-current and alternating-ourrent generators and motors and transformers. Among the more important machines built by the National Electric Company during this time are a 1,500-kw, 6,600-volt alternator for the power plant of the St. Louis Exposition; two 1,000-kw rotary converters for the Milwaukee Electric Railway & Light Company; four 1,000-kw motor-generators and four 1,000-kw frequency changers for the Union Electric Light & Power Company, St. Louis.

Mr. Waters' engineering ability has shown itself not only in his electrical designs, but also in the fact that he is the designer of a steam turbine with which the National Electric Company has been experimenting, and which is giving promising results. Mr. Waters is a member of the American Institute of Electrical Engineers and a contributor to its *Transactions*.

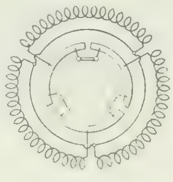
◆

CURRENT NEWS AND NOTES.

TELEPHONE SUBWAYS.—A lecture illustrated by lantern slides will be given by Mr. E. V. Cox, on December 20, before the Engineering Society of Columbia University, New York City, in room 203 of the Engineering Building. The subject is "Telephone Subways," and a general invitation is extended. The hour is 8.15 p.m.

NON-RESIDENT LECTURES.—Mr. J. M. S. Waring, of Chicago, gave a lecture before the Senior electrical engineers at the University of Minnesota upon "Storage Battery Engineering," on December 5, 1905. Mr. Waring outlined the principal uses of the storage battery, discussed the methods of operation, booster, and the advantages of the battery as a central station auxiliary. As a concrete example of storage battery engineering, Mr. Waring discussed the reasons for the adoption of storage batteries by the Elevated Railway companies in Chicago, and followed out in some detail the method of determining the location and method of handling the same.

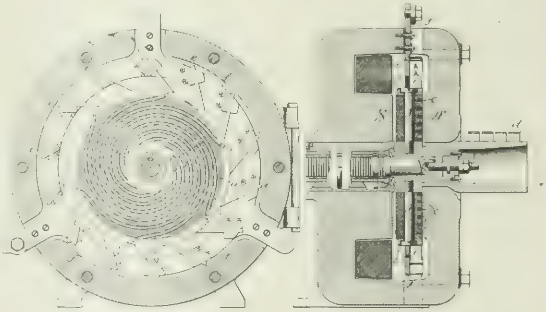
MAGNETITE AS A RESISTANCE MATERIAL.—Among the conducting materials having a negative temperature resistance coefficient, the ones possessing the most remarkable characteristics seem to be the tetroxid of iron or magnetite, or a mixture of magnetite and chromate of iron, the latter having a higher initial resistance than the former, but being equally conductive at high temperatures. In a patent issued December 5 to Dr. C. P. Steinmetz it is stated that these substances are chemically stable and structurally solid even at a red heat, while the resistance of magnetite at red heat is about one per cent of its resistance at ordinary temperatures. The patent describes the use of these substances as self-reducing starting resistances for direct-current, series-wound and shunt-wound motors and for induction motors. The illustration shows a method of using the resistance in the secondary circuit of an induction motor. The secondary coils are in three sets, all connected at one end to a short circuiting ring, and each at the other end is joined to a segment of a second short-circuiting ring. The gaps in this latter ring are bridged by magnetite resistances, and the effect of this construction is to check at first any rush of induced current in the secondary, but gradually to allow the current to increase as the speed of the motor increases and the resistances become heated.



SUBWAYS AND BUILDINGS.—The collapse of a part of Charing Cross Railway Station, London, has been attributed to the subway tunnels in the vicinity. Sir Benjamin Baker, consulting engineer to the Southeastern Railway Company, says that the snapping of a tie rod was undoubtedly the cause of the accident. Sir Benjamin, who is also consulting engineer to the Baker Street & Waterloo Railway, in an interview scouted the idea that the tunneling should be in any way responsible for the catastrophe. He pointed out in this connection that the Baker Street & Waterloo tunnels run at a depth of no less than 80 ft. below the surface of the roadway. "Of course," he remarked, "London is being honeycombed with these tunnels, but up to the present I have not heard of a single case of serious accident or subsidence during the tunneling operations connected with these lines." Mr. John Belcher, president of the Royal Institute of British Architects, expressed a very different opinion. "Undoubtedly the tunneling which is going on in London for the new tube railways must affect the stability of the buildings," he said. "I know that the engineers of these tubes say that it is not so, that the construction of these tubes renders them really as solid a foundation as the earth, and to a certain degree that view is true, but the danger arises from the diversion of the water under the soil. These burrowing operations drain off that water and open up new courses for underground streams, and that is what brings about the mischief. We have had a proof of it in the case of Queen Victoria Street."

TELEPHONY IN NEW YORK.—The Great Eastern Telephone Company, which proposes to cut almost in two the present telephone rates, made public last week the officers and directors of the organization. Mr. Reynolds, one of the organizers of the company, has been in the telephone business for years. He is president of the Coast Line Telephone Company, vice-president and manager of the State Line Telephone Company, manager of the Atlantic Telephone Company and treasurer and director of the New York Electric Lines Company, all of which companies practically have been absorbed by the new concern, as far as operation is concerned. The company intends to have 600,000 telephones in operation. It has a 99-year contract with the Inter-Ocean Telephone & Telegraph Company for itself and sixty associate independent telephone companies controlling long-distance business, New York, New Jersey, Pennsylvania and the West. Its circular states that contracts for service to the amount of more than $1,500,000 have already been signed and that there will be 200,000 subscribers before the preliminary canvass is completed. The capital stock of the company is announced as composed of 300,000 shares, 200,000 of which have been subscribed for or are contracted to be issued.

UNIPOLAR GENERATOR.—The illustration herewith shows a modified form of Faraday's disc used as a generator as proposed by Mr. H. H. Wait in a patent issued December 5. The machine is of the radial type, in which a disc is arranged to rotate in an annular field of force concentric with the disc, through which the lines pass transversely. The inductors consist of copper bars embedded in channels in the face of the disc and disposed generally in spiral grooves from the center to the edge of the disc. Collecting brushes are provided, one set of brushes resting upon a copper ring at the periphery of the disc, and the other set upon the collector ring or shaft. The e.m.f. generated in the inductors is exerted radially, and its value for each inductor is independent of the shape of the spiral, being proportional to the product of the total magnetic flux and the rotative speed of the disc. The inductors are placed in the spiral form in order that the current which flows therethrough may set up a field of force in a direction to assist the magnetization of the main field coils and thus give to the machine a compounding effect.



AN INDEPENDENT BUTTON.—The National Interstate Telephone Association has just issued a lapel button of the badge of the independents, showing the familiar shield. This is also made up in clasp pins and hat pins, and has been bought largely by managers of local exchanges for distribution among their employees and subscribers.

NEW YORK ELECTRICAL SOCIETY.—The 255th meeting of the New York Electrical Society will be held at the American Institute, 19 West Forty-fourth Street, Wednesday, December 20, at 8 p.m. Mr. J. M. Waldron, signal engineer of the Interborough Rapid Transit Company, will deliver a lecture on "The Signal System of the New York Subway." The lecture will be illustrated with lantern slides.

MILITARY SEARCHLIGHTS.—Orders have been issued by the United States War Department providing that searchlights at military forts shall not be thrown in night drills upon any vessels except those provided by the Government for artillery purposes. It is ordered that if a light is thrown upon any other vessel it shall be removed as soon as it is discovered that the vessel is a private one, or as soon as an alarm whistle is blown. This order is to prevent any interference in the navigation of vessels.

PUBLIC POLICY.—Mr. Arthur Williams, chairman of the committee on Public Policy of the National Electric Light Association, has begun the active work of this committee by sending out a copy of the first *Bulletin* of the Anti-Municipal Ownership League to every member company in the association, together with a letter calling his attention to the desirability of adopting special measures for the widespread publicity of more correct information than is generally obtained on the subject of municipal ownership.

LECTURE ON RESUSCITATION.—Under the auspices of the Hudson River Electric Power Company there was a gathering at the office of Dr. D. L. Kathan on Union Street in Schenectady, N. Y., last week. Those present included the heads of departments of the company and its allied and auxiliary companies at Mechanicville, Spier Falls, Utica, Schoharie, Watervliet, and the meeting was arranged by Brice E. Morrow, manager of the Electric Power Company. Dr. Kathan delivered an interesting discourse on the best and most modern methods of resuscitating a person who has received an electric shock, and also on the treatment of persons who have received electrical burns. The lecture was illustrated with a living subject. It is proposed to have similar lectures in the future for the instruction of the staff and employes of the companies interested.

POWER FACTOR METER.—It is well known that the phase position of the current with respect to the e.m.f. in alternating-current circuits can be ascertained by finding the voltage across a resistance in series with the receiver, the voltage across the receiver itself and the vector resultant of these two voltages. The simple calculations for determining the power factor are based on the assumption that the current in the circuit is in phase with the voltage across the resistance. An application of this method forms the basis of a patent issued December 5 to Mr. Joseph L. Routin, of Lyon, France. As a substitute for a simple resistance the inventor uses a series transformer supplying current to a secondary circuit in which is connected a non-inductive rheostat. A third coil on this transformer supplies to the voltmeter an e.m.f. in phase with the primary current. This e.m.f. is adjusted to equality with a certain portion of the receiver e.m.f. obtained from taps on an auto-transformer. The vector sum of these two equal e.m.f's having been obtained, the power factor can readily be calculated.

COAL MINES ON WHEELS.—In an interview last week Mr. Edison said: "The first great change in the production of electricity will abolish the carrying of coal for that purpose," he said. "Instead of digging gross material out of the earth, loading it on cars and carrying it, say, 500 miles, there to put it under a boiler, burn it, and so get power, we shall set up plants at the mouths of the mines, generate the power there and transmit it wherever it is needed by copper wires. It is preposterous to keep on putting the coal mines on wheels. It is too clumsy. It is too costly. There is no necessity for it. It is easier to carry molecular vibration—millions of waves a second—than freight cars full of crude matter. We can ship a 100,000 hp over a wire quicker and more economically than we can send the equivalent in coal over a railroad track. An Englishman told me a little while ago that he intended to set up a power station on the Thames, bring down coal by barges and sell electric power to London. I said to him, 'How foolish! Why not run a copper wire between London and the coal mines and develop your power where the coal is? If you build that power station it will be obsolete inside of fifteen years.' We must eliminate the railroad altogether from this problem."

WESTINGHOUSE INSPECTION TRIP.—A party of about 75 electric railway managers and consulting engineers from all over the Middle West was gathered at Indianapolis on December 9 as guests of the Westinghouse Electric & Manufacturing Company to inspect the single-phase railway of the Indianapolis & Cincinnati Traction Company in which there has been so much interest. T. P. Gaylord, manager of the Chicago office, brought in the largest party, which numbered 58, all of which were guests of the company, from Chicago, in three special cars, leaving Chicago at 8.40 p.m. the evening before and joining other small parties from Detroit and Cleveland at the Claypool Hotel in Indianapolis for breakfast. After breakfast a multiple-unit train of two single-phase motor cars was in readiness to take the guests to Rushville, where the power house and shops were inspected and full opportunity was afforded to investigate the equipments and details of maintenance. In the evening a theatre party was given, after which late trains were taken home. The party consisted of a fine representative body of representative interurban railway owners, managers and engineers, who much appreciated the opportunity to visit the road and the courtesy of the Westinghouse interests in planning and carrying out such a pleasant excursion.

ELECTRICITY FROM GARBAGE.—United States Consul-General Guenther, of Frankfort, furnishes the following description of a plant recently erected at Zurich, Switzerland, for disposing of the city's garbage by burning, the heat engendered being utilized to manufacture electricity. The consul-general says: "The plant is located in the outskirts and contains twelve furnaces, which are capable of burning 120 metric tons of garbage in 24 hours. The wagons loaded with garbage are lifted by means of an electric derrick upon a platform above the furnace into which the garbage is dumped. As garbage, however, does not burn easily, an electric blower injects a strong current of air which has been heated by passing through the flues in the furnace walls. The heat engendered by the burning of the garbage is sufficient to make steam in two large boilers at 8 atmospheres superpressure. The steam is used in the usual way to operate the dynamo. The electric power produced is used first for the purpose of the plant and to supply part of the power for the electric railroads of the city. Complete combustion of the garbage does not take place. From 30 to 40 per cent of its original weight remains in the form of slag. This slag, by mixing with lime, is used for making bricks and paving blocks. The plant is said to be paying well."

"AUTOMATIC GIRLS."—After a siege of "Frenzied Finance," the popular *Everybody's Magazine* is now devoting its energies to "frenzied science." This is one of its productions in that category: "Allentown, Pa.—Look it up in the atlas. Things of great pith and moment are being done there. A telephone exchange without telephone girls is in operation there. If the experiment does not fail girls will be banished gradually from "central" throughout the telephone districts of eastern Pennsylvania—of the whole country, perhaps. So much hangs upon Allentown. It may not be any of our business, but we do not sympathize with this exclusion act. The 'hello girl' may sometimes be a little less polished than Lady Clara Vere de Vere, but think of the everlasting jangling, the jumping of her nerves, the large percentage of pig-like people she has to deal with, the imperious impatience of the public, the gruffness of men, the occasional lapses of women telephoners from angelic sweetness. The innate and impenetrable stupidity of men loves to wreak itself upon the 'hello girl.' We have found her much more amiable and intelligent than most of her detractors. At the most she is only guilty of peeping into a novel or chewing gum. We like to think that she is pretty. Anyway, to supplant a girl with some sort of miserable, clicking, automatic machine is a mistake, probably a crime. Still, what is the use of complaining? They will be having automatic girls the next you know."

WIRELESS IN MEXICO.—The Mexican Government has requested the Telefunken Company, of Berlin, to establish for it a wireless telegraph system between S. Jose del Cabo and Maquallan, a distance of 320 km. across the sea.

TELEPHONE AND PHONOGRAPH.—U. S. Consul-General Guenther reports that Mr. Hans Starcke, of Eberfeld, Germany, has just obtained a patent for a device by which a phonograph is connected with a telephone. Even should nobody be present when a telephonic call is made, the words are recorded upon the phonograph and can be repeated ad libitum at any time. The idea is not new in America.

CENTRAL STATION ACTIVITY.—The *Central Station List*, issued by the McGraw Publishing Company, furnishes in many ways a vivid picture of the lighting and power industry, although to many it may seem a mere compilation of names and figures. It may be noted, for example, that in the March and September issues of the *List* no fewer than 3,300 changes of data were necessary, and the names of 302 new plants were added. Since September, 1904, there have been added to the *List* the names of 756 new plants, or plants most of which are new, a few others had not been in previous editions, and others had risen to central station dignity.

THE MONT BLANC RAILWAY.—U. S. Consul Keene, of Geneva, notes that work for the construction of the railroad to the summit of Mont Blanc has begun. The line, already mentioned in these columns, will be built like the Jungfrau line in the Bernese Oberland, Switzerland (system Guyer-Zeller). It will have a total length of 19 kilometers (11 4-5 miles) and will, it is hoped, be completed within five or six years. From the Fayet to the last station (via Chamonix, as there is already a railroad between the Fayet and Chamonix) the fare will be 100 francs ($19.30), and the trip will require four hours. The carriages will be heated and lighted by electricity, and the train will be composed of an electrical locomotive and two saloon cars, made to accommodate about 80 people. A special arrangement of the windows will permit all travelers indiscriminately to enjoy the scenery. Three kinds of powerful brakes, independent of each other, will be attached to the cars, thus rendering all accidents impossible. The telephone will be established along the line and will connect any point thereof with the head stations.

TECHNICAL EDUCATION OF THE XXTH CENTURY. In an address with this title delivered on Founders' Day, Nov. 30, at the Thomas S. Clarkson Memorial School, Potsdam, N. Y., Mr. John Cassan Wait laid stress upon the desirability of an engineer possessing something more than a mere technical education. The twentieth century education should not only cultivate the courage and capacity of a man to cope with nature, but should give him some insight into the laws, institutions and systems of society. It should embody artistic treatment in structural work and in mechanical contrivance—a relaxation from the intensely practical and economical to a study of what is pleasing and what is beautiful. Some have an idea that there is not much that is beautiful in the mechanical and industrial. Nothing is further from the truth. It is for the twentieth century education to impart the beautiful and artistic to the useful, to lend inspiration and give expression to the deeper feelings of industrial life, its burdens, its struggles, its rewards and its glorious victories. The twentieth century should make its technically educated men something more than mechanicians, something more than the mere directors of processes. Men and women should be taught to vary their employment and to seek recreation in the profitable exercise of their intellectual faculties. The spirit of man needs more than gain, more than crowning success of its efforts, more than the applause of fellow men; it needs the hope and cheer of the life everlasting.

ELECTRICITY IN SULPHUR.—According to a newspaper account, Mr. Clarence White, of the University of Illinois, has conducted a series of experiments which have led him to believe that there is a close relation between electricity and sulphur. It is stated that the idea was suggested to him by observing that the color of an electrical discharge and that of burning sulphur are similar, but he had previously been aware that a current could be produced by heating two dissimilar elements such as copper and sulphur, and that in every instance a sulphide, sulphate or sulpheret is formed, and that the resultant action produces an electrical current. To illustrate the theory he said that if a particle of sulphur is placed on the end of a wire and placed in a Bunsen flame, a galvanometer connected with the other end of the wire will be deflected. The results of his experiments have led Mr. White to conclude that sulphur is an important factor in producing electrical energy and that possibly sulphur will be found to be a constituent of heat as well as electricity. He believes, however, that there is some other element which combines with sulphur at certain temperatures to form electricity, which may be oxygen, radium or some other known or unknown element. He thinks the discovery will lead to a production of cheap and powerful batteries whereby automobiles, balloons and yachts may be driven. Since Mr. White has apparently segregated electricity as a form of matter, it would be interesting if he would determine its specific gravity.

METEOROLOGICAL RESEARCH.—Prof. Willis L. Moore, the chief of the Weather Bureau, in his annual report, has the following to say regarding the Mount Weather Research Observatory, the establishment of which was begun at Mount Weather, Va., three years ago. "In order to prosecute the researches contemplated at Mount Weather, we have established there a plant especially adapted to atmospheric research. By means of balloons and kites the temperature, moisture and movement of the air at great heights will be ascertained. The absorption of solar heat by the atmosphere will be measured by means of the pyrheliometer and actinometer. The dissipation of solar light and heat will be determined by the polariscope. The special analysis of the sunbeam will be carried out by means of the bolometer and spectrometer. The electric conditions will be determined by means of the electrometer, and the radioactivity or ionization of the air, by means of the dissipation apparatus of Ebert. To all this we have added apparatus for studying the relations to the atmosphere of the magnetism of the earth, the temperature of the soil, and even the motions of the earth as shown by the seismographs. All these phenomena have been shown to have a more or less intimate connection with meteorology. In so far as aerial research may require it, sounding balloons will be liberated from many of the Western stations, in co-operation with those at Mount Weather, since it is considered very important to know the condition of the atmosphere above the land every day of the year to the greatest attainable height, especially during the passage of storms and cold waves."

TROLLEYS IN SPAIN.—U. S. Commercial Agent Price, of Jeres de la Frontera, states that a correspondent in Gloucester, Mass., recently wrote to him inquiring as to the advisability of building an electric tramway in that place, but the correspondent failed to sign his name. In response Mr. Price writes as follows: There is one old-fashioned wagon, drawn by three slow mules which makes five or six trips a day from the railway station to one of the public squares, a distance of about three-fourths of a mile, and sometimes goes through the principal street to the fair grounds, a distance of one and one-half miles. It carries 600 to 800 passengers daily for a 5-cent fare. If the car was a clean and attractive carriage there would be a great increase of passengers. The streets here are wide and level, with a solid rock foundation. There is no need of ballast. All the work necessary would be laying the ties and spiking down the rails. I think the road could be ready for the cars for less than $2,000 per mile. The city of Jeres and Santa Maria and other towns would give a subsidy of $30,000 or $40,000. The company could issue its bonds for 75 per cent, and their stock for the same amount per mile as the bonds. It seems as if this is an opening for American skill and capital. It would be a great improvement for these cities and bridge the gulf from ancient Moorishdom to modern times. There are several small towns within a distance of eight or ten miles that have no connection by rail with Jeres. There is now a projected railroad from Jeres to two other towns. Surveys and estimates have been made, but no constructing company has yet been found. It is certain that the installation of electric tramways would be attended with most favorable results in the interests of Jeres by establishing closer connections with adjoining towns with which there is now no means of travel and transportation. A tramway of 25 miles could be built which would connect three very important towns and furnish available means of travel to passengers from other towns in this province.

Electricity and Sewage Disposal.

AMONG the more recent developments of the use of electrical power is the installation of a complete electrical power transmission scheme extending from Birmingham (England) down the valley of the Tame for a distance of about six miles. The object of the scheme is to enable the Birmingham, Tame and Rea District Drainage Board, for which the work has been done, to pump sewage up to a strip of land adjacent to and situated at a higher level than the main conduit which conveys the sewage from the outfall works within the city of Birmingham to the sewage farm located in the Tame Valley and extending from Birmingham to Curdworth. The Drainage Board's estate comprises a total area of 2,830 acres, nearly 2,000 of which are used for irrigation, the remainder being land unsuitable for irrigation or land occupied by roads, streams, buildings, tanks, cottage gardens, etc.

Apart from pumping sewage the power transmission scheme is employed to drive motors at various places along the valley, to drive sewage screening rakes, sludge elevators, sewage distributors, workshop appliances, farmyard machinery, lighting, etc.

The contract for the entire undertaking was provisionally let to the British Thomson-Houston Company, Limited, of Rugby, England, in July, 1901. As, however, the scheme involved the erection of a destructor by the city of Birmingham on land belonging to the Board, Parliamentary powers had to be obtained before the undertaking could be proceeded with, and, owing to various difficulties encountered, which delayed Parliamentary sanction, but which were not connected with or incident to the scheme itself, it was not until June 19, 1904, that the contract was finally confirmed and the work begun. The plant is now in full operation, and when the fact is taken into consideration that besides the destructor a generating station and five brick pumping stations with provision for a sub-station in each, five miles of overhead line with crossings underground under public roads, together with the complete equipment of the generating station, sub-stations and sundry machinery on different parts of the estate were involved, it will be apparent that no time has been lost in carrying out the undertaking.

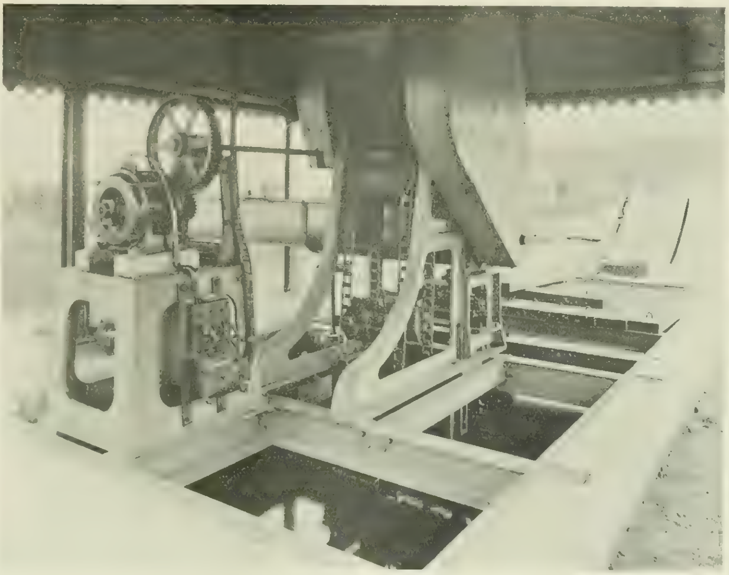


FIG. 1.—MOTOR-DRIVEN SEWAGE ELEVATOR.

The generating station is situated near the Saltley boundary of the Drainage Board's estate. It contains two British Thomson-Houston 115-kw alternating-current generators, each of which is coupled to a high-speed Belliss & Morcom engine. The generators are designed to give their output at 2,250 volts and 50 cycles, each generator being fitted with a direct-connected exciter so that the unit is self-contained. A small direct current steam set of 15 kw, 220 volts, is also installed in this station. This latter set is used to operate a number of enclosed arc lamps on the sewage beds at Saltley, to light the station and, in case of necessity, to excite the alternating-current generators. The steam is supplied to the engines from Lancashire boilers combined with the destructor which is adjacent to the generating station.

The destructor, as before mentioned, was erected by the city of Birmingham, and steam is supplied to the Drainage Board under an arrangement with the authorities of the city of Birmingham. Thus the cost of power required is reduced to a minimum by the utilization of material that would otherwise be valueless

The destructor is lighted throughout from the generating station, and there are two alternative systems of lighting—one from the direct-current side, and one from the alternating system of supply from the main generators; in the latter case suitable transformers being provided in a transformer chamber under the generating station to reduce the pressure from the primary 2,250 volts to 220 volts, which is the pressure of the lighting circuits.

The main switchboard bus-bars are connected to the overhead line by means of three high-tension cables separately supported from the walls of the generating station by heavy porcelain insulators and led up to the outlet, which consists of three separate porcelain outlet tubes built into the wall. Through these tubes high-tension insulated cables are led, and connected outside on shackle insulators to the overhead line, which consists of hard-drawn copper of special high tensile strength, supported throughout its entire length by high-tension insulators of the triple petticoat type. The section of the copper in the overhead line is so graded that a drop in pressure of only 7½ per cent over the whole line is obtained at maximum load. Throughout the length of the overhead line a barbed wire is run on the top of the poles and earthed at frequent intervals for protection against lightning. In all cases where the overhead line enters or leaves a building lightning arresters of the alternating current type have been installed.

For the underground road crossings a special form of steel terminal poles has been designed, on the top of which is fitted a dividing box into which the high-tension overhead wires are led, and there connected to a three core high tension cable, which is led down the inside of the pole and brought out at the bottom into the connection box. The cable from this point is laid in solid bitumen to the steel terminal pole on the opposite side of the crossing, where it is connected through another dividing box to the high-tension line; it then proceeds overhead up to the next crossing. The other poles are of creosoted wood and are set in concrete on account of the soft character of the soil in which they are planted, most of the land having been until comparatively recently, and in some cases still being, under irrigation.

From the generating station the line proceeds to the Drainage Board's Saltley farm. At Saltley the line is tapped and led into a sub-station which is a portion of the old farm buildings converted for the purpose.

This sub-station contains three 5-kw transformers, which supply power to three 2-hp motors driving sewage screens, and one 8-hp motor driving farm machinery through a countershaft, and for lighting the offices and works manager's house. The 2-hp motors for driving the screens are 200 volt, 50-cycle machines, running at 1,420 r.p.m. and are connected to the screens through spur reduction gearing.

From Saltley the high-tension line proceeds towards Minworth to the Troutpool pumping station.

All the pumping stations are of artistic appearance, and do not in the least detract from the landscape. They were designed in the offices of the engineer to the board, as was also the generating station at Saltley. Each pumping station is divided into two rooms, one containing the pump, motor, starting gear and high-tension switch gear and the other the transformers.

The Troutpool pumping station contains one 6-in. Gwynne centrifugal pump, designed to raise 696 gallons per minute against a head of 16 ft. It is direct connected to a 6 hp, 960-r.p.m., three-phase motor. The starting arrangement for this motor is supported on brackets from the floor immediately adjacent to the motor, and the same plan is followed in all the other pumping stations.

The transformer chamber at Troutpool contains two 4-kw single-phase transformers having a ratio of 2,200 to 200, and is divided from the pump-room by a brick partition, the door between being kept locked, and access to it only obtained by the authorized staff of the Board; thus the risk of accident, due to ignorance or carelessness is reduced to a minimum. Similar precautions are taken at all the other stations.

In all the pumping stations the cables connecting the transformers to the switchboard are run in special trenches, covered by checkered plates and are readily accessible. The back of the switch panel projects into the transformer chamber in such a manner that the switch panel itself really forms a portion of the dividing wall between the pump room and the transformer chamber. This ensures the most efficient and shortest length of cable connections possible between the transformers and the controlling gear. All the pumping and sub-stations are arranged in a similar manner, the only difference being in the number of circuits controlled from the sub-station to meet the requirements of the particular area supplied from it.

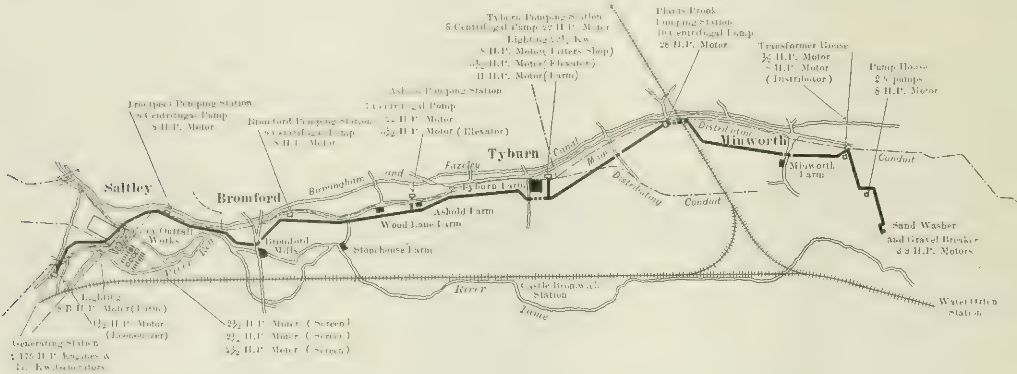


Fig. 2.—Map of Birmingham, Tame and Rea District Drainage.

From Troutpool the line proceeds to a pumping station at Bromford which, like the Troutpool pumping station, is equipped with a Gwynne 6-in. centrifugal pump designed to raise 696 gal. per minute against a head of 16 ft. and direct-connected to a motor of 8 hp capacity. The transformer equipment in this station is similar to that of Troutpool.

From Bromford the high-tension line proceeds to a pumping station at Ashold. This station contains one 7-in. pump designed to raise 896 gal. per minute against a head of 32 ft., and is direct-connected to a motor of 20 b.hp capacity, working at 585 r.p.m. The transformer chamber, which is designed in a similar manner to those already described, contains three single-phase transformers of 10 kw capacity each, and a switchboard built in the wall for controlling the high-tension current from the line to the transformer and then to the motor. In the case of this sub-station, however, the high-tension line is brought into the station underground, whereas in the case of the others the high-tension line is tapped immediately opposite to the sub-station, an offset being taken, and the line led into the sub-station from shackle insulators, to which are connected three highly insulated cables, which are led through the wall of the sub-station through a special type of porcelain duct. There are two low-tension circuits at Ashold, one for the pump motor, and one for the 3-hp motor which serves for driving an elevator similar to that at Tyburn.

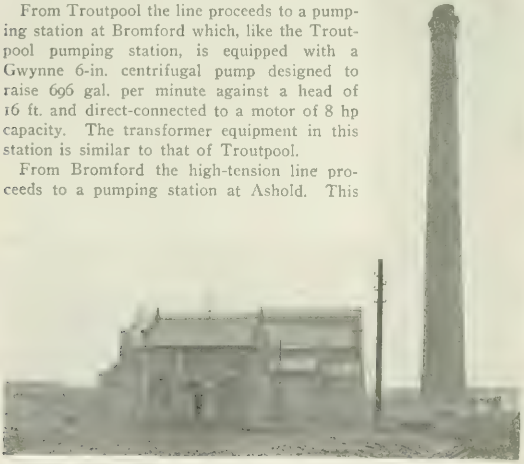


Fig. 3.—Destructor and Main Generating Station at Saltley.

From this station the high-tension line proceeds direct to Tyburn where the largest pumping and sub-station is situated. This station is also connected to the high-tension line by underground cable, and the transformer chamber contains three 15-kw single-phase transformers and three 7½-kw single-phase transformers, each being arranged for a ratio of 2,200 to 200 volts. The 15-kw transformers are for the power circuits, and the 7½-kw transformers for the lighting circuits. Each of the transformers is of the self-cooling, oil-immersed type.

At Tyburn the three power circuits are as follows:

Circuit No. 1.—This controls one motor of 8 hp running at 960 r.p.m. and one 10-hp motor running at 960 r.p.m. These motors are used for the operation of general farm machinery and for driving the mechanics shop where the mechanical repairs required to the existing plant on the Board's estate are carried out, and any special tools required on the estate are made.

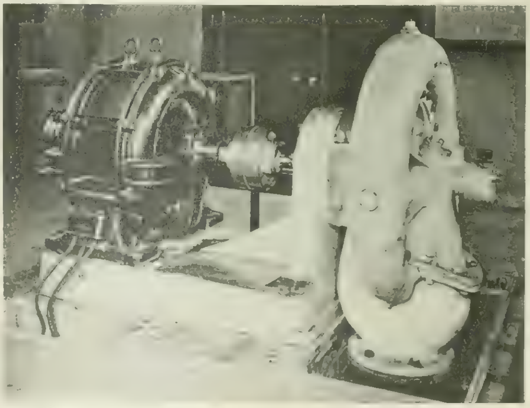


Fig. 4.—Pump Direct Connected to Induction Motor.

Circuit No. 2.—This controls the pumping station proper, which, as in the case of the other stations, is immediately adjacent to the transformer chamber and contained in the same building. This station contains two Gwynne 8-in. centrifugal pumps, each designed to raise 963 gal. per minute against a head of 30 ft. Each of these pumps is direct-connected to a three-phase induction motor, of 20-hp running at 585 r.p.m.

Circuit No. 3.—This controls one 3-hp motor running at 1,420 r.p.m. and driving a sewage elevator. The cable supplying this motor is partly underground and partly overhead. Fig. 1 shows the general arrangement of the motor and gearing for driving the sewage elevator.

The secondaries of the lighting transformers are connected to a special switchboard from which the circuits for the offices, engineer's residence and the home farm buildings are controlled. The cables for supplying these circuits are laid underground from the sub-station to the various buildings.

The high-tension line continues from Tyburn to Plantsbrook, which has the heaviest duty of any of the pumping stations on the estate. This station is a pumping station only, and contains one Gwynne 10-in. centrifugal pump designed to raise 1,900 gal. per minute against a head of 17 ft.; it is direct-connected to a 27-hp, three-phase induction motor, running at 485 r.p.m. The transformer chamber contains three 10-kw single-phase transformers having a ratio of 2,200 to 200 and the usual controlling switchboard.

Near this station the high-tension line is led into a conduit passing under the Midland Railway and thence to Minworth Greaves, where it terminates at present. The sub-station at Minworth Greaves is used for supplying power to operate two sewage distributors, which were previously operated mechanically, and which are used for distributing sewage over circular bacteria beds. This sub-station contains three transformers having a ratio of 2,200 to 200 volts and the necessary switchboard.

It is proposed to extend the high-tension line from this point one-half mile further towards Curdworth, where the Drainage Board is carrying out very extensive works in the building of bacteria beds, and where it is intended to electrically operate the gravel-washing machinery, which in this case consists of a pump, stone crusher and winch.

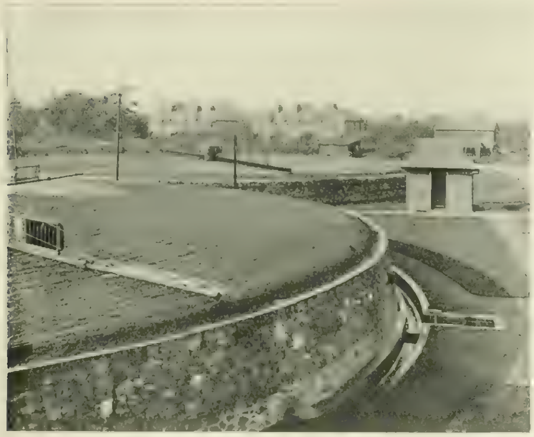


FIG. 5.—ELECTRICALLY OPERATED SEWAGE DISTRIBUTORS AT MINWORTH.

It is also intended to extend the use of the electric power thus obtained by installing deep-well pumps 400 yd. from the Minworth Greaves terminus. These pumps will be supplied with current at a pressure of 200 volts direct from the same sub-station as the gravel washer.

The undertaking of the Birmingham, Tame & Rea Drainage Board, embodying as it does all the features of a comprehensive high-tension power-distribution scheme, is one of the pioneer undertakings of its kind in Great Britain, and, in so far as the application of electricity to sewage disposal in the manner described is concerned, it is the first scheme of its kind in the world. Developments arising as a direct outcome of the undertaking will undoubtedly be watched with considerable interest by all those interested in the application of electrical power to the complex problem of sewage disposal, and other industrial purposes.

The inception of this sewage scheme is due to the initiative and enterprise of the engineer of the District Drainage Board, Mr. John D. Watson, C.E.

Commutation Theory.

BY A. PRESS.

TWO of the most important considerations in the design of direct-current machinery are sparking and heating. It is the sparking that usually makes itself inopportunely manifest, and for this reason some actual working rules for ascertaining the behavior of machines in this respect should prove of service.

In the accompanying illustration, let the coil EF be undergoing commutation, and further, let the following notation be used:

$T =$ time of commutation.
$I =$ current per circuit.
$R =$ resistance of brush for the current $2I$ per brush.
$t =$ element of time, T.
$L =$ coefficient of self-induction of coil.

If the brush, G, which has the same width as the commutator segment, is traveling in the direction of the arrow, it is obvious that the contact resistance at the segment A will be given for any instant after the beginning of contact at the edge of B, by $\frac{RT}{T-t}$, and, likewise, the contact resistance at B will be $\frac{RT}{t}$. In deriving an expression indicating the course of the phenomena of commutation it is as well to bring in as many of the elements as possible governing the actual case. Not alone is it necessary to observe that at the instant when the brush leaves the segment there will be an inductive potential due to the rate of change of current in the coil EF, but that there will also be an e.m.f. generated on account of the motion of the limbs of the coil through the actual field of flux. This flux can be set up by the inductors carrying current—the commutator coil cutting the lines of force due to the remaining conductors. The current set up by this cutting of lines will be assumed as superimposed upon the current variation in the coil EF and due to the brush passing from A to B.

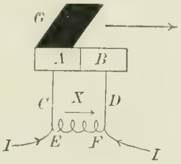


DIAGRAM SHOWING DISTRIBUTION OF CURRENTS.

Let the resistance in the leads C and D be represented by r, and let the resistance of the coil EF proper be designated as w. Obviously, the current at any instant, in the lead C will be $I - x$, and in D will be $I + x$, where x is the current in the coil itself. The drops, then, are as follows, referring to the diagram:

Contact resistance at $A = \frac{(I - x)}{T - t} TR.$
Contact resistance at $B = \frac{(I + x)}{t} TR.$
Lead resistance, $C = (I - x)\ r.$
Lead resistance, $D = (I + x)\ r.$
In the coil, $EF = L\frac{dx}{dt} + xw.$

Now, assuming that there is no cross field of flux (this latter will be taken as superimposable), by Kirchhoff's law the sum of the voltages in any circuit must be zero. Then

$$\frac{(I-x)}{T-t} TR + \frac{(I+x)}{t} TR + 2Ir + xw + L\frac{dx}{dt} = 0.$$

Consider now the conditions approached as the time, t, approaches the time of commutation, T. When $t = \frac{1}{2}T$, the value of x will be about 0 and $A = 2IR$. With $t = .9T$, the value of x will be of the order of $.9I$ and thus $\frac{.1\ IR}{.1} = IR$. Thus when $t = T$ and $x = I$, the value of A approaches to $-\left(\frac{dx}{dt}\right) TR$, and, therefore, the differential at equation can be evaluated without the very difficult process of integration. When $t = T$ and $x = J$, concurrently the equation becomes

$$-\left(\frac{dx}{dt}\right) TR + 2IR + 2Ir + Iw + L\left(\frac{dx}{dt}\right) = 0,$$

or

$$\frac{dx}{dt} = \frac{2IR + 2Ir + Iw}{RT - L}.$$

It is to be observed that the current density at the last instant is the cause of all the trouble. Should this density approach extraordinary magnitude, sparking must surely occur. Assuming the area of brush to be represented by a, the instantaneous area at A will be $a\frac{(T-t)}{T}$, and, since the current is $I - x$ the momentary density will be $\frac{I-x}{T-t} \cdot \frac{T}{a}$. However, in the limit when $t = T$ and $x = I$, if i_a is the current density at this last moment,

$$i_a = \frac{I-x}{T-t}\,\frac{T}{a} = \frac{T}{a}\left(\frac{dx}{dt}\right)$$

The value of $\frac{dx}{dt}$ is exactly the value derived above, and, therefore, by simple substitutions one has

$$i_a = \frac{T}{a} \cdot \frac{2IR + 2Ir + Iw}{RT - L}.$$

which can again be written

$$i_a = \frac{2I}{a}\left[\frac{R + r + \frac{w}{2}}{R\left(1 - \frac{L}{RT}\right)}\right]$$

Now, $\frac{w}{2}$ is the resistance of one-half of the coil proper and therefore $\frac{w}{2} + r$ is the resistance of one-half of the coil, counting leads and all. Let this latter be represented by W. Furthermore, let $\frac{2I}{a} = I_a$, which is the normal current density in the brush, counting all the current passing through the brush and the entire area of the brush. Therefore,

$$i_a = \frac{I_a\left[1 + \frac{W}{2R}\right]}{1 - \frac{L}{RT}}$$

From this equation is obtained a working rule: Firstly, that $\frac{L}{RT}$ shall at least be less than unity, and, secondly, that the resistance of the commutated coil leads and all shall be as small as possible.

The expression $\frac{W}{2R}$ can be written $\frac{IW}{2IR}$, in which IW is the ohmic drop in the coil (which is actually spanned by the leaving tip of brush at the last moment), and $2IR$ is the drop from brush to commutator with the whole current per brush.

To complete the conception of commutation phenomena, it will be necessary to allow for the voltage generated in the coil (with no shifting of brushes). It is this entire voltage that has to be corrected for by so adjusting the position of the brushes that at the last moment the current density is almost normal. Let the generated voltage be e. The resistance of the brush will have the same value as formerly, i. e., R. The resistance of contact at A is now $\frac{RT}{T-t}$, and at B it is $\frac{RT}{t}$. The total resistance of the circuit is, therefore,

$$\frac{RT}{T-t} + \frac{RT}{t} + W = \frac{RT^2}{t(T-t)} + W.$$

The current, y, set up will be due to the voltage, e, and the self-inductive relation will be later added. Thus,

$$y = \frac{e}{\frac{RT^2}{t(T-t)} + W},$$

and when $t = T$,

$$\frac{dy}{dt} = \frac{d}{dt}\left[\frac{etT - eT^2}{RT^2 + 2Wt(T-t)}\right] = -\frac{e}{RT}.$$

Now, if $y = f(x)$ and $y' = \phi(x)$, and $Y = y + y' = f(x) + \phi(x)$, and $\frac{dY}{dt} = f'(x) + \phi'(x)$, and thus the differentials add.

Hence, instead of $\frac{dx}{dt}$, which was used exclusively above, it is necessary now to take

$$\frac{dx'}{dt} = \frac{dx}{dt} + \frac{dy}{dt} = \frac{2IR + 2Ir + IW}{RT - L} + \frac{e}{RT}.$$

However, the current set up at the last moment, due to e, is

$$dy = -\left(\frac{e}{RT}\right) dt.$$

The area available is $a\frac{(T-t)}{T} = a\frac{dt}{T}$.

Let the extra current density be represented by i'_a. Then

$$i'_a = \frac{1}{a}\left(\frac{dy}{dt}\right) T = \frac{T}{a}\left(\frac{dy}{dt}\right) = \frac{e}{aR}$$

by substitution. Adding the current densities at the last moment one has

$$i''_a = i_a + i'_a = \frac{2I}{a}\left[\frac{1 + \frac{W}{2R}}{1 - \frac{L}{RT}}\right] + \frac{2I}{a} \cdot \frac{e}{2IR}.$$

Let the drop $2IR$ across the brush contact area be represented by V, then

$$i''_a = I_a\left[\frac{1 + \frac{IW}{V}}{1 - \frac{L}{RT}} + \frac{e}{V}\right]$$

One should, therefore, also endeavor to cut down the voltage due to armature reaction as well. The factor included in the brackets will indicate how much lag or lead must be given. This cannot be increased beyond a certain amount (dependent upon the type of pole shoes) before sparking will be increased, because the self-induction is increased by proximity to the pole shoes. The expression just evolved is a measure of the current density that would be produced at the last instant provided the brushes had been left in the no-load neutral position. If the self-induction be assumed of a value such as to make $\frac{L}{RT}$ negligibly small compared to unity, the factor for the current at the last moment reduces to $1 + \frac{IW + e}{V}$, and the whole expression is one which may be used as a criterion of sparking. In any event, it will serve to show the direction in which commutation can be improved. In practice it is found that commutation is made worse in about direct proportion to the number of bars covered. Furthermore, in wave-wound armatures a factor of safety should be introduced that would make this last factor at least one-half the number of poles times worse than what it would be for lap-wound armatures.

A New Type of Frequency Meter.

By A. S. LANGSDORF.

UNDER the above title the author presented a paper at the convention of the American Association for the Advancement of Science held in December, 1903, but the paper was not published except by title.* In June, 1904, the device originally described by the writer was independently conceived by Mr. J. F. Begole of the Wagner Electric Mfg. Co., and it has recently been placed on the market.

The principle involved in this instrument is based upon the fact that if an alternating (sinusoidal) electromotive force of E volts and frequency, f, is impressed upon a condenser of capacity C farads the current may be expressed in amperes as,

$$2\pi fEC.$$

In other words, for a given value of C, the indications of an ammeter will be proportional to the frequency, *provided* E remains constant, in which case the scale of the ammeter could be graduated to read directly in cycles.

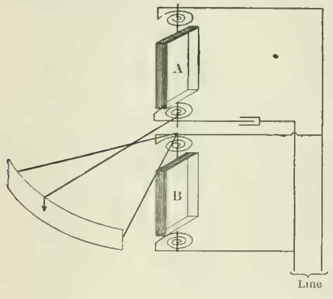


FIG. 1.—CIRCUITS OF FREQUENCY METER.

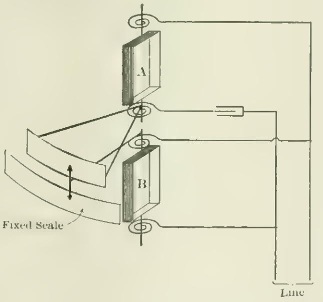


FIG. 2.—CIRCUITS OF COMBINED FREQUENCY METER AND VOLTMETER.

It is, of course, evident that the assumption of constant electromotive force is not justifiable where commercial circuits are concerned. If the scale of the ammeter mentioned above were graduated to read cycles, a change in line voltage would be recorded as an apparent change in frequency. This difficulty can be overcome, however, if the scale of the ammeter is itself movable, and is pivoted on a line coaxial with that of the pointer or indicator of the ammeter; if the motion of the scale, due to a change of voltage, is made equal to, and in the same direction as, that of the ammeter needle, there will be no relative motion between the two, and the reading will remain unaltered.

To secure this compensating scale motion, the scale need only be attached to a bobbin which is constructed in all respects like that of an ordinary voltmeter, this voltmeter winding being then connected across the line.

The mechanical construction and electrical connections of the instrument will be easily understood by an inspection of the diagram, Fig. 1. *A* is a bobbin to which the pointer is fastened, and which carries the condenser current. Directly below (or above) it is mounted the bobbin, *B*, which carries the graduated scale.

As the instrument is actually constructed, advantage is taken of the fact that the presence of bobbin, *B*, permits of voltage indications also; this latter idea is due to Mr. Begole. Fig. 2 is a diagram of the combined voltmeter and frequency indicator. The scale and pointer of Fig. 1 are here interchanged, *A* now carrying the movable scale and *B* the pointer; an extension of the latter, moving over a fixed scale, indicates volts

A Short Single-Phase Railway on Long Island.

AN urban railway system which has recently been installed by the Long Island Railroad Company at Glen Cove, L. I., possesses many points of more than passing interest when considered in connection with present developments in the electric railway field. The railway is intended to convey passengers from Sea Cliff and Glen Cove stations on the Long Island Railroad to the neighboring steamboat landings on Long Island Sound.

The principal interest in the railway system resides not in the magnitude of the undertaking, since the total length of track now completed and under construction is only about five miles, but in the means employed for supplying power to the rolling stock. The present system had its beginning in a small direct-current railway which was owned by the Long Island Railroad Company, which purchased the necessary power for operation from a local electric company. When the Long Island Railroad Company established a generating station at Long Island City it was ascertained that power could be transmitted from this station over the intervening distance of about 27 miles, and there used by single-phase motors more advantageously than it could be purchased and used by direct-current motors.

The power is transmitted directly at the station pressure of 11,000 volts over two No. 1 bare copper wires placed on a wooden pole line extending from the Belmont Park sub-station of the Long Island electric railway system to a transforming sub-station located adjacent to the passenger station of the Long Island Railroad at Glen Cove. The transforming sub-station equipment consists of two 200-kw, oil-cooled, 11,000-volt to 2,200-volt, 25-cycle transformers, and the necessary switching and protecting devices. The high-potential lines enter through the center of double-glass windows and, passing through spiral choke coils, terminate in oil switches which are connected in the primary circuit of the transformers. The oil switches are enclosed in separate cement compartments and are operated by a system of levers, the handle for which is placed on a separate panel adjacent to the 2,200-volt switchboard. The 11,000-volt circuits are in no wise connected to the switchboard, and the 2,200-volt circuits are represented in the front of the board only after having passed through current and potential transformers. A bank of low-equivalent lightning arresters serves to protect each line entering the building.

No attendants are required at the sub-station. In the event of the primary switches being opened from any cause, an electric bell in the adjacent passenger station notifies the agent, who can conveniently close the switch. Although only one of the phases of the three-phase generating system at present supplies power to the railway, the sub-station equipment is designed for three-phase operation. All switches, lightning arresters and switchboards are of the three-phase type, two-thirds of the equipment being used at present. With future extensions, a third transmission wire will be erected and a third transformer will be installed, so that power can be obtained from all three of the phases.

A view of the interior of the sub-station is given in Fig. 3, which shows the switchboard panels for the 11,000-volt and the 2,200-volt circuits, and the high-potential lightning arresters and indicates the location of the choke coils and oil switches. The overload release device is operated by current from the low-potential circuit, but it is arranged to open the oil switches in the primary circuits of the transformers. The handle for the lever which controls these switches is placed at the center of the right-hand panel, and the trip which causes the lever to operate is moved by an electromagnet located immediately below the handle. The mechanical connection between the levers and the corresponding switches is made by means of iron pipes which are arranged beneath the concrete flooring of the second story of the sub-station building. The lower story of the building contains the transformers, and it serves also as an office for the operating and constructing forces of the railway company. A complete record is kept of the energy used by the railway during each day, a watt-hour meter being used for this purpose. Tests have shown that the original expectations as to the economy of operating with alternating current transmitted from Long Island City rather than with direct current purchased locally have been fully realized.

---

* *Proc.* Amer. Assn. Adv. Science, Vol. LIII. (1904), p. 380.

FIG. 1.—VIEW OF SINGLE-PHASE CAR, GLEN COVE RAILWAY.

At the present time four cars have been equipped. Two of these cars are of the single-truck type, and each weighs 14 tons, while each of the other cars is supplied with double trucks and weighs 17 tons. The single-truck cars are of the semi-convertible type, were supplied by the J. G. Brill Company and are mounted on that company's No. 21-E truck. One of the double-truck cars is also of the semi-convertible type, similar to the ones just described, while the other is of the open type.

The driving equipment of each car consists of two 50-hp Westinghouse single-phase, conductively-compensated series motors, operated permanently in parallel and subjected to potential control. Each motor is a four-pole machine, designed for 25-cycle current at an effective potential of 300 volts. Each armature is provided with a lap-connected winding, taps being taken from the end of each coil to the corresponding commutator segment through a certain resistance lead which is placed in the bottom of an armature slot. The motor is supplied with four brush studs, there being two brushes per stud. Each brush is ⅜ in. in width and covers approximately 1.5 commutator segments. Inspection shows that very little sparking is produced even under the severest starting conditions, and that the arcing is not destructive in nature. The application of a thin coating of vaseline about once each week represents the extent of the attention required by the commutator. The four brush studs are mounted on an annular ring, which is arranged to be rotated through 360° when desirable, so that all brushes can be inspected from the top opening in the frame of the motor. The brush studs are connected in two pairs to two copper bus rings which are joined to flexible leads, which pass through the frame by way of substantial insulating bushings, after the compensating stator winding has been included in the armature circuit. All of the bearings of the motor are provided with boxes in which waste is placed, and lubrication is obtained by the use of heavy machine oil.

As stated previously, the variation of the speed of the motor is obtained by subjecting the motor circuits to different voltages. For this purpose there is provided on each car a variable-ratio transformer having a single coil, which acts simultaneously as a primary and a secondary. This so-called auto-transformer is connected directly across between the trolley and the rail circuits, and voltages of different values are obtained by connecting the receiver apparatus between the rail circuit and intermediate taps on the transformer winding. Six of the intermediate taps, giving effective e.m.f's of 160 volts, 190 volts, 220 volts, 250 volts, 288 volts and 310 volts, respectively, are devoted to the use of the propelling motors. There are on the controller, however, only five running points, corresponding to voltages 175, 205, 235, 265 and 295, respectively. It will be observed that the e.m.f. impressed upon the motor circuits is in each case intermediate between the voltages available at the transformer taps. This intermediate voltage is obtained through the use of so-called preventive resistance and preventive reactance, the prime object of which is to eliminate sparking at the controller. The motor circuits receive current from the middle points of the preventive reactance coil and the preventive resistance. When the controller is on any one of the first four accelerating points, both the coil and the resistance are submitted to an e.m.f. of 30 volts. This voltage forces a certain current through the preventive resistance independent of the operation of the motors, and it causes a certain exciting current to flow through the preventive coil. In addition to its exciting current, there flows through each half of the preventive coil one-half of the current to the motor circuits, the two components of the motor current flowing in opposite directions in the two sections of the coil. In changing the controller from a running position to the one next higher in voltage, the lower e.m.f. terminals of the preventive coil and resistance are disconnected from the corresponding tap on the auto-transformer and transferred to another tap 60 volts higher in e.m.f. At the intermediate position of the controller only the necessary exciting current flows through the preventive coil, while one-half of the preventive resistance carries the whole of the current to the motor circuit. It is evident, therefore, that the windings on the transformer are never short-circuited and the circuit to the motors is never opened during the accelerating period. When the controller is placed on the running position giving the highest voltage, the preventive resistance is excluded from the circuit and only the preventive coil is in use, thus eliminating that loss in the preventive resistance due to the 30 volts across its terminals, which is found at the four other running points of lower voltage. Experience shows that there is no perceptible arcing at the contacts when the controller is changed from one running position to another, and that when the controller is thrown to the "off" position the arcing is very slight. Mechanically, the preventive resistance is built up of cast-iron grids similar to those used in direct-current street car rheostats, and is suspended from the supporting beams of the car body. The preventive coil is an air-cooled, 30-volt auto-transformer, and is similarly disposed.

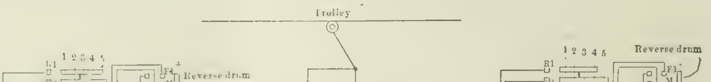


FIG. 2.—DIAGRAM OF CONTROLLER CIRCUITS.

The main auto-transformer of each of the double-truck cars is rated at 50 kw, and is of the air-cooled type. Special pains have been taken to eliminate all unnecessary weight of this transformer and to render it as compact as possible. Although each single-truck car is provided with two 25-kw auto-transformers, they are electrically so interconnected as to form virtually a single 50-kw transformer. The object in thus dividing the transformer was to allow of a proper distribution of the weight, since sufficient space was not available for placing it under the center of the car, and it was not considered advisable to concentrate the weight at one end. The division of the transformer into two parts also permits of cooling each part more effectively than would be true with a single transformer, since the superficial area of the two smaller transformers is much greater than that of the single transformer. It is worthy of note in this connection that even on the small 14-ton cars no trouble whatsoever has been encountered in finding abundant room for all of the equipment, and there is little about the car itself to suggest to the casual observer that the equipment is other than that usually found on direct-current railways.

The lamps of the car, including those for the two headlights, are connected in parallel and receive current from the 110-volt tap of the main auto-transformer. From the same tap is taken current for operating the rheostatic heaters of the car.

Each car is provided with a plain mechanical hand brake. Although no air-brake equipment is supplied, and the controller has not been designed especially for electric braking, it is worthy of note that there is available an emergency braking arrangement in event of the simultaneous failure of the hand brakes and the interruption of the supply of power. When the controller is in any running position the two motors are joined directly in parallel. It is found that if, when the car is traveling in a certain direction, the reverse lever be thrown over and the controller handle be placed in any running position, the motors will act as opposed direct-current series generators and rapidly limit the speed of the car, in the manner well known with direct-current equipments.

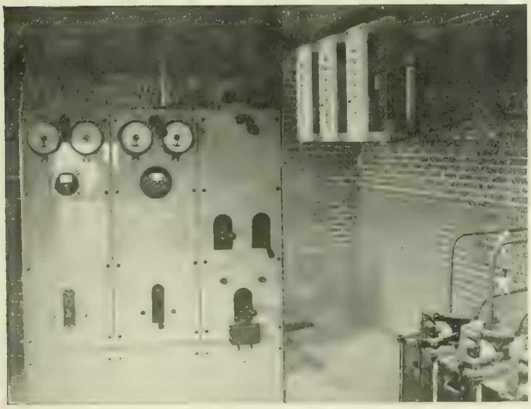


FIG. 3.—INTERIOR VIEW OF SUB-STATION.

The most prominent feature of the high-potential circuits of the car resides in the extreme simplicity. The trolley pole differs in no wise from the standard construction used in street car work, and it is provided with the usual grooved wheel. The socket in which the base of the pole is placed is rigidly attached to a special platform which is mounted on four substantial porcelain insulators immediately over the center of the car. The conducting circuit from the pole passes across a Wurts lightning arrester equipment suspended beneath the special platform, and is then led through grounded protecting tubing to an oil circuit-breaker and switch placed in the canopy of the vestibule. All metallic parts of the car are thoroughly grounded, even the lower end of the trolley rope being joined to the framework. Two wooden strain insulators are inserted in the trolley rope for the purpose of preventing the passage of leakage current when the rope is damp.

The overhead trolley work throughout is of an exceedingly substantial nature. The conducting wire has an area equivalent to a B. & S. No. 3-0. It is of a specially grooved section, and is held in place by means of clamping ears which are suspended from a 7/16-in. steel cable catenary. The method of supporting the catenary varies with the curvature of the track and the nature of the locality. Since very little of the road length is laid on tangents and the route covers village streets, country roads and steam road beds, almost all types of suspensions are in use. Along the track which is laid on the bed of the steam road, that is, for a distance of one-half mile between Sea Cliff and Glen Cove stations, and along a portion of the country roads, the catenary is held in place by means of a bracket arm construction employing wooden poles spaced 120 ft. apart. Along the route of the old direct-current railway, the original side brackets were used without alteration. Each bracket arm is an iron pipe 2 in. in diameter, which serves to hold the trolley wire about 21 ft. above the rails. Along the line adjacent to the steam road the brackets are made of substantial T-irons. Within the towns the catenary is held in place by means of side pole and double span-wire construction. In the town of Glen Cove the side poles are built up of iron piping of three sizes, having diameters of 6 in., 7 in. and 8 in., respectively. Each pole is 30 ft. in length and is set 6 ft. in the ground on a bed of concrete, the hole being filled with concrete to the level of the ground. The span wires, which are made of 7/16-in. steel cable, are supported and insulated from the iron poles by means of substantial porcelain sleeves. Each sleeve is cemented around a short length of iron piping, the two ends of which are secured to the iron pole by clamps and retaining bolts. The span wires are fastened to a malleable-iron collar, which surrounds the porcelain sleeve, a separating lead collar serving to insure that the mechanical pressure of the iron collar is properly distributed over the porcelain sleeve. In all cases the major insulation of the line is provided by these porcelain sleeves. The catenary is connected directly to a center porcelain sleeve insulator which is supported from the lower of two span wires. This lower span wire is itself supported from the upper span wire, and in it are inserted two hickory strain insulators, one on each side of the center porcelain sleeve. Owing to the fact that the trolley collector is of the wheel type, guard loops are provided for those porcelain sleeves from which the catenary is directly suspended, in order to protect the insulator in event of the trolley wheel leaving the wire.

Over certain sections of the railway, where electric light and telephone wires are numerous, guard wires have been erected in order to prevent fallen wires from coming in contact with the catenary or the trolley wire. For this purpose 30 in. above the central trolley wire and catenary have been placed two galvanized-iron wires, which are separated from each other by 18 in. These guard wires are thoroughly insulated from, and supported by, a system of span wires, which are grounded to the side poles. The two wires are transposed at frequent intervals, and it is expected that they can be utilized as a telephone circuit in spite of their proximity to the trolley wire carrying alternating current.

In the town of Glen Cove the street over which the cars operate is paved with brick. Throughout this section of the railway the track is formed of 130-lb. girder rails, electrically-connected through protected ribbon bonds. The terminals of these bonds are placed in holes freshly drilled in the rails, and excellent and continued conductivity is assured by the use of a wedge-shaped steel core which is driven in a hole in the terminal, and forces the copper of the terminal into intimate contact with the unoxidized surface of the iron web. This bond is then covered by the fish plate. The track, which is laid parallel to the steam road and on the same roadbed, is formed of 70-lb. T-rails, which were previously used on the steam road. These rails are interconnected by means of protected ribbon bonds, similar to those used on the girder rails

This road has been in service for the past two months with thoroughly satisfactory results. While the original rolling stock is now idle, and the cars at present in use are throughout of new construction, it is the intention to substitute alternating-current motors for the direct-current machines on the older cars, and to place all cars in service during the next summer season.

Acknowledgments are due for courtesies extended in the preparation of this article to Mr. L. S. Wells, electrical superintendent of the Long Island Railroad; to Mr. George Gibbs, chief engineer of the Pennsylvania, New York & Long Island Railroad; to Mr. R. G. Slack, of the Long Island Railroad, and to Mr. H. T. Gibbs, of the Westinghouse Electric & Manufacturing Company. The work was carried out under the direct supervision of Mr. Wells, and the equipment of the road with the single-phase system was due largely to his advocacy of it.

Some Obstacles to Electrical Development in Great Britain.

By W. Valentine Ball, M.A., *Cantab. Barrister-at-Law.*

PEOPLE in the United States sometimes wonder why the old country is so much behind hand in matters electrical. At least they wonder why the statement is so often made that, in spite of its having given the lead in these matters England no longer takes a foremost place among the countries where electricity is used for light and power.

It is unnecessary for the present purpose to make any admission as to the truth of the above statement. Indeed, it would be the task of an expert electrician to decide which of any two countries was ahead—leader of the electrical world. Many circumstances would have to be considered; many causes, wholly beyond the control of the government or the legislature of a country might tend to retard its progress in this respect. A single illustration suffices. In a country where there is abundant water power, the ingenuity of the inhabitants will be directed toward transmitting that power from the mountain torrent to the manufacturing center. Naturally electricity is the chosen medium, and in the result an impetus is given to electrical development which is not experienced in a country where coal is abundant, and the necessity for transmitting power over long distances is not so apparent.

The absence of water power is a difficulty which it is beyond the power of man to overcome. If the natural advantages of one country outweigh those of another in one respect there is sure to be some compensating advantages somewhere else.

Other influences may, however, be at work to stem the tide of electrical progression. It is with these influences which have been at work in England ever since electricity became a power in the world, that we propose to deal in the present article.

To indicate to the American reader exactly how electrical progress in England is checked by governmental and other interference it will be necessary to explain, as shortly as possible, the manner in which power to supply electricity (whether for lighting or power purposes) must be acquired.

Let us first take electric light. If a company is formed for the purpose of generating electricity to furnish a town or district it is practically necessary to obtain the sanction of Parliament. It is true that in England there is no reason why a private person or company should not supply electricity to his neighbors upon whatever terms he chooses; but in order to obtain leave to break up streets for the purpose of laying down mains and cables it is necessary to obtain the sanction of Parliament.

It is obvious that unless a supply company is allowed to carry its mains over or under the streets of a town, the scope of its operation must be very much restricted. What, then, is the procedure to be adopted in order to obtain the sanction of Parliament? Two acts were passed, in 1882 and 1888, respectively, which laid down certain general rules and conditions on which a "provisional order" for the supply of electricity may be granted. A provisional order is an order made by the Board of Trade which specifies the conditions under which the supply of electricity is to be given to the public; the notices which are to be given to those whose property may be interfered with by the uprooting of streets; the maximum prices which may be charged to the consumer, and makes provision for the regulation and testing of the motors used by consumers. The common and usual clauses in a provisional order are now to be found in the schedule to the Electric Lighting (clauses) Act, which was passed in 1899. This schedule is incorporated with every private act which regulates the supply of electricity, although in particular instances its provisions may be subject to modification.

A provisional order must be confirmed by an act of Parliament before it becomes law; but it may be mentioned that for a number of years past this confirmation has been a mere matter of form unless some clause of an unusual character made its appearance in the order. Note, however, that although it is in practice a mere form the confirmation of every provisional order by act of Parliament is essential. Let us go one step further and see how a provisional order comes before Parliament for confirmation. The usual preliminaries having been complied with, the bill comes before a parliamentary committee who consider its various clauses. The promoters of the bill call witnesses in support of its provisions, and to show that a supply of electric light in the district is needful. Opposition may take the form of an objection to the principle of the bill on the ground, say, that the supply of electricity is not necessary in the district; or else opponents may object to particular clauses. For instance, a land owner might object on the ground that it was proposed to take a portion of his land on which to build a generating station. After it has been approved by a committee the bill then goes before the houses of Parliament, and is passed into law.

The parliamentary formalities which must be gone through in order to obtain the necessary power to supply electricity are not here described for the purpose of showing that they place serious obstacles in the way of the promoter.

The chief obstacles are those which are presented by the opponents, who, then, are the opponents to measures which, even if they were promoted by persons as a speculation, are incidentally of great public importance. It is the local authorities who have shown determined opposition; it is the craze for municipal trading in England which has formed the chief obstacle to private electrical enterprise. Nay, it might almost be said that this craze has proved a hindrance to electrical enterprise of every kind, although it is true that there are numerous local bodies in the country who are using electricity in one form or other. To put it bluntly, Parliament has conceded to local authorities a right to oppose the grant of powers to private bodies, with the result that although the opposing body may not be ready to embark upon enterprise on its own account, it is able to clog the wheels of private enterprise. Let us give an illustration of the way in which this right to oppose may be exercised. The electric lighting acts decree that if a private company seeks power to supply electricity in any district, it cannot obtain a provisional order for the purpose *except with the consent of the local authority.* It is true that a government department—namely, the Board of Trade—has power to dispense with this consent; but this power of dispensation has seldom, if ever, been exercised, and in the promotion of larger schemes for the spread of electrical power the opposition of local authorities is always the most formidable difficulty in the way of the promoters. We venture to quote, in illustration of this point, a passage from the history of a scheme known as the Administrative County of London Electric Power scheme, which was frustrated.

Strange as it may appear, the English metropolis is very badly served with electricity. Owing to the fact that many of the generating stations which do exist are small, out of date, and in such positions that fuel supply is a constant and increasing source of difficulty, the prices at present charged for electric light are far too high, while even the charges for electricity for power purposes are well nigh so large as to prohibit the use of electricity for power purposes. So expensive is the supply of electricity for lighting purposes that in many districts the street authorities are having recourse to gas instead of electricity for street lamps. It should be pointed out that the present supply, such as it is, is partly in the hands of private companies and partly in the hands of the borough councils. London is divided up into a number of boroughs and the council of many a borough has power to grant the right for supplying electricity for lighting.

Until 1904 no serious attempt was made to remedy this state of things in the English metropolis. In this year, however, a bill was brought before Parliament by which it was sought to establish a power scheme for the supply of the whole of London. Put shortly, the idea was to establish two or three large generating stations on the banks of the Thames. In such a position water-borne fuel can be easily obtained, while there is an ample supply of water for condensing purposes. It was proposed to use turbo-generators of large size. In order to have due regard for the vested interests of existing supply companies and borough councils, it was suggested by the bill to supply these bodies with power "in bulk" and allow them to redistribute it to the private consumer; and it was estimated that owing to the low cost of production the central body would be able to supply power in bulk at the extremely low price of .8d. per kw-hour and yet make a profit! Seeing that this bill would be of enormous advantages to manufacturers it was received with acclamation by all who wanted a supply of electricity on a large scale for power purposes; and it may be prophesied that, had it not been for the opposition which was experienced from local authorities, the promoters would have been successful in their venture. What was the nature of this opposition? It came, in the first place, from many of the borough councils, who feared that the ultimate effect of the bill would be to oust them from their respective positions as electric supply authorities; and in the second place opposition came from the London County Council, which body, although they had no similar scheme of their own on the *tapis,* appeared to consider that the door should be kept open for them in the future. The bill was considered and ultimately approved by a committee of the House of Lords and a committee of the House of Commons, but owing to the bitter nature of the opposition the session of Parliament for 1904 was rapidly drawing to a close when the bill had passed through committee. Owing to pressure of other business the House of Commons was unable to consider the bill before August 12, with the result that it had to be dropped. If the promoters desire to repeat their attempt they must needs go over the same ground in the next session of Parliament. When it is mentioned that the cost of promotion in 1904 came to something like $250,000, the true meaning of opposition on the part of local authorities is brought into relief. Such is English parliamentary procedure that all this expense will have to be incurred in another session if the promoters are desirous of carrying out their undertaking. But as a matter of fact, what has happened in the meantime? The London County Council, who led the van of those who opposed the promoters, are now proposing to put forward a bill on their own account under which they will seek to supply power to the whole of London. This bill is to come up for consideration in 1906, and it is quite possible that Parliament, as then constituted, will lend a more favorable ear to the County Council than to those who were the founders and originators of the whole scheme.

What has been done on a large scale in the above case is continually occurring on a small scale in relation to the supply of electricity whether for lighting or power purposes. The development of electric tramway systems has been subjected to the same hindrances. Let us now draw attention to some of the advantages which a local authority supplying electricity enjoys, advantages which are by no means extended to private electrical undertakings. We have seen that a local authority may veto the grant of power to supply electricity to any company in its district; it may exercise this power whether it is or is not in a position to supply electricity itself. By so doing it may keep down opposition and preserve a virtual monopoly for itself.

Then again, suppose a private person or firm starts to supply his neighbors with electric light. The local authority, which in England as a general rule has control over the highways, may draw a circle around his area of supply by prohibiting him laying mains under or over the road. Further, in granting a supply on their own account, a local authority enjoys an immunity and a license which is not extended to ordinary companies. Thus an action brought against a supply company for negligence must be commenced within a certain time or it may not be commenced at all; and if the plaintiff loses his case he has to pay the defendant's costs on a scale which is much higher than that usually applicable. It may, however, be stated here, for the benefit of American readers, that in England as a general rule, the unsuccessful party has to pay the successful party's costs. In ordinary cases they are a sufficient burden for the disappointed litigant; but when a local authority has been successful a very serious burden is imposed upon the unsuccessful party.

Having enumerated the disabilities under which private companies supply electricity in England, it may be asked why is no redress sought? The answer is that it has been sought without avail. Time and again bills have been introduced into Parliament for the purpose of removing that embargo which under existing conditions local authorities are enabled to put upon electrical enterprise. For some reason or other this bill has never been successful. It is hoped, however, that in some future session the question may have the earnest attention of the legislature.

◆

Electric Lift for Swiss Mountain.

An electric lift is being constructed to give easy access to the summit of Mont Hammetschwand, in Switzerland. It is 518 ft. high. Motive power is supplied by a 15-hp shunt-wound motor with Gramme armature, running at 900 r.p.m. at 1,200 volts. All operations of starting and stopping are performed at the bottom of the lift. The greater part of the lift is girder construction, anchored at intervals to the vertical side of the mountain.

Reflectors, Shades and Globes.—IV.

By J. R. Cravath and V. R. Lansingh.

Having shown tests on a large number of miscellaneous reflectors in previous chapters we come now to the prismatic glass types of reflectors, in which the reflection is accomplished by means of prisms pressed in the glass. The popularity of this class of reflectors lies in the fact that they can be designed so as to give almost any kind of a downward distribution of light desired, while at the same time enough light passes through the glass without reflection so that the ceilings and upper walls of a room are not left in darkness. Some of these reflectors are designed to be very powerful concentrators of light, while others distribute the light over a wide angle below the lamp, giving an even illumination over a large area. In the practical application of light, very many cases arise where it is desired to have the greater part of the light concentrated under the lamp, and yet where it is not desirable to have the reflector entirely opaque. The prisms break up the light rays so that the reflected light with these types is almost free from streaks.

Fig. 23 shows the distribution of light about a 120-watt "Meridian" incandescent lamp with a "Pagoda" prismatic reflector. This lamp, which is shown in Fig. 23A, has a large spherical frosted bulb

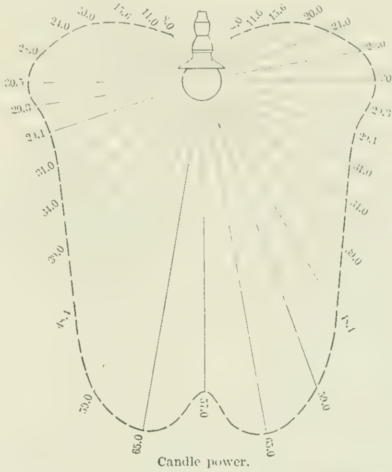


FIG. 23.—DISTRIBUTION OF LIGHT FROM "MERIDIAN" LAMP WITH "PAGODA" REFLECTOR.

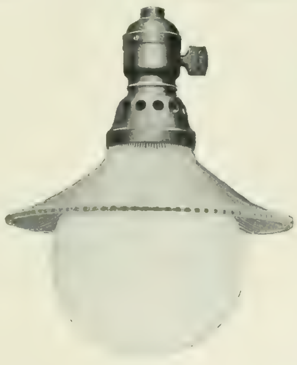
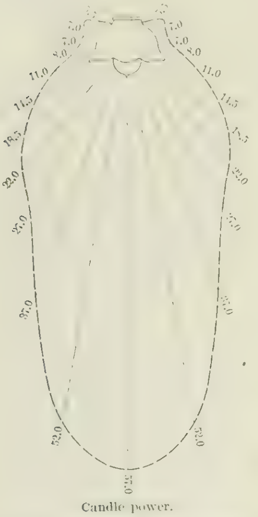


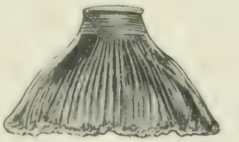
FIG. 23A.—"MERIDIAN" LAMP WITH "PAGODA" REFLECTOR.

The upper part of the bulb coming next to the reflector is not frosted. It will be seen that this gives a fairly concentrated downward light. It should not, therefore, be attempted to make this lamp cover too great an area. On account of its artistic appearance, the lamp is well adapted to use on a ceiling to be studded with a number of lights, or for the lighting of a small room with one central light at the ceiling. It is also suited for use on chandeliers where a concentrated light is desired below the chandelier. As a light producer this lamp is very similar to a standard frosted bulb 32-cp incandescent lamp equipped with a prismatic reflector. Its cost is somewhat higher than the standard lamp, but its appearance is by some considered enough better to justify the expense.

Another incandescent lighting unit using prismatic glass reflectors is the new high-efficiency graphitized filament incandescent lamp of the General Electric Company. These are sold with sockets fitted with substantial shade holders, the lamp socket and shade holder being sold usually as a unit. As the photometric curves showing the distribution of light around these lamps equipped with their reflectors have been extensively published in descriptive and advertising matter pertaining to these lamps, it will hardly be necessary to reproduce them here. These lamps are equipped with frosted bulbs, as they give a very powerful light, and if some means of diffusion was not provided the blinding effect due to the glare of the filament would be very great.

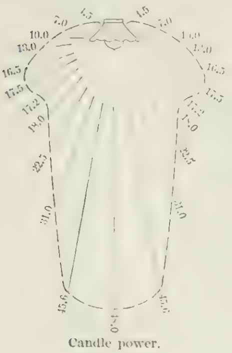
We will now take up several representative types of prismatic glass reflectors designed for use over standard incandescent lamps with standard shade holders. As many of the photometric tests on these reflectors are obtainable from their manufacturers upon application, it will not be necessary here to give anything further than the tests of a few representative types. Only enough tests will be given to afford the reader a good idea of what the various types accomplish and how they compare with other kinds of reflectors.

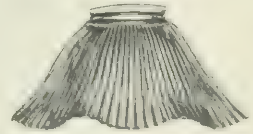




FIGS. 24 AND 24A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

Fig. 24 shows the distribution of light about a 16-cp incandescent lamp in a "Pagoda" prismatic reflector, shown in Fig. 24A, which is in extensive use, and concentrates a large amount of light below the lamp. The maximum candle-power for an angle of a few degrees is as high as 57, while it gives more than would the bare incandescent lamp at all angles below 30° from the horizontal. This reflector is suited to all locations where a concentrated light is desired at one point, without distribution over a wide area. This includes desk lights and reading lights on downwardly pointed pockets on chandeliers. It would be a mistake to attempt the general illumination of a large room with this particular reflector unless a large number pointing in various directions were used on a chandelier.



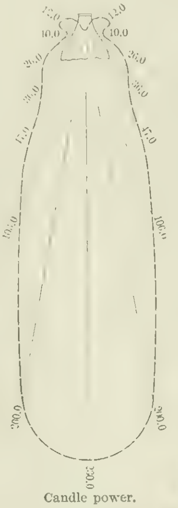


FIGS. 25 AND 25A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

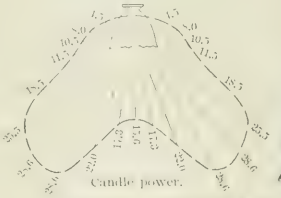
Fig. 25 shows the distribution of light about a 16-cp incandescent lamp in a "Pagoda" prismatic reflector. This reflector is shown in Fig. 25A. It does not concentrate the light so much as the reflectors shown in Figs. 24 and 24A, and for that reason will be found of more general application than the former, as there are many cases where the light from the other would be too much concentrated at one point.

Fig. 26 shows the distribution of light about a 32-cp incandescent lamp in a "Pagoda" prismatic reflector. This reflector is shown in Fig. 26A. It represents an extreme case of concentrating light over a small area, yet at the same time a limited amount escapes through the reflector so that it is not entirely opaque. The same reflector with a 16-cp lamp gives about 120 cp at the tips. A reflector of this kind is manifestly suited only to places where a small, but very concentrated, beam of light is wanted, as in lighting store windows, draughting, lighting of small desks, and pendant reading lights used by one person only.

Fig. 27 shows the distribution of light about a 16-cp incandescent lamp in a "Pagoda" prismatic reflector. This reflector is shown in Fig. 27A. The distribution of light is in marked contrast to that in Fig. 26, as this reflector is designed to throw an even illumination over a considerable floor area below it. In fact, if the candle-power falling on a floor or table underneath this reflector is calculated for different points, it will be found that the illumination within 40° each way from the vertical is very nearly even. This reflector comes down over the lamp, so as to protect the eyes from the glare of the bare filament when it is hanging pendant, in much the same way as the opal dome reflector, tests on which have been shown. The contrast between Figs. 26 and 27 makes it clear how important it is to select the proper reflector for a given piece of work. It would evidently be a great mistake to select the concentrating reflector shown in Fig. 26 for use on a chandelier where it is desired to make one or two lights furnish general illumination for an entire small room. If this was done, the result would be very strong light immediately under the lamp if the lamp were in a pendant position (pointing straight down) and the rest of the room would receive only a small amount of light. The reflector shown in Fig. 27A would throw light evenly over the entire floor of a small room, but would not make a very intense light at any one place. It would, on the other hand, be a great mistake to put the reflector shown in Fig. 27 at the top of a store window for lighting the goods in the window, or on a chandelier for reading purposes under the chandelier.



FIGS. 26 AND 26A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.



FIGS. 27 AND 27A.—DISTRIBUTION OF LIGHT FROM "PAGODA" PRISMATIC REFLECTOR.

Prismatic reflectors are also made which give a distribution of light which is a compromise between the concentration shown in Fig. 26 and the distribution shown in Fig. 27.

In the next and concluding chapter tests on some representative "Holophane" globes, shades and hemispheres will be given.

The Approximate Calculation of Plunger Electromagnets.

By Charles R. Underhill.

In the calculation of the pull for electromagnets with air-gaps and particularly for plunger electromagnets, it is desirous quickly to determine the proper cross-sectional area of core or plunger to use in order to obtain a specified pull with the minimum ampere-turns, which shall be consistent with the cost of the magnet and the service required of it. It is well known that the pull between the plunger and stop of a plunger electromagnet is

$$P = \frac{B^2 A}{72134000} \qquad (1)$$

$$\text{where } B = \frac{IN}{.3133\, l} \qquad (2)$$

$$\text{Hence } P = A\left(\frac{IN}{2660\, l}\right)^2 \qquad (3)$$

all expressed in English units.

In order to determine the total pull due to a plunger electromagnet the pull due to the solenoid effect must be added to the value of P in (3)*.

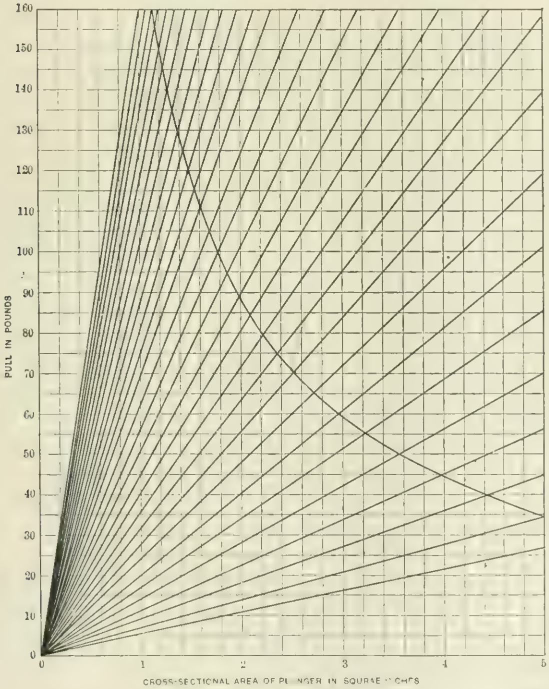


FIG. 1.—RELATION BETWEEN PULL AND CROSS-SECTIONAL AREA OF PLUNGER OR GAP.

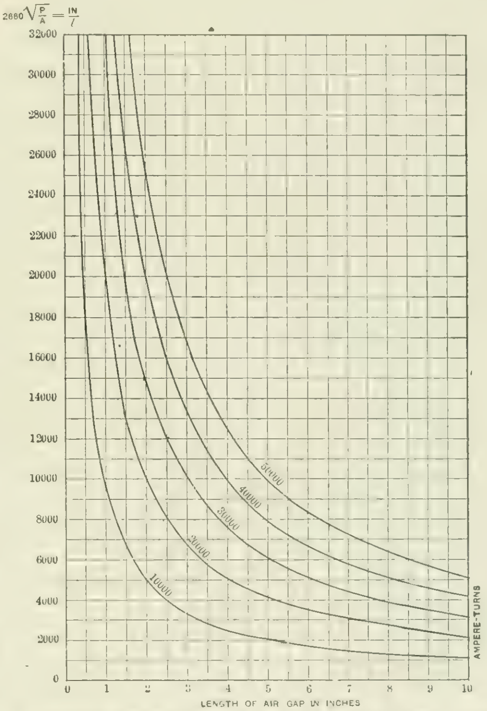


FIG. 2.—RELATION BETWEEN AIR-GAP AND AMPERE-TURNS FOR CERTAIN PULLS.

It is the intention of this article merely to show graphically the relations between pull, area, ampere-turns, and length of air-gap, or stroke of plunger, as expressed by the above well-known law.

$$\text{Transposing (3)} \quad \frac{IN}{l} = 2660\sqrt{\frac{P}{A}} \qquad (4)$$

Equation (4) shows that the ampere-turns divided by the length of the air-gap is directly proportional to the square root of the pull divided by the cross-sectional area of the air-gap between the faces of the plunger and the stop. The diameters of the plunger and the stop are assumed to be the same in this article.

By arranging the values of $2660\sqrt{\frac{P}{A}}$ as in Fig. 1, the pull in pounds, and the cross-sectional area of the plunger or gap, in square inches may be compared, for a given value of $2660\sqrt{\frac{P}{A}}$ and then the ampere-turns and the length of the air-gap may be compared for this same value.

As an example, assume that a pull of 85 pounds is required at the beginning of a range of 3 inches, and that the cross-sectional area of the plunger is 3 square inches. Beginning at the intersection of the ordinates representing 85 pounds pull, and 3 square inches in Fig. 1, follow the nearest diagonal to the curve. This gives the value of $2660\sqrt{\frac{P}{A}}$ at the right as 14,000 in this case. From the point of intersection of the ordinate 14,000 with the abscissa representing the 3-in. air-gap in Fig. 2, it is seen that approximately 42,000 ampere-turns will be required.

In case the ampere-turns, range and core are given, the pull may be quickly approximated very accurately. Assume the ampere-turns to be 20000, the range or length of the gap 2 in., and the cross sectional area of the core or plunger 2 square inches. From the point of intersection of the 2-in. gap abscissa with the 20,000 ampere-turns curve of Fig. 2 it is seen that $\frac{IN}{l} = 10{,}000 = 2660\sqrt{\frac{P}{A}}$ Following the diagonal from the curve to where it intersects the ab-

---

* See Elec. World & Engr., May 20, 1905; also Elec. World & Engr., June 3, 1905.

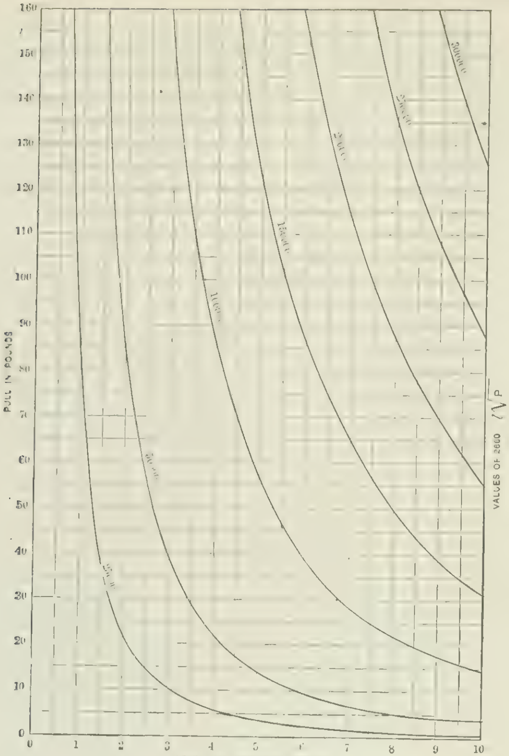


FIG. 3.—RELATION OF PULL TO LENGTH.

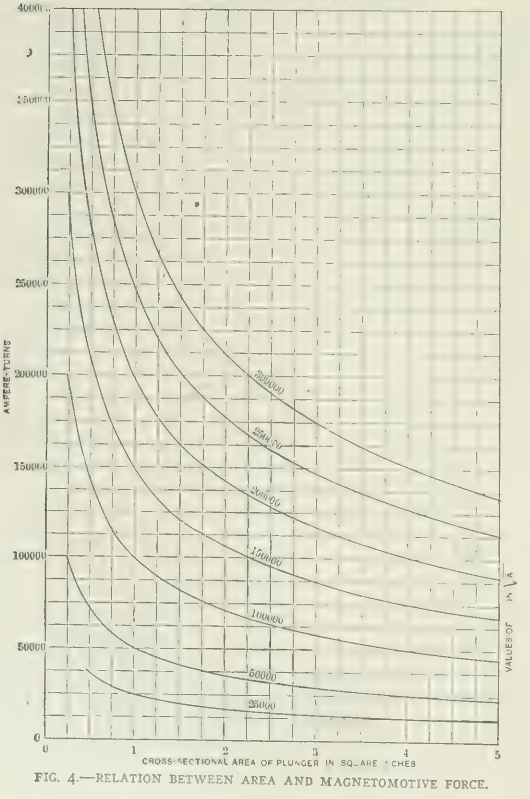


FIG. 4.—RELATION BETWEEN AREA AND MAGNETOMOTIVE FORCE.

scissa representing 2 square inches, in Fig. 1, the pull is found to be approximately 28 pounds.

Again transposing (3), $2660\, l \sqrt{P} = IN \sqrt{A}$ (5). By comparing the values of $2660\, l \sqrt{P}$ in Fig. 3 with the values of $IN \sqrt{A}$ in Fig. 4, the proper cross-section of core and the necessary ampere-turns may quickly be found for a specified pull and range.

As an example, assume that a pull of 70 pounds is required at a distance of 4½ in. Referring to Fig. 3 it is found that $2660\, l \sqrt{P}$ must equal 100,000 in order to fulfill these requirements, and, hence, $IN \sqrt{A}$ must also equal 100.000. Referring now to Fig. 4 it is seen that when $IN \sqrt{A} = 100{,}000$, any of the following values may be used:

50,000	ampere-turns	and	4	square inches.
62,500	"	"	2.56	" "
75,000	"	"	1.77	" "
87,500	"	"	1.3	" "
100,000	"	"	1.	" "

The diameters of the plungers could, therefore, be

Area in sq. inches	Diameter of plunger in inches
4	2.26
2.56	1.81
1.77	1.5
1.3	1.29
1	1.13

As the diameter of the plunger is often limited by the outside diameter of the coil, or for other reasons, as for instance its inertia where a quick action is required, it often is necessary to sacrifice ampere-turns in order to reduce the cross-sectional area of the plunger, and thus keep the diameter small. This is, of course, optional with the designer, and is easily determined by reference to Fig. 4.

Recent Electrochemical Developments.

ELECTRIC FURNACE PROCESSES.

The revolution in workshop practice, brought about by the arrival of high-speed tool steels, has been intimately connected with the revolution in the ferro-alloy industry, due to the introduction of the electric furnace. It is only in the electric furnace that most high percentage ferro-alloys, low in carbon, can be made. The only process which the electric furnace industry has to compete with is the alumino-thermic method, using aluminum as the reducing agent (instead of carbon in ordinary electric furnace practice). By the alumino-thermic method several carbon-free metals, like chromium, etc., are produced. The feature which distinguishes both the electric furnace and the alumino-thermic methods from the blast furnace process is that very high temperatures may be easily obtained in the former two methods. Nevertheless, it appears that so far it has been impossible to reduce some extremely refractory oxides, like that of titanium, to the metallic state by either of the two methods. It is not strange that to reach this goal a combination of both methods is now being tried. The recent American Electrochemical Society paper of O. P. Watts described experiments made in this direction, by adding the heat of the electric arc to that of the alumino-thermic reaction.

A. J. Rossi, the pioneer of ferro-titanium, is also working in a similar direction, as shown by a patent recently granted to him. The feature which distinguishes his method from the alumino-thermic process is that he does not use finely powdered aluminum, but scrap or pieces of aluminum in any form, which he introduces first into the electric furnace. When the current is turned on the aluminum is fused. The refractory oxide to be reduced is then introduced into the fused bath of aluminum. Thus not only the electrically generated heat is utilized, but also the oxidation heat of the aluminum (of course minus the reduction heat of the oxide).

A new form of electric furnace for the production of calcium carbide has recently been patented by Appleby. It is chiefly characterized by a movable bottom so that constantly fresh portions of the charge are introduced into the zone of the stationary electrodes.

ELECTROLYSIS OF SODIUM SULPHATE.

The production of caustic soda and chlorine compounds, especially bleaching powder, by electrolysis of sodium chloride, is one of the largest electrochemical industries. The analogous problem of electrolyzing sodium sulphate has not been attacked so far on a commercial scale. The cathodic reaction is, of course, the same in both cases. The anodic reaction is different. In the case of sodium chloride electrolysis with an inert anode (like graphite or platinum) chlorine is developed which escapes as a gas. In the case of sodium sulphate oxygen is set free and sulphuric acid is produced in the electrolyte. Hence the end products are in this case caustic soda at the cathode and sulphuric acid at the anode. This indicates at once the engineering difficulties of the problem. Both products are obtained in the solution, and it is absolutely necessary to prevent their mixing, since this would result in the reformation of sodium sulphate and a low efficiency.

H. S. Anderson endeavors in a recent patent to solve this problem by a combination of mercury cathode cell and diaphragm cell. The mercury cathode absorbs the sodium set free by the current and the caustic soda solution is produced in an outside cell, in a way familiar from the Castner-Kellner process. To prevent any sulphuric acid from coming near the mercury cathode (which is, of course, at the bottom of the electrolyzer), he provides a horizontal porous diaphragm above the mercury cathode; moreover, he passes continually a stream of fresh sodium sulphate solution between the cathode and diaphragm, so as to carry off any sulphuric acid which might pass through the diaphragm into the cathode compartment.

VARIOUS ELECTROLYTIC PROCESSES.

Several patents, recently granted to A. G. Betts and E. F. Kern, relate to details of apparatus and method of Betts' lead refining and slimes treatment processes, which have already been discussed in these columns.

Another recent patent of A. G. Betts is quite interesting from a general point of view. He improves the efficiency of an electrolytic process with an insoluble anode very materially by giving it a very quick, regular reciprocating motion. The beneficial effect is due to the fact that fresh solution is continually brought into immediate contact with the anode, and is analogous to the well-known beneficial effects of stirring, revolving cathode, etc., in the case of metal deposition

ELECTRIC DISCHARGES THROUGH GASES.

A recent patent of E. Marquardt describes an apparatus for the production of oxides of nitrogen from air by means of electric discharges. The feature of the apparatus is that the air continually performs a cycle, passing through an arc discharge and then to a cooling and condensing apparatus, then returning to the arc and so on. The apparatus is so constructed that the gases may be maintained at any desired pressure.

A recent patent of A. C. Wood relates to details of construction of the electrodes for producing silent discharges for the manufacture of ozone from air

These two patents have been mentioned for the sake of convenience under the same heading—electric discharges through gases. But it should not be forgotten that the two problems of producing nitric acid from air and ozone from air require very different kinds of discharges. For nitric acid production arcs are necessary, while in the production of ozone arcs would be fatal, and what is required are silent discharges.

A recent patent of A. M. Gow relates to the fixation of atmospheric nitrogen. By passing an arc discharge through a mixture of methane with nitrogen or air, he produces hydrocyanic acid. The temperature must be high enough to result in the fixation of the nitrogen, but not so high as to redecompose a part of the compounds formed.

Letter to the Editors.

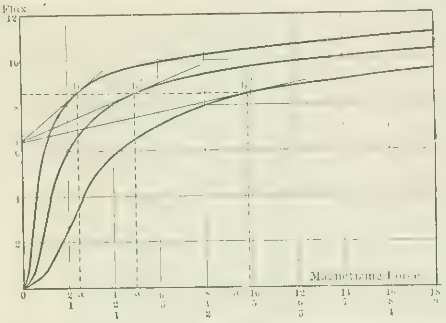
Saturation Expressed in Percent.

To the Editors of Electrical World and Engineer:

Sirs: In speaking of the amount of saturation of a given flux path, there is no recognized standard for comparing the degree of saturation in two different cases. We say that a certain machine "is worked well up to the knee," and another "well below the knee," but this method of defining saturation is deceptive because the position of "the knee" depends upon the scales to which the saturation curve is plotted, as will be seen by the attached curves, all of which are plotted from the same data except that they are drawn to different horizontal scales.

What is desired is a definition which will indicate 100 per cent saturation for the condition in which there is no increase of flux for an increase of magnetizing force, and will indicate zero saturation for the condition in which the flux increases proportionally to the magnetizing force.

The definition derived from the following construction fulfills these conditions: Draw a tangent to the saturation curve (at point under consideration) cutting the Y axis. The percentage of saturation is the percentage that the intercept (OT) on the Y axis, is of the ordinate (ab) of the point. It will be seen that this definition is independent of the scales to which the curve is plotted, as indicated by similar points (b, b' and b'') on the saturation curves shown plotted to different horizontal scales. Thus the percentage of saturation of the point b is $100 \cdot \frac{OT}{ab} = 75.2$.



SATURATION CURVE PLOTTED TO DIFFERENT HORIZONTAL SCALES

With the above definition of per cent saturation, if a machine is said to be working at, say, 60 per cent saturation, it is known immediately that a 1 per cent increase of field current will produce a 4 per cent increase in voltage. At 80 per cent saturation a 1 per cent increase of field current will produce a 0.2 per cent increase in voltage and so on.

Wilkinsburg, Pa. H. S. Baker.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Induction Motor.—In notes on the recent Olympia Exhibition in London, induction motors made by Siemens Brothers are mentioned in which the rotor-starting resistance is carried on the rotor itself and is switched out without assistance of external connections. The gear for switching out the resistance is shown in Fig. 1 in its final position, i. e., with all the extra resistance cut out from the rotor circuit. In starting up the position of the auxiliary plunger, *B*, is such that the roller, *C*, engages with Vee slot 1. As the screw, *M*, is rotated by means of the hand wheel, *L*, it forces the bush, *E*, from left to right, and the pull is transmitted to the auxiliary plunger, *B*, causing the latter to force back plunger *F* against the action of the spring, *G*. The hand wheel is slowly rotated until such a position is reached that the action of spring *D* overcomes the action of the plunger *F*, thus causing the plunger *B* to jump until the roller *C* occupies Vee slot 2. This movement is immediately taken up by plunger *A* under the action of plunger *B*. In moving the plunger *A* carries with it the pin, *H*, which, rolling in a spiral slot in the collar, *J*, gives to the latter a rotary motion. The collar, *J*, carries the blade, *K*, which intermittently short-circuits the contacts *A'*, *B'*, *C'* and *D'*. If the hand wheel, *L*, is still rotated, then the movement of plungers *A* and *B* is repeated and the roller, *C*, successively occupies the Vee slots 1, 2, 3 and 4. The number of Vee slots corresponds to the number of resistance contacts, and the blade, *K*, occupies a definite position when the roller, *C*, is in any one of the Vee slots. *N* is an indicator working in a slot, *O*, which reveals to the operator the position of the blade, *K*. The whole of the mechanism for the intermittent motion is entirely enclosed in a cast iron case, *P*, and secured to the end of the bearing of the motor. *Q* is a screwed plug for adjustment of the spring, *G*, and the plunger, *F*, is prevented from rotating by the action of the screw, *R*, sliding in a keyway.—Lond. *Elec.*, November 17.

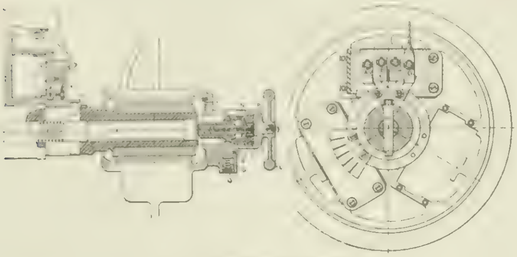


FIG. 1.—INDUCTION MOTOR.

Single-Phase Motor.—Among notes on the recent Olympia Electrical Exposition in London, a single-phase elevator motor of the "reactance type" is mentioned, built by Crompton & Company and designed to start against heavy torques with a small starting current. The motor in question was designed to give 10 hp under ordinary lift conditions, and to run at a speed of 750 r.p.m. The rotor is of the usual construction, provided with three-phase, star-connected winding, the neutral and the free ends of the winding being connected to a special form of slip ring. There are three or more of these rings. On each ring is fitted a number of insulated bars equal to the number of poles on the motor, and spaced equidistantly on the rings. These insulated bars are all connected to the neutral point of the rotor winding and the action of the motor when starting is as follows: When one of the brushes is in a position to connect the insulated bar and ring, it short-circuits one of the rotor phases and produces a repulsion torque. By properly staggering the brushes on the different rings, a continuous repulsion torque is obtained. The brushes on the rings are also connected to an ordinary starting resistance, this resistance being gradually cut out. As soon as the motor has reached its normal speed and the starting resistance is short-circuited, the machine acts as an ordinary induction motor, and runs practically at synchronous speed, irrespective of the load. When used for lift or crane work the motor can be reversed by shifting the brush gear through a small angle, and for this purpose the brush gear is connected mechanically to the controller. The rotor circuit is quite distinct from the stator circuit, so that the rotor and starting resistance can be arranged for low voltage. The special starting switch for use with these motors resembles a three-phase reversing switch with several starting contacts, but the movement of the switch arm in each direction is controlled by a dash-pot, so that however rapidly the lift rope may be pulled the motor is still switched on slowly. A device is added, however, which causes the switch to return to the "off" position with a quick motion, the dash-pot only acting when the switch is moving to the full-speed position in each direction.—Lond. *Elec.*, November 10.

Dynamos with Interpoles.—An illustrated article stating that the British firm of Thomas Parker has begun using auxiliary commutation poles to a very large extent on all kinds of dynamos from 500 kw. down to motors of 10 hp. The auxiliary poles are, however, not fitted to all standard machines, but only to those in which the inductance of the armature coils is high. Since it is not necessary to shift the brushes of machines with auxiliary poles, it is customary to omit the usual brush-rocking devices, the brush gear being "pegged" in [illegible] after the test. The section of the auxiliary poles is made larger or smaller according to the reactance of the armature coils to be balanced. The straight lines in Fig. 2 indicate the sparking limits of such machines fitted with auxiliary poles. Fig. 2 relates to a 200-volt, 500-amp., four-pole dynamo designed to run at 350 r.p.m. The greater the distance between the two parallel lines, the larger the overload capacity and the greater the movement of the brushes around the commutator without sparking. The latter possibly may be utilized for varying the speed of motors and, in dynamos, in making use of the compounding effect of the armature [illegible]. For instance, the speed of a 250-volt [illegible] between 680 and 1,180 r.p.m. by merely shifting the brushes. In an editorial note it is stated that the shifting of the brushes out of their "best" position always leads to a reduction of the efficiency. One of the reasons for the adoption of auxiliary poles is to enable wide speed variation to be effected with the ordinary field rheostat without its being necessary to shift the brushes to avoid sparking. The other reasons for this special construction, applicable in the case of generators as well as motors, is to diminish the size and cost of those machines which have hitherto had to be designed on the basis of the limit due to sparking instead of that due exclusively to the temperature rise.—Lond. *Elec.*, November 24.

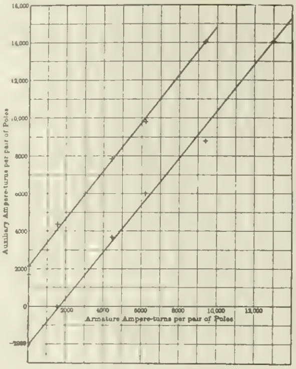


FIG. 2.—INTER-POLE DYNAMOS.

Commutation Poles.—ARNOLD.—A mathematical article on the theory of direct-current dynamos with commutation poles.—*Zeit. f. Elek.* (Vienna), November 26.

Liege Exposition.—REYVAL.—An illustrated description of several machines exhibited at Liege by the firm of Pieper. One is the steam-driven, 400-kw, 440-volt, direct-current machine, second a steam-driven, 90-kw, 440-volt, direct-current machine, and the third a gas-driven, 500-kw, direct-current machine. The gas engine will be operated with coke oven gas, but at the Exposition in Liege it is operated from the municipal gas supply. Illustrations and detailed dimensions are given of each of the machines.—*L'Eclairage Elec.*, November 25.

LIGHTS AND LIGHTING.

Flame Arc Lamp.—In notes on the recent Olympia Electrical Exposition in London a new flame arc lamp of the Armorduct Manufacturing Company is mentioned. This lamp is of the converging carbon type with magnetic blow-out, differentially wound and escapement controlled. The magnetic blow-out coil has a double winding. One of these windings is in circuit when the lamp is burning, and creates a weak magnetic field in which the flame is maintained. The second winding is brought into use when the carbons are burned out. This is effected by an automatic switch which serves the dual purpose of cutting out the shunt coil, and at the same time switching in the second winding of the blow-out coil, which effectually blows out the arc. The clockwork mechanism is simple and is actuated by weights to which the carbon holders are fixed, the escapement being released by means of the differential coils, and dash-pot. The weights and carbon holders are fitted with roller bearings throughout, by which means the friction is reduced to a minimum and the makers state that it is practically impossible for the carbons to stick, so that there is a perfectly steady feed. The whole of the mechanism is protected from the fumes given off by the sodium-cored carbons. The lamps are designed for both continuous and alternating current in the following sizes: Direct-current, 6, 8, 10 and 12 amp. (burning hours 7 to 19); alternating-current, 8, 10, 12 and 15 amp. (burning hours 7 to 17). Terminal voltage from 45 to 48. The hemispherical candle-power is stated to be approximately as follows: 6 amp., 1,750 cp; 8 amp., 2,500 cp; 10 amp., 3,600 cp; 12 amp., 4,750 cp.—Lond. *Elec.*, November 17.

Arc Lamp.—An illustrated note on the last design of the Jandus arc lamp. In the mechanism of the lamp is a compound-wound solenoid which acts on an armature of nearly three pounds weight. The great inertia of this heavy weight steadies small fluctuations.

The manufacturer still adheres to the use of powerful shunt coils for series lamps (these coils balancing the arc voltages within one or two volts), and does not rely on the use of series coils only for the regulation of the arc voltage. It is stated that the present lamp will burn for 200 hours at one trimming without any blackening of the globe, flickering of the light or explosions.—Lond. *Elec.*, November 17.

Train Lighting.—Dick.—A lecture on the systems of train lighting in which both a dynamo and storage battery are used. There are two different methods. The first is to have on the locomotive only one dynamo, which is connected with all the cars and batteries. The second method is to have both a dynamo and a storage battery on each car. The author believes that the latter system is the only practical one. He reviews the general principles of the same and also gives some data on the cost. He claims that electric lighting by this method is able to compete with any other kind of lighting.—*Zeit. f. Elek.* (Vienna), November 26.

Mercury Arc Lamp.—Letheule.—A summary of a recent paper of Leblanc on the researches of Cooper Hewitt and his co-workers on the mercury vapor lamp and rectifier.—*Revue Gen. des Sciences.*—November 15.

Power.

Refuse Destruction.—An article on the new refuse destruction plant of the city of Fiume. Daily 20 to 22 tons of refuse are collected, of which one-third is refuse from the streets. At the test of the plant 8.3 tons of refuse were burned in six hours, which represented 345.75 kg. per square meter of grate and per hour. The evaporation amounted to 1.034 kg. of water per 1 kg. of refuse. It is stated that this is considerably better than the result obtained in a similar plant in Zurich. The refuse destructor is operated in connection with a three-phase generating plant.—*Zeit. f. Elek.* (Vienna), November 12.

Power Supply in London.—A reprint of the report of the Financial Committee of the London County Council in opposition to the Highways Committee on electric power supply in London, and an editorial discussion of the subject.—Lond. *Elec.*, November 17.

Lubrication.—Strohm.—An article of a practical nature, illustrated by diagrams, on steam engine lubrication.—*Am. Elec.*, December.

Electric Crane.—An illustrated description of a large electric crane, its lifting capacity being 50 tons at a maximum radius of 87 ft.—*Scien. Am. Sup.*, November 25.

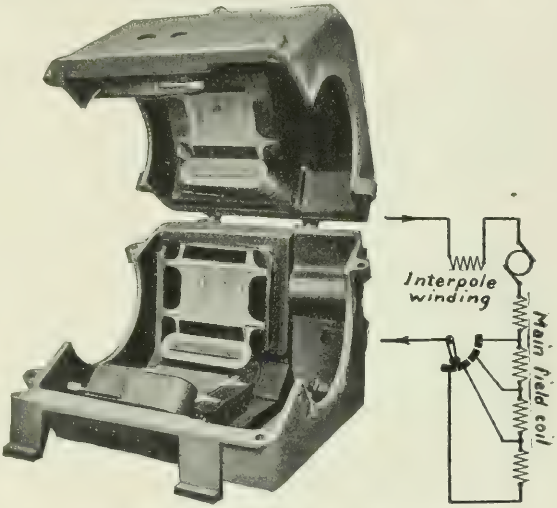
Turbo-Generator.—Schulte.—A description of the new 1,000-kw turbo-generator at the Courl mine in Germany. It consists of a Zoelly steam turbine directly coupled with a 1,500-hp, three-phase generator, the speed being 1,500 r.p.m.—*Glueckauf*, November 11.

Traction.

Brakes.—In tramcars whose brakes are applied by the action of an electromagnet, it has been the practice to keep the brake in the "on" position by a ratchet and pawl arrangement. This locking device has recently been displaced to a large extent in Germany by a hydraulic arrangement. The plunger of the electromagnet takes the form of a piston moving within a cylinder. When the plunger is sucked up into its solenoid against the pressure of a spring, liquid is drawn into the cylinder from a small tank. If, now, the current to the electromagnet be interrupted, the plunger cannot move backwards, because the liquid previously drawn through the non-return valve cannot escape, and, therefore, the brakes cannot come off. This valve can be lifted to a smaller or greater extent by a separate electromagnet of small dimensions. The application of the brake and the release valve is governed by a small controller near the car driver. The handle of this controller is capable, not only of being rotated, but also of being moved up and down. While a rotary movement of the handle causes more or less current to flow through the main electromagnet, the up or down movement of the handle makes or breaks contact with the small electromagnet. The total weight of the apparatus described, including the brake controller, is stated to be 150 kg. (330 lbs.). Lond. *Elec.*, November 17.

Trolley Wheels.—Cooper.—Some notes on trolley wheels. The writer points out that a trolley wheel should be soft and of as good conductivity as possible, otherwise the wire will suffer instead of the wheel, and it is much cheaper to renew the wheels than the wire. The author points out the very great importance of the absolute balancing of the wheel and the exact centering of the bush in the wheel, and of the hole of the bushing itself. With respect to the pressure of the trolley wheel against the wire, he says that this depends very largely upon the height of the wire, the size of the wheel, the character of the overhead work and the speed of the car. For ordinary urban work where the average speed of the car does not go over 10 m.p.h. a pressure of 15 lbs. will give perfect contact at the end of a 12-ft. trolley pole, provided that the overhead work is not so high that the trolley is to assume an angle of over 75°. From this, which is the lightest safe pressure that can be used, the pressure will run up to 35 lbs. on high-speed interurban lines using large and heavy wheels. The writer describes a simple method of measuring the pressure against the wire.—*St. R'y. Jour.*, December 2.

New Direct-Current Traction Motor.—An illustrated description of a new direct-current traction motor of the Oerlikon Company. It is designed for a load of 200 hp during one hour at voltages up to 800 and at 400 revolutions. An interesting feature is that the motor is equipped with commutation poles ("interpoles"), as shown in Fig. 3. The slots of the armature are entirely closed. The highest speed which may be used is 1,000, the peripheral speed of the commutator being in this case 25 meters. The armature contains 518 bars, two per slot, and the commutator has 259 segments. The exciting coils are made from copper ribbon and are insulated with presspahn, there being no cotton insulation whatever. The method of speed regulation is indicated in Fig. 4, which shows that one or more portions of the windings of the main poles may be disconnected.—*Elek. Bahnen*, November 14.



Figs. 3 and 4.—New Traction Motor and Diagram of Windings.

Electric Locomotives.—An illustrated description of the new electric locomotives which will displace those now driven by steam which haul the London & North Western trains from the Mansion House to Broad Street, via Willesden. Each locomotive has four motors each of 200 hp and the multiple unit control system will be used.—Lond. *Elec.*, November 17.

Petrol Motor.—A fully illustrated description of a 140-hp Wolseley petrol motor weighing only 80 cwt. The placing of the order for this motor was influenced largely by the success of similar Wolseley engines employed by the North Eastern Railway Company to drive electric generators for supplying current to motors operating passenger coaches in use on local lines. The new motor is built by the General Electric Company of this country and is to be applied to the same purpose on one of the American lines.—Lond. *Eng'ing*, November 10.

Surface Contact Systems. An illustrated description, with some critical comment, of the four surface contact systems in England which are "alive or in a state of partially suspended animation." These four systems are the Lorain, the Dolter, the G.B. system, and the Kingsland. The anonymous writer appears to favor the Kingsland system.—Lond. *Elec. Rev.*, November 10.

Storage Battery Locomotive.—An illustrated description of an electric storage battery locomotive for construction and emergency use in one of the new deep-level subways in London.—*Scien. Am.*, November 25.

High Speed Traction.—The conclusion of the voluminous report, giving detailed and very valuable information on the high-speed traction tests between Berlin and Zossen. The concluding section is devoted mainly to a discussion of the measurement of the energy consumption and to the results of the braking tests of 1902, and contains numerous tables, drawings and diagrams.—*St. R'y. Jour.*, December 2.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Vulcanized Fibre.—WERNICKE.—An account of some trials of vulcanized fibre as insulating material. It was found that vulcanized fibre when dry is a pretty good insulating material, but in moist air—i.e., under conditions as they generally exist in free air or in many installations—it is entirely unsuitable since it easily absorbs considerable amounts of moisture and gives them off only slowly later on. Some notes are given on the development of blisters on the surface of the insulator when heated under certain conditions. *Elek. Zeit.*, November 23.

Electricity in Hospital.—A long and fully illustrated description of the electrical equipment in the London hospital. The installation comprises nearly 6,000 lights and about 100 motors, and there is a complete equipment for the application of Roentgen rays, high frequency oscillations, the treatment of lupus by means of Finsen light, etc.—Lond. *Elec. Rev.*, November 10.

WIRES, WIRING AND CONDUITS.

Lead-Covered Wiring.—MACKENZIE.—A discussion of the advantages and disadvantages of lead-covered wiring. The advantages are given as follows: The wire comes to the contractor, already provided with its own continuous metallic sheathing, and generally requires no further protection. The sheathing is water tight, and the whole installation can quite readily be made so too. The great flexibility of the wire enables it to be installed with much less damage to buildings. The small diameter of the wire enables it to be used in surface work, where any other system would be an eyesore. The difficulty in making joints practically compels the adoption of a loop-in system. The disadvantages urged against the system are many and various, but fall under two general heads, viz: First, risk of injury during erection from carelessness of the wiremen and other workingmen, and second, risk of injury after erection. Among the latter risk the author mentions that if a failure of insulation takes place, a wire connot readily be withdrawn and replaced. He says that this is the only point where conduit systems can show any real superiority over the lead-covered. Another risk is that lead expands with increase of temperature and may not go back to its original length when cold, and hence it may come in contact with other metals or may even get cracked and broken. For this reason, where wire is to be subjected to very great variations in temperature lead should not be used, but this is never the case in houses or shops under ordinary circumstances. Another risk is that the electric resistance of lead being high, contact with other metals may form a better "earth" than the proper earth connection; when the earth appears, the lead may fuse at the point of contact as quickly as the fuse wire does. In order to overcome these disadvantages, it is sufficient to bond all the lead wires together at frequent intervals and so get the advantage of all the sheathing. For this purpose the writer uses a solder containing a large proportion of lead. Since the presence of other metals such as brass saddles in lamp situations may cause electrolytic action, lead saddles should be used, which are quite as sufficient. The author claims that, if properly handled, lead-covered wiring is good. It is often very improperly applied, however. He mentions a case where lead-covered wires had been drawn into iron gas pipes laid in the ground, whereby the lead covering had been scratched and perhaps cut with the inevitable result of breakdown. Instead of this method the wire ought to have been laid either in wood troughing and pitched in solid or drawn into smooth earthenware or concrete conduits.—Lond. *Elec. Rev.*, November 10.

Making Copper Wire.—An illustrated description of a method of Cowper-Coles for making copper wire by means of the centrifugal electrolytic process. A revolving mandrel is provided with a spiral scratch. The effect of this scratch which must be angular is to disturb the molecular structure of the electro-deposited copper and to form a cleavage plane. When the deposit has reached a sufficient thickness the current is interrupted and the deposit can be taken off in form of a helix, the copper parting along the line of scratch.—Lond. *Elec.*, November 10.

ELECTROPHYSICS AND MAGNETISM.

Magnetization Within Wide Limits of Temperature.—HONDA AND SHIMIZU.—The first part of a paper, giving an account of a very extended investigation of the magnetization and the magnetic change of length in ferro-magnetic metals and alloys at temperatures ranging from 186° C. to + 1,200° C. In Swedish iron, tungsten-steel and nickel, the cooling by liquid air diminishes the magnetization in low fields, but increases it in the strong. In Swedish iron and tungsten-steel the change is very small, amounting at most to 2 or 3 per cent; but in nickel the initial diminution is considerably larger, amounting to about 10 per cent in the maximum. As in the case of iron, tungsten-steel, and nickel, the magnetization of the alloys of nickel-steels containing amounts of nickel greater than 26.64 per cent is decreased in weak fields and increased in strong, by cooling them in liquid air. In alloys containing lower percentages of nickel, the magnetization always increases on cooling. Steinmetz's formula giving the relation between the hysteresis loss and the maximum induction holds for nickel and annealed cobalt up to an induction of 3,000 c.g.s.; it holds for cast cobalt and tungsten-steel up to 8,000 c.g.s.; and, lastly, for Swedish iron, it fails beyond an induction of 18,000 c.g.s. If, however, the specimens are cooled in liquid air, the applicable range of the law for induction is notably extended, as regards the residual magnetism, the cooling always increases it in a marked degree. The hysteresis loss of nickel-steels at ordinary temperature is generally small, compared with that of other ferro-magnetic metals. In Swedish iron and tungsten-steel, cooling by liquid air decreases the elongation of the metals; the change in tungsten-steel is very small, but in Swedish iron it is relatively large. In nickel, the contraction is diminished by cooling to a field of 670 c.g.s.; but it is increased in stronger fields. The paper is to be concluded.—*Phil. Mag.*, November.

Radiations Given off in an Alternating Condenser Field.—SANFORD.—An account of measurements of the wave length of the radiation from different metals, when these metals are joined to the cathode of the secondary of an induction coil or are placed in the field of an air condenser, the plates of which are joined to the terminals of an induction coil. In general the radiation from each metal seems very homogeneous. The wave lengths from the different metals tested vary between 330 and $400\mu\mu$.—*Phys. Rev.*, November.

Measuring Conductivity of Air.—GARDIEN.—An illustrated description of an apparatus for measuring the absolute conductivity of air. It consists of two concentric cylinder electrodes between which the air stream is passed. The result is independent of the speed of the air.—*Phys. Zeit.*, November 9.

Speed of Roentgen Rays.—MARX.—The complete paper with illustrations and diagrams of his measuring arrangements, an abstract of which was recently noticed in the Digest.—*Phys. Zeit.*, November 9.

Electricity in Gases.—STARK.—A paper giving the present situation of the investigation of electricity in gases.—*Phys. Zeit.*, November 9.

Congress of German Naturalists.—An account of the proceedings of the 77th meeting held by the Association of German Naturalists and Physicians in Meran from September 24 to 30, 1905. Those papers which refer to electrical subjects have been or will be abstracted in the Digest.—*Phys. Zeit.*, November 9.

ELECTROCHEMISTRY AND BATTERIES.

Storage Battery.—GRADENWITZ.—An illustrated description of the Ziegenberg lead-zinc storage battery with some notes showing how to use it under certain circumstances as primary battery. The battery is discussed in an editorial.—*Am. Elec.*, December.

Copper Oxide Cell.—RAMMELSBERG.—Some notes on the rational reoxidation of the copper electrode of copper oxide cell.—*Centralbl. f. Accum.*, November 1.

Physical Chemistry.—VAN'T HOFF.—His full paper presented before the International Congress of Arts and Science last year on the relation of physical chemistry to physics and chemistry.—*Science*, November 24.

Units, Measurements and Instruments.

Transformer Arrangement for Testing Purposes.—McCarty.—In testing induction motors in large numbers it is very desirable to run a number at the same time. For this purpose it is necessary to get as many voltage combinations as possible from a restricted number of transformers. The author discusses the different arrangements which are possible with two single-phase transformers. Assuming a line e.m.f. of 220 volts, two-phase, Fig. 5 indicates the phases and voltages that may be secured from two single-phase transformers. The upper part of the figure shows the connections as they are made on the transformers referred to. In the lower part of the figure the same connections are shown but given in the more usual diagrammatic form for two-to-three-phase transformation.—*Elec. Jour.*, November.

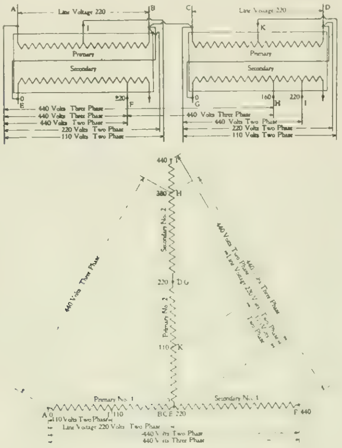


FIG. 5.—ARRANGEMENT OF TRANSFORMERS FOR TESTING PURPOSES.

Theory of Phase Meters.—Sumpner.—An abstract of a (British) Physical Soc. paper on the construction and theory of phase meters. The main results of the author were as follows: Phase meters for multiphase circuits are all equally accurate on balanced loads, provided they have been correctly calibrated and possess no faults due to purely mechanical causes. Their accuracy is not affected by variations in wave form or in current frequency. The calibration of the scale is affected by the number of coils used in the instrument, by the ratios of the ampere-turns used with these coils, by the distribution of the windings, and by the magnetic nature and properties of the magnetic circuits, especially if these contain iron; but the accuracy of the indications is not dependent upon any of these considerations, if the working of the instrument is satisfactory from a mechanical point of view. Phase-meters can be simply and accurately calibrated for balanced loads by means of a direct-current method of test. The error of phase-meters on unbalanced circuits is generally serious for loads which are badly out of balance. The error, like that of a wattmeter, increases rapidly as the power factor of the load diminishes. It can only be reduced at the expense of complication in the instrument, by increasing the number of coils used in the fixed and moving systems, and by arranging the coils and magnetic circuits to be symmetrical in regard to one another. If the true power factor of the load is *cos* ϕ, the reading of the instrument is $\cos\phi + \beta \sin\phi$, where β is the phase error due to the unbalanced load.—Lond. *Elec. Eng.*, November 3.

Reading Error of Indicating Instruments.—Brackett.—An article pointing out the importance of users of instruments understanding the limits of accuracy in reading. A curve is given referring to a uniform-scale direct-reading ammeter of the range from 0 to 100 amperes. The author shows how the per cent error caused by an uncertainty of one-tenth of one scale division changes with the number of amperes read off. Since the smallest of the scale divisions represents one ampere, the reading of the position of its pointer can be made to the accuracy of one tenth of one ampere, without any consideration of the size of the reading. This uncertainty of one-tenth of one ampere is only one-tenth of one per cent when the current read is 100 amperes, but it becomes one per cent when the instrument is used to measure ten amperes, and for currents less than ten amperes the uncertainty or the possible error in the reading of the instrument, even when its indications are absolutely correct, increases in a most remarkable way. When a direct-reading instrument has a scale that is more open at its middle with smaller divisions at the ends, the uncertainty of low readings is necessarily greater and the point where reasonable accuracy may be secured is not reached until the quantities measured are relatively much larger. *Elec. Jour.*, November

Dynamometer.—Guarini.—An illustrated description of a new dynamometer built by J. J. Rieter & Co., for a capacity of about 12 hp. —*Am. Machinist*, November 16

Air Pump.—Gaede.—A description of a new revolving mercury air pump —*Phys. Zeit.*, November 9

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—Braun.—An account of some experiments made by him in Strassburg on sending wireless telegraph messages in a certain direction only. The method is based on the possibility of producing two high-frequency electric oscillations of equal amplitude and frequency, but differing in phase by portions of one millionth of a second. After methods for this purpose had been developed the actual tests were made by an arrangement shown in Fig. 6, which shows the transmitting station. It comprises three wooden masts which are placed at equal distances of 30 meters from each other. An insulated copper wire goes from the top of each mast to the bottom and from there to the wooden shanty in the center which contains the apparatus. From there, the three electric oscillations are impressed on the three wires. The principle of the method may be understood from the following consideration: The wires 1 and 2 may receive absolutely identical oscillations, while the wire 3 may get an oscillation which is slightly lacking in phase behind that of the two others; then the wave emitted from the latter will lag still more in phase when it reaches the line between 1 and 2. This total phase difference may be adjusted so that the wave from 3 annihilates the waves going out from 1 and 2. On the other hand, if the wire 3 be supplied with the oscillations ahead in phase before those of 1 and 2, then the wave emitted from 3 may strengthen the waves from 1 and 2. It is thus possible to annihilate or strengthen at will any wave going from 3 towards 1 — 2. The experimental results agreed exactly with the theory. If one uses five vertical masts in proper positions it is possible to direct a wave quite precisely in a certain direction.—*Elek. u. Polyt. Rundschau*, November 1.

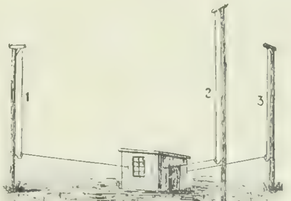


FIG. 6.—WIRELESS TELEGRAPHY.

Wireless Telegraphy.—Slaby.—A further paper in his serial on tuned wireless telegraphy. In the present installment he deals with indirectly excited transmitters with a decreased damping effect. He gives a complete theory of the "coupled" transmitter, and gives formulas for calculating the wave lengths of the two waves produced in it. Actual measurements have shown his formulas to be exact.—*Elek. Zeit.*, November 9.

Telephone Switchboard.—An illustrated description of a new telephone switchboard which has been specially built for use in connection with the distribution system of the Lancashire Electric Power Company. Its special feature lies in the precautions which have been taken to guard the operator against any shock from the 10,000-volt overhead transmission line.—Lond. *Elec.*, November 17.

Telephone Lamps.—An illustrated description of the more important commercial incandescent lamps for telephone service.—*Dingler's Polyt. Jour.*, November 11, 18.

MISCELLANEOUS.

Liege Exposition.—Fully illustrated descriptions by Orban of the exhibits of the electric generating sets, prime movers, electric capstans and electric lighting systems for railway trains, also an article by Pierart on telegraph exhibits.—*Bull. Mensuel Soc. Belge Elec.*, November.

Electric Heating.—Jepson.—A well illustrated article on the history and development of electric heating.—*Elec. Age*, November.

Magnetic Separator.—An illustrated description of the Ball & Norton belt-type magnetic separator.—*Iron Age*, November 23.

Soldering.—In an article entitled "Experience on the Road," some practical notes are given on soldering, especially in connection with heavy cable terminals and bar windings.—*Elec. Jour.*, November.

Electric Manufacturing Works.—An illustrated description of the East Pilton Works of Bruce Peebles & Company, Ltd.—Lond. *Elec. Rev.*, November 17.

Niagara Falls.—Lincoln.—Reminiscences on electrical engineering at Niagara Falls.—*Elec. Age*, November.

Biographical.—A biographical sketch of the new president of the British Institution of Electrical Engineers, Mr. John Gavey, who is a distinguished British telegraph and telephone engineer.—Lond. *Elec. Rev.*, November 3.

BOOK REVIEW.

Elemente der Vektor-Analysis. Second Edition. By A. H. Bucherer. Leipzig: B. G. Teubner. 103 pages, illustrated. Price, 2.40 marks.

The study of vector analysis is daily becoming more important in dealing with quantitative physics, and theoretical mechanics. This little volume gives a brief account of the principles of vectors from the quaternion standpoint as interpreted by Heaviside and Föppl. As a compendium of the fundamental space theorems of physics and mechanics expressed in vector notation, the book will be of service to advanced students in mathematics.

BOOKS RECEIVED.

Die Aufgaben der Photochemie. By Dr. R. Luther. Leipzig: Johann Ambrosius Barth. 18 pages. Price, 80 pfennigs.

Die Elektrochemie der Organischen Verbindungen. By Dr. Walther Lob. Halle: Wilhelm Knapp. 320 pages, illustrated. Price, 9 marks.

Theoretische Elektrochemie. By Dr. Heinrich Dannee. Leipzig: C. J. Goeschen. 197 pages, 18 illustrations. Price, 80 pfennigs.

Elektrolyse Geschmolzener Salze. By Richard Lorenz. Vols. I and II. Halle: Wilhelm Knapp. Vol. I, 217 pages; Vol. II, 257 pages. Price, 8 marks.

Traité Pratique D'Électrochemie. By Richard Lorenz. Paris: Gauthier-Villars. 323 pages, 77 illustrations. Price, 9 francs.

The Allis-Chalmers Steam Turbine.

The first steam turbine installed by the Allis-Chalmers Company is now in operation in the Washington Street power house of the Utica Gas & Electric Company, Utica, N. Y. This turbine, shown in Fig. 2, is rated at 1,500 kw normal load, and runs at a speed of 1,800 r.p.m. It is direct coupled to an Allis-Chalmers two-phase, 60-cycle, revolving-field alternator, operating at 2,500 volts. The unit has a continuous overload capacity of 25 per cent, with a three-hour 50 per cent overload capacity without exceeding a safe generator temperature, and capable of a 100 per cent safe momentary overload. Artificial ventilation by means of an electrically-driven fan blower will, however, enable the unit to be run safely beyond its rated overload capacity.

The turbine follows the well known Parsons type which has proven itself eminently successful in numerous installations both here and abroad. The Allis-Chalmers construction, however, embodies a number of features which are new in this country, and which are claimed by the builders to be distinct improvements.

The chief distinguishing feature of this construction is the blading which, while it is of the Parsons reaction type as regards the principle of operation, differs in mechanical construction in a number of essential details. The roots of the blades are formed in dovetail shape by special machinery, and are inserted in slots cut in foundation or base rings, these slots being formed by special machine tools in such a way as to exactly conform to the shapes of the blade roots. The foundation rings themselves are of dovetail shape in cross section and are inserted in dovetailed grooves cut in the turbine cylinder and spindle respectively, in which they are firmly held by key pieces, much in the same way that the well known "Lewis bolt" is fastened. In order further to ensure the integrity of the construction, the key pieces or rings after being driven into place are upset into undercut grooves.

Another noticeable feature of the blading is the method of reinforcing and protecting the tips of the blades. This point in steam turbine design is one upon which much thought has been expended by various inventors, and the Allis-Chalmers Company claims that the construction employed by it successfully solves all difficulties.

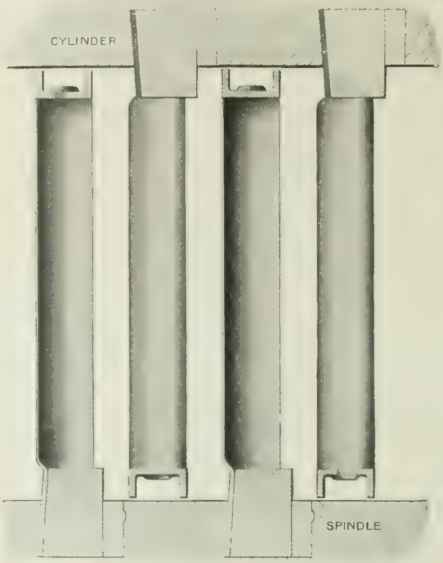


FIG. 1.—METHOD OF FASTENING BLADES.

In forming the blades a shouldered projection is left at the tip. This is inserted in a slot punched in a shroud ring, the slots being punched by special machinery in such a way as to produce accurate spacing and at the same time form the slots so that they will give the proper angles to the blades independent of the slots in the base ring. After the blade tips are inserted in the slots in the shroud rings they are riveted over by specially arranged pneumatic machinery.

The shroud rings are made in channel shape, with outwardly projecting flanges which, after assembly in the turbine, are turned and bored to give the necessary working clearance. The flanges of the channels are made so thin that, although amply sufficient for stiffness, the ring does not have the disadvantage of a solid shroud which acquires a dangerous temperature by friction in case of an accidental contact of the rotating and stationary parts. It is claimed for this construction that the blades are stiffened against the effect of vibration in a much more substantial manner than by any other means thus far employed, while the use of a protecting shroud ring enables the working clearance to be made smaller than in the case of naked blade tips, without danger in case of accidental contact, thus reducing the leakage loss to a minimum, the leakage past the blade tips being the principal source of loss in the steam turbine. As to the safety from damage in case of accidental contact, it is claimed that this has been proven by experiment with actual blading, by throwing the bearings out of center so as to produce contact, without detrimental results. An incidental advantage claimed for this construction is that if by chance a blade should prove defective, it is so held in place by the shroud ring that it cannot possibly work loose and produce damage.

By the method of construction described, the entire blading is produced by machinery, thus eliminating the personal equation which enters into blading done by hand work and which depends upon the skill of the individual workmen. Besides ensuring that every blade is securely fastened, all blades are necessarily set at exactly the designed angle and pitch, the openings between blades, upon which in great part the economical performance depends, being absolutely uniform. The blading is made up in half rings in the blading shop and is carefully inspected before being inserted in the turbine.

Fig. 1, which was photographed from a drawing, shows the general scheme of the blading, illustrating the method of fastening the blades as well as the channel shaped shroud ring. Fig 4 is from a photograph of blading, showing the substantiality of the construction as well as the uniformity of the work. Fig. 3 shows a turbine spindle of the same size as that of the Utica turbine, this photograph having been taken in the West Allis shops of the Allis-Chalmers Company.

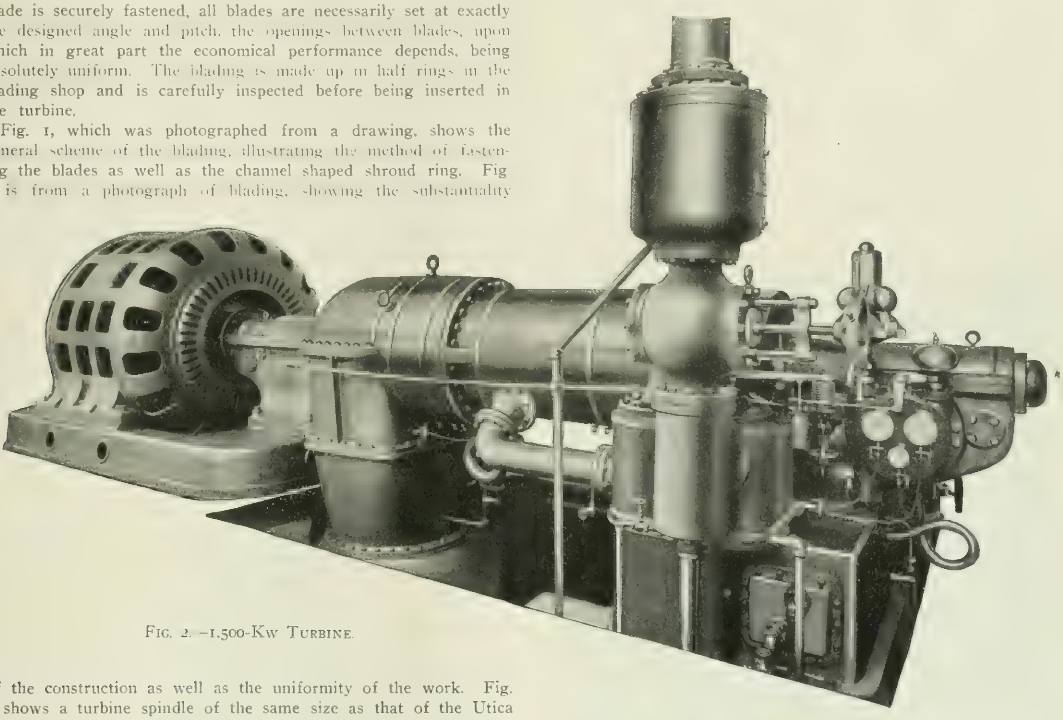


Fig. 2.—1,500-Kw Turbine.

Another special feature of this turbine will be noticed by referring to Fig. 3, viz., the absence of the usual low-pressure "balance piston," thus avoiding the difficulty of producing a balance piston of the size required for balancing the low-pressure stage of the turbine and at the same time make it sufficiently rigid to run with the necessary small working clearance. In the Allis-Chalmers construction there is, however, a third balance piston, but instead of being at the high pressure end of the turbine, as formerly arranged, it is at the low-pressure end, and as it is smaller than the large end of the spindle it is hidden from sight in the photograph. By making this piston in such a way that its circular area is equal to the annular area of the piston used in the older construction, the low-pressure balance piston is made much smaller. Instead of reducing the leakage past this piston by means of "dummy packing," as in the high-pressure and intermediate pistons, and as used in the low-pressure pistons of the older construction, a labyrinth packing of radial baffling type has been adopted, thus eliminating small axial clearance in this turbine. A considerable advantage is claimed for this construction in permitting of the use of smaller working clearances in the high-pressure and intermediate balance pistons.

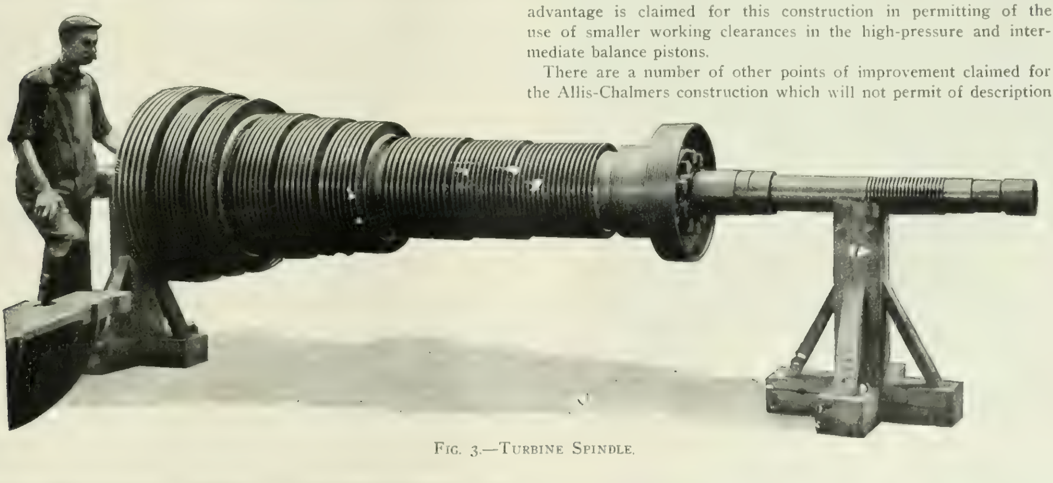


Fig. 3.—Turbine Spindle.

There are a number of other points of improvement claimed for the Allis-Chalmers construction which will not permit of description within the space of the present article. These include details of spindle construction, governing mechanism, lubrication and other minor features.

The alternating-current generator of the Utica outfit also is [illegible] more description than the present article will allow. Perhaps the most noticeable feature of this generator is the substantial design of the revolving field, providing great strength and at the same time giving the thorough ventilation which is essential. Particular attention has been paid to the insulation, as may be inferred from the fact that the armature was subjected to an alternating-current insulation test of 10,000 volts for the period of fifteen minutes. This generator was built at the Bullock Works of the Allis-Chalmers Company at Cincinnati, where the generators for all of their other turbine outfits are being built.

The Allis-Chalmers Company, in entering the steam turbine field, effected an alliance with the Turbine Advisory Syndicate of England, thereby securing the co-operation of the firms therein interested, including Messrs. Willans & Robinson, the famous high-speed engine builders, of Rugby; Yarrow & Company, the well known torpedo boat builders, of the Isle of Dogs, London; and the Neptune Shipbuilding Works, Walker-on-Tyne. The Utica turbine, in fact, was built for the Allis-Chalmers Company by Messrs. Willans & Robinson, to whom a number of turbine contracts were sublet by the Allis-Chalmers Company before the latter had perfected the installation of its special machinery for turbine manufacture. An agreement has more recently been effected with Hon. Charles A. Parsons, C.B., for interchange of data, thereby giving to the Allis-Chalmers Company the benefit of the vast experience of Mr. Parsons, the original inventor of this type of turbine, and to whose engineering ability and indomitable energy the evolution and present state of perfection of the successful steam turbine are principally due. The Allis-Chalmers Company has also secured rights under Mr. Parsons' patents for marine turbines and turbo compressors and blowers, for which there is a growing demand.

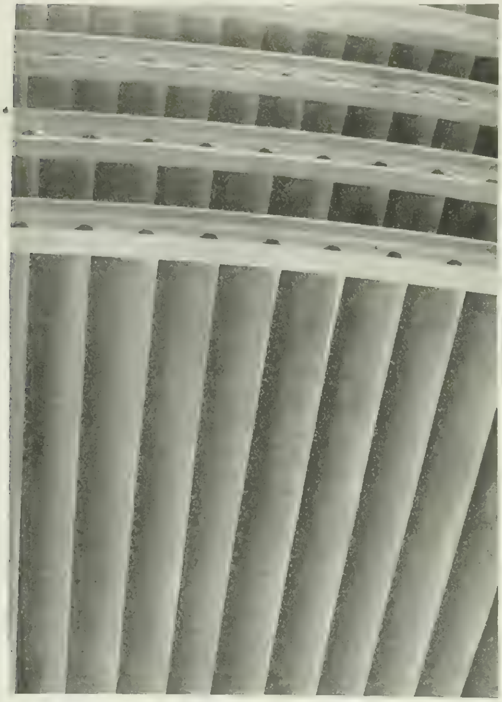


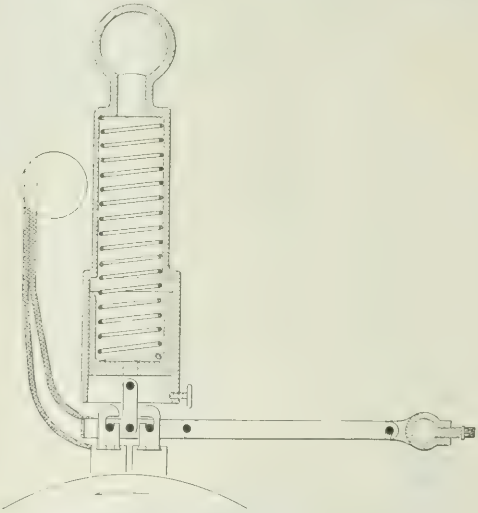
FIG. 4.—SECTION OF BLADING.

At present the Allis-Chalmers Company is building its steam turbines in its engine works at West Allis. The growth of the business, however, has led to a large extension of the works, amounting to a practical doubling of the present plant. A considerable part of the extension will be devoted to the manufacture of steam turbines and the accompanying electric generators, one of the three new manufacturing buildings being given up to the exclusive manufacture of the turbines themselves. The first steam turbine of the Allis-Chalmers Company's own make, of 5,500-kw capacity, has recently been shipped, and others are following as fast as the present crowded condition of the shops will permit.

Pneumatic Brush Holders for Turbo-Generators.

One of the most difficult problems connected with the design of direct-current generators for abnormally high speeds resides in the selection of material and arrangement of parts of the brushes and brush holders. It is essential that the pressure exerted by the brush mechanism be sufficient to cause the brush to remain always in contact with the commutator, and yet an excessive pressure entails a considerable frictional loss at the high peripheral speed of the commutator. The problem is rendered yet more difficult if the surface of the commutator is irregular, for in this case the mass of the moving members of the brush mechanism must be kept at a low value in order that its inertia may speedily be overcome without the application of an abnormal force.

The accompanying illustration shows a recent design for brush holders, including the advantageous features of a minimum mass of moving parts and uniform pressure to all brushes independent of their number. The flexible leads are embedded in the brush during the process of manufacture. The brush is mechanically connected through links to a light piston in a cylinder into which air is admitted under a pressure of about five pounds per square inch. Owing to the small value of the inertia the brush responds rapidly to any slight irregularity of the surface of the commutator, thus insuring good contact at all times with a minimum of friction. Each brush is made in two parts, which are so interconnected mechanically that each part may move independently of the other, which construction affords an additional assurance that a proper area of contact will always be maintained with the commutator.



PNEUMATIC BRUSH HOLDER.

By the employment of compressed air absolutely uniform pressure is assured for all of the brushes, a condition which is difficult to obtain when the pressure of each brush is regulated independently. In practical operation the air under pressure is supplied from a compressor run in connection with the oil pump. Each brush is built up of laminæ of graphite, which have been subjected to enormous mechanical pressure between their faces. It is claimed that the unsymmetrical arrangement of the molecules which thus results causes the specific electrical resistance to be much greater in line with the pressure than in mechanical quadrature therewith. The advantageous features claimed for this brush are as follows: Extremely high conductivity along the brush, considerable transverse resistance, comparatively high contact resistance and unique lubricating qualities. It is stated that large generators, which sparked at half load with carbon brushes, are now running satisfactorily at full load with these special graphite brushes, and that owing to the electrical properties above noted the total increase in efficiency in special cases has been as much as 5 per cent, and is generally from 2 to 3 per cent, by the mere substitution of these brushes for ones made of the ordinary carbon.

The pneumatic brush holder for turbo-generators and the "Morganite" graphite brushes for both direct and alternating-current commutation are manufactured at the Battersea Works of the Morgan Crucible Company, Limited, London, England.

Electric Pipe Thawing Apparatus.

The Westinghouse Electric & Manufacturing Company has placed on the market two pipe-thawing outfits, one for heavy service, comprising a specially designed choke coil used in connection with the primaries of a standard transformer, and another for lighter service, consisting of a transformer adapted for suitable secondary voltage adjustments mounted in the cast-iron top and bottom frames. The heavy-duty outfit consists of a choke coil connected in series with the primary of a standard 2,200-volt, 60-cycle transformer of from 15 to 25 kw capacity. The coil is compactly built and enclosed in a cast-iron case with a base 16 by 16 in. Five plug receptacles mounted in the upper portion of the case provide a simple means of varying the primary voltage. The various taps give approximately 50, 60, 75, 87 and 95 per cent of the full-line voltage. By changing the position of the plugs any one of these combinations may be used.

THAWING OUTFIT.

The smaller outfit is intended for lighter service, such as thawing house piping. It is compactly built and enclosed in a case with cast-iron top and bottom, the transformer laminations themselves being exposed to the air, thus providing excellent conditions for cooling. Handles are provided on the top casting which will enable one man in an emergency to carry the transformer, as its weight complete is approximately 100 pounds. It is intended for use on 2,200-volt, 60-cycle circuits. The variation in secondary voltage is from 55 to 35 and a current of 100 amp. can be maintained for one-half hour without undue heating. No oil is used with this transformer, as the insulation is specially prepared to withstand severe conditions.

In operation the transformer should be placed as near the pipes to be thawed as possible. For dwellings one low-tension lead may be connected to a house faucet and the other to a hydrant beyond the frozen section. For thawing street mains two hydrants may be conveniently used. On account of the different conditions met with it is impossible to prescribe the exact voltage or current necessary to do any particular thawing. In general the voltage necessary to force the same amount of current over pipes of the same diameter will vary with the length of pipe. Large pipes require less voltage to force the same current through a given length, but require more current to thaw them out.

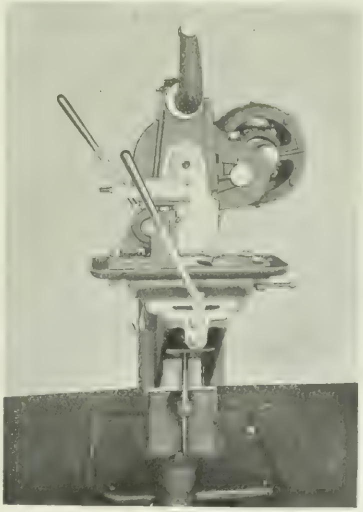
For pipes up to 5 in. in diameter approximately 500 amp. is usually sufficient, while 12-in. mains may require 1,000 amp. As a rule, a small current for a long period of time will do the work of a large current applied a shorter time, and the thawing will be done with less chance of injury to the piping system.

1,000-HP Induction Motor in a Paper Mill.

An interesting installation of induction motors has recently been completed at Massena, N. Y., taking power from the generating station of the St. Lawrence River Power Company. This company furnishes electricity for the operation of various industries, including the manufacture of paper from wood pulp. It is in this class of work that the induction motor has been found most suitable and an example is to be found in the plant of the Remington Martin Paper Company. In this mill the pulp grinders are direct-connected to an induction motor of 1,000 hp, which operates at 2,080 volts, 25 cycles, three-phase, at 214 r.p.m. This motor, which was made by the General Electric Company, drives four wood pulp grinders, two being connected at each end of its shaft. It is started with an external resistance connected through collector rings to the rotor. The grinding of pulp with electric power has been found so satisfactory that the company is about to adopt it in another mill.

Motor-Driven Hand Miller.

For milling machines, not back-geared, a simple and compact form of motor drive is shown in the illustration of a hand milling machine, built by the Garvin Machine Co., New York. A variable-speed motor having a range of four to one is used, and is geared to the spindle, through an intermediate gear shaft. A bronze pinion is used on the motor, and all the gears are totally enclosed, and run very smoothly, without noise. With this arrangement, the spindle has a range of speeds from 60 to 240.


MOTOR DRIVEN MILLING MACHINE.

The head on the table carries a vertical slide, having a movement of 1⅝ in. by lever and pinion, on which the vise is mounted, and the table itself has a horizontal movement of 7 in. by level, through rack and pinion. Both slides are fitted with stops, and may be operated simultaneously. These machines are particularly economical in manufacturing operations, requiring short cuts. The weight is 1,300 pounds.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade broadens in a healthy manner in response to lower temperatures and holiday demands. Business in holiday goods promises to add another high-level record to this record-breaking year, but retail trade in seasonable goods fluctuates in volume due to the irregularities of the weather. The approach of the stock-taking period brings with it quieting tendencies in wholesale trade. Activity still prevails in the industries, iron and steel and building being notable instances. New business is not coming forward so freely, but the demand for many products is so far ahead of the supply that there is little interest in current operations. The leading steel producer announces that contracts average about 50,000 tons daily, which is 15,000 tons in excess of capacity. Activity is still a feature in textile trades. The recent advance in cotton and the talk of 15 cents for the balance of the crop are disturbing elements in future business. Railway business continues remarkably heavy, gross receipts for November promising an increase of about 9 per cent over last year. Holding of cotton at the South and of grain at the West, coupled with the car congestion, retard collections. The prices for staples show unsurpassed strength, and there is an unprecedented demand. The market for metals, other than iron and steel, is higher. Copper advanced ½c.; Lake and electrolytic closing at 18c and casting stock at 17⅞c. *Bradstreet's* reports 203 business failures during the week ending December 7, as against 188 the preceding week and 231 the corresponding week last year.

TRADE IN MANUFACTURES.—The manufacturers of the country continue to increase their share in both the imports and the exports of the United States. In the 10 months ending with October, 1905, their importations of materials for use in manufacturing formed 47.8 per cent of the imports of the country, against 45.8 per cent. in the corresponding period of last year, and their exports of manufactures formed 38.2 per cent of the total domestic exportations, against 36.7 per cent in the corresponding months of 1904. Manufacturers' materials show a greater increase in the imports than all the other classes of imports combined, and manufactures show a greater gain in exports than all the other classes combined. The increase in the importation of manufacturers' materials in the 10 months ending with October, 1905, amounts to $81,000,000, an increase of 21 per cent over the corresponding months of last year, while the increase in all other imports amounts to but $54,000,000, an increase of 12 per cent over the corresponding months of last year. In exports the increase of manufactures is $58,000,000, or 14 per cent, while the gain of all other exports is but $49,000,000, an increase of 7 per cent over the corresponding months of 1904. On the export side the largest increases are in cotton cloths, copper, manufactures of iron and steel and leather and its manufactures. The exports of copper were $72,000,000 in value, against a little less than $61,000,000 in the corresponding months of last year; iron and steel, $115,000,000, against $105,000,000 in the same months of last year, and leather, $32,500,000, against $28,750,000 in the same months of last year.

BIDS FOR NAVY SUPPLIES.—Bids will be received until December 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., motor-generator sets, conduit and fittings, electrical supplies; also on January 9 to furnish at the navy yards at Mare Island, Cal., and Puget Sound, Wash., motors, cable, circuit-breakers, electrical supplies, electric hoist and runway, electric motor-driven outfit. H. T. B. Harris, Paymaster-General, U. S. N. Bids will be received until Dec. 19 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., rubber and lead-covered wire, iron conduit and fittings, switches, electrical supplies and motor-generator set. H. T. B. Harris, paymaster-general U. S. N.

THE PELTON WATER WHEEL COMPANY has been awarded a contract for another impulse wheel by the Vancouver Power Company, of Vancouver, B. C. A generating set will be installed consisting of a 3,000-hp Pelton unit of the "double-overhung" type, direct-connected to a 1,500-kw, three-phase, 2-r.p.m. generator, operating at a head of 300 ft. Similar units have been installed with Pelton wheels and the power house is arranged for the reception of two additional units providing for a total overhead capacity of 15,000 hp. The Eastern works of the Pelton Company will construct the additional pressure pipe line comprising about 1,050 ft. of pipe, varying from 48 in. in diameter and 9/32 in. thickness to 42 in. diameter and 17/32 in. thickness. The contract calls for the material delivered installed. The Columbus Consolidated Mining Company, of Utah, has duplicated its order for a 750-hp Pelton water wheel, the original of which was filled two years ago, while the United Light & Power Company, of Georgetown, Cal., is installing an additional 1,000-hp Pelton unit, this being the second order received from that company within three years.

INDUSTRIAL ADVERTISING MANAGERS DINE.—The Technical Publicity Association, whose members are the advertising managers of the machinery and electrical manufacturers east of Ohio, dined and held an open meeting at the Aldine Association, 111 Fifth Avenue, Friday, December 8, 1905. Mr. Geo. H. Gibson, a former secretary of the association, made an address on "Lost Motion in Machinery Advertising," which was followed by an informal discussion. Among the concerns represented at the dinner were the Ingersoll-Rand Drill Co., New York; Niles-Bement-Pond Co., of New York; General Electric Co., Schenectady, N. Y.; Crocker-Wheeler Company, Ampere, N. J.; Sprague Electric Company, New York; De La Vergne Mechine Co., New York; John A. Roebling's Sons Co., Trenton, N. J.; M. H. Treadwell Co., New York; the Westinghouse Companies, Pittsburg, Pa.; New York Edison Co.; Yale & Towne Manufacturing Co., New York; American Wood Working Machinery Co., New York; B. F. Sturtevant Co., Boston, Mass.; H. W. Johns-Manville Co., New York; Holophane Glass Co.; Sawyer-Man Electric Co., New York.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is doing a large business in equipping mines with electric locomotives. A recent contract closed by the Westinghouse Company is one with the Newport Mining Company, which has decided to equip its mines at Ironton, Mich., with both surface and underground electric haulage. It will use electric locomotives the year around in the various levels underground for bringing the ore to the bottom of the shaft, and after the transportation season has closed will use electric locomotives on the surface for hauling ore from the top of the shaft to the various stock piles for storage. For these purposes it has ordered 6 four-ton Westinghouse mine locomotives. Electrical apparatus for the equipment of the necessary power station will also be provided by the Westinghouse Company, consisting of a 150-kw, 250-volt generator, direct-connected to a Corliss engine of 130 r.p.m., and a three-panel switchboard, besides other auxiliary apparatus.

CONSOLIDATED POWER PLANTS.—The Consolidated Railway Company, the holding corporation for the street railways and interurban electric lines controlled by the New York, New Haven & Hartford Railroad Company, is considering a plan to centralize the electrical generating plants for the four divisions in southeastern Connecticut, comprising the Norwich & Willimantic, the Norwich Street Railway, the Montville Street Railway and the New London Street Railway systems, by doing away with the four separate power stations and substituting for them one big central generating station at Thamesville. The proposition will not do away entirely with the local power stations, but will convert them into sub-stations. Electrical Engineer Gaillard has been investigating the several plants of the four systems for the purpose of figuring on the cost of the central power station.

THE NORTHERN ENGINEERING WORKS, crane builders, of Detroit, Mich., have been awarded the contract for the electric cranes required in the new steel casting foundry of the Monarch Coupler Company, Limited, of Detroit, Mich. There will be one 25-ton, 4-motor electric ladle crane, 50-ft. span, one 10-ton, 4-motor standard crane, 50-ft. span. The Northern Engineering Works have also recently completed installing three electric traveling cranes in the plant of the Detroit Steel Casting Company, consisting of one 30-ton, 4-motor ladle crane and two 10-ton, 3-motor electric cranes, 70-ft. span, and are now constructing for the same firm a 10-ton, 80-ft. electric gantry for yard service.

TAYLOR'S FALLS POWER.—The plan for transmitting 50,000-volt current from the power house at Taylor's Falls to the city of Minneapolis, Minn., embraces a distance of 41 miles, for which a 60-ft. right of way has been purchased. Oregon cedar poles will be used, but in some sections, on unusually heavy strain, steel towers will be substituted. The porcelain insulators each weigh 22 pounds. Power will be generated as three-phase currents at a pressure of 2,300 volts. The line at present under construction will have a capacity of 25,000 hp, which will be used in Minneapolis.

STURTEVANT ORDERS.—Among recent contracts for heating and ventilating equipment placed with the B. F. Sturtevant Co., Boston, Mass., are included those for the National Tube Co., McKeesport, Pa., for rolling mills and machine shop, containing over 1,000,000 cu. ft. of space; for the Fairbanks-Morse-Canadian Mfg. Co., Toronto, Ont., including separate apparatus for machine shop, blacksmith shop and foundry; for Brown & Sharpe Mfg. Co., Providence, R. I., for Pressed Steel Car Co., McKees Rocks, Pa., for car paint shop containing nearly 4,000,000 cu. ft. of space; and for a similar shop containing over 2,500,000 cu. ft. at the Allegheny, Pa., plant of the same company. The new office building for the Studebaker Bros. Mfg. Co., South Bend, Ind., is to be heated and ventilated by a fan system. Orders for generating sets have recently been placed with B. F. Sturtevant Co., Boston, Mass., by W. D. Byron & Sons, Monroesburg, Pa.; Chas. E. King, Brooklyn, N. Y., and Old Colony Street Railroad Company, Quincy Point, Mass. Mechanical draft apparatus is to be installed by Appleton Woolen Mills, Reedsburg, Wis.; Lancaster Cotton Mills, Lancaster, S. C.; Lukens Iron & Steel Company, Coatesville, Pa., and Arnold Print Works, North Adams, Mass. The well-known soap manufacturers, James T. & W. S. Pyle, Edgewater, Bergen County, N. J., are installing in their boiler plant complete induced draft equipment furnished by the B. F. Sturtevant Co.

WESTINGHOUSE ORDERS.—The Westinghouse Electric & Manufacturing Company has recently shipped a 1,200-kw generator to the Hawaiian Electric Company, of Honolulu, making the second order of this kind placed by the same company. Another order recently received was from the Los Angeles Light & Power Company for a 7,500-kw machine. A duplicate of this order was also received from the Rapid Transit Development Company, of Brooklyn, which acts as the purchasing agent for the Brooklyn Rapid Transit Company. The Westinghouse Company has received orders for turbines running between 10.000 and 12.000 hp from the Brooklyn Rapid Transit, the Interborough Company, the Philadelphia Transit Company, the New York Edison Company and the Los Angeles Light & Power Company. The Missouri River Power Transmission Company, whose plant is located near Helena, Mont., has begun the erection of a steam turbine power plant to operate as a reserve to its water power plant. A large part of the output of the Missouri River Company is transmitted to the city of Butte and to the Anaconda district mining properties, and the erection of this reserve plant is to guard against serious fluctuations in the available water power. Two Parsons turbines of 2.000 kw capacity each will be installed. During October the Westinghouse Electric plant at East Pittsburg shipped various kinds of electrical apparatus with a total weight of 17,000,000 pounds, consisting of 5,000 individual consignments.

THE R. M. PATRICK COMPANY has been incorporated in Chicago with a capital stock of $35,000, to carry on several departments of work. One department is to be devoted to contracting, electrical and hydraulic engineering. Mr. R. M. Patrick, the head of the company, has been prominently connected with several Canadian hydro-electric developments. The company is also prepared to act as consulting engineers, making reports, surveys and estimates on all kinds of engineering work. It will have a corps of experienced engineers in all lines. Another department of the company is prepared to finance new properties or buy and sell and improve properties already in existence. The three departments will be conducted independently. The company announces that it is prepared to undertake contracts of any magnitude, having ample financial resources to carry out any contract that may be offered. A suite of offices is now being fitted up in the First National Bank Building, Chicago.

AUTOMOBILE SHOW.—When the sixth annual show of the Automobile Club of America is opened on Saturday night, January 13, the public will have its first view of the fine new armory of the Sixty-ninth Regiment, the most convenient entrance of which will be on Twenty-sixth Street near Fourth Avenue, with other entrances on Lexington Avenue and Twenty-fifth Street. The cost of this big structure is placed at $1.500,000, and the spacious exhibition hall possesses what is probably the largest brick arch in the world. With everything new and thoroughly up to date, this huge building will supply a spacious home for the most comprehensive exposition of the automobile industry ever held in this country. Gasoline, steam and electric vehicles, both for pleasure and business purposes, will be attractively distributed, with space left for all sorts of accessories and sundries; in fact, everything connected with the industry will be given a place in the extensive show.

C. W. LEE COMPANY, Scheuer Building, Newark, N. J., has been formed to handle and prepare advertising and publicity matter for the various electric light and power companies throughout the country. The new concern has secured the advertising contract of the Public Service Corporation of New Jersey, covering all the departments of electricity, gas and street car lines. Mr. Lee has already made quite a reputation by his work on behalf of this great company and thus has a splendid basis for a similar campaign elsewhere. Mr. Lee is vice-president and manager of the concern and the secretary is Mr. Frank B. Rae, Jr., the publisher of *More Juice* and *Electric Service*. The business of Ried & Rae Co., Inc., of Detroit, has been purchased and the new combination has at once become an important factor in the electric and gas commercial fields.

THE PENNSYLVANIA RAILROAD COMPANY has given this week to the General Electric Company a contract for the electrification of one of its lines from Philadelphia to Atlantic City, involving an expenditure of from $2,000,000 to $3,000,000. As a railroad project it is in more ways than one unique, and is the first contract of its kind, so far as is known. It means the scrapping of the entire equipment of the line involved, or at least the transferring of the succeeded steam equipment to other divisions. About 60 miles of line in all are to be converted to electricity. Included in the contract is the power station with Curtis turbines. Cars are to be equipped with the Sprague-General Electric multiple-unit control, and are to be run on a 15-minute service just as are the trains in the subway and on the elevated. Work on the enterprise will begin immediately.

THE LIVE STOCK PAVILION erected recently at the Union Stock Yards, Chicago, has a seating capacity for 7,000 people. The main arches are 200 ft. from center to center of bases approximately and 1,000 tons of steel were required in its construction. The structural work was furnished by the Modern Steel Structural Company, of Waukesha, Wis. The same company has just completed the erection of a steel coal-handling bridge for the Robins Conveying Belt Company, of New York, built for the Semet-Solvay Company at its Milwaukee coke plant The bridge, which is one of the largest structures of its kind in the world, is supported by a pivotal tower, and swings around on a stiff leg in a half circle The distance between tower and leg is 300 ft. The length of the bridge, including cantilevers, is 500 ft.

THE COPPER POSITION.—Copper went to 18 cents the past week and is in a strong position. The movement for the first few days of December indicates that the exports this month will probably considerably exceed those of November. For the first week of this month the exports have amounted to over 4,500 tons, compared with a total of about 12,400 tons for the entire month of November. The record of copper exports for the past few years shows in general a steady increase. It was in January, 1904, that the maximum was reached, but many of the months this year have exceeded the figures for the corresponding months last year. From present indications the total exports of copper this year will almost equal those for the previous twelve months, during which 247,421 tons were exported.

TALLAPOOSA ELECTRIC PLANT.—Bids will be received until Jan. 2 by Mayor G. W. Shepperd and Council, Tallapoosa, Ga., for machinery and material and installing complete an electric light plant. The proposed plant embraces one 66-in. x 18-ft. high pressure boiler and stack, one 100-kw alternating current unit. Bids will be received on generator belted to Corliss engine, and also on generator direct-connected to automatic engine, 6 arcs and 74 50-cp series incandescents, 1,000-light transformer and meter capacity, and poles line. Address J. B. McCray, engineer, Senoia, Ga.

POWER DEVELOPMENT IN OREGON.—The Cascade Power Company, Portland, Ore., announces its intention of utilizing the headwaters of the Sandy River at a point 14 miles above the Bull Run pipe-line bridge, and establishing there a plant of sufficient power to generate 25,000 horse-power. It is expected that work will begin at once and power be delivered to the city by August, 1906. E. R. Richardson and A. C. Churchill & Co. are interested in the enterprise. B. Chase and H. I. Neville are engineers

CONSTRUCTION CONTRACT.—The Wernersville Electric Light, Heat & Power Company has awarded the contract for the apparatus for its power station at Wernersville to the Brown Engineering Company, of Reading, Pa. The General Electric apparatus will be used, and a three-phase system for power and light will be installed. George W. Wertz, president of the company, advises that the plant will be pushed to completion at an early date and will be in a position to supply current in a short time.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Fulton, Kan.; Jamestown, N. Y.; Spanish Fork, Utah, Tonopah, Nev.; Leechburg, Pa.; Whiting, Ind.; Tingley, Iowa; Herrick, Ill.; La Grange, Ky.; Streator, Ill.; Seattle, Wash., and Germantown, Neb.

MILWAUKEE BONDS.—Spencer Trask & Co. and N. W. Harris & Co. announce their joint purchase of $2,000,000 refunding and extension mortgage 4½ per cent gold bonds of the Milwaukee Electric Railway & Light Company.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock speculation was active and strong in tone under manipulation, despite the highest money rates of the year, industrial stocks being particularly prominent. Railroad stocks, while relatively quiet, were firm. The disposition of the market was to disregard unfavorable factors and to discount the beneficial effects of the present situation upon railroad and industrial properties. More or less weight is attached to the position taken by the President in his message of opposition to tariff changes, which was used as an argument in favor of bullishness regarding the securities of steel and iron corporations. There also seemed to be a disposition to consider that Congress is unlikely to take action in relation to the so-called trust problem, which would adversely influence the industrial stocks, and the latter, accordingly, were more prominent than were the railroad securities. Amalgamated Copper advanced to 98, on the copper trade situation. The United States Steel stocks, however, remained quiet, despite further intimations that earnings for the current quarter are highly satisfactory. There was considerable activity in Allis-Chalmers common, 86,500 shares having been sold at prices ranging between 19½, the lowest, and 24¼, the highest. The closing quotation was 23¼, which is a net gain of 3¾ points. Preferred reached 66¼ and closed at 65¼, this being an advance of 3¼ points. General Electric was quiet and closed at 184½, a net gain of ½ point. Westinghouse was weak and comparatively neglected, closing at 173, which is a net loss of 1⅛ points. American Locomotive had a downward tendency. Common ranged between 69 and 73, and closed at 69¾, this being a decline of 1¼. Preferred closed at 117. Tractions were weak and on the decline. Brooklyn Rapid Transit closed at 85 and Metropolitan Street Railway at 118½, the latter being a net loss of ¼ point. Interborough Rapid Transit advanced 1 point, closing at 211. The telegraph list was featureless. American Telephone & Telegraph closed at 133¾, a net decline of 4¾, and Western Union at 92¼, which represents a gain of ⅜ point. Mackay Companies declined 1⅛ points, closing at 50¾. The curb market was agitated by the pools, with much manipulation of the low-priced copper shares. Changes in other stocks were mixed. Following are the closing quotations of December 12:

NEW YORK

	Dec. 5	Dec. 12		Dec. 5	Dec. 12
Allis-Chalmers Co	22¼	22	General Electric.... .. .	185½	183
Allis-Chalmers Co. pfd .	64	62	Hudson River Tel... .	.	..
American Dist. Tel	37	37	Interborough Rap. Tran ..	211	208
American Locomotive	72⅛	70	Mackay Cos.......	50½	50¾
American Locomotive pfd .	118	116½	Mackay Cos. pfd	71	72
American Tel. & Cable . .	90	84	Marconi Tel	.	..
American Tel. & Tel. ...	132	133	Metropolitan St. Ry	117¾	118⅜
Brooklyn Rapid Transit	85	86	N. Y. & N. J. Tel.. . .	.	.
Electric Boat	32	25	Western Union Tel .. .	92½	93
Electric Boat pfd.......	70	65	Westinghouse com. .	170	171
Electric Vehicle.	14	12	Westinghouse pfd		..
Electric Vehicle pfd........	20	17			

BOSTON

	Dec. 5	Dec. 12		Dec. 5	Dec. 1
American Tel. & Tel ..	132⅞	135	Mass. Elec. Ry. pfd . ..	59½	60
Cumberland Telephone			Mexican Telephone.	1½	1½
Edison Elec. Illum.		239	New England Telephone.		132
General Electric			Western Tel. & Tel...	12	
Mass. Elec. Ry....			Western Tel. & Tel. pfd .		

PHILADELPHIA

	Dec. 5	Dec. 12		Dec. 5	Dec. 12
American Railways. .	52	52¼	Phila. Electric	8⅜	8⅝
Elec. Co. of America. .	11¼	11⅛	Phila. Rapid Trans.... .	31¾	32⅞
Elec. Storage Battery	80½	82	Phila. Traction.		100¾
Elec. Storage Battery pfd.					

CHICAGO

	Dec. 5	Dec. 12		Dec. 5	Dec. 12
Chicago City Ry .	200	200	National Carbon	76½	75
Chicago Edison.............	161	...	National Carbon pfd.......	*120	117
Chicago Subway .	53		Union Traction. . .		..
Chicago Tel. Co . ..	137		Union Traction pfd .		..
Metropolitan Elev. com	27	25½			

* Asked.

DIVIDENDS.—Interborough Rapid Transit Company's directors have declared the regular 2 per cent quarterly dividend, payable January 2, to the holders of the voting trust certificates of record December 11. The directors of the Mackay Companies have declared the regular dividends on the common and preferred stock. The common is 1 per cent semi-annually and the preferred is 1 per cent quarterly. The United Railways Investment Company, of San Francisco, has declared its full semi-annual dividend of 2½ per cent. For the first half of this year the dividend was 2 per cent. The back dividend on the preferred stock amounts to $900,000. Arrangements are now under way to have these arrears paid by some sort of funding operation. The United Railroads of San Francisco have declared the regular half yearly dividend of 2 per cent on the preferred stock. J. G. White Co., Inc., has declared its eleventh regular quarterly dividend of 1½ per cent on the preferred stock, payable January 1, 1906. A regular semi-annual dividend of $5 has been declared on West Philadelphia Passenger Railway Company, payable January 2. A regular semi-annual dividend of $4.75 has been declared on Union Passenger Railway Company, payable January 2. The directors of the Twin City Rapid Transit have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable January 2. Directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock. The executive committee of Western Union has recommended the declaration of the regular quarterly dividend of 1¼ per cent. The Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent, payable December 30. The Strowger Automatic Telephone Company has declared a semi-annual dividend of 50 cents, payable January 2.

LEHIGH VALLEY TRACTION COMPANY.—The reorganization committee of the Lehigh Valley Traction Company has notified the preferred and common stockholders that the assessment of $1 per share is payable Jan. 15. It is expected that the securities of the Lehigh Vailey Transit Company will be ready for delivery early in the new year. The various properties of the system were turned over to the Lehigh Valley Transit Company on Dec. 1. The reorganization committee has decided to pay, as permitted by the plan, the three defaulted coupons—December, 1904, and June and Dec., 1905—on the $2,770,000 first mortgage 4's of the Lehigh Valley Traction Company; also to pay off the loan secured by deposit of the remaining $230,000 of the authorized issue of $3,000,000 of these bonds.

NEW YORK BUILDING.—The valuation of building permits filed in Greater New York from January 1 to November 30, 1905, aggregated $217,953,000, as compared with $129,792,600 in the corresponding period of last year. In no previous year has such a large total been reached. The building permits in thirty-two of the principal cities of the country in the month of November aggregated $41,366,000, as compared with $33,517,000 in the corresponding month of last year. Omaha leads the list, showing an increase of 443 per cent. Denver is second with 223 per cent.

PHILADELPHIA BELL.—Advices from Philadelphia state that the Bell Telephone Company, of Philadelphia earnings for the first half of the year are more than sustained in the second half, and 1905 gross should exceed $4,000,000 and net $1,250,000. The indicated net is equal to nearly 8 per cent on the stock, of which $16,000,000 has now been issued. The 1904 gross was $3,756,059 and the net $945,256. The company has now installed in Philadelphia and on its Delaware & Atlantic lines over 120,000 telephones, an increase of over 37,000 since January 1, 1905.

NORTHERN TEXAS ELECTRIC.—Stone & Webster, of Boston, have organized the Northern Texas Electric Company, which owns practically all the stock of the Northern Texas Traction Company. This company operates an electric street railway system in Fort Worth, Texas, and an interurban line from that city to Dallas, a distance of about 30 miles. The earnings of this system are satisfactory and are increasing rapidly. The Northern Texas Electric Company is issuing no bonds, the capitalization consisting of preferred and common stock.

COOPER HEWITT LAMPS FOR GOVERNMENT BUREAU. The Cooper Hewitt Electric Company has just closed a contract with the Bureau of Engraving and Printing at Washington, for a large number of Cooper Hewitt lamps. After thorough test, the Bureau has found that these lamps are excellently adapted to the work of printing, and it is understood that our currency, as well as internal revenue tobacco stamps, will hereafter be printed under the Cooper Hewitt light.

NEW YORK TROLLEYS.—The Bronx, Yonkers & White Plains Railway Company has been incorporated with the secretary of State of New York to build and operate an electric surface road, eleven miles in length. The capital stock is $110,000, consisting of shares of $100 each. The directors are John H. Matthews, George Matthews, M. H. Wood, C. H. West and others, of New York City.

CONNECTICUT.—The Consolidated Railway of Connecticut, controlled by the New York, New Haven and Hartford, has completed arrangements to take over the Western Massachusetts Street Railway and the Woronoco Street Railway. Holders of the last-named stock may take in exchange Consolidated Company's 4 per cent. bonds at $180. The Woronoco stock goes in at $175.

BOSTON & WORCESTER.—At the annual meeting of the Boston & Worcester Electric Companies, President Shaw reported that for the year ended September 20 the earnings show an increase of $53,882, or over 13 per cent. The property has earned 4 per cent on the preferred shares outstanding, after allowing liberal charges for the taking care of its track, roadway and equipment.

GENERAL ELECTRIC STOCK.—The terms under which the General Electric Company offers its new stock issue of $6,000,000 are one share at $100 for each eight shares standing in the name of the stockholder on the company's books on December 16.

MICHIGAN STATE TELEPHONE.—The Michigan State Telephone Company will spend $2,000,000 in extensions in 1906. Five thousand miles of copper wire will be required. The system has 92,000 telephones, an increase of 30,000 this year.

General News of the Week

The Telephone.

HUNTSVILLE, ALA.—The Inter-County Telephone Company has almost finished its new system of telephones, covering the southeastern portion of Morgan county and connecting the system with Huntsville. The new system, which will probably be ready for operation in two weeks, included ten toll stations and a large number of private houses in Morgan county across the Tennessee river. The Inter-County company was incorporated with a capital stock of $20,000, and its officers are C. L. Hogeboom, president, Gus May, vice-president, C. D. Hogeboom, secretary. The purpose of the company is to establish a system of telephones covering 60 miles of territory.

CORONA, CAL.—The board of trustees of this place has granted a telephone franchise to A. C. Wood.

BOISE, IDAHO.—The Rocky Mountain Bell Telephone Company has awarded a contact for extensive improvements to its exchange here. A new $30,000 switchboard will be installed.

MOSCOW, IDAHO.—The Interstate Co-operative Telephone Company will soon commence the work of extending its line from this city to Lewiston. The Company is rapidly extending its system both in this state and in Washington.

QUINCY, ILL.—The work of laying the conduits and putting the wires in position for the new Home Telephone Company is being pushed very rapidly.

NEW MILFORD, ILL.—The New Milford Telephone Company has been formed. Capital, $5,000; incorporators: T. W. Evans, F. C. Bell and A. T. Chase.

GALVA, ILL.—A number of Galva citizens have held a meeting for the purpose of organizing a mutual telephone company. A committee was appointed to formulate a plan of organization and report later.

CONNELTON, IND.—The Connelton, Branchville & Eckerly Telephone Company, which obtained a municipal franchise in this city last July has begun the erection of a telephone plant in this place for local and county service.

INDIANAPOLIS, IND.—The interests in control of the Indianapolis Telephone Company on Dec. 1 elected the following as voting trustees for the property: James J. Robinson, James S. Brailey, Jr., Breckenridge Jones, W. F. Nolker, E. C. Stifel, N. H. Bauer and Henry Koehler.

FORT WAYNE, IND.—A telephone merger of great importance is under consideration by the Home Telephone Company and the National Telephone Company, whereby the former proposes to take over the latter at a price not made known. The capital stock of each company is $250,000, and the former has the same amount of bonds as the latter.

INDIANAPOLIS, IND.—Mr. C. E. Stinson, formerly manager of the Toledo Home Telephone property, but now general manager of the Indianapolis Telephone Company and the New Long-Distance Telephone Company, has adopted a plan of retrenchment and has already reduced the running expenses $20,000 a year. Several employes have resigned, including H. C. Goldrich, chief electrician.

CAMBRIDGE CITY, IND.—The Citizens' Telephone Company, of this city, has bought the Hagerstown telephone plant and the two exchanges will be consolidated at once, and when united free service will be extended to 1,600 patrons. The lines cover a strip of territory from Losantville on the north to within a short distance of Connersville on the south, and has direct connection with the entire independent telephone system of the State.

MARION, IND.—The Board of Public Works has granted a franchise to Indianapolis, Muncie, Chicago and Marion capitalists, represented by O. L. Barger, to establish an automatic telephone system in this city. No charge is to be made for the use of any telephone until 1,000 have been placed. The rates are to be $[illegible] and $2.50 for residence and business telephones respectively. A tax of 66⅔ cents for each telephone will be paid annually into the city treasury.

NEW CASTLE, IND.—With a view of securing closer relations between independent companies and to arrange for a better interchange of business representatives of telephone companies operating in Richmond, Cambridge City, Sulphur Springs, Springport, Spreeland, Liberty, New Lisbon, Mt. Summit, Hagerstown and New Castle held a meeting in this city on Nov. 25. A. C. Lindermuth, of Richmond, was elected president, and C. A. Phelps, of New Castle, secretary.

WABASH, IND.—The Rochester Telephone Company has just won a curious suit, defining, as the decision does, the limitation of the liability of telephone companies for injuries sustained by freaks of lightning. Mrs. John Flinn sued the company for $10,000, alleging that her husband was killed by a flash of lightning which struck the telephone wire, burned off the wire and allowed the ends to fall across a barbed wire fence, the current following the barbed wire for seventy yards and killed her husband who was leaning against the fence. The court held that the liability of the company was too far fetched and dismissed the suit.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company recently acquired by St. Louis and Toledo people is preparing to ask the new board of public works of this city and the new city administration for modifications and alterations in the franchise contract now existing with a purpose to raise the rates from $24 to $32 a year for residence telephones and from $40 to $54 for business houses. The company bases its request upon the greatly increased proportions reached by the company's business and that in order to float a bond issue of $500,000 to meet expenses of extensive improvements now contemplated the company will ask to have the franchise extended for forty years. The company also asks for relief in part of its tax. The present franchise requires the company to pay the city $[illegible] annually and $2 a year for every telephone over 6,000. The latter tax is not required of the Central Union Company, and it is claimed that there is a discrimination. It is already manifest that the people will oppose any change in the present contract relating to the rates.

FULTON, IA.—The telephone line between Fulton and Andrew has been rebuilt.

LAKE MILLS, IA.—The new telephone line to Northwood is expected to be completed and in working order soon.

NEW ORLEANS, LA.—The Home Telephone Company has arranged to begin the work of reconstructing the system of the Eastern Shore Telephone Company, which was absorbed by the Home Company some weeks ago. Cable lines are to be run through the country and exchanges opened at Bay Minette and Fairhope.

JACKSON, MICH.—Announcement is made that the Citizens' Telephone Company has planned to extend its rural lines next summer, and nearly double if possible the number of county telephones now in service.

PONTIAC, MICH.—A contract has been entered into between the Oakland Telephone Company of this city and the Peninsular Telephone Company of Detroit. The latter company expects to control the independent toll line service.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company starts the month of December with 7,[illegible] telephones in the local exchange and with over [illegible] orders to fill. During the month of November 136 orders for new telephones were taken by the company.

SAVAGE, MINN.—The Star Telephone Company, of Lakeville, is contemplating establishing an exchange in this city.

REDWOOD FALLS, MINN.—The Minnesota Central Telephone Company will at once commence the construction of an additional copper line from Minneapolis to Granite Falls.

MERIDIAN, MISS.—New common battery boards are being installed by the Cumberland Telephone & Telegraph Company in Meridian, Miss., and Paducah, Ky.

ANACONDA, MONT.—The Anaconda & Big Hole Telephone Company has been incorporated with a capital stock of $5,000.

KANSAS CITY, MO.—The American Telephone & Telegraph Company has 150 workmen engaged in stringing new lines between this city and Chicago direct. Heretofore the only way to reach Chicago was by way of St. Louis or Omaha.

CARTHAGE, MO.—Purchase by the Missouri & Kansas Telephone Company of the lines of the Southwest Telephone Company is reported. The Southwest lines cover all of Lawrence and Berry counties, and parts of Newton, McDonald and Greene counties. Exchanges are located at Pierce City, Mount Vernon, Monett and almost all other towns between Carthage and Springfield.

YERINGTON, NEV.—C. W. Fancher and Thos. Harris, both of San Jose, Cal., are interested in the construction of a power plant to be located in the canyon between the Matthews and Boerlin ranches.

CARSON CITY, NEV.—Articles of incorporation of the Silver Bow Telephone & Telegraph Company, capitalized at $50,000, have been filed with the secretary of state. The principal place of business of the company will be at Tonopah. The incorporators are W. L. McGonigill, W. J. Wheaton and Raymond D. Frisbie.

HORNELLSVILLE, N. Y.—The New York & Pennsylvania Telephone Company will erect a new building and install a new exchange in this city.

RIVERHEAD, L. I., N. Y.—The directors of the Baiting Hollow & Roanoke Telephone Company have voted to ask the stockholders to authorize an increase of capital stock from $20,000 to $50,000 for the purpose of extending the company's service.

ROCHESTER, N. Y.—The stockholders of the Rochester Telephone Company have received circulars from the United States Independent Telephone Company, of which Thomas W. Finucane is president, withdrawing in effect a former offer to take over the stock of the Rochester Company for cash. The circular releases the Rochester Company stockholders from existing option agreements, but allows them to exchange Rochester telephone stock for United States Independent stock if they so desire, thus putting all compensation in stock instead of in cash.

ASHEVILLE, N. C.—The Southern Bell Telephone & Telegraph Company has approved plans for a new exchange building in Asheville.

WINSTON, N. C.—A private telephone line 123 miles long has just been completed for Winston to the Washington cotton mills at Fries, Va., the line having connection with the Bell long-distance lines to New York.

CHESTER, PA.—Ground has been broken by the contractors for a new telephone exchange building of the Delaware & Atlantic Telephone Company.

DALLAS, PA.—The National Telephone Company has just completed the construction of some new lines in the neighborhood of Majorsville and Dallas, where it is preparing to establish a number of farmer lines. It will establish an exchange at Dallas. The company has commenced stringing ten copper wires from Pleasant Valley to West Alexander, where connections will be made with the exchange of the Claysville Telephone Company in that place.

MILLBANK, S. D.—The Grant County Telephone Company will build 135 miles of new line.

ABERDEEN, S. D.—The Dakota Central Telephone Company contemplates stringing a direct circuit between this city and [illegible], and another between this city, Watertown and [illegible].

NASHVILLE, TENN.—The Springfield Home Telephone Company, of Robertson County, has been incorporated with a capital stock of $5,000. The incorporators are: Tom McMurray, A. L. Dorsey, B. C. Moore, G. S. Moore, [illegible] Pitt, H. J. Stratton, Jr., and H. C. Fine.

DALLAS, TEX.—The Texas Long Distance Consolidated Telephone Company has amended its charter, increasing its capital stock from $120,000 to [illegible].

WALLA WALLA, WASH.—A franchise has been granted to the Automatic Telephone Company.

WALLA WALLA, WASH.—There is a strong sentiment here against the granting of a franchise for a second telephone system. The Commercial Club has entered a protest and it is proposed to call a meeting of business men for the purpose of petitioning the mayor to withhold his signature from the ordinance granting a franchise to the Home Telephone Company.

BALDWIN, WIS.—A franchise has been granted to the Rush River and Eau Galle Telephone Company.

MILWAUKEE, WIS.—Preparations are being made by the Wisconsin Telephone Company to install 10,000 more telephones next year. The Washington Street exchange, Milwaukee, will be enlarged and a new exchange opened at St. Martins.

LAS VEGAS, NEW MEX.—The Colorado Telephone Company will erect a new exchange in this place.

AMHERST, N. B.—The Cumberland Telephone Company was sold under the hammer recently and was bought by Dr. C. W. Hewson, who paid $14,000 for the property. It is stated that a company has been formed to carry on the business.

VANCOUVER, B. C.—The Home Telegraph & Telephone Company has applied to the City Council for a franchise, and offers the city 1 per cent. of the total receipts and 35 free telephones. The wires will be laid underground if the franchise is granted. The charges will be $4 per month for business houses and $2 per month for residences. The British Columbia Telephone Company will build a new exchange in this city.

Electric Light and Power.

JASPER, ALA.—The Jasper Light & Power Company proposes to install a new engine and a 75-kw. generator.

MONTGOMERY, ALA.—The Citizens Light, Heat & Power Company contemplates installing a 500-kw, 2,200-volt alternator with Corliss engine or turbine to drive the same. P. P. Whiting is manager.

EUREKA, CAL.—The North Mountain Power Company proposes constructing a 5,000-hp hydraulic plant.

LOYALTON, CAL.—The Loyalton Electric Light Company has in contemplation extensive improvements, requiring a plant of 5,500 to 10,000-hp water power.

LOS ANGELES, CAL.—The Inner Harbor Gas & Electric Company has been incorporated with a capital stock of $200,000. The directors are: C. J. Walker, H. S. Farnsworth, W. B. Redbyrrn, H. T. Cooley and others.

RIO VISTA, CAL.—Application has been made to the board of town trustees for an electric light franchise for a term of 20 years from Jan. 1, 1906. Bids for said franchise will be received until Dec. 28 by F. J. Kalber, Town Clerk.

SAN FRANCISCO, CAL.—N. W. Halsey, of the New York banking firm of N. W. Halsey & Company, now here, authorizes the statement that there is no doubt that all of the conditions will be fulfilled to make effective the proposed deal consolidating the San Francisco Gas & Electric Company and the California Gas & Electric Corporation under the name of the Pacific Gas & Electric Company.

SAN FRANCISCO, CAL.—The Westinghouse Electric & Manufacturing Company has closed contracts to supply a number of special direct-current, 150-volt motors, which are to be direct connected to gas engines made by the Union Gas Engine Company, of San Francisco, these generating sets to be used by the Navy Department in the numerous wireless telegraph stations to be established along the coast from Bremerton, Wash., to San Diego, Cal. There will be one 15-hp motor, two tens, three fives and two threes.

VISALIA, CAL.—The Mount Whitney Power Company has closed a contract, through Hunt, Mirk & Co., of San Francisco, for a 1,000-kw., 3-phase Westinghouse-Parsons turbo-generator and all other equipment necessary for a complete steam reserve plant, to be installed at Visalia. Boilers, condensers and transformers are included, the contract price being about $100,000. This plant will be operated five months of the year, during the dry season, as an auxiliary to the company's two water-power electric plants. A transmission line about 35 miles long will be constructed connecting with the existing lines.

SAN FRANCISCO, CAL.—The Northern California Power Company, which has been constructing a new pole line from De Lar Mar, Cal., to Kennett, has sent a force of men to Tehama to commence work on a transmission line from that point to the Volta power station near Shingletown, Shasta County. The construction of this 50-mile line will require considerable time. The fact that this water power concern was one of a very few which passed through the late prolonged dry season without serious water shortage, has had a beneficial influence, and it is rumored that a deal is on hand with the California Gas & Electric Corporation [illegible] this company.

SAN FRANCISCO, CAL.—The California Gas & Electric Corporation has closed contracts for a quantity of power station equipment, needed for its extensions during the coming year. Three direct-connected 5,500-kw., 220-volt, 3-phase, [illegible] generating units are included, with direct-connected water wheels. The additional unit to be installed at the Centerville power station will consist of a 5,500-kw., 400 r.p.m. generator and an Allis-Chalmers Francis wheel, operating head 550 ft. Seven miles of ditch will be enlarged to conduct additional water from the De Sabla power house for use at the Centerville plant. The new unit for the Colgate power station will be a Westinghouse [illegible],500-kw., 300-r.p.m. generator and a Doble impulse wheel, operating head 600 ft. This will replace a 133-cycle unit. The third 5,500-kw. unit will be installed in a new power plant to be installed on Deer Creek, near Nevada City. It will consist of a Westinghouse generator of 300 r.p.m. and a Pelton wheel, operating head 785 ft. Water will be taken from the South Yuba Water Company's ditch system, and the plant is to be in operation by Aug. 1, next. Ten miles of transmission line will be constructed to enable the new power station to tie in with the lines from Colgate and Centerville. Stanley transformers of sufficient capacity for the new generators will be used to step up to the line voltage. Those to be installed at Deer Creek and Centerville will be built in 2,000-kilowatt units. These accessions, with the gas-engine reserve plant near San Francisco and the steam plant acquired with the San Francisco Gas & Electric Company, will place the transmission lines in position to give a much better service next summer.

DENVER, COL.—The Continental Mine, Power & Reduction Company proposes to construct in the spring a power plant to cost from $50,000 to $75,000, and a tunnel at a probable cost of $200,000. Capt. Henry I. Seemann, of Denver, is interested.

NEW HAVEN, CONN.—Regarding the new contract with the United Illuminating Company for lighting, the only changes announced are in the number of lights and the price. Under the contract which is about to expire 574 lights have been supplied at a price of $82.12½ per light per year, making a total of $47,057.62 for the lighting for each year. The new contract proposes that the city have 600 lights in operation by July 1 next. The company will agree to furnish the power for these lights at $78.47½ per year per light, a reduction on an individual light of $3.65. This will make the total cost under the new contract $47,084.00 per year, or an increase of $27.37 only for 26 new lights supplied.

NEW HAVEN, CONN.—The Board of Aldermen has considered a plan for purchase of the United Illuminating Company's plant in this city and then tabled the resolution. The matter came up on a favorable report for the execution of the new contract with the United Illuminating Company for the city's electric lighting and then Alderman Healey put in a resolution in favor of purchasing the plant. Alderman Curtiss explained that a new plant would cost between $240,000 and $300,000, or from $400 to $500 per light. It was estimated that with its own plant the city could furnish lights for $38,000 or $40,000, but he thought the present contract was very favorable and the best for the city. The money in the lighting business was made from the incandescent lights and not from the arcs. He said he did not believe the plant was for sale. The entire report was then tabled for printing.

TALLAPOOSA, GA.—Bonds to the amount of $10,000 have been voted for an electric light plant for this town.

ALBANY, GA.—Electrical pumps and motors are being installed in the city water and light plant here, to supplant steam apparatus. With the changes in progress the city will duplicate the steam and electrically-driven plants.

AUGUSTA, GA.—The City Council on Dec. 4 passed a resolution to investigate the advisability of the city constructing its own electric light plant, to be completed the time the present contract expires. Address, Nisbet Wingfield, City Engineer.

SAVANNAH, GA.—The Savannah Electric Company has given an order for an 800-kw. generating unit, and plans have been made for the building of an extension to the Indian Street station of the company, where power for the operation of the street railway system will be generated. At the present time railway power comes from the Bolton Street station, but it is the purpose of the company to combine the two plants, when the Bolton Street station will be shut down. The new apparatus in the extension will represent an investment of over $100,000.

MOSCOW, IDAHO.—The Moscow Electric Light & Power Company is contemplating the extension of its power line from the main line at the Lewiston Water Power Company's plant to and through neighboring towns.

JACKSONVILLE, ILL.—This city contemplates enlarging its municipal electric lighting plant, including the installation of generators and engines.

ANDREWS, IND.—Nichola & Thornton have secured a franchise for an electric light plant and water works.

JASPER, IND.—It is proposed to install at the municipal electric light plant a new 50-kw alternating dynamo. Jos. P. Kunkel is the purchasing agent.

MICHIGAN CITY, IND.—The Michigan City Light & Power Company has filed articles of incorporation with a capital stock of $150,000. Robert Garrettson, J. M. Garrettson and J. A. Garrettson are the incorporators.

TERRE HAUTE, IND.—At a meeting of the City Council Dec. 6, to consider a remonstrance against the construction of a municipal lighting plant at this time, the council voted to go ahead with the proposition and bids will be solicited at once.

OSAWATOMIE, KAN.—The Osawatomie Light & Power Company proposes to construct an electric light plant at a cost of about $10,000. It will add an ice plant later on.

PLAQUEMINE, LA.—The electric light plant which has been in the course of construction here for some months past, but was delayed on account of the quarantines, has been completed and the town is now electrically lighted.

PRESQUE ISLE, ME.—Things are looking very promising for Mr. A. R. Gould and those associated with him in the enterprise of developing the Aroostook Falls water power. There will be an extensive demand for the power for lighting and mechanical purposes from such points as Monticello, Bridgewater, Blaine, Mars Hill, Sprague's Mill, Fort Fairfield, Presque Isle, Limestone and Van Buren.

GARDNER, MASS.—The Gardner Electric Light Company is adding a Diesel gas engine to its equipment, installed by the American Diesel Company, of New York.

QUINCY, MASS.—An order favoring a municipal lighting plant in Quincy was reported by the special committee on the subject at the last meeting of the City Council, and was laid on the table. The order authorizes the city "to construct, purchase, lease or maintain one or more plants for the manufacture and distribution of gas and electricity for light, heat and power, except for the operation of cars, for municipal use and the use of the inhabitants of the city." Under the law, to become operative such an order must be passed by a two-thirds vote of two successive city councils, and then be submitted to the voters at a city election.

COLDWATER, MICH.—It is proposed to install a 50-hp. compound engine at the municipal electric light plant. John A. Cavanagh is superintendent.

LANSING, MICH.—The ordinance granting to W. L. Haag the use of the streets for the purpose of installing poles and wires for furnishing electric power has been passed by the Council. A section provides that the city shall have a right to purchase all of the rights and privileges at the expiration of the franchise.

GRAND RAPIDS, MICH.—It is expected that the Grand Rapids-Muskegon Water Power Company will ask the Common Council for a franchise to deliver power within the city limits. The work of setting poles and the erection of a power house has so far advanced that the company, it is said, will be able to deliver power by February 1.

GRAND RAPIDS, MICH.—Because the Thornapple Electric Company does not see its way clear to accept the amendments which the ordinance committee of the Common Council has attached to the franchise granted to that company a year ago, there is now danger of legal complications arising. The amendments require that the company shall pay an ultimate maximum fee of $500 per annum and that power shall actually be delivered in the city within two years from May 1, 1906.

ABERDEEN, MISS.—This city will, in a short time, be in the market for a 200-kw., 60-cycle alternator. J. M. Acker is mayor.

GRENADA, MISS.—The City Council has decided to issue $30,000 bonds, to be used for improving the streets and the water works sewerage and electric light plant.

KIRKSVILLE, MO.—The Kirksville Gas, Heat & Electric Company has been incorporated with a capital of $30,000 by Fred. Grassie, Chas. Sands, and others.

INDEPENDENCE, MO.—The Jackson County Light, Heat and Power Company has been incorporated with a capital stock of $300,000. The incorporators are Thomas A. Rockwell, G. L. Goodney, W. L. Lyons and others.

JERSEY CITY, N. J.—The Jersey City Electric Company, with a capital of $250,000, has been incorporated by Frank W. Walton, Frank F. Geoff and H. W. Hedenberg.

JERSEY CITY, N. J.—The Luzerne Light, Heat & Power Company has been incorporated with a capital stock of $200,000. The incorporators are Thomas H. Sheridan, Guy B. Hurlbut and Maturin Ballou.

KEARNEY, NEB.—The North-Western Electric Heat & Power Company has changed hands and it is stated that the plant will be enlarged and improved.

UNION, N. Y.—The citizens have voted to issue $15,000 bonds for the construction of an electric light plant.

NEWARK, N. Y.—The Niagara, Lockport & Ontario Power Company has secured franchises in Newark, Lyons and Clyde.

NIAGARA FALLS, N. Y.—Work has been commenced on the new transformer station near Lockport for the Niagara, Lockport & Ontario Power Company. The cost of this station will be $100,000.

SYRACUSE, N. Y.—The Syracuse Light & Equipment Company has been incorporated with a capital stock of $100,000. The directors are: William Darrone and C. E. Darrone, of Syracuse, and A. A. Buck, of New York.

TICONDEROGA, N. Y.—The Ticonderoga Electric Light & Power Company has applied to the State Electrical Commission for permission to issue $50,000 bonds. It is the intention of the company to construct, this fall, a steam plant at Burleigh dock.

CORINTH, N. Y.—The Corinth Electric Light Company has almost completed a wing dam on the Hudson River to which site the electrical equipment of the present steam plant will be moved about the first of the year. A general reduction in rates will follow and a day service for power purposes will probably be inaugurated in the near future.

CHARLOTTE, N. C.—The Catawba Power Company has completed a survey for a power line to Gastonia, 21 miles away. Other lines are also to be built and it is said that power will certainly be carried to Columbia, S. C.

NILES, OHIO.—Bonds to the amount of $20,000 have been issued for improving the electric light plant and water works.

HILLSBORO, OHIO.—The Hillsboro Light & Fuel Company is in the market for an engine and a 2,200-volt, 60-cycle, single-phase generator.

McMINNVILLE, ORE.—New bids will probably be called for in about 60 days for an electric light plant and water works, to cost from $60,000 to $80,000. W. M. Bostoph, Ogden, Utah, is the engineer.

PENDLETON, ORE.—The Forest Reserve Bureau has granted the Umatilla Electric Power Company a right of way through the Wenaha Forest reserve. The company will now proceed with the establishment of its power system, which includes the development of power on the North Fork of the Umatilla River.

ASHLAND, ORE.—Judge Hanna, of the Circuit Court of Oregon, has handed down a decision dissolving the temporary injunction against the Ashland Electric Light and Power Company, owned by the stockholders of the Siskiyou Electric Power Company, which was obtained by the city of Ashland, preventing the company from planting its poles within the city. In his decision Judge Hanna makes the dissolving of the temporary injunction permanent, gives costs and expenditures in favor of the company and declares that the electric company's franchise is perpetual, same having been obtained prior to the granting of the city's charter, which limits franchises to ten years.

HOMESTEAD, PA.—The Council has authorized the lighting committee to procure estimates of cost of constructing and maintaining a municipal electric light plant.

LAWRENCEBURG, TENN.—Kirkpatrick & Johnson, of Jackson, Miss., have been selected to prepare plans and supervise the construction of the municipal water works and electric light plant here. Jas. Dunn is city secretary-treasurer.

BEAUMONT, TEX.—Emmett Landry will petition for an electric light franchise.

LEHI, UTAH.—A mass meeting of citizens was recently held, at which it was decided to ask the City Council to take steps toward issuing bonds to increase the holdings of the city in the Utah County Light & Power Company. It is proposed to increase the capitalization to $200,000 and to enlarge the capacity of the plant.

SHENANDOAH, VA.—Geo. Cadogan Morgan, 169 Jackson Boulevard, Chicago, Ill., will be engineer in charge of the construction of the combined water works and electric light plant at Shenandoah. Bids for material and machinery will be received by A. R. Martin, town clerk, until Jan. 2.

FAIRBANKS, WASH.—The Tanana Electric Company has started the operation of its plant on the Chatanika River, 25 miles from Fairbanks. The occasion was marked by enthusiastic ceremonies.

LA CROSSE, WIS.—The La Crosse Hydro-Electric Light & Power Company has filed articles of incorporation at Madison. The company has a capital of $1,000,000, and has a State charter granting it rights to erect and maintain a water power plant near Black River Falls. It will expend about $750,000 in the construction of a dam. Power will be transmitted to La Crosse, a distance of about 55 miles. Orlando Holway, E. G. Boynton and Roy F. Bingham, all of La Crosse, are the incorporators.

BASIN, WYO.—A franchise has been granted by the City Council for an electric light plant, and the company which is promoting the project will soon be organized. The incorporators will be Josiah Cook, G. W. Richardson, Barnette G. Rogers, Lewis Zane, C. A. Cook, F. I. Rue, Simion Cockins, C. A. Zaring, W. J. Booth and W. S. Collins. The company will be capitalized at $50,000.

COBOURG, ONT.—The Northumberland-Durham Power Company is reported incorporated with a capital of $750,000 by W. J. Crossen, J. A. Culverwell, Chas. Donnelly, and others, to develop the water power of Healy Falls.

OWEN SOUND, ONT.—This city is figuring on installing at the municipal electric light plant a 300-kw. 3-phase generator, driven by engine direct, and three new boilers. Jos. McLinden is superintendent and chief electrician.

The Electric Railway.

SAN FRANCISCO, CAL.—The Public Utilities and Finance Committees have chosen a site at Geary and Baker Streets for the power house of the proposed municipal street railway on Geary Street.

VENTURA, CAL.—The Independent Railroad Company is planning to build an electric railway from Ventura through Casitas Pass to Santa Barbara. The officers of the company are R. A. Phillips, president; George Lemcke, first vice-president; E. C. Herlow, second vice-president; and H. W. Lemcke, general manager.

NORWICH, CONN.—The work of building the Norwich-Stonington Electric Railway is now under way. Much of the line is over private right of way.

THAMESVILLE, CONN.—The Consolidated Railway Company is considering an important proposition to centralize the electrical plants for the four divisions in Southeastern Connecticut, comprising the Norwich and Willimantic, the Norwich street railway, the Montville street railway and the New London street railway systems, by substituting one central generating station at Thamesville. The change is in the interests of centralization and economy.

AUGUSTA, GA.—Jas. U. Jackson and the syndicate which he represents have taken over the properties of the Augusta electric railway system and the Augusta-Aiken electric line, from the Williams-Middendorf interests, the deal involving $5,000,000. The Aiken line, it is said, will be extended to Columbia, S. C., at once.

EDWARDSVILLE, ILL.—At the meeting of the Edwardsville City Council, an ordinance was presented by the McKinley syndicate, which is constructing the interurban railway from Springfield to St. Louis through Edwardsville, asking for an extended franchise to construct and operate an electric light, gas and heating plant in the city and fixing the minimum rates to be charged for the commodities.

INDIANAPOLIS, IND.—The Indianapolis & Frankfort Traction Company has filed articles of incorporation. Albert Pierson, Frank C. Gaven and Theodore P. Davis are the incorporators.

DARLINGTON, IND.—A movement has been started to build an interurban railway from Terre Haute to Kokomo, via Darlington and Frankfort. P. M. Dunn, of Indianapolis, and H. C. Woods, of Darlington, are active in the undertaking.

LOUISVILLE, KY.—In an effort to organize a company to build an electric railway from Utica, Ind., to the line of the Louisville & Southern Indiana Traction Company, connecting Jeffersonville and Jasper, Ind., Ebenezer Howes, of Utica, is interested. The proposed line is to be eight miles in length.

LANSING, MICH.—It is reported that the Lansing & Suburban Traction Company will purchase the property of the Michigan Traction Company, including the suburban line between Battle Creek and Kalamazoo and the city lines in both Battle Creek and Kalamazoo.

SPRINGFIELD, MO.—The Springfield Traction Company, which has the only street railway in the city, has been sold to the McKinley syndicate and will be extended to Joplin. Col. T. H. Murray, W. B. Sanford and H. B. McDaniel, local capitalists, recently obtained control of about 37,000 of the 400,000 shares of stock.

CAMDEN, N. J.—The Lexington & Interurban Railway Company has been incorporated here with a capital of $1,000,000. The incorporators are John A. MacPeak, F. R. Hansell and George H. B. Martin.

SPRINGFIELD, OHIO.—The proposed sale of the Springfield, South Charleston, Washington C. H. and Chillicothe Traction Company has been postponed until Dec. 28 at the request of the reorganization committee. A number of the creditors have accepted the reorganization plan, which involves issuing bonds to pay off debts and finish the road.

SEELEYVILLE, PA.—W. A. Heller, of Danville, Pa., is promoting an electric street railway between Seeleyville and Hawley. The new road will be known as the Honesville & Hawley Electric Railway, and will be 12 miles in length, the power plant being at Honesdale. A charter will shortly be applied for.

SOUTH BETHLEHEM, PA.—A charter for an electric railway from South Bethlehem to Centre Valley has been secured by C. P. Hoffman, A. L. Cope and W. H. Lauer, of this borough, and the new line will be connected with the Philadelphia & Lehigh Valley Traction Company's line at Centre Valley. As connection will be made with the Easton Transit Company's line at Bethlehem, a new route will be formed between Philadelphia and Easton.

KNOXVILLE, TENN.—The Knoxville & Maryville Electric Railway Company, with a capital stock of $100,000, has been incorporated by W. S. Nash, Robert Vester, Joseph P. Gant, W. T. Parham, J. C. Sterchi, J. Burger and Haywood Garrick.

SALT LAKE CITY, UTAH.—Fred G. Palmer, of this city, has asked the City Council for a franchise for the construction of an electric railway from this city to Garfield, where a large smelter plant is in course of construction. Garfield is about 18 miles distant from the city.

NEWPORT NEWS, VA.—Negotiations between representatives of the Hampton Roads Traction Company, which acquired the property of the Hampton Roads Railway & Electric Company at the recent foreclosure sale made by the United States Court, and W. J. Payne, president of the Newport News & Old Point Railway & Electric Company were concluded a few days ago the control and management of that property, consisting of about 22 miles of electric railway lines, was turned over to the latter. For about two years the Hampton Roads Railway & Electric Company was in the hands of receivers. The conclusion of this fight leaves the Newport News & Old Point Railway & Electric Company in entire control of the railway and lighting situation in this territory.

New Industrial Companies.

THE C. F. COOK ELECTRIC COMPANY has been formed at Los Angeles, Cal., with a capital stock of $[illegible]. The directors are C. F. Cook, W. J. Schmeit, of Whitney, and A. St. Clair Perry, of Los Angeles.

THE NASH ELECTRICAL SUPPLY COMPANY has been incorporated at Santa Fe, New Mex., with a capital stock of $[illegible], all subscribed. The incorporators are M. Nash, Katie Nash and Carl Gilman, all of Albuquerque.

THE INFALLIBLE ALARM COMPANY, of North Collins, N. Y., has been incorporated to manufacture fire and burglar alarms. The capital stock is $[illegible], and the directors are D. P. Graham, G. H. Davis and W. G. Lyman, of North Collins.

Legal.

BOSTON DAMAGES.—The city of Boston has been ordered to pay to the Boston [illegible] Light Company the sum of $[illegible] as damages for interference with [illegible] The case has been on trial for several days, and the claimant [illegible] for city improvements the city authorities deprived [illegible] possessed [illegible] street, South Boston.

MOVING STAIRWAYS.—[illegible] patent brought by Charles D. Seeberger [illegible] the Reno Inclined Elevator Company [illegible] Judge Wallace [illegible] The [illegible] by [illegible] against the Reno Company [illegible]

Educational.

UNIVERSITY OF WASHINGTON.—[illegible] lectures are being given by the Department of Electrical Engineering of the University of Washington [illegible] on electrical subjects. [illegible] will be included in the [illegible] by the semester examinations [illegible] as follows: Electric [illegible] by Mr. Elbert G. Allen, M. S. (Mass. [illegible]), Chief Electrical Engineer Seattle Electric Company. Dec. [illegible] Dec. 11, [illegible] Dec. 18, [illegible] Electric Railway [illegible] Power Distribution [illegible] "Railway Economics." Central Station Practice by Mr. J. D. Ross, Chief Electrical Engineer, Seattle Municipal Electric Light & Power System. Feb. 5, "Central Station Organization, Management and Records." Feb. 12, "Switchboards." Feb. 19, "Metering." Feb. 26, "Arc-Lighting." March 5, "Tests, Repairs and Trouble Work." Electric Power Transmission by Mr. John Harisberger, Chief Electrical Engineer Seattle-Tacoma Power Company. Apr. 30, "Source of Power." May 7, "Prime Movers." May 14, "Apparatus for Generating Electric Power." May 21, "The Transmission Line." May 28, "The Receiving Stations and Distributing Lines."

Personal.

JAS. A. WOTTON.

MR. JAMES ASHLEY WOTTON was born in Charleston, S. C., October 30, 1861, where he attended private schools until he entered the University of Georgia at Athens, Ga., in 1879, graduating with the degree of B. C. S. in 1882. From 1880 to 1883 he held the position of assistant state chemist, from which he resigned in 1883 to accept a position with the Southern Bell Telephone & Telegraph Company, at Atlanta, Ga. The company at that time was just beginning to establish itself in the Southern States. With this company he rose by successive steps to be manager of the shops, electrician and chief electrical engineer, remaining with them until 1900. During this time Mr. Wotton was an important factor in the general development of the telephone business throughout the South, his inventive genius having contributed to the production of many of the essential features of the apparatus of the present day. In this his knowledge of chemistry often played an important part. In 1900 he was called to New York as assistant electrician for the American Telephone & Telegraph Company, resigning from this position later to enter the independent telephone field as a manufacturer. In this latter role he became identified, as chief engineer, with the Wotton Electric & Manufacturing Company, located at Atlanta, Ga., and was engaged in the manufacture and sale of telephone equipments of all description. This company was in the early spring of 1905 merged into the Electric Manufacturing & Equipment Company, formed to manufacture telephone equipments under Mr. Wotton's design and patents, with which company he now holds the position of chief engineer. Mr. Wotton is a full member of the American Institute of Electrical Engineers.

MR. C. E. BRADSHAW, the city electrician of Charlotte, N. C., was a recent visitor to New York City, and attended the meeting of the Fire Underwriters.

DR. A. C. HUMPHREYS, President of Stevens Institute of Technology, has been elected a director of the Equitable Life Assurance Company under the new regime.

MR. J. A. BRETT, formerly of the Chicago office of the Westinghouse Electric & Manufacturing Company, has been made manager of the Cincinnati office of that company.

MR. ROBERT S. CLEMONS, recently of the Crocker-Wheeler Company, has become associated with Dodge & Day, of Philadelphia, as a specialist in power-house construction.

MR. JOSEPH SACHS, of enclosed fuse fame, has resigned from the Johns Pratt Company, and severed his connection with Noarc interests. He has become president of the Arknot Company, of Hartford, Conn.

MR. GEORGE N. EASTMAN, chief of the testing department of the Chicago Edison Company, who has been obliged to temporarily give up his duties on account of his health, is now in California, and his friends will be glad to learn of encouraging reports as to his improvement in health.

MR. T. R. MERCEIN, secretary of the Northwestern Electrical Association and general manager of the Electrical Trades Exposition Company, of Chicago, has been in New York during the past week on matters connected with the Chicago Show to [illegible] next January. He counts on making a considerable success.

MR. J. G. WHITE, [illegible] the large engineering interests in America and England [illegible] returned last week from England, and will spend the winter in New York. He speaks very hopefully of financial and industrial conditions in [illegible] as well as of the important engineering projects now being carried out [illegible] White management in various parts of the world.

MR. A. B. CONOVER [illegible] been elected treasurer and general manager of the [illegible] Company to fill the vacancy caused by the death of Mr. [illegible] Bailey. Mr. Conover has been connected with the [illegible] company for the past 18 years. About a year ago [illegible] during Mr. Bailey's absence on account of sickness.

MR. L. L. MAY, [illegible] representative of the Columbia Incandescent Lamp Company [illegible] and who recently represented the Sawyer-Man Company in the Eastern territory, has returned to the Columbia Company [illegible] of the business of that company in Texas. Mr. May [illegible] at Dallas and will look after the company's interests in [illegible] Texas.

MR. HAMILTON [illegible] R., the well-known English electrical engineer, [illegible] & Kilgour "Electrical Pocket Book," is now visiting the United States to study American power house and electric railway construction. He [illegible] spend about three months on this side of the Atlantic. Mr. Kilgour has had a long practical experience as electrical engineer to the Cheltenham Corporation.

MR. HARRY C. GOLDRICK has become the representative of the Kellogg Switchboard & Supply Company in the Central Southern States. He has a wide acquaintance in the independent telephone field and the electrical trade and was with the independent telephone company in Indianapolis for seven years. He has had an extensive experience in the construction, installation, maintenance and operating departments. He is an associate member of the American Institute of Electrical Engineers. His territory for the Kellogg interests will include Kentucky, Tennessee, Alabama and Mississippi.

MR. E. P. COLEMAN has resigned as general manager of the Consolidated Lighting Company, of Montpelier, Vt., his clients having sold their interest in the property. He has opened an office in the Vermont Mutual Building, Montpelier, and is now in a position to give attention to mechanical and electrical engineering of all kinds, especially physical and financial examinations of central station properties. He has also formed an affiliation with one of the foremost mill engineering firms of New England, and is prepared to plan and superintend the construction or alteration of electric power stations, mills and manufactories of every description.

MR. J. D. ROCKEFELLER, JR., is said to be interested as president of the Continental-Mexican Rubber Company in the production of rubber. The company is erecting a factory at Torreon, Mexico, to manufacture rubber from the guayule plant. It is stated that the factory will cost more than one million dollars and will be the largest of its kind in Mexico. It was less than two years ago that the discovery was made that a certain quality of rubber can be manufactured from the guayule plant, which grows in its wild state, and in great abundance all over the plateaus of Northern Mexico. Several factories for utilizing the plant have already been established and are turning out large quantities of the product.

MR. JOHN W. LIEB, JR., gave a luncheon at Delmonico's, last week, on December 9, to Mayor and Mrs. Barnard, of Asheville, N. C., whose personal attentions and efforts contributed so much to the success of the meeting of the American Institute of Electrical Engineers last June, in the North Carolina health resort. Among those present at this enjoyable reunion to meet Mr. and Mrs. Barnard were Mrs. J. W. Lieb, Jr.; Mr. and Mrs. F. C. Bates, Secretary R. W. Pope, Mr. A. Williams, Mr. Calvin W. Rice and Mr. T. C. Martin, most of whom had participated actively in the Asheville convention, over which Mr. Lieb had presided and which had constituted a notable event in institute history. A member of the party also was Mr. Chas. E. Waddell, chairman of the Institute Committee at Asheville. On Tuesday, December 9, a little dinner was given Mr. Waddell at the Cafe Martin, after which hosts and guest adjourned to attend the opening of the Electrical Show in Madison Square Garden.

Trade Publications.

CHEMICALS FOR TECHNICAL WORK.—The J. T. Baker Chemical Company, Easton, Pa., has issued a price list of analyzed chemicals for laboratory and technical work.

KELLOGG SWITCHBOARD & SUPPLY COMPANY is issuing neat souvenir postal cards showing Kellogg apparatus to be the "gold standard" of telephony. The cards are printed in colors and gold.

"LIVE WIRE" is the title of a publication issued monthly by the Wesco Supply Company, of St. Louis, as a house organ. It is entering upon its third year of publication, and has a regular mailing list of 1,200 buyers of electrical goods. The circulation is in the territory of the Wesco Company, including the vast and prosperous region south of the Ohio River and west of the eastern boundary of Indiana. Its "Want Ad" columns are free to readers and there is no subscription price charged. It is a quarto publication, handsomely got up, illustrated, and full of good, bright matter.

GASOLINE MOTOR CARS FOR RAILWAY WORK.—Catalogue No. 101 A of Fairbanks, Morse & Co., Chicago, describes Sheffield gasoline motor cars for railway work. These cars are similar in some respects to automobiles, but are designed for operation on standard railway tracks. They are built in all sizes from a small tool car to a passenger omnibus. An interesting equipment is a gasoline trolley repair motor car designed for repair work on electric roads. The tower is made in two sections, the upper of which is telescoped into the lower when traveling over the line.

News of the Trade.

JANDUS ELECTRIC COMPANY, Cleveland, Ohio, moved its offices recently up to its factory. This has improved facilities for controlling closely the work in the factory. At the same it has taken more space in the building it occupies, so as to largely increase its capacity. The move was made necessary by the growth of its business.

THE AMERICAN ARC LAMP COMPANY, Kalamazoo, Mich., which manufactures the American enclosed arc lamp that was so well known for some years as the Lea lamp, says that its November sales exceeded anything in the history of the lamp, both in amount and the territory covered, while the outlook at the beginning of December was very flattering.

HOLTZER-CABOT ELECTRIC COMPANY, of Brookline, Mass., in order to concentrate its business, is closing up its New York offices, and requests that hereafter all communications in the locality named be addressed to the Brookline headquarters. It is believed that this method of dealing directly will facilitate greatly the execution or orders. Business is very good and growing.

THE CURTIS & CURTIS COMPANY, of Bridgeport, Conn., manufacturer of pipe cutting and threading machinery, has just opened a large store at 60 Centre St., New York City, where a full line of its pipe cutting and threading machines will be on exhibition and can be seen in operation. Mr. H. H. Walker will be in charge. He will be pleased to receive calls from any one interested in this class of machinery and will demonstrate the many advantages possessed by this make of machines.

TESTS OF TRANSFORMERS. A very interesting exhibit is to be held at the Madison Square Garden at the present electrical show, whereby the Electro-Dynamic Company will show actual tests of the Moloney transformers. These tests will be made before engineers or customers, and will show the low copper losses and other interesting data. The experiment is made with all the necessary instruments. Such an exhibit as this is not only convincing but also instructive, and illustrates the latest methods for testing the various efficiencies of transformers.

STERLING MOTOR COMPANY.—From December 1, the Eastern office of the Sterling Electric Motor Company will be at 143 Liberty Street, New York City, Mr. Allen, formerly consulting electrical engineer of the Marine Engine & Machine Company, and Mr. J. J. Estabrook and others have formed a company called The Engineering Specialty Company, which will have the handling of the Sterling machines in that territory. Mr. Estabrook was formerly manager of the New York office for Holtzer-Cabot Electric Company. The new firm is well equipped to cover the field for the Sterling line. A complete stock of machinery will be kept at the New York end for immediate delivery in that territory.

THE POWER IMPROVEMENT COMPANY, of Milwaukee, has been incorporated under the laws of the State of Wisconsin. Mr. George P. Dravo is president, Mr. James Drought, vice-president; Mr. Andrew Pinkerton, secretary and treasurer. Mr. Dravo is a mechanical engineer with many years' experience, and Mr. Pinkerton has been for 11 years electrical engineer for the American Sheet & Tin Plate Company (formerly Apollo Iron & Steel Company) and also for the Vandergrift Electric Light & Power Company and for the Vandergrift Telephone Company. Prior to his engagement with the Apollo Company, he was on the engineering staff of Siemens Bros. & Co., of London, England. The firm will practice as industrial and commercial engineers and is prepared to make examinations and reports on new propositions and also on the betterment of existing plants. The company took over the agency relations of Mr. Dravo of the De Laval Steam Turbine Co. and the Foster Superheaters.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 5, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

806,107. COMBINED SOCKET AND ROSETTE; Walter A. Church, Binghamton, N. Y. App. filed Dec. 6, 1902. Detail.

806,150. ELECTRIC AND PNEUMATIC GOVERNOR; Thomas F. Kelly, Philadelphia, Pa. App. filed Nov. 11, 1904. The usual diaphragm connected to the usual pressure reservoir has a compound lever attachment, one part of which releases a detent and allows the circuit closing members to fall, while the other arm has a contact wheel which makes connection with a sliding plate until the solenoid for breaking the main contacts has been raised sufficiently to be engaged by the detent.

806,15[illegible]. THIRD RAIL PROTECTOR; William H. Keber and Charles F. Warner, Lancaster, O. App. filed Mar. 6, 1905. An inverted L-shaped head composed of alternate sheets or laminations of metal and insulating material is supported over the usual third rail. The different plates and insulating sheets are lapped with respect to one another so as to be more effectively separated at their edges.

806,173. ELECTRIC FURNACE; Romaine W. Myers, Fruitvale, Cal. App. filed Feb. 14, 1905.

806,217. DYNAMO ELECTRIC MACHINE; Henry H. Wait, Chicago, Ill. App. filed April 24, 1905. (See Current News and Notes.)

806,238. SIGNAL APPARATUS; Clarence W. Coleman, Westfield, N. J. App. filed July 1, 1905. A motor for operating semaphore signals comprising a base carrying a small bi-polar motor which is connected by reduction gearing with a crank pin which acts on a movable bar or cross head so as to produce harmonic motion thereof. Stop motions for the motor are provided at the ends of the movement.

806,[illegible]. TROLLEY; George R. Fletcher, Cambridge, O. App. filed May 31, 1905. A notched scraper blade has a pair of forked extremities which are supported by the usual trolley axle, and is spring pressed upward against the wire so as to remove the ice and sleet therefrom.

806,[illegible]. MOUTHPIECE ATTACHMENT FOR TELEPHONES; Metta France Hubbard Phillips and William Beck Hubbard, Boston, Mass. App. filed March 6, [illegible].

806,[illegible]. TROLLEY WIRE HOLDER; Frank M. Zimmerman, Aurora, Ill. App. filed Mar. 21, 1905. Details of a trolley wire holder having a cylindrical cavity with ledges at its interior end adapted to receive a general cone-shaped projection on the usual hanger.

806,[illegible]. AUTOMATIC PARALLELING DEVICE FOR ALTERNATING CURRENT GENERATORS; George A. [illegible], Willimantic, Conn. App. filed Jan. 4, 1904. A transformer is connected to each generator. The secondary windings of these transformers are joined in a circuit with an electromagnetic switch around which there is a normally closed shunt, the switch serving to control the paralleling currents.

806,316. AUTOMATIC SIGNAL; Andrew B. Burt and Frank I. [illegible], San Francisco, Cal. App. filed June [illegible], 1905. A section of rubber hose is laid alongside the track rail so as to be compressed by the tread of the wheel passing over it and has pneumatic cylinders for closing a circuit at one or the other end, depending on the direction of movement of the wheel passing thereover.

806,3[illegible]. AUTOMATIC PRESSURE CONTROL; John H. Crawford, Camden, N. J. App. filed Dec. 8, 1904. The regulating cylinder connected to the pressure reservoir has its piston attached to a leaf spring forming an [illegible] the system [illegible] ceases abruptly after a certain [illegible] and its corrected [illegible]

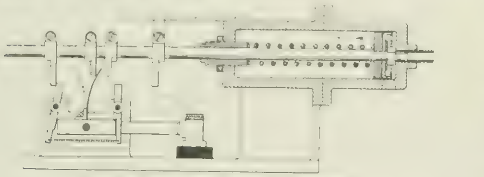
[illegible] ELECTRIC CLOCK SYSTEM; Martin Fischer, Zurich, Switzerland. App. filed [illegible]. A small magneto generator [illegible] to transmit [illegible] periodically under trip connections from the mechanism of the master clock, and in order to reduce the inertia of the moving part, the [illegible] H armature is held stationary and the magnets [illegible] moved so as to [illegible] cut the lines of force therebetween.

[illegible] TELEPHONE SHELF; Joseph S. Gable, Jackson, Ohio. App. filed [illegible]

[illegible] TELEPHONE ATTACHMENT; Joseph Silverman, San Francisco, Cal. App. filed May 26, 1905.

[illegible] TELEGRAPH REPEATER; Francis W. Jones, New York, N. Y. App. filed Sept. [illegible]. Both of the transmitting magnets are wound with three separate coils, one of which has its circuit broken by the break points of the receiving relay, the second coil being in a permanently closed [illegible] circuit, and the third coil having its polarity controlled by contact points on the opposite transmitter.

[illegible] ELECTRODE FOR ELECTROLIZERS USED IN THE MANUFACTURE OF BLEACHING LIQUORS; Richard Kother, Grunewalde, Germany. App. filed Sept. 7, 1905.



806,325. Automatic Pressure Controls.

[illegible] TROLLEY SIGNAL; Benjamin H. Roberts, Haverhill, Mass. App. filed Oct. 5, 1905. Details of a system for single track trolley roads in which a ratchet is stepped around for every car that enters a block, and reversely moved whenever a car leaves the same.

[illegible] ELECTRIC SWITCH OPERATING DEVICE; Ira J. Stouffer, Altoona, Pa. App. filed July 10, 1905. A contact shoe is hung alongside the usual conductor, so as to be charged by contact springs on the trolley [illegible]. Two switch operating magnets are so connected by compound levers that one of them is effective to hold the switch point in its thrown position until the other magnet has been energized.

[illegible] AUTOMATIC CONTROLLER FOR ELECTRICALLY ACTUATED COMPRESSORS; Niels A. Christensen, Milwaukee, Wis. App. filed May [illegible], 1898. In order to avoid the destructive spark incident to breaking the motor circuit, the patentee has a fluid motor for operating the usual switch and provides an air blast directed against the contacts at the instant the circuit is broken.

[illegible] WIRE CONNECTOR; Nathaniel W. Tilbe, Somerville, Mass., and Anton Freter, Boston, Mass. App. filed Feb. 20, 1905. A strip of metal is shaped to join adjacent recesses to receive the wires, the metal being softer and more pliable in the middle than at the ends.

[illegible] COMPOSITE INSULATOR; Louis Steinberger, New York, N. Y. App. filed Nov. 26, 1904. Comprises a head provided with a portion threaded externally and with a ring spaced apart from this portion so as to leave a slot between, and a hood threaded internally so as to engage said portion and provided with an annular portion for entering said slot.

806,538. ELECTRIC SIGNAL FOR RAILWAYS; John B. Gorrell and Hiram A. Gorrell, Lacto, Ind. App. filed June 21, 1905. Circuits laid along the usual block section, including special semaphore signals by which a train may be flagged in case it inadvertently passes the main signals.

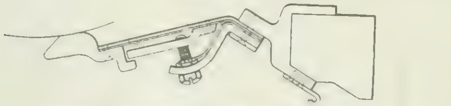
[illegible] LOCKING OR BOLTING DOORS AND THE LIKE; Claude E. Hensley, Elreno, Oklahoma Ter. App. filed May 13, 1904. The locking bolt uses compound multiplying lever connections with the magnetic trip so that the latter will release properly in spite of the friction and inertia of the heavy bolt mechanism and its impelling springs.

[illegible] ELECTRICAL MEASURING INSTRUMENT; Edwin F. Northrup, Philadelphia, Pa. App. filed May 12, 1905. A method of measuring an alternating current which consists in passing current from the alternating current to be measured through one conductor and a direct current of comparison through another conductor, and adjusting the current through one of said conductors until the relative expansion of both conductors shows that the current value of the alternating current bears a known relation to that of the direct current of comparison.

806,568. ELECTRIC SWITCH FOR STREET RAILWAYS; James A. Posey, Midlothian, Texas. App. filed Jan. 21, 1905. Alongside the track rail is placed a depressible bearer with connections to the switch point. There are also a pair of contact plates for making an electrical circuit which renders said connections effective to move the switch point in a different way when the circuit is energized than otherwise.

[illegible] MEANS FOR ASCERTAINING THE POWER FACTOR IN ALTERNATING CURRENT SYSTEMS; Joseph Louis Routin, Lyon, France. App. filed Nov. [illegible], 1904. (See Current News and Notes.)

806,57[illegible]. INSULATED WIRES; George H. Ripley, Schenectady, N. Y. App. filed Jan. [illegible]. Method of coating wires with linseed oil which is afterward baked to the point of destructive distillation so as to leave an infusible residuum.



806,630. Adjustable Controller Finger.

[illegible] ELECTRICAL INSULATOR; Herbert Sinclair, Trenton, N. J. App. filed May 5, 1905. The body of the insulator is [illegible] cross-section, with the long axis of the oval [illegible] perpendicular to the length of the wire groove. Corresponding [illegible] of the body [illegible] to form a cross-groove for the wire.

[illegible] PROCESS OF STERILIZING MILK AND OTHER LIQUIDS; Robert C. Turner, Columbus, O. App. filed [illegible]. A method of sterilizing milk which consists in [illegible] series of [illegible] cascades and passing [illegible] through the fluid stream for the momentary interval [illegible]

806,601. APPARATUS FOR STERILIZING MILK AND OTHER LIQUIDS; Robert C. Turner, Columbus, O. App. filed [illegible]. An apparatus for carrying out the foregoing process [illegible] receptacles [illegible] plates, and [illegible]

[illegible] TROLLEY; Amos Bopp, Baltimore, Md. App. filed Mar. 25, 1905. The trolley wheel is vertically swiveled within a cage having two upper [illegible] rods or shoes, curved to prevent injury to the wheel in case it leaves the wire, by the guy ropes, trees, etc.

[illegible] MOTOR CONTROL SYSTEM; Eugene R. Carichoff, East Orange, N. J. App. filed Aug. 4, 1904. A complete multiple unit control system having among other features a pair of locks operable from the controller and operatively connected to both the reversing and controlling switches, one of said locks being inoperative with respect to the reversing switch when the other is actuated.

[illegible] ELECTROMAGNETIC VIBRATOR; Ragner Carlstedt, Jersey City, N. J. App. filed Aug. 22, 1904. A vibrator employing an H armature between two curved pole faces and having an ordinary circuit breaker to cause its vibration.

806,628. SIGNAL FOR SECTIONAL CONDUCTORS; Frank E. Case, Schenectady, N. Y. App. filed May 21, 1904. A system for indicating to a motorman whether either of two sections of the third rail ahead is grounded, and also whether the sections are at the same potential. A semaphore magnet is energized in case the rail sections are at a different potential or in case either one of them is grounded.

806,630. ADJUSTABLE CONTROLLER FINGER; Frank E. Case, Schenectady, N. Y. App. filed July 19, 1904. An adjustment for contact springs in which part of the usual spring is made use of for the purpose of adjustment and the remainder for the purpose of resiliency.

806,666. AUTOMATIC CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Oct. 11, 1897. The circuit breaker has a plurality of tripping magnets in different circuits which act on a common trip so as to break the circuits at separate points, but employing a common blow-out magnet.

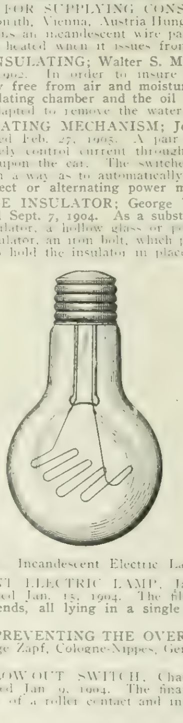
806,667. SYSTEM OF ELECTRIC GENERATION AND DISTRIBUTION; Edward M. Hewlett, Schenectady, N. Y. App. filed October 5, 1901. The system comprises a generating outfit, a sectional bus-bar, and a plurality of distribution units, each supplied by a plurality of feeders leading from different sections of the bus-bars.

806,694. INSTRUMENT FOR SUPPLYING CONSTANT CURRENTS OF HOT AIR; Victor Monath, Vienna, Austria-Hungary. App. filed May 25, 1905. A casing contains an incandescent wire past which a current of air flows so as to become heated when it issues from the nozzle.

806,696. METHOD OF INSULATING; Walter S. Moody, Schenectady, N. Y. App. filed Apr. 26, 1902. In order to insure the oil within a circuit breaker being perfectly free from air and moisture, the air is initially exhausted from the insulating chamber and the oil is flowed therein through a drying apparatus adapted to remove the water.

806,709. SWITCH OPERATING MECHANISM; Jesse S. Pevear, Schenectady, N. Y. App. filed Feb. 27, 1905. A pair of oil-bath switches are connected to respectively control current through alternating current and direct-current motors upon the car. The switches are arranged in transformer circuits in such a way as to automatically throw the proper switch by connections to direct or alternating power mains.

806,717. HIGH-VOLTAGE INSULATOR; George W. Thomas, East Liverpool, Ohio. App. filed Sept. 7, 1904. As a substitute for the wooden pin for a high-voltage insulator, a hollow glass or porcelain post is cemented to the body of the insulator, an iron bolt, which passes through the center of the post, serving to hold the insulator in place on the cross arm.



806,723. Incandescent Electric Lamp.

806,723. INCANDESCENT ELECTRIC LAMP; James C. Wormley, New York, N. Y. App. filed Jan. 15, 1904. The filament is formed with a plurality of zig-zag bends, all lying in a single plane transverse to the axis of the lamp.

806,728. DEVICE FOR PREVENTING THE OVERCHARGING OF ELECTRIC CABLES; George Zapf, Cologne-Nippes, Germany. App. filed March 28, 1905.

806,733. MAGNETIC BLOW-OUT SWITCH; Charles E. Carpenter, New York, N. Y. App. filed Jan. 9, 1904. The final break of the circuit is made upon the surface of a roller contact and in proximity to a magnetic blow-out pole.

806,734. APPARATUS FOR STOPPING ELECTRIC MOTORS; Charles E. Carpenter, New York, N. Y. App. filed Apr. 29, 1904. In order to secure a uniform braking effect, the motor armature is connected into a closed circuit, including a heavy inductive resistance, the impedance of which prevents excessive current at the initial closure of the circuit.

806,735. ELECTRIC CONTROLLING AND REVERSING SWITCH; Charles E. Carpenter, New York, N. Y. App. filed Feb. 3, 1905. In order to prevent the controller arm being thrown too suddenly past its central position for the purpose of reversing the motor, a separately hand-manipulated stop is interposed, which is effective to stop the controller arm at center whichever way it happens to be moving.

806,745. ELEVATOR SYSTEM; George A. Le Fevre, Orangeburg, N. Y. App. filed Dec. [illegible]. The elevator has a safety clutch operated by a solenoid magnet which is in circuit with the usual controller, so that the safety clutch is thrown into action whenever the main motor circuit is broken.

806,749. TRANSFORMING DEVICE FOR ELECTRIC CURRENTS; Jacob F. [illegible], Schenectady, N. Y. App. filed May 26, 1904.

806,751. SWITCH CONTROLLING MECHANISM; Jesse S. Pevear, Schenectady, N. Y. App. filed Feb. 27, 1905. Relates to details of an automatic switching mechanism for connecting different circuits to the mains according to whether they are supplied with direct or alternating current.

806,752. COMBINED ALTERNATING AND DIRECT-CURRENT CONTROL APPARATUS; Jesse S. Pevear, Schenectady, N. Y. App. filed May [illegible]. Construction of a master switch or controller adapted to operate [illegible] either from a high-tension alternating current or from a low-tension direct current.

806,758. RESISTANCE FOR ELECTRICAL APPARATUS; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 21, 1903. (See Current News and Notes.)

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

Vol. XLVI. NEW YORK, SATURDAY, DECEMBER 23, 1905. No. 26.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 Liberty Street, New York.

Telephone Call: 7005 Cortlandt. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office	1139 Monadnock Block
Philadelphia Office	929 Chestnut Street
Cleveland Office	403 Cuyahoga Building
European Office	Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGraw Publishing Co.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for 1905 to date,* **699,500.**

NEW YORK, SATURDAY, DECEMBER 23, 1905.

CONTENTS.

Editorial 1055
A New and Higher Standard of Direct Current Operation. By Frank J. Sprague 1058
The Electric Underground Road for Philadelphia 1058
Electrolysis of Gas Pipes 1059
The Zambesi Power Scheme 1059
Exhaust Steam Direct Current Turbines in Philadelphia 1060
To Begin Electrification of Erie Railroad 1060
A High-Speed Suburban Road 1060
Electrical Engineers of the Times.—XLI. C. L. de Muralt 1061
Current News and Notes 1061
Electricity Direct from the Coal Mine at Radcliff, England 1065
Regulation and Compounding of Lighting Balancers. By Budd Frankenfield 1067
The Practical Application of the Heyland Diagram for Induction Motors. By W. C. Way 1069
Core Losses in Induction Motors. By R. E. Hellmund 1071
Test of a Valve Magnet. By C. P. Nachod 1071
Tests of Magnet Wire. By C. H. Barrett 1072
An Alternating Current Rectifier 1072
Reflectors, Shades and Globes.—V. By J. R. Cravath and V. R. Lansingh 1074
Central Station Operating Points at Kewanee, Ill 1076
December Meeting of the American Institute of Electrical Engineers 1077
New Telephone Patents 1079
Letter to the Editors:
The Patent Question. By T. J. Johnston 1080
Digest of Current Electrical Literature 1083
Charging Receptacles 1085
Steel Tower Pole Line 1086
The American Electrical Salesmen Association 1086
The Trolley at Leith, Scotland 1086
New York Electrical Show 1087
Industrial and Commercial News 1090
General News of the Week 1093
Moonlight Tables for 1906 .... Supplement

The Compounding of Lighting Balancers.

The direct-current balancer is a well-known and very useful device for maintaining regulation on a three-wire or multiple-wire system subject to unbalanced loads and supplied by a generator connected only to the outers of the distributing system. A comparatively small balancing machine is capable of regulating or maintaining balance upon such a system. When motors only are operated from the multi-voltage system the balancer is not called upon to be very precise in its work, because so long as the voltage variations between any pair of conductors are not sudden their range may be fairly wide without sensibly disturbing the operation of the system. When, however, incandescent lamps have to be operated from a balancer, the best regulation it can be made to give will not be good enough for the station manager and more care has to be devoted to the degree of automatic regulation supplied by the balancer. In the ordinary simple shunt-balancer, the voltage always falls to some extent on the loaded side, just as it does in the ordinary three-wire Edison system operated by a pair of constant-potential dynamos in series. The cause of this behavior is explained in the article by Mr. Budd Frankenfield on page 1067 of this number.

The article shows that the best way to excite shunt-balancer fields is to connect its coils from opposite sides of the system. Otherwise the better plan is to connect them across the outers. Compound-wound balancers are, however, relied upon for the best work in regulation, and the exact amount of compounding required is not easy to predetermine. In fact, it usually takes a considerable amount of experimental adjustment to determine the best numbers of series turns on a balancer set in order to arrive at the best automatic regulation. One notable simplification in the balancer problem as applied to incandescent lighting is that only three wires and two similar members have to be considered. That is to say, lighting balancers are rarely called upon to give more than two equal voltages, so as to provide a neutral point. The two members, being thus equal and symmetrical, are relatively easy to deal with. In the case of motor control in factories, however, where individual tools must be capable of continuous operation over a wide range of speeds, three voltages of different magnitudes have usually to be provided, thus calling for three members in the balancer set, of different e.m.f's resistance and power. The accurate compounding of such multiple sets is naturally a more complex problem.

Converter Substations.

The rotary converter has become the main reliance of electric railways of the larger sort, and while it is unquestionably a valuable piece of apparatus, it has earned a somewhat unenviable reputation for a certain asperity of disposition, as one may say, that leads the operator to use extreme tact in dealing with it. Mr. Ashe's discussion, in his recent A. I. E. E. paper, of starting conditions impresses one very forcibly with the complexity of the situation from the operative standpoint. Of the three methods noted none is entirely satisfactory and each is considerably used. We are rather disposed to look upon starting from the direct-current side as upon the whole the best. For one thing it permits great exactness in synchronizing, so that when it is necessary to throw in a fresh converter with the minimum disturbance of voltage the other methods seem rather crude. They are nevertheless much used, even starting the converter as an induction motor being a method by no means uncommon. This was the earliest method employed, and crude though it is, it is simple and certain. Converters, however, are generally so bad as induction motors that the starting currents run very high and the effects on the line voltage are liable to be serious, especially if the converters are used on the same circuit with lights. Purely for railway working, however, this objection ceases to be serious. Any rigid requirement as to uniformity of voltage is likely to encourage the use of motor-generators. But from any point of view a rotary sub-station is a costly and complicated affair. The change from alternating current on the distributing system to direct current on the working conductors is one made at considerable loss, both in energy and in fixed and operating charges, and after it is completed the voltage at which the direct current is furnished is too low for large work save at forbidding expense for conducting material.

This question aside, however, the converter sub-station has been made operatively successful and is the main reliance of many important systems. It is clear from the paper before us that the same questions as to switchboard arise in generating stations and substations. For the past few years a theory of switchboard construction and design has been uppermost which has not been altogether happy in its applications. In effect the advanced switchboard designer has tried to eliminate the human element as far as possible, and for every imaginable contingency has tried to provide a remedy on the board, automatic if possible. The result has been a large amount of highly ingenious switchboard apparatus, costly to install, and requiring considerable care in maintenance. In the design of a modern station the switchboard has become a very large item of expense, rising to a quarter or a third of the cost of the electrical apparatus it is intended to control. And frankly, if one examines such a structure he generally finds that nearly half the cost lies in various refinements that are of somewhat fanciful utility. Even so valuable a thing as the remote-control switch is not infrequently installed where a manual switchboard would do precisely as well at a small fraction of the cost. The mere fact that remote-control switches are provided with return signals to show whether the alleged automatic devices have really worked is inspiring of solemn thought. We believe that at the present time there is beginning to appear a tendency toward reversion to simpler apparatus of control. The mere cost of application is serious, and from an operative standpoint simplicity is the thing. It is very gratifying to have a large assortment of polished and lacquered automatic circuit-breakers, but we have seen too many of them tied up to regard them with proper respect. It is the operator who watches his machines and pulls his load through that makes the system reliable. Automatic apparatus cannot see beyond the actuating forces, while human intelligence can look to the underlying causes and act accordingly. The thinking machine has yet to be invented.

◆

THE PATENT SITUATION.

We print in another column a communication which presents a view of the patent situation from the standpoint of the patent attorney, and which appears to imply that in offering suggestions on patent reform from another standpoint we have been guilty of an impertinence. So far from misunderstanding what patents purport to be, as seems to be insinuated, we know only too well how far what they purport to be swings wide of what they ought to be. The view of the patent system which our correspondent arises to defend is naturally *ex parte,* while our view is that the sole purpose of patents should be to benefit the public and inventor rather than to promote the interests of the legal fraternity. We made the suggestion that "a patent once issued ought to carry with it the highest presumption of full validity and should protect its owner in the right of manufacture." In reality patents do not protect the inventor because they do not grant to him any rights of which he can be assured prior to a long term of costly and wearisome litigation, and they do not protect the public interests for the same excellent reason. To say that the Patent Office proceedings are *ex parte* is a waste of breath, as any one who has watched a really vigorous interference case ought to know. In the present state of things they are *ex parte* merely until the Examiner sees a conflict of rights with another case. The Patent Office actually does exercise judicial functions, and in our view should be authorized and directed to exercise them much more fully than at present, so that as respects not only conflict with cases in the office, but with patents already issued, the rights of the inventor should be defined once for all, save as in rare instances allegations of fraud might be raised. The examiner now cites in his answers to applicant prior patents, and it is our contention that no patent should issue until the relation of the new matter to the old is determined, not by a long drawn litigation conducted years afterwards, but by final action in the Office, by process alien to interference proceedings, in case the applicant preferred pushing his case to taking what he could get. And in our view the result of such a course should be to settle once for all whether a patent as issued is free in its entirety or is directly tributary to fundamental patents and merely an improvement thereon. The Patent Office lacks now the very power that it should have, to guarantee to the inventor who is granted a patent that his rights as therein defined are not to be assailed in virtue of vague and shadowy claims skulking behind the prolix verbiage of the attorney who drew them. If one invents an improvement, let us say in telephony, let him know from the start what he is entitled to and to what patents, if any, he is frankly subsidiary, and subject to this plain declaration hold him safe from attack, unless for fraud.

We are well aware that such a revolution in procedure would reduce the number of patents granted and would increase the cost of getting them, but once obtained they would be of some value, and an intending manufacturer could acquire a patent on its merits without buying a series of lawsuits along with it. Moreover, greater strictness would tend to reduce the number of frivolous and "paper" patents which now clutter the way of improvement. Of course our correspondent may shudder with sympathy for the poor inventor facing the terrors of the Patent Office under the new régime, but we assure him that the poor inventor would be better off thus than when given a cheap patent which he can neither sell nor even pawn on account of threatened infringement suits. Much nonsense and some truth has been written about the heart-rending efforts of the poor inventor struggling against poverty and discouragement to bring to perfection the product of his genius. But these preliminaries are insignificant compared with the terrors which he faces when he gets his patent and tries to do something with it in face of the ensuing storm of litigation. An old *Patent Office Gazette* is the saddest graveyard of wasted money and blasted hopes that can well be imagined. An analysis of the history of its contents, if such a thing were possible, would be the most terrible arraignment of our present patent system that could ever be devised. Under the beautiful procedure that our correspondent so strenuously defends, the inventor asks a fish, and the Patent Office blithely passes him out a serpent. The inventor is not the sole sufferer, for many a manufacturer has taken up an article in perfectly good faith only to be wrecked by the vicious litigation that has been opened as soon as his business has grown profitable. As our correspondent very justly intimates, our present system is largely due to the efforts of the patent attorneys—it is now time for the inventor and the investor to have a voice.

From a technical standpoint a rigid examination of apparent conflicts in the office has an enormous advantage over a struggle conducted years afterwards. At the present time one of the greatest difficulties in getting at the rights of a patent litigation is that of keeping distinct the difference between the state of the art when the patent was granted and that which has grown up since. In electrical causes particularly the just adjudication of conflicting claims ten years old is sometimes well nigh impossible. At the time the patents were issued their relation could have easily been made clear, but after the art has changed the men who drew the claims cannot remember what they intended them to mean. If conflicts could be decided in the office they could easily be made brief and to the point, however distasteful such a change in procedure might be to those benefitting from conflicts. The government which grants a patent certainly has full rights in determining the conditions of the grant, no one being under any compulsion to apply for a patent unless he believes it to be for his advantage. The patent system has to-day become more through custom than through fundamental principles a hotbed of litigation. The English system, loose as it is, has proved hardly more objectionable in practice. The remedies for litigation proposed by the attorneys are delightfully naïve—more courts, with more room for litigation. Our own belief, looking at the matter from the standpoint of the inventor and manufacturer, is that the Patent Office should be clothed with more power and dignity, its head be made a better paid and more permanent official, its examiners more carefully trained and selected and given a better outlook, and that the procedure of the office should be so changed as to make a patent once issued extremely difficult to assail, perhaps even by statute incontestable after a fixed period like a land title under the registration system. Reform of the patent procedure in the courts is a good thing in its way, as half a loaf is better than no bread; but it is more important to discourage the beginnings of litigation.

An Alternating-Current Rectifier.

Rotating parts are essential in any dynamo-electric machine which converts alternating current into direct current. This is an unfortunate penalty attached to such conversion; and we would gladly possess as simple a stationary apparatus for converting alternating into direct currents as we already possess in the transformer for changing alternating into alternating currents of different pressures. It may be that the general solution of this problem will be furnished by vacuum tube or by other non-magnetic means; but at present we have to be content with revolving parts for all conversion on a large scale. We print on page 1072 this week an article describing a "permutator" of European manufacture, as exhibited recently at the Liege Electrical Exhibition. Allusion has already been made to this machine in our Digest columns of November 11. It appears on examination that the machine is a particular form of converter, and not a rectifier as that term is ordinarily used. In the ordinary type of converter there is an external stator field frame, embracing a rotor armature arranged to revolve about a horizontal shaft. The armature has a single closed winding, which is tapped at intervals and connected both to slip rings and to the segments of a commutator. Stationary brushes lead alternating currents into the winding through the slip rings on one side, while other stationary brushes lead direct currents out of the commutator on the other side. Since relative motion only is required between the stator and the rotary field, the machine is manifestly capable of being made to operate with the armature stationary, and the field magnetism plus direct-current brushes revolving. This is just what the article describes in the permutator, which is the rotor-stator inversion of the ordinary type of converter. The stator armature is the external member, and within it is placed a rotor field magnet, arranged to rotate about a vertical axis. The direct-current brushes are fastened to the rotor field magnet system. The stator armature winding is connected in six-phase to the secondary windings of a three-phase transformer system, and also to a stationary commutator of the ordinary direct-current type. A rotating magnetic field is thus set up in the stator by the six-phase alternating current. By means of the brushes rotating synchronously around the commutator at the proper positions with respect to the rotating magnetic field, the direct currents are carried away, being converted from the alternating currents admitted to the apparatus.

The question arises as to the relative advantages or disadvantages of this type of converter by comparison with the ordinary type, the electromagnetic actions occurring in both being the same. It does not appear that the efficiency or power factor reported of the "permutator" are superior to those of an ordinary converter of the same power. From a mechanical standpoint the brushes and brush-holders of the permutator are harder to design than those of a converter, because centrifugal force in the type described tends to reduce their pressure on the commutator at full speed. If any brush gets out of order in a converter it may readily be replaced. In the permutator a brush cannot be changed or adjusted without stopping the machine. On the other hand, the permutator leads in regard to compactness. The rotor field magnets have about the same weight and size as the commutator. The permutator type may well save in floor space and in size of machine, items which are of considerable importance in city or suburban traction. Of course this compactness introduces difficulties in cooling that may appreciably influence the design. It is claimed that 66.6 watts per kilogramme, or about 30 watts per pound of total machine weight, can be obtained from these permutators, whereas only about 15 watts per pound can be obtained in practice from ordinary converters. A considerable advantage in favor of the permutator type lies in its small radius of gyration and moment of inertia. This should enable the machine to follow changes in frequency without nearly so much danger of dropping out of step as exists in ordinary converters. It is true that the ordinary converter, as at present constructed, is a very satisfactory machine; but if the generating plant gets into trouble and begins to oscillate in frequency, it stands to reason that the lower the moments of inertia of converter rotors connected to the system, the more range of oscillation they will stand without breaking out of synchronism, and also the smaller the correcting currents required to maintain isochronism during the disturbance. The statement that these permutators, in 150-kw sizes, can be synchronized from rest in three seconds of time, bears upon and ilustrates their responsiveness to changes in frequency. Taking all things into consideration, therefore, it would seem as though the permutator type of converter might come into favor.

A New and Higher Standard of Direct-Current Operation.

By Frank J. Sprague.

THE hope of extended electric equipment and operation on the main lines of trunk railways, as distinguished from special problems such as terminals, tunnels and congested sections, lies not alone in the possibility of increased traffic or economy of operation, but in such limitation of capital investment as will keep the burden of interest account measurably below the savings effected.

A vital element in this investment is of course that relating to sub-stations and conductors. As to the latter, it is evident that greatly increased potentials are necessary to keep down their size, or with any given cost of conductor per mile to increase the distance between sub-stations, with resultant less aggregate investment in them and higher economy in operation. These are common requirements no matter whether alternating or direct currents are used. The bearing of the increase of potential upon the problem is quite evident from a consideration of the following general facts: When the traffic increases directly as the mileage the distance between sub-stations, with any given loss and size of working conductor, will increase directly as the increase of working potential; on the other hand, so long as the train load between sub-stations is not increased, this distance will increase as the square of the potential; but taking the average of service conditions on a trunk line, the allowable increase in sub-station distance will lie between these extremes. To illustrate: Doubling the working potential would probably on an average allow trebling the sub-station distances, and trebling the potential would very likely allow an increase to say five times in distance.

To meet the various economic requirements, and proceeding on the assumption that 500 to 600 volts is the limiting standard for direct-current operation, the principal energies of many engineers and manufacturing companies have of late been devoted to operation by alternating currents, with varying degrees of success as applied to railroads, with the abandonment of third-rail construction and adoption of a special type of overhead contact. These developments have resulted in a variety of designs for both polyphase and single-phase motors, and considerable divergence in views as to potentials, frequency, and mode of construction and operation where the single-phase has been adopted.

It is not my purpose at present to enter into a discussion as to the comparative merits of the various systems, each of which has its field of usefulness. I have long advocated and am keenly alive to the economic bearing of increased potentials, however obtained, but also mindful of certain practical features which must be considered in connection with them. I believe, however, that where alternating-current motor operation, with overhead construction, is adopted, there is little reason for halting at any moderate limit, but that such potential should be used as may be necessary, all things considered, to get a reasonably full measure of the possible economy of investment.

On the other hand, I have frequently pointed out that the limits of direct-current operation are by no means reached, and that five or six hundred volts was an arbitrary standard which present possibilities in construction of apparatus no longer warrants maintaining when leaving the field of tramways to take up the consideration of trunk line applications.

The time has now come, I think, in view of the developments which are taking place on the terminals of the roads entering New York City, the interest which railway officials are taking in the subject, and especially because of the various claims which are from time to time made, when equipment engineers, in considering the practical application of electricity to the more serious problems of railway operation, shall have as a choice the possibilities of higher limits in direct current as well as in alternating-current operation.

To that end I beg, therefore, to announce that if in any case, after considering the various kinds of equipment possible, it should seem from an analysis of all elements entering into the problem that a comparatively high-potential, direct-current equipment would produce the best net results, I am prepared to engineer and carry to a successful conclusion a direct-current installation at a working pressure, even on a third rail, of not less than 1,500 volts, which is at least two and a half times that ordinarily used.

I believe that it may be admitted that although oftentimes having taken a somewhat radical and advanced position in electric railway matters I have never made a public proposal which I have not been ready when called upon to carry out, and should conditions arise warranting an equipment such as is proposed, I propose to establish a new and necessary comparative standard in equipment possibilities. And I venture further to affirm that 1,500 volts is not the limit of practical direct-current operation.

The Electric Underground Road for Philadelphia.

For some time past an electric subway has been in process of construction in Philadelphia, under the management and control of the Philadelphia Rapid Transit Company, which operates the bulk of the surface trolley lines. The work now nears completion, and this week, on Monday, December 18, the first section of the subway was officially opened by the operation of surface cars through it on a five-minute schedule, these cars belonging to one of the divisions of surface cars which run out Market Street. The section of subway now in use extends under Market Street from Fifteenth Street to the Schuylkill River. After leaving the subway the cars cross the river on the new bridge erected by the Philadelphia Rapid Transit Company, connecting Philadelphia and West Philadelphia. The subway is not entirely completed from Fifteenth Street west. There are to be four tracks, two for express trains and two outside for surface cars.

For the express service the company will employ trains of all-steel cars, which after crossing the Schuylkill River, will continue out on Market Street, upon an elevated railway structure as far as Sixty-third Street. Owing to a strike in the building trades it will not be possible to put the elevated trains in service for some considerable time. It was thought desirable, therefore, to utilize the subway for surface cars meantime, and thus relieve the existing pressure on traffic facilities. The trolley cars for the present leave Market Street at about Thirtieth Street and cross the river on the new bridge. The local tracks in the subway are used as far east as the Nineteenth Street station, where the surface cars cross over on to the express tracks, and they then use these tracks to Fifteenth Street.

On December 16 about 500 prominent street and steam railway engineers and managers, city officials and others interested in elevated and underground traffic made an informal inspection of the subway, as the personal guests of John B. Parsons, president of the Philadelphia Rapid Transit Company. The guests walked through the underground passage, which was lighted by temporary fixtures as well as by the permanent lighting system of the tunnel. At 1 o'clock lunch was served at the Nineteenth Street station, which had been temporarily enlarged by extending the platform over the west-bound track. On Sunday, December 17, the Philadelphia Rapid Transit Company extended a general invitation to the citizens of Philadelphia to visit and inspect the subway, and more than 50,000 people crowded in to take this opportunity.

The completed subway section between Sixteenth Street and the Schuylkill River, at Twenty-fifth Street, is a small portion only of the proposed system. When completed there will be an elevated railway from Thirtieth Street to Sixty-third Street. The subway is to be extended east around the City Hall and thence under Market Street to Water Street, where it will emerge through a portal on to an elevated structure which runs north on Water Street and east on Arch Street to the Delaware River, and then south along the river front, a distance of a little over a half mile. This portion of the subway will be double-tracked and is for express trains only. The two outer tracks in the subway, which are to be used by the trolley cars, will branch off from the present subway at the City Hall and will make a loop through the business district via Walnut Street, Fifth Street and Arch Street. In this way the trolley cars bound east from West Philadelphia will run on the south outside track in the present subway, and after making the loop will return west by the north outside track.

The present subway structure has a width of 48 ft. 6 in. in the clear between walls, and 14 ft. 6 in. high in the clear, above the rails. Three intermediate lines of columns support the roof, which is designed to support the heaviest street traffic. The roof is formed of concrete arches, supported on steel I-beams, 5 ft. apart, placed across the subway; the side walls are of concrete, reinforced with steel rods, and the floor is of concrete alone. Terra cotta ducts, with manholes at frequent intervals, are built in the south wall, forming the conduits for the cables conducting electricity for the operation of the railway and lighting the subway and stations. The roof over its entire length is water-proofed with asphaltic mastic 1 in. thick. The side walls are water-proofed where necessary with layers of burlap, coated with a compound consisting of the residuum from the refining of petroleum. The underdrains include two lines of terra cotta pipe, one under each outside track, with laterals passing to the exterior of the side walls every 50 ft. The main drains lead to a pump well at Twenty-second Street, where the water is discharged into a sewer by electrically-driven centrifugal pumps regulated automatically by floats.

The stations on the present section are at Fifteenth Street, Nineteenth Street, and at the east end of the Schuylkill River Bridge, near the line of Twenty-fourth Street. The latter station is designed to make connection with the Baltimore & Ohio Railroad station, and with the Fifteenth Street station is for both express and local trains. The stations at Nineteenth and Twenty-fourth Streets are intended for the trolley cars only.

The lighting circuits in the subway are entirely separate from the power circuits. The subway is divided into sections about half a mile in length, and the lamps at each station and for a distance half way to the next station on each side are supplied on a 110-volt circuit from a transformer located in the station. Each transformer sub-station is provided with a throw-over switch by which the lamps can be connected, if necessary, in groups of five, on to the railway circuit.

The track is quite novel as no ballast is used. The object is to keep everything in a perfectly sanitary condition, and the entire roadbed can be washed down with the hose and drained through sumps which are placed at frequent intervals. A different form of construction has been used in the express and in the local track. In the latter the rails are mounted on cast-iron chairs, which, with the rails, are completely embedded in concrete. This form of construction has been used for a number of years on the surface lines of the company with excellent results. The chairs or yokes are spaced 5 ft. apart and are provided at their upper ends with guide lugs in which are adjusting screws. The inside ends of these screws bear against holding blocks which grip the foot of the rail so that the rail is adjustable to exact gauge by manipulating the screws. The rails are laid in a trench left in the concrete which forms the rest of the roadbed. The rails are then aligned and the concrete is filled into the trench even with the top of the head of the rail on the outside and with the lower part of the head of the rail on the inside. In this way, if a rail has to be replaced, it is only necessary to remove the concrete in the trench. Sumps are provided in the local tracks at average distances of 50 ft.

On the express tracks, except at crossovers, the rails are mounted directly on yellow pine blocks 6 in. by 24 in. by 10 in., to which they are attached by clips and screw spikes. The longitudinal channels are set in concrete. The sumps on the express track are placed 500 ft. apart. One rail of each express track has been reserved for block signaling. The other rail is bonded with a protected bond and the two return rails are cross-bonded. The return circuit is then reinforced by a 2,500,000-cir.-mil cable. The local track rails are laid with the standard zinc joint of the Philadelphia Rapid Transit Company. The rails for both tracks are 90-lb. A. S. C. E. standard.

As the local tracks are to be used by surface trolley cars they are equipped with an overhead wire, which is supported in a special flexible suspension. This consists of two U-shaped brackets, which are attached to brackets set in the concrete roof of the tunnel while the latter was being built. The insulator hanger, which is of the usual bell type, is supported on a span wire connecting these two U-shaped brackets. The usual wooden guard plank is carried above the trolley wire. The express tracks and elevated structure will be equipped with a third-rail system. At present the express tracks will be equipped with the trolley system and will be used by the trolley cars until the elevated structure is completed.

Ventilation is secured not only by the openings into the street at the different passenger stations, but also by special chambers which are connected to stacks outside. Arrangements have been made at the base of these stacks for the installation of fans if necessary, but in most cases it is thought that the natural draft will be sufficient. There are three of these stacks on the section now completed, viz.: at Fifteenth Street, Nineteenth Street and Twenty-second Street. Similar ventilation shafts will be constructed on private property on the section of the subway which will next be opened, viz.: that east of Fifteenth Street.

For the present the surface cars will be used, but an order for 40 steel cars to be employed in express service has been awarded the Pressed Steel Car Company. These cars are provided with side doors as well as end doors, although it is not the present purpose of the company to utilize these side doors. In case the traffic increases, however, so as to cause any considerable delay in station stops, the seats will be removed and the side doors will be used. The platform doors are arranged to be opened pneumatically, as in the latest cars of the Boston Elevated Railway Company.

Electrolysis of Gas Pipes.

In discussing a paper on "High-pressure Gas Distribution of To-day," read by Mr. H. L. Rice before the meeting of the American Gas Light Association, at Milwaukee, Wis., on October 19, Mr. Frank S. Richardson related some experiences with electrolysis of gas pipes due to the current which escaped from a neighboring trolley railway. The power station for the railway is located at about the middle of a six-mile pipe line, and the pipe is connected to the trolley rail at this point in five places. About 600 ft. of pipe has recently been removed opposite the power house on account of the damage which had been done before the pipe was connected to the rail. One length of pipe had 27 pits in it, and three other lengths were pitted so badly that they leaked. Formerly there was an insulated joint in the pipe line at intervals of 500 ft., but the pipe has recently been bonded with No. 4-0 wire, making the line a continuous conductor. Experience indicates that it is best to have the line free from insulated joints and to bond to the rails wherever possible. Tests have shown that, due to the unavoidable potential drop in the rail portion of the electric railway circuit, difference in potential exists between the opposite ends of each insulating joint and current will pass from one length of pipe to the next by way of the soil. Observations have furnished conclusive evidence that insulated joints will not keep the pipe from being damaged, and that the best method is to bond the pipe joints.

Mr. Theodore Bunker stated that a difference of potential as high as 25 volts had been found between the pipe line from Camden to Trenton, N. J., which is laid parallel to a poorly bonded electric railway. A heavy copper wire was run from the pipe to the power house and after three years of operation, when the pipe was uncovered, it was found that no damage had been caused by electrolysis.

The Zambesi Power Scheme.

Prof. W. E. Ayrton in the London *Times* criticizes severely the Zambesi power scheme, the details of which have recently been given in these columns. He denies the possibility of such a scheme being commercially successful, and condemns the comparisons made between the power schemes at Victoria and Niagara, as the latter only delivers electrical energy over a distance of 30 miles while the former proposes to deliver it over 745 miles. At present the Rand consumes about 150,000 hp at a cost of something like $100 per year per horse power. Niagara sends 24,000 hp to Buffalo, 30 miles away, and sells it at 14 cents per horse-power-hour to an eight-hour customer, which is equal to $125 per horse-power-year. There is a plentiful supply of coal in the neighborhood of Johannesburg, and estimates have been obtained and accurate analyses made of about 20 different kinds of coal, giving the specific gravity and the percentages of carbon, ash, volatile matter, coke, as well as the evaporation factor, with the result that at a price of $2.60 to $3.00 a ton excellent coal can be delivered on the Rand itself. How is it possible, therefore, asks Prof. Ayrton, to "transmit electric energy 745 miles and sell it more cheaply than it can be obtained from coal on the spot?" He also points out the dangers from native interference with the line, and summarizes his objections to the scheme in the sentence that "such lengthy transmissions, more than three times as long as have ever yet been made, because more than three times as long as even the enterprising Americans have ever yet considered commercially possible, could certainly never succeed in such an unsettled country as South Africa."

Exhaust Steam Direct-Current Turbines in Philadelphia.

The Philadelphia Rapid Transit Company has just installed at its power station at Thirteenth and Mt. Vernon Streets an 800-kw Curtis low-pressure turbine, which takes steam from the engine exhaust. This station is equipped with four 1,500-hp and one 2,200-hp Wetherill Corliss engines, and as it is located at a distance from both the Schuylkill and Delaware Rivers, has always been run without condensers. An Alberger condenser and cooling tower with 8,000 sq. ft. have recently been erected, however, for the use of the low-pressure turbine. The cooling towers are 22 ft. in diameter and 41 ft. high and the rotary pumps for circulating the water in these towers are directly connected to a 120-hp inter-pole electric motor. The average vacuum attained in the condenser since starting a few days ago is 28 in., although it is said that a vacuum as high as 29½ in. has been secured.

The 1,500-hp engines are each direct-connected to a 1,500-kw generator which develops an average of about 2,000 amp. at 575 volts. The turbine takes steam from the exhaust main at a pressure of, say, 1 lb. above the atmosphere, and is provided with four wheels, each with a single row of buckets. Exhaust steam from one engine when operated at 2,500 hp or 2,000 amp. is sufficient to secure an output from the turbine of 1,300 amp. at 575 volts, with no increase in the back pressure on the engines. As about 150 amp. are required to operate the auxiliaries, the gain from the use of the turbine is from 1,000 to 1,200 amp., or approximately 66⅔ per cent of the output of the original generating unit, instead of the 25 per cent usually expected from the introduction of a condenser.

The generator portion of the turbo-unit is also interesting, as it is a direct-current machine, having six poles and running at from 1,100 to 1,200 r.p.m. The voltage is remarkably steady in spite of the fact that no governor is used on the turbine.

The turbine was put in service December 15 and tests are now being conducted to determine its steam consumption. The rated capacity of the turbo-generator is 800 kw at a speed of 1,200 revolutions. With the turbine receiving steam at atmospheric pressure without moisture and with 2 in. absolute back pressure in the condenser, a water rate is guaranteed of 36 lb. at full load and 40 lb. at half load. At 4 in. absolute back pressure the guarantee is 45 lb. and 50 lb., respectively. It is stated that on recent tests on this unit made at Schenectady these figures were met with a large margin to spare, thus showing that low-pressure turbines can be used to great advantage where a comparatively large amount of exhaust steam is available. The Philadelphia Rapid Transit Company has ordered a duplicate of the present unit.

◆

To Begin Electrification of Erie Road.

In accordance with reports frequently referred to in these columns, the management of the Erie Railroad has now announced its intention to begin the construction of an electric line from Binghamton, N. Y., to Corning, a distance of 76 miles. The new line will parallel the present line of the Erie between these two points, and is intended to care for local passenger traffic. The surveys for the line are to be made immediately, and the contracts for the construction work will be let probably in January. This line will mark the entrance of the Erie Railroad into the electric traction field. In general its policy is the same as that of the New York Central and the New York, New Haven & Hartford Railroads. Both these roads have for some time been buying control of electric lines at points where the trolley lines seriously interfered with the local traffic of the railroads.

The cost of the Erie's electric line will be in the neighborhood of $1,500,000. This money, it is understood, will be provided out of the proceeds of the recently authorized $12,000,000 issue of convertible bonds. This first piece of electric road under Erie control is likely to be followed by the construction of other electric lines at various points where the Erie management may consider it wise to construct them. It has adopted this policy, it is said, in order to discourage the construction of electric roads paralleling the Erie lines.

The Erie's new line from Binghamton to Corning will be built along the present right of way, making a third standard track adjoining the two tracks which the Erie now has in operation between these points. The line will be so constructed that it will be available for the operation of the company's regular trains should occasion arise for such use of the new tracks. If the traffic on the new line warrants it, a fourth track, also equipped electrically, may be added.

The line, starting from Binghamton, will run through the towns of Union, Owego, Southboro, Waverly, Chemung, Elmira and Horse Heads, ending at Corning, where the northern line of the Erie diverges from the main line. There will be considerable local passenger traffic along the new line, and it is hoped to relieve the Erie's main tracks of its burden, leaving them to be used for through trains and for freight. It is probable that trains will be run on the electric line at intervals of an hour, or perhaps even closer together.

No decision has yet been reached by the Erie officials in regard to the electrification of its suburban lines running out of Jersey City. It is the ultimate intention of the management to electrify these lines, but how soon and in just what manner has not been determined. It is probable, however, that the further electrification of the Erie's lines will be undertaken at various points before the work is begun on the road's lines in New Jersey. Ultimately there will be an Erie electric tunnel under the Hudson into New York.

◆

A High-Speed Suburban Road.

The end of the prolonged fight extending over four years for a franchise, first before the Board of Aldermen and then before the Board of Estimate, by the Port Chester Railroad Company, was reached last week, when the company persuaded the Board of Estimate to approve its application. The board adopted a resolution fixing terms under which the road may obtain a franchise to operate in the Bronx, but the action is tentative inasmuch as the terms have to be advertised for twenty days under the law, and also because the courts have not yet passed on the constitutionality of the act giving franchise-granting powers to the Board of Estimate instead of to the Board of Aldermen. Under the terms, as approved by the Board of Estimate, there are 42 sections, all of which have been accepted by President W. C. Gottshall of the road and by ex-Judge D. Cady Herrick as counsel. The franchise is to run for 25 years with the privilege of another like term on a revaluation. For the first five years the company is to pay $8,000 a year to the city, with $13,000 a year for the second five years, and $35,000 a year for the next fifteen years.

In addition the company will have to pay 5.4 cents per linear foot of track per year for the first five years, 7 cents per foot for the second five years, and 20 cents per foot for the last fifteen years.

In addition to these payments the terms demand that the company shall complete work to the value of $1,000,000 within five years from the date of the execution of the contracts. A bond for $100,000 guaranteeing the performance of this work must be deposited in the Comptroller's office. The company is prevented from mortgaging or selling out to any other company. There are to be no grade crossings, and the city is to be guaranteed from damage in operation. At least 60 trains per day in each direction are to be operated, with $50 penalty for each train under that number. The road is to be four-tracked south to One Hundred and Seventy-seventh Street and two-tracked down to the Harlem River, with a heavy high-speed electric service.

◆

Gifts to Princeton.

The Princeton University trustees held a meeting at Princeton on December 14 at which was announced the receipt of $80,076 in gifts to the university since October. Announcement was made that the Supreme Court of Missouri had upheld the validity of the will of the late Dr. John S. Sayre, class of '78. From this the university will receive about $40.000, to be used for the endowment of a Fellowship of Applied Chemistry and a Fellowship of Applied Electricity, both in the John C. Green School of Science. The remainder of the bequest is to be used for the endowment of scholarships to be known as the Class of '78 Scholarships. In his will Dr. Sayre expressed the desire that his classmates should contribute an equal amount for the same purpose.

Electrical Engineers of the Times.—XLI.

MR. C. L. DE MURALT.

Carl Leonard de Muralt was born in Brooklyn, N. Y., January 29, 1873. His parents having moved to Europe while he was a child, his primary education was received in the schools of Zurich, Switzerland. After graduation from the Zurich Gymnasium, he studied five semesters at the Polytechnic of Zurich, and two semesters at the University of Munich, Germany, subsequently taking up some special research work under Prof. H. F. Weber at the Polytechnic of Zurich.

In 1895 Mr. de Muralt returned to America, where he entered the employ of the General Electric Company, first in the shops at Schenectady and then in the engineering department under Dr. C. P. Steinmetz. In 1897 he was detailed by the General Electric Company to the Union Elektricitäts Gesellschaft in Berlin, Germany, as engineer of the lighting and power department. Under this appointment he had charge of the design and erection of some of the most important plants installed by the Union in various European countries, among others the city lighting plant of Madrid, Spain, which was one of the first plants in Europe to use high-tension alternating currents in connection with a system of subterranean transformer sub-stations and distribution through an extensive underground cable network. In 1899 he entered the employ of Brown, Boveri & Co., of Baden, Switzerland, for whom he designed several large power transmission plants, including the installation of the Fure & Morge Company, near Grenoble, France, which makes use of a large water power on the northern slope of the Alps and transmits the energy down into the French plains. There it is distributed to a large number of towns for use in small and large industrial establishments, notably silk spinning and weaving mills, paper factories, etc., the motor equipment for all of which was included in the contract. The transmission voltage of this installation is the highest used by any plant in Europe and the use of synchronous as well as asynchronous motors gives this plant a remarkably high power factor through the system. The building of the well-known Swiss three-phase, alternating-current railways by Brown, Boveri & Co. gave Mr. de Muralt an opportunity to do considerable original work in this interesting field, in which his firm acted as pioneers. He is a strong believer in the advantages of polyphase alternating currents for heavy railroad work and he has more than once given public expression to this opinion, even at a time when he was practically alone in taking this standpoint.

MR. C. L. DE MURALT.

In 1902 Mr. de Muralt was called to America as consulting engineer for the Lake Superior Power Company, of Sault Ste. Marie. In the same year he established the firm of Muralt & Co., consulting and contracting engineers, New York, and he has since been connected with a number of important American electric propositions. He is a member of the American Institute of Electrical Engineers, to the *Transactions* of which he has contributed papers on "Polyphase Alternating Currents for Railroads" (1902), and "Heavy Electric Traction" (1905). He has contributed articles to the technical periodicals both in this country and abroad, and is the author of a leading article in the *North American Review* of May, 1903, on heavy railroading.

CURRENT NEWS AND NOTES.

DEAD AT THE BOARD.—A very unusual occurrence was the death last week at the switchboard of one of the girl operators in the Chelsea exchange of the New York Telephone Company. It was a case of heart disease, to which the young woman was subject; but the thorough care in selection of employes renders such an incident practically unique in telephone work.

MORE STREET DESTRUCTION.—The Great Eastern Telephone Company announced last week that it would begin to dig the ditches for its conduits in Manhattan and the Bronx within the next two weeks. "At the opening of spring," D. A. Reynolds, president of the company, said, "we shall begin work in Brooklyn. We hope to have the plant in operation inside of six months."

SOUTH AMERICAN CABLES.—The cable steamship *Faraday*, belonging to Messrs. Siemens Brothers & Co., having on board 1,750 knots of cable for the Central and South American Telegraph Company, has sailed for Valparaiso, where she is due to arrive about December 28. This cable is to duplicate the Central and South American Telegraph Company's system between Valparaiso-Iquique, Chili, and Callao, Peru.

RADIOACTIVE ELEMENT.—Instructor O. Hahn, working under Prof. Ramsay at the University College, London, claims to have found a new radioactive element. It is said that the new substance is nearly as active as radium and is a constituent of thorium, used in the manufacture of gas mantles. The substance has been named radio-thorium. Pending further details, the announcement does not reveal any very startling novelty.

HARTFORD ELECTRICAL SOCIETY.—The Hartford (Conn.) Electrical Society has elected the following officers: President, Prof. Henry A. Perkins; vice-president, Charles A. Hovey; recording secretary, A. G. Steele; financial secretary, S. W. Harney; treasurer, Frederick C. Hedrick; lecturer, T. H. Day. "Electric Light and Power Economics" was fixed as the subject of a lecture by Prof. Perkins before the society on the evening of December 21.

CAPITAL PUNISHMENT FOR STEALING WIRE.—A City of Mexico correspondent states that a bill has been introduced in the Mexican Congress to make the theft of copper wire, used for transmission purposes, punishable by death in case such theft causes fatal accident to any one. It is stated that over $30,000 worth of copper wire has been stolen from electric power concerns in the City of Mexico recently.

A FAILURE ABROAD.—A dispatch from Washington of December 9 states that Prof. Frank H. Roberts, of the University of Denver, was presented to the President by Representative Mondell, of Wyoming. Prof. Roberts returned recently from an extended trip in Europe, where he went to study the question of municipal ownership of public utilities. He visited Glasgow, Manchester, Liverpool, London, Brussels, Amsterdam, Antwerp, Hamburg and Berlin. He expressed to the President the opinion that public ownership of public utilities was a failure in Europe, and predicted that, in a few years, it would have few supporters even in Great Britain, where it has been popular.

MOTOR BOOTS are thus described in a special dispatch from Paris of December 16: "Parisians were startled yesterday by seeing a big-booted man whizzing along the Avenue des Champs Elysèes, and thence to the Bois de Boulogne at the rate of 25 miles an hour. It was Constantini, the inventor of motor boots, displaying the new footwear. The boots resemble tiny automobiles, 15 in. long, fixed on high boots. Each has four rubber-tired wheels 8 in. in diameter. Accumulators are carried in a belt. They transmit by wires 1¼ hp to each motor. The motors can be run at a speed ranging from six to thirty miles an hour. Each boot weighs 16 pounds, but as the feet are not lifted up the weight does not matter. Constantini says he has traveled several hundred miles with them. He intends to travel from Paris to St. Petersburg on them. When asked what would happen if one motor started at the rate of six miles an hour and the other at thirty he became diffident and declined to discuss the subject." We should greatly like to see those accumulators.

STANDARDIZATION IN TELEPHONY.—Mr. F. R. McBerty addressed the electrical section of the Western Society of Engineers at Chicago December 15 on standardization in telephony. The topic brought out considerable discussion, as might be expected in a field where so much diversity now exists.

FRENCH ELECTRICAL DECORATIONS.—A Paris dispatch regarding the automobile exhibition in that city says that the scheme of decoration of the Grand Palais is entirely different from last year's plans. The decorations this year comprise 50,000 electric lamps, with a huge luminous sun in the center, surrounded by hundreds of luminous stars.

A CENSUS TEXT-BOOK.—The department of electrical engineering at Cornell University has recently adopted as a text-book the United States Census Bureau report on electric and street railways issued this year. The report, which is a large quarto volume of 439 pages, profusely illustrated, not only embodies the statistics of the art up to 1903, but gives a large amount of technical, economic, sociological and historical data.

WEST INDIAN WIRELESS.—A correspondent at Key West writes us: "It may be of interest to you to know that the wireless station at Colon, Panama Isthmus and the station at Key West have communicated with each other regularly at night since December 1. The large station at Manhattan Beach is heard every night at San Juan and Key West. Communication between sunrise and sunset over long distances has not yet been accomplished by these stations."

FOR UNION COLLEGE.—At a dinner of the Union College Alumni Association, held at the Hotel Manhattan last week, announcement was made of a gift by Andrew Carnegie. The General Electric Company has already presented the college with a building for electrical engineering, to cost $25,000.. This Mr. Carnegie has now promised to equip at an expense of $100,000, provided the college itself raises another $100,000 to endow it. More than $20,000 has been raised in the last few days by the alumni and friends of the institution.

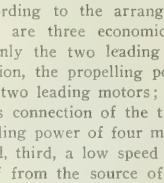
THE QUESTION BOX.—President Blood has appointed Mr. Paul Lüpke, superintendent of the Trenton division of the Public Service Corporation of New Jersey, editor of the "Question Box" for the twenty-ninth convention of the National Electric Light Association, to be held next May or June. Mr Lüpke has been from the first one of the most enthusiastic admirers and close students of the "Question Box," and is a firm believer in its value to central stations. He is himself a thorough engineer and will undoubtedly make this year's work at least the equal of its predecessors.

THE NOBEL PRIZES.—Rules regarding the awarding of the famous Nobel peace prize have been received by the Department of State. All proposals of candidates for the prize which is to be distributed December 10, 1906, must be laid before the Nobel Committee of the Norwegian Parliament by a duly qualified person before the 1st of February of the same year. Any one of the following persons is held to be duly qualified: Members of the Nobel Committee of the Norwegian Parliament, as well as the advisers appointed at the Norwegian Nobel Institute; members of Parliament and members of government of the different states, as well as members of the Interparliamentary Union; members of the International Arbitration Court at The Hague; members of the Commission of the International Peace Bureau; members of the Institute of International Law; university professors of political science, and of law, of history and of philosophy; and persons who have received the Nobel peace prize. The grounds upon which any proposal is made must be stated; every written work, to qualify for a prize, must have appeared in print. For particulars qualified persons are requested to apply to the office of the Nobel Committee of the Norwegian Parliament, Drammensvei 19, Christiania.

AMUNDSEN'S WORK.—Writing with regard to Amundsen's work in locating the magnetic north pole, and the value of the determination, Prof. W. Hallock, of Columbia University, says: "Is it not natural that our pulse should quicken at the narration of the brilliant achievement of the Norwegian who shut himself in the frozen north, and while his fellow-countrymen were making a new kingdom and a new King he made for himself a place in history as enviable and as lasting as that of any King? When Roald Amundsen pitched his little settlement upon the shores of King William Land and proceeded to set up his magnetic apparatuses in the chilly prospect of spending two years in watching them, and then possibly succeeding in getting home with his records, he faced a proposition that might well stagger the bravest. This was no rampart that could be stormed with a glorious dash, to the sound of music, and before the eyes of admiring fellows. Here was what Horace so aptly described as *'vir tenax praepositum,'* a man so tenacious of his undertaking that he had no suspicion of the possibility of failure; who succeeds because he sets out with the firm conviction that he will succeed. In 1831 Ross located the 'magnetic pole' on the west shore of Bootia Felix (Boothia or Boothia Isthmus); it was approximately located about 60 miles farther west in 1879, and here this persistent hunter camped as near its trail as possible, and provisional reports indicate that it is now 'near Boothia Felix.' The scientific world is waiting with considerable impatience for his results. They are reported as 'very satisfactory,' and in that case they will stand out absolutely unique. Two years of successful observations at that point are a treasure without price."

CASCADE CONNECTION OF POLYPHASE INDUCTION MOTORS.—A patent issued December 12 to Mr. Coloman de Kando, of Budapest, Austria-Hungary, relates to the operation of polyphase induction motors at variable speeds for railway work. The inventor proposes to use a plurality of cascades of induction motors, each motor having a three-phase primary and a three-phase secondary winding. Thus with a four-motor equipment, there would be two cascades, each containing two motors. Under the usual method of operation, this arrangement would permit of two economical speeds. According to the arrangement disclosed in the patent, however, there are three economical speeds—namely, the highest speeds with only the two leading or primary motors of the cascades in operation, the propelling power being that due to the operation of these two leading motors; second, an intermediate speed due to the series connection of the two motors in each cascade, whereby a propelling power of four motors is obtained at this intermediate speed, and, third, a low speed with the leading motor of one cascade cut off from the source of supply and the second motor of this cascade switched in series with the two motors of the other cascade. In the latter case, the propelling power is due to the operation of three motors at the slowest speed.

INDUCTION WATT-HOUR METER.—A simple form of watt-hour meter is disclosed in a patent issued December 12, to Messrs. William Hamilton and S. Z. Ferranti. As indicated in the accompanying illustration, the shunt-wound magnet, which is disposed above the outer portion of the revolving disk, has three limbs, on the central one of which the coil is placed, so that at any instant when the central limb is of a central polarity the two outer limbs are of the opposite polarity. The two poles of the series-wound magnet, which is below the disk, are arranged practically opposite to the poles of the shunt-wound magnet. In order to obtain a lag of 90 degrees of the effective torque producing flux behind the impressed electromotive force of the shunt coil, the leakage of magnetic lines is made considerable by placing the shunt coil high up on the central limb and providing the lower part of this limb with an additional metallic cross-section, the effect of which is to produce a further lag in the magnetic flux which enters the revolving disk. The inventors state that it is possible and convenient thus to produce an excessive lag, and to reduce this to exactly 90 degrees by means of a series non-inductive resistance.



RUSSIAN TELEGRAPH STRIKE.—A special dispatch from Russia, dated December 13, says: "The Government is making little headway in crushing the telegraph strike. The wires of the few lines over which service had been temporarily restored are constantly cut, and not a single wire is working out of St. Petersburg this morning. The new committee of the Postal-Telegraph Union has decided to continue the strike until the strikers' demands are completely satisfied."

THE NOBEL PRIZES.—The new Nobel Prizes, awarded this week, include the following: Physics, Philipp Lenard, professor at Kiel University, for researches into cathode rays. Chemistry, Adolph von Boeyer, professor at the University of Munchen, for researches leading to the evolution of organic chemistry and the development of the chemical industry. Each prize amounts to about $40,000. The awards are distributed at the Royal Academy of Music by King Oscar and all the members of the royal family and of the diplomatic corps are expected to be present.

ELECTRIFIED WEST SHORE.—A special telegram from Utica, N. Y., of December 14, says: "Three large trolley cars filled with railroad officials and other guests this afternoon made the formal trip from this city to Little Falls, running about three miles over the West Shore Railroad. To-morrow the new line will be open for regular business and eighty trolley cars a day will hereafter be run over the electrified portion of the steam railroad. This is the first section of the West Shore to be used by trolleys. It is expected that within a year the road will be used for trolleys between Utica and Syracuse." Data with regard to the service and equipment appeared in these pages last week.

MAGNETIC POLE DATA.—A special telegram from Seattle, Wash., of December 15 says: "The information that the Norwegian explorer, Capt. R. Amundsen, who discovered the northwest passage, had made magnetic observations, was conveyed to this city in a cable dispatch addressed to Major W. A. Glassford, and signed by Capt. Hartman, of the Signal Corps at Valdez, under date of December 12. The dispatch also states that an observation station had been maintained for two years in latitude 68° and 30′ North and 90° West, and that the data acquired corroborate the magnetic observations of Sir Charles Ross. These observations are expected to be of the utmost importance to scientific men and mariners navigating northern waters."

MEDALS FOR SUBWAY.—The last meeting of the New York Chamber of Commerce was devoted to the presentation of gold medals to the following members of the Rapid Transit Commission who are also members of the Chamber: Alexander E. Orr, Morris K. Jesup, John Claflin, Woodbury Langdon, Seth Low, John H. Starin and Charles Stewart Smith. On one side of the medal is a cross-section view of the subway and on the other side the name of the owner. The committee which presented the medals called attention to the fact that the Chamber of Commerce initiated the plan and prepared the bill passed by the Legislature on May 24, 1894, under the provision of which the subway was built. The committee also reported that a book on rapid transit, to be issued by the Chamber, is now being prepared.

TAXING SLOT TELEPHONES.—The city officials of Montreal intend to put into force the new by-law in regard to taxing slot machines. The following is the clause in the by-law imposing the tax: "Section 11.—No person, firm, company or corporation shall have under his control or in his possession any slot machines, in which the public is allowed to drop money, without having previously obtained a license from the city and without having paid to the city treasury certain sums." The tax was assailed by the Bell Telephone Company, which held that the city had not the right to impose it. The recorder has upheld the action of the city in this connection; in consequence of the judgment the by-law will be put into force and the company in question will be called upon to pay the tax, the same as any other company or individual. Officers of the company state that the decision, which compels them to take out licenses at a stated sum annually for all slot telephones, will not, even if enforced, cause them to abandon the system generally, though it would cause them to withdraw instruments which are now earning very small sums.

THE CARNEGIE FOUNDATION.—Dr. Henry S. Pritchett, formerly president of the Massachusetts Institute of Technology, will begin his work as president and executive officer of the $10,000,000 Carnegie Foundation on January 1 with a permanent residence in New York, at 542 and 544 Fifth Avenue. The Carnegie Foundation, which Mr. Carnegie established with a gift of $10,000,000, is designed to aid deserving and elderly teachers and professors and make possible larger opportunity for research work. In its executive committee are many of the presidents and most prominent instructors of the institutions of learning in the United States. Dr. Pritchett took charge of the Massachusetts Institute of Technology five years ago. Previous to that time he was superintendent of the United States Coast Survey, stationed at Washington. He is a native of Missouri and a graduate of the University of Munich.

ABOUT LORD RAYLEIGH.—The distinguished English physicist, Lord Rayleigh, has been elected president of the Royal Society. He has taken all physics to be his province, and has worked to reduce them to a compact homogeneous system. The discovery of argon made him known to the general public, but this was only part of the results of a delicate investigation intended to throw light on the gaseous state of matter. Few physicists have a more extensive record of achievement. Nevertheless, Lord Rayleigh has found time for public affairs as well. He held the Cavendish professorship of experimental physics at Cambridge University for five years, and there conducted those absolute electrical determinations which have been part of the foundation of practical measurement in electrical engineering. He was secretary of the Royal Society for ten years, and has presided over the development of the National Physical Laboratory.

THE WATERWAYS COMMISSION.—It is stated from Washington that in order to prevent international complications growing out of the indiscriminate use of the waters of the Sault Ste. Marie by Canadian and American power companies an effort will be made in the near future to secure the adhesion of the two countries to an agreement, recommended by the International Waterways Commission, to withhold the issue of any further rights or privileges for the diversion of these waters until the commission has collected enough data to formulate joint rules to regulate the disposition of the water. Rival power companies on both sides of the river are trying to extend their plants, and the commission has pointed out to the War Department that the future navigation may be seriously jeopardized unless some regulations are adopted that shall be binding upon both sides. The acceptance of the commission's recommendation, which is regarded as probable here, would imply the continuance of the body for another year at least, and it may be that in the legislation that will be proposed to Congress by Secretary Taft provision will be made for a permanent international waterways commission.

MORE TUNNELS.—Delegations from various sections of the city attended the meeting of the New York Rapid Transit Commission on December 14 until the place was jammed. One delegation of 250 from Brooklyn, present on the suggestion of the Bensonhurst and Bath Beach Subway Association, urged additional subway service through those sections of the city. The speakers urged that the residents were entitled to subway accommodations, and they wanted a line extended from the Flatbush Avenue terminal. Delegations from the Ozone Park Board of Trade and from other sections of Queens were heard, suggesting changes in the proposed Jamaica Avenue line, so that the residents of Ozone Park would have a subway loop. The Washington Heights Taxpayers' Association likewise had a grievance, as had the North Manhattan Taxpayers' Association also. Both organizations wanted to know why the Washington Heights section of the subway has not been opened north of One Hundred and Fifty-seventh Street. Speakers declared that the subway was completed to King's Bridge and that the tracks were being used for switching and car storage purposes. The plan for the extension of the Flatbush line of the Brooklyn Tunnel of the Interborough Rapid Transit Company, submitted also at a recent meeting of the Rapid Transit Commission by the Park Department, is looked upon with some favor by the Interborough interests. Heretofore it had been proposed to run the sidings for the storage of cars underneath the parks. The new plan is to run the sidings under a vacant lot opposite the parks.

FRANKLIN'S BIRTHDAY.—The two hundrelth anniversary of Benjamin Franklin's birthday was celebrated by the Pennsylvania Society of New York, on December 12, at the Waldorf-Astoria, on the occasion of the annual banquet. The date is in reality January 17. Some 500 members and guests were present. Among the speakers was Mr. F. P. Fish, whose toast was "Franklin as a Scientist."

TELE-STEERING.—The following item is a reminder of the work done in the same field some years ago by Mr. Tesla in New York: "The London *Telegraph* of November 10, furnished by Consul Brittain, of Kehl, reports an interesting experiment in the outer harbor of Bilboa, Spain. It consisted in driving and steering a boat by electric power stationed some distance away; that is to say, the propellors were worked by electric waves transmitted without wires. The inventor, Senor Torres Quevedo, considers it possible to apply his system to aerial navigation. A large crowd witnessed the experiments, which were regarded as a great success."

POWER IN CENTRAL NEW YORK.—The Hudson River Electric Power Company, of Albany, which is supplying power to the Utica & Mohawk Valley Railway Company, for the operation of its traction lines between Rome and Little Falls and in the city of Utica, has been notified by the latter company that it will require additional power, as the result of the electrification of the West Shore Railroad, between Utica and Syracuse, which is controlled by the Vanderbilt interest. This request is very gratifying to the officials of the power company and especially so in view of the fact that the Ontario Power Company, at Niagara Falls, was endeavoring to secure this contract. The power company has been supplying power to the railway company since July 1, 1905, and has erected a 5,000-hp steam turbine plant at Utica to take care of this work.

NEW YORK FIRE PROTECTION.—The National Board of Fire Underwriters in its report issued last week condemned the conditions in the Boroughs of Manhattan and the Bronx regarding the risks by fires. Capt. Sewell of the United States Engineers, who assisted in the examination and investigation, asserts in the report that the general situation in Manhattan is by far the most serious fire and conflagration hazard known to him. The reasons for this, it is pointed out, are the many narrow streets in the older part of New York city, the type and occupancy of buildings, and the enormous hazard involved because of the inadequacy of the water supply and the distribution. The Fire Department is not criticised outright, but the engines are said to be deficient in size and generally in poor condition. "Discipline and methods are fair," the report goes on to say, "service as a whole efficient and powerful." It is recommended among other things that the electrolysis of water mains be thoroughly investigated. The fire alarm system in both boroughs is criticised as being "extremely defective."

WIRELESS INTERCEPTIONS.—A note as to the wireless telegraph practice by the United States Signal Corps away inland at Leavenworth, gives some interesting items as to unexpected interceptions. While Major George Squier, chief of the signal school for officers, and Capt. Mitchell were flying kites 7 ft. high and 5 ft. broad connected with a wireless instruments they intercepted a message sent from President Roosevelt on board the *West Virginia,* going from New Orleans to Washington, a distance of 2,250 miles from Fort Leavenworth. The wireless operators caught a message the same evening from a young woman on the *Concho*, of the Mallory Line, in the Gulf of Mexico. It was intended for the wireless receiving station in Galveston, Texas, and was to be forwarded from there to Austin. Their greatest feat was intercepting a message from the Standard Oil Company steamship *Maverick*, sent when that vessel was off the coast of Porto Rico. The Signal Corps men would not believe they had intercepted a message from so great a distance until they had written to New York and learned that such a dispatch had been sent.

CONTINENTAL MINE POWER.—Mr. C. Smith, in an article in the December *Mines and Minerals,* says: "The use of electrical power in mines is rapidly increasing in extent since mine owners are finally realizing in their study to attain greater economy in present existing methods, that this form of energy is best adapted to their needs; and the purposes for which power is required are perhaps greater in this line of work than in any other industry. On the continent of Europe, especially where competition is keen, general recourse has been had to electrical power during the last few years. In considering the reasons for this we have in some cases simply to consider the facility and economy with which electrical power can be transmitted from one central station to a great distance. Take for instance a group of mines scattered over a large area. Here these two advantages alone, namely, centralizing the power generation and economy of transmission, render electrical power unsurpassed for the purpose. Even considering a single mine, the total lengths amount to considerable, especially if a deep-level mine."

ENGLISH CONTACT ROADS.—United States Consul Mahin, of Nottingham, reports recent efforts to do away with the overhead trolley in England. The plan employed is surface contact: "The town of Lincoln, with 50,000 population, 33 miles northeast of Nottingham, has adopted a street railway system which has several unique features. Construction is now under way. The line will be about a mile and three-quarters in length, eight cars will be used and the entire cost will be about $140,000. The system was adopted by the Lincoln City Council after long and careful investigation and consideration, and the securing of guarantees that place the corporation beyond possible risk of loss, such, for instance, as an undertaking by the constructors of the line to equip it with the familiar trolley if their system failed to work satisfactorily. The system adopted is known as the 'G. B. surface contact.' The initials stand for Griffiths & Bedell, the patentees. The inventor is Mr. B. H. Bedell, an electrical engineer. The invention was substantially completed in 1904, though some modifications have since been introduced. An experimental line has been operated near London for over a year, but Lincoln is the first town to adopt the system. A dozen or more surface-contact systems have been tried and submitted to the judgment of tramway engineers and municipal authorities, but, if I am correctly informed, the 'G. B.' is the first British invention to be adopted for practical use in this country. It is claimed, being the latest, to have eliminated all the faults discovered in other systems and to be as near to absolute perfection as is possible. An American surface-contact system, the Lorain, has been operated at Wolverhampton for the past three years. The last report of the tramway committee of that city's council says the operation of the system has been satisfactory."

SAVED BY WIRELESS.—The wireless has just aided effectively in saving human life. While the Nantucket South Shoal Lightship No. 58, chained to a spot far out in the North Atlantic, was plunging about on December 10 in the severest storm so far this season, a leak was discovered in the fireroom compartments. It let in the water so steadily that when wireless communication ceased at 3.30 o'clock the fires had been extinguished and the vessel was helpless. It was 9 o'clock a.m., while the storm was at its height, that the naval wireless station at the Newport, R. I., torpedo station received a message stating that the lightship had sprung a leak early in the day, and that although the pumps had been kept constantly at work, the water was gaining. The water appeared to be coming in somewhere above the fireroom plates, but the leak could not be definitely located. Three hours later another message was received saying that the water was still gaining, and asking that assistance be sent as soon as possible. At 3 o'clock it was announced that the fires had been extinguished and that the fireroom had been flooded. The gale at the lightship had backed in the northwest, which had kicked up a heavy cross sea. At 3.30 wireless communication ceased, indicating that the dynamos had given out. The last message received at the naval station was: "Water gaining; we are helpless." As the lightship was equipped with five water-tight compartments, it was believed by the lighthouse officials that she would survive the gale, which at that time was backing into the northwest. Nevertheless, every effort was made to go to her assistance. As the sea was very heavy off shore and none but the stoutest vessels could be used, it was found that the gunboat *Hist* was the only one available in port. Just as she was about to leave her steering gear gave out. The lighthouse officials in Boston, however, dispatched the lighthouse tender *Azalea* from New Bedford, and the revenue cutter *Gresham* also started. The lightship sank soon after the rescue of the crew and electrical staff had been effected.

Electricity Direct from the Coal Mine at Radcliff, England.

FIG. 1.—COTTON MILL WITHOUT CHIMNEY.

In connection with the suggestions which have been heard frequently concerning the relative economy of transmitting energy in the form of electricity directly from the coal mine or conveying the coal by rail to the place where the energy is needed, a description of an electric generating equipment which has recently been placed in operation by the Lancashire (England) Electric Power Company should prove of interest.

The power station is situated on the left bank of the River Irwell, and is contiguous on the other side to the Lancashire & Yorkshire Railway. The site adjoins the Outwood coal mine, so that an abundant supply of coal and condensing water is assured. It is believed that, by keeping the fuel cost at the minimum value by using the cheapest coal in the best and most efficient machinery, the expense of operation will compare favorably with that found with hydro-electric transmission schemes.

A feature which renders the site chosen particularly advantageous resides in the fact that the local railroad from the mouth of the mine is some 50 ft. above that part of the land on which the power station is built, so that coal can be taken directly from the mine cars to the grate of the boilers entirely by gravity. Coal is conveyed from the pit mouth in trucks which are shunted on to a side track back of the power house by an electric locomotive, to which is also fitted a 10-ton jib crane for tipping purposes. At the end of, and under the siding, is fitted a containing hopper into which the coal from the trucks is emptied. Under this hopper again is a small railway running down an incline, and at right angles to the siding. Coal is conveyed down this in a small truck, into which it is weighed in one-ton lots from the hopper. Gravity takes the truck down the inclined railway into the top of the boiler house and over the bunkers, where a toggle on the truck engages with a trip set at the bunker it is required to fill, and the sides of the bogie fall open, and it is emptied practically instantaneously; the empty truck is then returned to its original position under the siding hopper by a falling weight, which had previously been lifted by the truck on its downward journey. The coal is fed from the bunkers by chutes onto the grates, which are of the chain type, driven by electric motors.

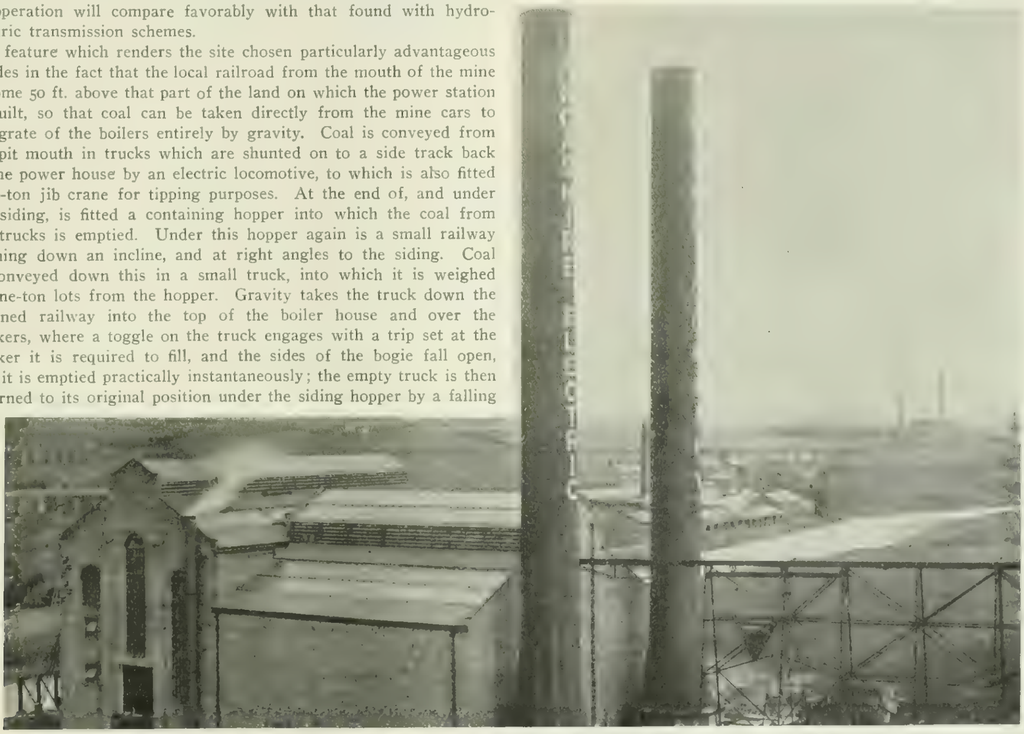


Fig. 2.—View of Power House, Showing Coal-Handling Device.

As seen from the sectional view of Fig. 3, the power house consists of a boiler and a turbine room. The house is of steel work construction, filled in with brick, built on a foundation slab of concrete, 3 ft. thick, stiffened by a grillage of steel girders. This slab forms the floor of the basements. Nine feet above the foundation slab are the floors of the turbine room and the boiler room, which are composed of steel girders with concrete on corrugated iron formers. The dimensions of the boiler room are 70 ft. by 80 ft., and of the turbine room 100 ft. by 50 ft. These dimensions are remarkable, inasmuch as 8,000 kw of generating plant is contained in the building, whereas perhaps a generating plant of one-tenth the power would suffice to fill it according to less up-to-date methods.

The boilers, of which there are six, are of the Babcock & Wilcox water-tube type, with superheaters. Each is capable of evaporating 20,000 lb. of water per hour from 60° F., to steam at 160 lb. per square inch pressure, and 150° F. superheat. The heating surface of each is 5,730 sq. ft., and the grate area 100 sq. ft. They are arranged in two banks of three, one bank on each side of the boiler room. Each bank has its own flue beneath the boilers, which is led out to its own brick-lined steel chimney, 150 ft. high and 10 ft. diameter. The ashes and clinkers fall from the back of the chain grates into the basement, from whence they are taken away in trucks on an industrial railway. The hot-wells are in duplicate at the turbine room end of the basement. There are no economizers, the feed water being heated by the exhaust from the exciter sets. The make-up water is taken from the local supply mains.

The steam from each boiler is fed into a ring of piping, so that in case of mishap the steam can be fed either way round the ring to the turbines, etc. The steam is brought through the wall dividing the engine room from the boiler room, each turbine being fed direct from the steam ring in the boiler room. A branch is also brought through for feeding the exciter sets.

The generating equipment consists of four 2,000-kw Curtis turbo-generators, made by the British Thomson-Houston Co., of Rugby, England. Each generator delivers 50-cycle, three-phase current directly at 10,000 volts, the transmission pressure. Each set consists of a vertical steam turbine and an alternator, mounted on the same shaft.

The turbines being vertical, the whole of the weight of both the turbine diaphragms and also of the rotating element of the alternator is borne by the vertical shaft; the bearing on which this rotates is of a very special construction. The bottom end of the shaft is finished flat and rests in a cup-shaped bottom block, which is capable of being raised or lowered by means of a suitable screw. Through the center of this block is bored a hole through which water is fed at a pressure of 400 lb. to the square inch; this raises the shaft from the block, and the water comes out in a constant film, about one-thousandth of an inch thick, and escapes round the top of the cup; the bearing is practically frictionless. The water at this pressure is provided by two force pumps, one capable of dealing with all the turbines and one a spare; these are triplex pumps and are electrically driven, as seen in Fig. 4. As it is of utmost importance that the water should not fail, there is a water accumulator, which consists of a ram provided with heavy weights, and is so arranged that if the pump fails the accumulator gives the supply, at the same time ringing an alarm bell, allowing ample time for the attendants to start up the spare plant.

The condensers are placed right against the turbines, and the air pumps are directly beyond; the whole making very compact units The condensers are of the vertical type with very ample surface, so as to obtain a high degree of vacuum. The air pumps are of the triplex type, and driven direct by motors.

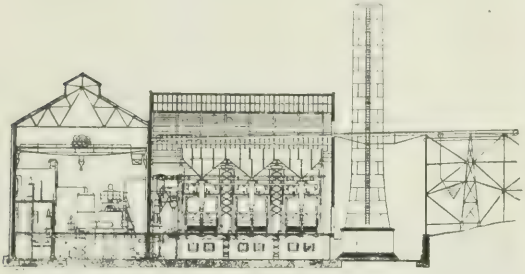


FIG. 3.—SECTION THROUGH TURBINE AND BOILER HOUSE.

The excitation for the turbines, as well as the current for all the auxiliary plant, is obtained from three 150-kw, direct-current dynamos, direct-connected to reciprocating high-speed engines, which run non-condensing, the exhaust heating the feed water as mentioned before. In the engine room is also a dry-air pump; this keeps the water part of the condenser free from air and keeps the circulation good by maintaining a syphonic action in the circulating system; the pump also is used to prime the circulating pumps. There is a 25-ton electric crane which travels the length of the engine room.

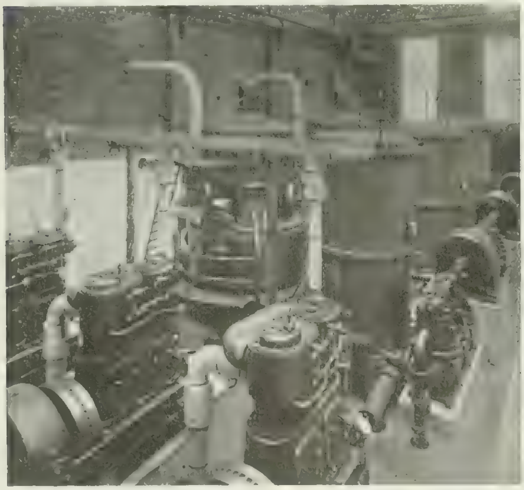


FIG. 4.—STEAM TURBINES, MOTOR-DRIVEN PUMPS AND STEAM EXCITER SETS.

The main cables from the generators and all the other cable work are fixed to the ceiling of the basement, being thus in sight and at the same time in a safe and convenient position. They are brought through the wall into the switch rooms. These are in three stories, one on the basement level, one on the engine floor, and the third on the operating gallery above. In the basement are the potential transformers. These are for reducing the pressure from the generating voltage to that suitable for operating the voltmeters. These transformers are each partitioned off in brick chambers. On the floor above are the first main switches. The current is led directly from the generators to these, which are motor-operated switches, each in its own compartment. Each switch is of the plunger type, having three limbs, one for each phase. The current is brought to a contact which is in the bottom of a tube, on the top of which is an insulator through which a plunger passes. The tube is filled with oil, so that when the contact is broken the arc is extinguished by the oil. These plungers are connected to wooden rods passing through to the operating mechanism which consists of a small motor and a system of strong springs; the motor is connected by a magnetic clutch to the levers, and on being started releases one spring, closes or opens the switch and compresses the spring in the opposite direction. The current now passes to the bus-bars. These are in the center of the same chamber, and are of bare copper supported on insulators enclosed in brickwork with suitable holes for inspection; they are in two sections, each section taking two machines. From the bus-bars the current passes to the floor above to other oil switches which connect the feeder circuits on to the bars; each circuit has two mains, and one of each of the mains is connected to the various bars so as to give additional safety. From these circuit switches the mains pass out through the walls on to the overhead construction; before leaving the building they are connected to a lightning arrester device for preventing undue rises of pressure, which consists of a series of metal discs placed in a row, with carbon resistances in series, and the end connected to earth.

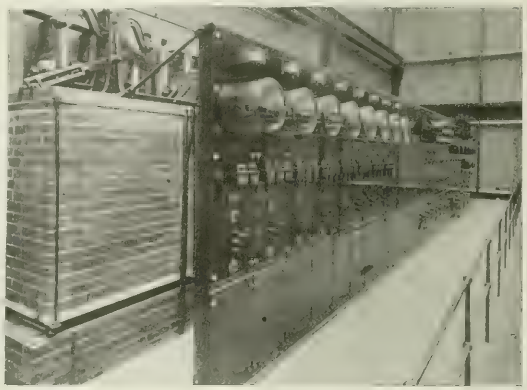


FIG. 5.—SWITCHBOARD AND REMOTE-CONTROLLED OIL SWITCHES.

The control mechanism for the oil switch motors, and in fact all the controlling apparatus in the station, is mounted on the operating board: low-tension current frcm the exciter circuits being used to drive the switch motors. Current from the current transformers operates the ammeters and automatic cut-outs; the voltmeters are operated from the special potential transformers described above; thus, no high pressure is brought near the operating board, no heavy current and no big switches are there, and so the handling is extremely simple, one man being able easily to deal with the whole plant. The arrangement also is very safe, for there are no large powers to cause electrical fires, and even in the case of some small mishap the main cable cannot be affected, and the supply in consequence is not interfered with. All the current from the exciter sets is brought up to a low-tension board at the end of the operating gallery and distributed from there. The engineer's offices are in the same line as the switch rooms.

The mains leave the station overhead, and are partly underground and partly overhead, as may be most suitable. The underground cables are three-core, paper-insulated, lead-covered, wire-armored, laid in bitumen in wooden troughs. Already many contracts of great interest have been entered into, notably one with the Acme Mill (Fig. 1), which has 75,000 spindles, of both the mule and ring type. The Pendlebury Spinning Company has a steam-driven mill of the same size adjoining, so that electricity will have a good chance of proving its superiority. Many other works, covering a variety of industries, are also to be supplied with power.

Regulation and Compounding of Lighting Balancers.

By Budd Frankenfield.

THE problem of predetermining the regulation of a direct-current lighting balancer is complicated by the very simplicity and well-understood principles of the component apparatus involved. Just as a crystal presents many facets, each throwing off a little light, so in the balancer problem numerous probable solutions are presented; and one is confused in the selection of a point of attack. There are several other problems peculiar to the combination of two armature windings into a balancer set, which make the apparatus an interesting study, but they are beyond the scope of the present article.

A balancer consists of either a dynamotor or a motor-generator, and its object is to equalize the pressures of a three-wire lighting system fed from the bus-bars of a two-wire plant. Figs. 1, 2, 3, 4 and 5 illustrate several arrangements which have been used as balancers.

In Fig. 1 + and — are leads from the station bus-bars, which connect with the balancer and with the feeders of the lighting system. The neutral, ±, connects only with the lights and the balancer. The two armatures are mechanically coupled and each revolves in an independent field, the winding of which is often connected across the mains. When the load is balanced the two armatures operate as motors running idle. If there is an excess of load on the right-hand side of the system, the pressure of that side will drop below the counter e.m.f. of the low-voltage machine, which will begin to operate as a generator, drawing power from the other machine, which continues to operate as a motor. This generator action supplies the required neutral current and keeps the voltage on the right from falling an excessive amount, and the voltage on the left from rising an excessive amount. An excess of load on the left side causes the right-hand pressure to rise and increase the speed of the low-voltage machine as a motor. The increase of speed augments the generator e.m.f. of the high-voltage machine, whereupon it operates as a generator connected in parallel with the station bus-bars, and again the unbalancing of pressures is arrested.

The operation of the arrangements shown in Figs. 2, 3, 4 and 5 is in general the same as that of Fig. 1, except that a rise of pressure on either side, if lightly loaded, produces a motor action in the corresponding armature while the fall on the opposite side acts simultaneously to produce a generator action in the other armature; that is, there is a change in terminal pressure of each armature acting as a first cause in the process of equalization, while in the arrangement of Fig. 1 only the low-voltage armature is subjected to an external first cause. The arrangement in which an armature is connected across each side of the system furnishes a more sensitive unit. Another point of difference is that in the arrangement of Fig. 1 all the power represented by the current in the neutral wire must undergo, or be the result of, a transformation, the current in the neutral wire being that of the low-voltage armature; whereas in the other systems only that portion of the power represented by the generator current has been transformed, the current in the neutral wire being in this case the sum of motor and generator currents. These conditions require a balancer of much smaller size for the same neutral current and the operative efficiency is higher.

In regard to the question of balancer ratings, it seems obvious that the logical rating is one based on the value of the neutral current, i. e., a balancer having a capacity of 50 kw on a 240-volt three-wire system would provide for a neutral current of 417 amp. at 120 volts. In the arrangement of Fig. 1 each armature must be able to withstand an intake of 50 kw plus the losses of conversion, while in the arrangements shown in the other figures each armature must have a capacity of 25 kw plus the losses of conversion, which in these cases are much smaller.

Omitting Fig. 1 from further consideration, the division of the neutral current between the two armature windings as represented in the other diagrams may be determined as follows:

Let Ig = generator current.
Im = motor current.
In = neutral current.
eg = generator efficiency.
em = motor efficiency:
Then $egem$ = balancer efficiency.

$$Ig = Im\,em\,eg. \tag{1}$$

$$In = Im + Ig. \tag{2}$$

$$Im = \frac{In}{1 + em\,eg}. \tag{3}$$

$$Ig = \frac{In\,em\,eg}{1 + em\,eg}. \tag{4}$$

Approximations:

Assume $eg = em = e$, the average efficiency.

$$Im = \frac{In}{1 + e^2}. \tag{5}$$

$$Ig = \frac{In\,e^2}{1 + e^2}. \tag{6}$$

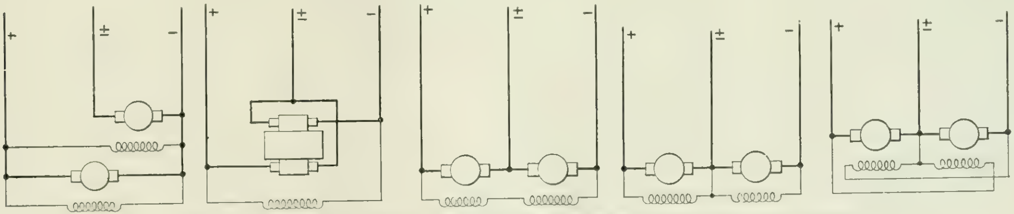
Again:

$$Im = \frac{In}{2e}. \tag{7}$$

$$Ig = \frac{In\,e}{2}. \tag{8}$$

Thus there are three methods for determining the division of the neutral current. As to comparative accuracy, equations (3) and (4) may be taken as standard; then, for a balancer set with $eg = 0.7$, $em = 0.6$, $e = 0.65$, equations (5) and (6) give values of Im and Ig, 1.4 per cent and 2 per cent high, respectively, while equations (7) and (8) give values 8.4 per cent and 9.8 per cent high. For $eg = 0.81$, $em = 0.79$, $e = 0.8$, equations (5) and (6) are practically accurate, while (7) and (8) give values 2.5 per cent high. It is thus seen that even for an absurdly small balancer set the various equations are sufficiently close for most purposes.

For more refined caluculation, equations (1) and (2) should be used, the efficiencies em and eg being computed exclusive of the field circuit loss. These equations hold strictly true for the arrangements shown in Figs. 2 and 3, and are practically true for the arrangements of Figs. 4 and 5, where the proportion of the field current derived from the neutral is always negligible. Of course, the field circuit losses should be considered in calculating the balancer efficiency. Other sources of error are in the variation of stray power due to change in speed and to change in flux with load. These may be taken into account when necessary, but such refinement is seldom required.



Figs. 1, 2, 3, 4 and 5.—Various Arrangements of Motor-Generators as Balancers.

In the design of a balancer it is probably easier not to calculate the individual efficiencies at all, but to construct a table as follows:

I (armature) ....
I^2R (arm. and brushes) ....
Fixed losses ....
Total losses ....
EI ....
EI − losses (= mot. output) ....
EI + losses (= gen. intake) ....

From this table a double set of curves of current against watts may be plotted as in Fig. 6. Motor current is measured to the left of the zero, generator current to the right. Any ordinate value common to these curves represents the motor output and the simultaneous generator intake, and the horizontal distance between the two equal ordinates indicates the current in the neutral wire. In this instance a generator current of 32.5 amp. and a simultaneous motor current of 58.5 amp. combine to make a neutral current of 91 amp. This service would require a balancer rated at 10 kw at 110 volts, with a combined armature efficiency of 55.6 per cent. The losses in this example were purposely exaggerated in order to show the characteristics of the curves. It will be noticed that each is slightly convex toward the right.

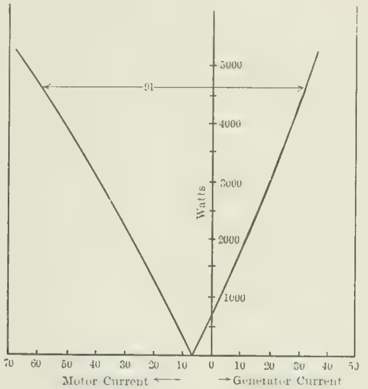


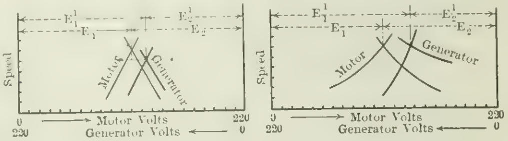
FIG. 6.—CHARACTERISTICS OF MOTOR-GENERATOR BALANCER.

The operation of the balancer is clearly shown. At balanced load the two machines take a motor current of 6.7 amp., representing the stray power of the machines; there is no neutral current. As soon as the load becomes slightly unbalanced, the motor current of one machine decreases and the motor current of the other increases by an equal amount. The neutral current is the difference between the two motor currents. Finally the one machine takes absolutely no current and the other takes twice the no-load value, representing the combined stray power of the two armatures. The neutral wire furnishes this current. With a still greater unbalancing the first machine begins to supply a generator current, deriving its power from the other armature, which acts as a motor, and the current in the neutral wire is the sum of the generator and motor currents of the two armatures.

The inherent regulation of a shunt balancer depends upon the field circuit connections. Three distinct solutions will be given. Figs. 2 and 3 present the same problem, Fig. 4 another and Fig. 5 still another. The method of solution involves the speed-pressure curve of each machine, and a graphical representation with double curves is used.

In the case of Figs. 2 and 3, the method is particularly simple. The left-hand lines on Fig. 7 are the no-load curves plotted between armature pressure and speed. The common base line of these curves represents the total voltage of the system. The curves are symmetrical with respect to a vertical axis through the point of neutral potential, and they intersect on this axis, i. e., the point of common speed occurs at exactly balanced voltage. To ascertain the regulation at a certain load, the division of current is taken from the curves, Fig. 6, and the speed curves are plotted for the respective currents, allowing for the resistance drop in the armature and brushes. The motor curve will be a straight line parallel and to the right of the no-load curve, as shown by the right-hand line, i. e., the motor will require a higher impressed pressure to maintain a certain speed under load than at no load. Similarly the generator will deliver less voltage at a certain load than at no load, and its speed curve will be parallel and to the right of the no-load generator curve. This curve is also shown at the right. The point of intersection of the load curves, the point of common speed, determines the regulation, at the chosen neutral current. The shifting of the neutral potential is clearly shown to be the average of the two armature drops. It is the product of half of the neutral current multiplied by the resistance of the one armature including brushes. The curves are not needed for a practical case, but are given because they illustrate the operation so clearly.

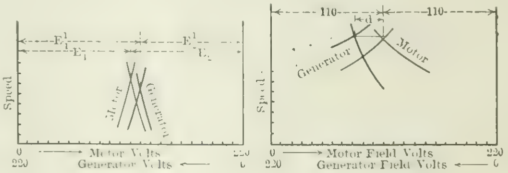
In this, as in the cases that follow, armature reaction has been neglected. The operating position of the brushes is neutral, because either armature must be reversible in its function as generator or motor. Even if the brushes were shifted, the increase in speed of the motor would be almost compensated by the decrease in the voltage of the generator, and the regulation would remain practically undisturbed. For equal brush leads the motor would have a slightly greater armature reaction, but in the dynamotor the regulation would not be affected even with a large excess of motor armature reaction, since both windings are in the same field.



FIGS. 7 AND 8.—CHARACTERISTICS OF MOTOR-GENERATOR BALANCERS.

In the arrangement shown in Fig. 4 the regulation is obtained by the same method, but the curves take a different form. Here the junction of the two field windings is connected to the neutral wire and the speed is determined by two varying factors, field flux and armature voltage. Knowing the winding of the machine, the speed can be expressed by the equation, $V = \dfrac{e}{\phi} k$, where V = speed, e = internal or generated pressure, ϕ = flux, and k is a constant.

Knowing the saturation curve, several points may be chosen along its working portion and the corresponding speeds calculated. In this manner the no-load and full-load curves (Fig. 8) have been obtained, and the regulation determined as before. The displacement of the potential of the neutral wire is greater than in the previous case, because the motor field is strengthened by the unbalanced load and the generator field weakened, i. e., the motor requires a greater voltage to make the common speed and the generator gives a lesser voltage at the common speed. The moral is that connecting the neutral wire to the "straight" field coils is damaging to regulation.



FIGS. 9 AND 10.—CHARACTERISTICS OF MOTOR-GENERATOR BALANCERS.

The regulation with crossed field coils, Fig. 5, is ascertained in the same way; but it must be remembered in deriving the curves that the impressed pressure assumed for the armature of one machine is the field pressure on the other machine. Expressing this fact in another way, for a given voltage on the armature of a machine the field voltage of this same machine is equal to the total line voltage minus the given voltage. It is convenient in this and in the other cases to plot the saturation curve in terms of flux and pressure across the field coil. From the speed curves, Fig. 9, may be determined the regulation, which is better in this than in any of the previous cases. This result may be attributed to the fact that the motor field is weakened and the field of the generator strengthened by an unbalanced load; i. e., the motor requires a lesser voltage to make the common speed, and the generator gives a greater voltage at the common speed. This is the method by which a shunt balancer should be connected.

Whether the shunt field coils are connected according to diagrams 3, 4 or 5, the series ampere turns for level compounding will be the same, because the shunt field coils will in all cases be subjected to the same voltage. The speed curves, Fig. 10, are plotted against field circuit pressure, the armature pressures being assumed constant and balanced. The shifting of the intercept of the two curves from no load to full load, represented by the distance *d* is the average of the voltage by which the e.m.f. of the field circuit of the motor should be decreased and that of the field circuit of the generator increased in order to balance the system. Knowing the resistance and the number of turns of the field winding, the distance *d* can be translated into ampere-turns, from which may be ascertained the number of series-turns for level compounding.

For over compounding, as in the case of a heavy neutral drop, the same methods can be used. The connection of the shunt field is a factor in determining the result. The problem is of little more than academic importance and will not be pursued.

In applying these methods for determining the regulation or the compounding, it is not necessary to compute the no-load curves, as their intercept always falls on the axis of neutral potential.

Industrial machines give better regulation than indicated in the examples given, the losses having been, in this instance, purposely exaggerated to amplify characteristics.

The Practical Application of the Heyland Diagram for Induction Motors.

By W. C. Way.

Few diagrams are so complete in every detail as the Heyland diagram; in fact, there is very little information relating to the performance of an induction motor which it does not give when fully developed. The Heyland or "circle diagram," as it was originally called, is simple in practical construction and accurate in its results. The induction motor has a definite set of characteristics. A definite current gives a definite torque at a definite speed. This fact makes it possible to construct curves, such that a definite point on the one corresponds to definite points on the others.

In dealing with the induction motor it is necessary to recognize two different frequencies, one for the primary and one for the secondary circuit. Let n_1 cycles per second be the frequency of the current in the primary circuit and n_2 cycles that in the secondary, then $n_1 - n_2 = s$ is the slip, and it indicates the rate at which the secondary winding is cut by the primary lines of force. The e.m.f. thus generated produces a secondary current with its accompanying flux, which revolves with a speed s relative to the rotor. Since this speed is in the same direction as the mechanical rotation, the absolute speed of the flux is $n_2 + s = n_1$, or the same as that of the primary flux.

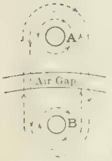


FIG. 1.—MAGNETIC FLUXES IN AN INDUCTION MOTOR.

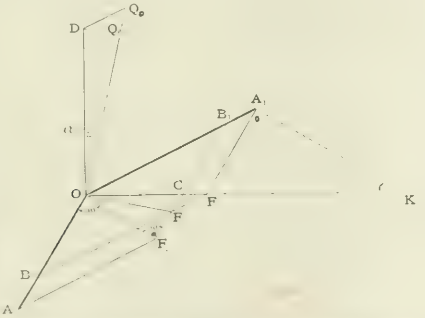


FIG. 2.—RELATION OF MAGNETOMOTIVE FORCES IN AN INDUCTION MOTOR.

Fig. 1 represents two wires, *A* and *B*, of an induction motor directly opposite and separated by an air-gap, the wires being practically surrounded by iron. Now if a current is passed through the wire, *A*, lines of force are set up which encircle both *A* and *B*. These lines induce a secondary e.m.f. in *B* and the secondary current produced sends lines in the opposite direction, which encircle both wires. There is also a leakage flux around each separate wire, the flux produced by the secondary current being opposite to that in the primary circuit. Of course, neither the primary nor the secondary flux really exists separately, but the resultant of these two is real. It is more convenient, however, to consider them separately. The magnetic flux in the primary differs from that in the air-gap flux by the primary leakage flux. Such is also true of the secondary flux.

Let the example now be extended to the whole of the winding, taking the flux proportional to the ampere-turns. In Fig. 2 $O A_1$ is drawn proportional to the primary ampere-turns, with the primary current at some definite phase lag ϕ, and $O A_2$ is drawn to represent the ampere-turns of the secondary. The primary and secondary fluxes are also proportional to these lines. The leakage flux in the primary is represented by A_1B_1, and that in the secondary by A_2B_2. The ratio of A_1B_1 to $O B_1$ is constant, and also the ratio of A_2B_2 to $O B_2$ is constant. The actual flux in the primary iron is the resultant of $O B_2$ and $O A_1$, or is represented by $O F_1$. Similarly in the secondary iron the resultant flux is $O F_2$. The flux in the air-gap is the resultant of $O B_1$ and $O B_2$, represented by $O F_0$. The e.m.f. which would produce the flux $O F_1$ in the primary would be 90° ahead, and so is represented by $O D$. To this e.m.f. is added the primary ohmic drop, I_0R_1 parallel to the magnetizing current. Thus is obtained $O Q_0$, which equals the impressed e.m.f. at no load. $D Q_6$ is taken perpendicular to $O D$, since the leakage current is nearly at right angles to the effective e.m.f, $O D$. A_1K is drawn parallel to $O F_2$, meeting $O F_1$ produced at K. The triangles $O F_2C$ and A_1F_1K being similar, the angle F_1A_1K equals the angle $O F_2C$, which equals 90°, since for any value of the primary current the angle $O F_2C$ is always equal to $A_2O F_2$, which has been shown to be equal to 90°. Now if F_1K is constant and not dependent on the value of the primary current, A_1 will travel in a semi-circle. This relation can be proved as follows:

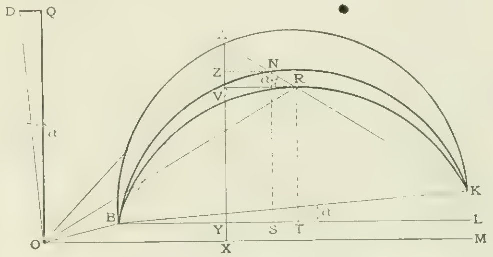


FIG. 3. IDEAL CIRCLE DIAGRAM OF AN INDUCTION MOTOR.

$O B_1/O A_1 =$ a constant $= n_1$; also $O B_2/O A_2 = n_2$, since the ratio of the leakage flux to the total flux may be taken as constant.

$$\frac{K F_1}{O C} = \frac{A_1F_1}{C F_2} = \frac{A_1F_1}{B_1F_2 - B_1C} = \frac{O B_2}{B_1F_1} - B_1C = n_2 \times \frac{O A_2}{B_1F_2} - B_1C$$

$$O C = \frac{O B_1}{O A_1} \times O F_1 = n_1 \times O F_1;$$

$$B_1F_2 = O A_2.$$

$$B_1C = n_1 \times A_1F_1 = n_1n_2 \times O A_2$$

Substituting $K F_1 = \dfrac{O F_1 \times n_1n_2}{1 - n_1n_2}$, which is constant, since $O F_1$ is assumed constant.

The angle $D O A_1$ measures the angle of lag for the value of current corresponding to $O A_1$, and as this angle varies A_1 travels in a semi-circle, with F_1K as the base. The value of the primary current varies from $O F_1$ at synchronism to $O K$ at standstill.

In the above proof the resistance of the winding and the exciting current have been neglected. Now considering these, $O Q_6$ will be the e.m.f. applied to the primary circuit at synchronism, or no load. It is convenient in making the diagram to have $O Q_0$ vertical; therefore, in Fig. 3 the diagram is revolved through the angle $D O Q_0$, equal α_0. $O B$ is then drawn equal to the no-load exciting current with the proper power factor. $B L$ is drawn horizontal from B and the angle $K B L$ is made equal the angle α_0, and the semi-circle is described as in the previous figure.

The primary current at a certain load represented by the point A will have two components: $B A$, the useful component, and $O B$, the no-load exciting component, the latter including the effect of the iron loss, friction and windage, the exciting current being assumed to remain constant. The distance $A R$ is made proportional to $A B$, the useful component of the primary current. $A X$ is drawn perpendicular to $O M$, and $V R$ perpendicular to $A X$. The line $B R$ is then drawn. Now $A R$ is equal to $k \times A B$ (k being a constant).

$$\frac{A R}{A B} = \cot A R B = \frac{k . A B}{A B} = k,$$

that is, the angle $A R B$ is constant; therefore, the angle $B R K$ must be constant, not depending upon the value of the primary current, i. e., R always lies on the arc of a circle drawn through the three points $B R K$. $A V = A R \sin \alpha$, but $A R$ varies as I (I being the useful component of the primary current). $\sin \alpha$ varies as I; therefore, $A V$ varies as I^2.

If $A R$ is taken to the proper scale, $A V$ measures the watts lost in resistance. $A X$ measures the input to the same scale, $X Y$ the iron loss and $R T$ the output. If $A R$ is divided in the ratio of primary to secondary resistance, a point, N, is found. Since this ratio is constant, N lies on the arc of a circle. The line $N Z$ is drawn perpendicular to $A X$, then $Z V$ represents the loss due to secondary resistance, and $N S$ equals the synchronous watts and therefore the torque to proper scale. The torque in pound-feet is found by dividing the synchronous watts by the synchronous speed in r.p.m. and multiplying the result by the constant, 7.04.

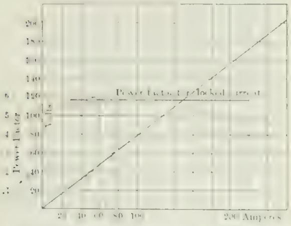


FIG. 4.—STARTING CURRENT OF 10-HP. TWO-PHASE INDUCTION MOTOR.

PRACTICAL APPLICATION.

In the test which is outlined below the machine used was a two-phase induction motor designed for 10 hp at 200 volts, full-load speed 850 r.p.m. The readings taken may be seen from Tables 1 and 2. The method employed for taking speed, by speed indicator, was not perfectly accurate, but the results obtained were sufficiently exact to show how well the points plotted from the readings fell upon the curves of input, synchronous watts and output, thus proving the theory employed.

At the beginning of the test readings were taken to determine the locked current, i. e., with the rotor at rest. Table 1 gives the readings obtained and these are plotted in Fig. 4. By drawing a straight line through the points obtained, the current corresponding to normal voltage was found to be 256 amp. At the lower voltages the points [illegible] below the straight line. This is on account of the change of primary resistance due to heating and also to the inductance being proportionally greater to the current before saturation than after. On the same diagram the power factors for different values of locked current are plotted, showing the power factor to be practically constant. The value at normal voltage is obtained by taking an average. The resistances of both phases of the primary circuit were also observed after having run the machine long enough to heat the winding. For readings in Table 2 the motor was loaded by means of a mechanical brake with a 2.5-ft. lever. The power factors were calculated for different sets of readings of Table 2. These values are plotted as in Fig. 5. The line $a b$ shows the no-load current with proper power factor. A horizontal line, $b t$, is drawn from b, the angle α_0 is calculated from the relation $\tan \alpha_0 = \frac{I_0 R_1}{E}$, I_0 equals the no-load current, R_1 equals the primary resistance, and E equals the primary voltage. A line is then drawn from b making the angle α_0 with $b t$. This line is the base of the semi-circle. The locked current at normal voltage is plotted with power factor 0.574 previously obtained. Having two points and the position of the base the semi-circle of input can be described.

TABLE 1.

Phase (A)			Phase (B)			
Volts.	Amperes.	Kilowatts.	Volts.	Amperes.	Kilowatts.	Power Factor.
[illegible]	13.75	[illegible]	20.5	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.43	33.5	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	0.73	42.5	[illegible]	[illegible]	[illegible]
[illegible]	37.20	1.20	[illegible]	[illegible]	1.20	0.584
[illegible]	[illegible]	1.43	[illegible]	39.30	[illegible]	0.588
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 2.

Phase (A)			Phase (B)									
Volts.	Amperes.	Kilowatts.	Volts.	Amperes.	Kilowatts.	Speed of motor = n_1.	Synch. speed = n.	Lbs.	Power factor.	Output K.W.	Input K.W.	Synch. kilowatts.
200.	7.1	0.12	199.0	6.7	0.22	894	906	0.0	0.123	0.0	0.34	0.00
[illegible]	[illegible]	0.88	[illegible]	8.0	0.96	898	908	4.4	0.568	1.4	1.84	1.41
201.0	[illegible]	1.50	[illegible]	10.5	1.64	884	902	8.4	0.754	2.64	3.14	2.70
[illegible]	[illegible]	2.18	[illegible]	13.2	2.28	870	896	12.4	0.850	3.86	4.46	3.95
201.5	[illegible]	2.80	200.5	16.7	3.00	886	908	16.4	0.878	5.16	5.80	5.28
199.0	[illegible]	[illegible]	198.8	20.3	3.80	862	896	20.4	0.915	6.24	7.30	6.50
202.0	23.8	4.50	205.0	24.5	4.56	876	912	24.4	0.925	7.60	9.06	7.91
No-load current												
[illegible]	7.45	[illegible]	[illegible]	7.42	0.06							

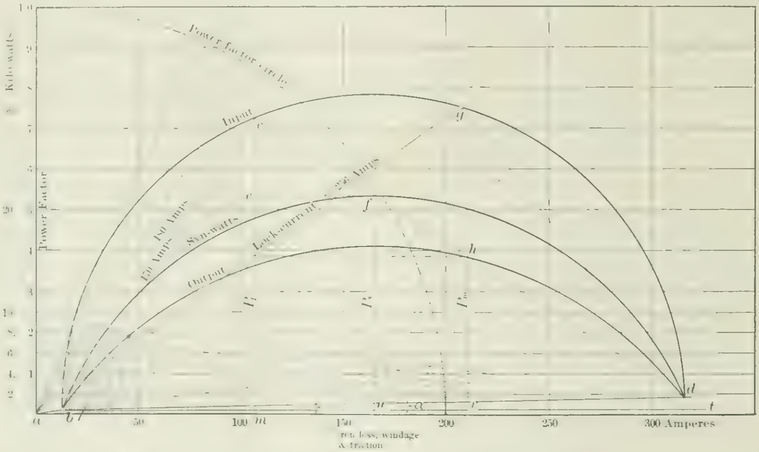


FIG. 5.—CIRCLE DIAGRAM FOR 10-HP. 200-VOLT INDUCTION MOTOR.

Taking any convenient value of the primary current, as for example 180 amp., chosen in plotting these results, the line $a c$ is so drawn that it has the proper value of 180 amp. to scale. The line $c m$ is drawn perpendicular to $b t$. Along $c m$ is measured the value of $I_1^2 R_1 = 7.67$ kw, which is plotted as $c e$. The horizontal line, $e f$, meets, $c d$ at f, the circle for synchronous watts passes through this point. The two other points, b and d, having previously been obtained, this segment can be drawn. Another arc of a circle is drawn tangent to $g d$ and passing through b and d. This is the circle of output. From f and h perpendiculars are drawn to the line $b t$.

Synchronous watts for 180 amp. is $f n = P_s$, from which the torque can be obtained. Output is $h r = P_m$.

$$\frac{\text{actual speed}}{\text{synchronous speed}} = \frac{P_m}{P_s}.$$

$$\text{Slip} = (P_s - P_m) / P_s.$$

The actual efficiency is P_m/P_1. The points on the left of the diagram which are encircled were plotted from experimental data, and from these it can be seen how nearly they fall on the circles drawn in accordance with theory.

$$Tan\ a_0 = \frac{I_0R_1}{E} = 0.0168.$$

$$\text{Output in kilowatts} = \frac{0.746 \times T \times 2\pi \times n_1}{550 \times 60} = X.$$

$$\text{Synchronous watts} = \frac{X \times n}{n_1}.$$

(n = synchronous speed, n_1 = speed of motor.)

$$\text{Resistance of stator winding per phase} = \frac{12}{22.6} = 0.532.$$

Core Losses in Induction Motors.

By R. E. Hellmund.

In testing induction motors it is difficult to determine the true core losses for the loaded motor. It is, therefore, customary to test the core losses at no load, and to assume that the losses for the loaded motor are the same. This of course is only approximately true.

For motors with phase-wound secondaries, the following method gives more correct values: In addition to the usual tests necessary for drawing the circle diagram of the motor, the following tests are required: First, the no-load losses and currents are ascertained for different potentials as is usually done, in order to determine the no-load core losses (curve *A* in Fig. 1). Second, a high resistance is connected in each phase of the secondary circuit, and always so regulated that the rotor slip is as high as it is for the load for which the iron losses are to be determined. Under this latter condition the no-load losses and currents are again observed for different potentials (curve *B* in Fig. 1).

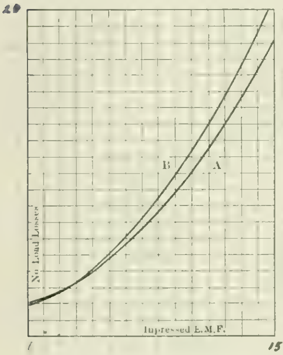


FIG. 1.—RELATION OF NO-LOAD LOSSES TO IMPRESSED E.M.F.

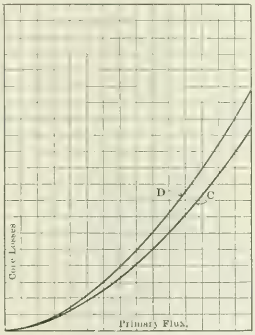


FIG. 2.—RELATION OF CORE LOSS TO PRIMARY FLUX.

By deducting from the no-load losses the I^2R and friction losses, which are both easily determined, the pure core losses for both cases are easily derived. They are given in Fig. 2 by the curves *C* and *D*, corresponding to *A* and *B*, respectively; instead of the impressed e.m.f. the corresponding primary field flux is introduced on the lower scale of this figure.

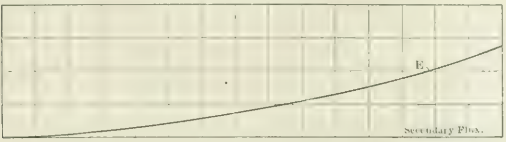


FIG. 3.—RELATION OF SECONDARY CORE LOSS TO SECONDARY FLUX.

The differences between the values of curve *C* and *D* are given in curve *E* of Fig. 3. On the lower scale of this figure, however, instead of the primary field there is used the corresponding secondary field, which may be easily determined from the circle diagram.

Now curve *C* of Fig. 2 shows for all different field values the core losses which are caused by the high-frequency or primary flux, and curve *E* of Fig. 3 shows the core losses which are caused for a certain slip by the low-frequency or secondary flux. The changes of the fluxes from the tested no-load condition as given above to the condition for the loaded motor are as follows:

First, The primary flux diminishes on account of the primary drop of potential caused by the ohmic resistance. The actual value of the primary flux at load is given, however, in the circle diagram and the corresponding core losses may be found from curve *C*.

Second, the secondary flux diminishes on account of the primary ohmic drop and the secondary reaction. The actual value of the secondary flux is also given by the circle diagram and the corresponding core losses may be found from curve *E*.

Third, the leakage flux increases.

The greater part of this flux, however, goes through air, and, therefore, does not cause any core losses. Only a small part of the leakage flux, the zig-zag leakage, goes through a small part of the top of those teeth which are at a pole limit. The core losses thereby caused are very small, since the flux as well as the amount of iron, through which it passes, are very small. The change of the core losses caused by the change of the leakage flux may, therefore, be neglected.

Thus, the total core losses for the loaded motor are equal to the sum of the values obtained from curves *C* and *E* as described above.

◆

Test of a Valve Magnet.

By C. P. Nachod.

Apropos of Mr. C. R. Underhill's interesting and valuable papers on electromagnets is the following test on a magnet, as showing the effect which the position of the magnetizing coil with respect to the working air-gap has on the pull produced.

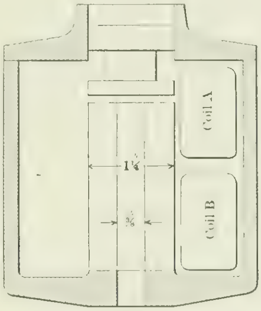


FIG. 1.—VALVE MAGNET.

This magnet, shown in Fig. 1, has a short stroke, and is designed to operate an air-valve by means of a brass rod (not shown) passing through the hole in the core. The core and armature are of Norway iron; the core has an outside diameter of 1¼ in. and has a ⅜-in. hole through it. The magnet is of the iron-clad type with cast-iron shell and top. There is a cylindrical clearance gap between the armature and top, which, being invariable, has not been considered.

There are two exciting coils, *A* and *B*. The former, having 1,860 turns of No. 25 wire is used as an operating coil to draw down the armature; and the latter, of 1,765 turns of No. 26 wire, serves as a retaining coil to hold it down against the air-pressure, after the circuit in the other coil is broken. Coil *A*, as shown in Fig. 1, is located so as to encircle the working gap, which is not the case with *B*.

The test was made with a simple traction permeameter, definite air-gaps being obtained by measured brass washers.

Fig. 2 shows the pull produced with varying excitation for each coil separately, with a constant air-gap of .0162 in. In the curve for coil *A* the range of magnetic densities is sufficient to show clearly the change in permeability of the iron circuit. For so small an air gap, the difference between the pulls produced by the two coils with the same magnetizing force is remarkably great. The ratio of these pulls has been plotted, and the curve shows that coil *B* is only from .4 to .8 as effective as *A*, due solely to its position on the core, which permits a larger magnetic leakage. This ratio curve has a peculiar feature, in that it approaches unity as the flux-density is increased, as though the leakage were less at higher densities—a phenomenon not easily explained.

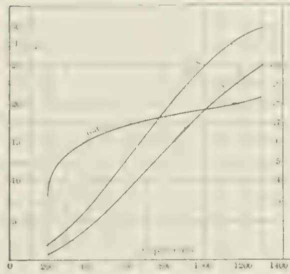


FIG. 2.—PULL WITH .0162 IN. GAP.

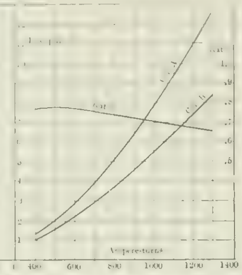


FIG. 3.—PULL WITH .081 IN. GAP.

Fig. 3 shows the same relations with an air-gap of .081 in. or five times as great as in the previous case. With this gap the range of flux density is not great enough to produce an inflection point in either curve; and the ratio of pulls for the same excitation is more nearly constant, averaging a little over .7, but decreasing with increasing density.

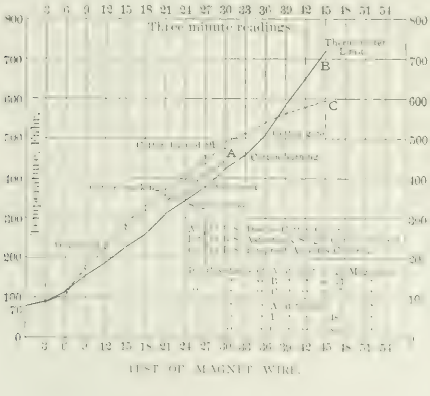
From the curves it appears that, if it were desired to connect the coils in series so that the magnetic effect of *B* would neutralize that of *A*, it would be possible to do so for only one, instead of all current values, and that such a neutralizing coil for all current values should have the same axial length and slide within or without the other.

* * *

Tests of Magnet Wire.

By C. H. Barrett.

The tests of magnet wire described below were undertaken as a result of considerable trouble from the field coils of motors breaking down, due to exposure to high temperatures. The motors were mostly on furnace cranes handling molten metal, and the temperature of the cases frequently reached 360° to 400° F.



TEST OF MAGNET WIRE.

Curve A shows the results of a test on No. 16 B. & S. double-cotton covered magnet wire of [illegible] in. outside diameter. The covering at 280° F. showed discoloration; at 370° the covering was smoking badly, and at 472° wire was completely bare. This wire showed the highest insulation resistance at the start, but fell down after passing 370°.

Curve B refers to a test on No. 16 B. & S. asbestos and single cotton-covered wire. At 340° a slight smoke showed up; at 372° discoloration of cotton took place; at 460° the cotton burned, and at 506° cotton was gone. From 506° up to 720°, which was the limit of the thermometer in use, the asbestos held good and showed an insulation resistance of 480 megohms at close, against 11 megohms at start. The asbestos, however, would not stand very rough handling, though considering the temperature it was in pretty fair shape. The outside diameter over insulation of this wire was .068 in.

In curve C are plotted the data of a test on No. 16 B. & S. fire-proof wire which withstood the high temperature excellently except for a slight discoloration, and was in good shape at the finish. Its insulation resistance at start was lower than any, but at the finish reached as high as 800 megohms.

After making the tests it was decided to use the asbestos and cotton-covered wire and motor troubles were practically ended. Coils have been opened up with every vestige of cotton gone, yet the asbestos kept the insulation almost perfect. It was found necessary to insulate only the top, bottom and inside of coils heavily, leaving the outside with just a covering of cotton tape, thus assisting radiation of the heat. The reason the fire-proof wire was not used was on account of its affinity for moisture due, undoubtedly, to the large amount of silicate of soda used in the composition of its covering. In very damp weather the insulation resistance would fall very low on this wire.

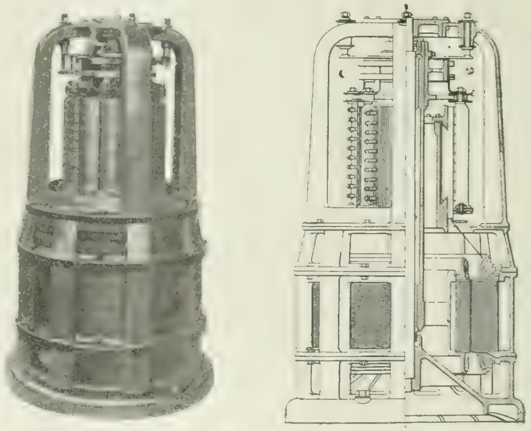
The wire in each case was wound on bare sheet-iron spools, then joined in series and a current of 22 amp. passed through them. A thermometer was placed in each coil and the temperature taken every three minutes. The resistance was taken with Wheatstone bridge. The thermometers were carefully selected for accurate reading.

* * *

An Alternating Current Rectifier.

On page 827 of our issue for November 11 was given a short description of the "permutator," of the Société Anonyme Egyptienne d'Electricite, in service at the Liege Exposition. We are able to give below a more complete account of the machine.

The input side of the machine is similar to the stationary primary winding of a polyphase induction motor, while the winding of the output side, which is arranged adjacent to the primary, is connected to a commutator similar to that of an armature of a direct-current generator. These two windings of the machine are stationary. The current in the polyphase primary winding produces a revolving field which penetrates into the secondary armature winding. This field generates a counter e.m.f. balancing the primary voltage, and it generates in the stationary armature conductors an alternating e.m.f. which bears to the primary e.m.f. the effective ratio of the turns of the corresponding windings. By means of brushes on the commutator which rotate synchronously with the revolving field a unidirectional e.m.f. is obtained from the stationary armature.



FIGS. 1 AND 2.—PERSPECTIVE VIEW AND SECTIONAL ELEVATION OF CONVERTER.

As seen from Figs. 1 and 2, the general appearance of the permutator is quite similar to that of a Curtis turbine. It is provided with a stationary magnetic circuit in the lower part of the structure. The commutator, shown near the top, is also stationary. The brushes, however, revolve, the two slip rings serving as a path for the unidirectional current from the armature.

The brush rigging is driven synchronously by means of a derivation of the main flux from the primary, and not by a separate motor as might be assumed. Fig. 3 indicates the magnetic circuits of the machine and shows the circular electromagnet to which the brush rigging is directly attached. It is evident that this movable concentric iron mass with its winding may be caused to operate in all respects similarly to the rotary secondary of an induction motor. The induction motor action is employed in accelerating the brush rigging from standstill, but during normal operation the wiring of the electromagnet is fed with direct current from the machine itself, and, therefore, this secondary winding revolves synchronously without slip.

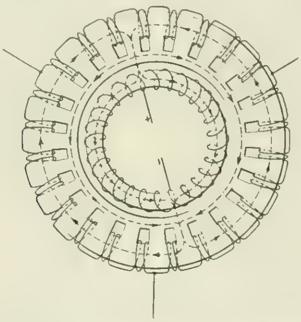


FIG. 3.—DIAGRAM OF ELECTRIC AND MAGNETIC CIRCUITS IN A PERMUTATOR.

An advantageous feature of the machine resides in the fact that the small mass of the revolving parts can rapidly be accelerated to full speed, and the time consumed in synchronizing the machine is inappreciable in comparison with that necessary with a rotary converter. The starting and speeding up of the machine present no more complication than is the case with a regular induction motor. The direct current in the movable secondary winding not only causes the brushes to revolve synchronously, but it serves to supply the exciting current to the machine, which on its input side, therefore, operates similarly to a synchronous motor. Thus the machine starts as an induction motor having a rotor of minimum inertia and assumes the characteristics of a rotary converter after having been synchronized. The ratio between the alternating and direct voltage can be placed at any value desired. The primary can be wound directly for the line voltage, thus dispensing with the use of stationary transformers.

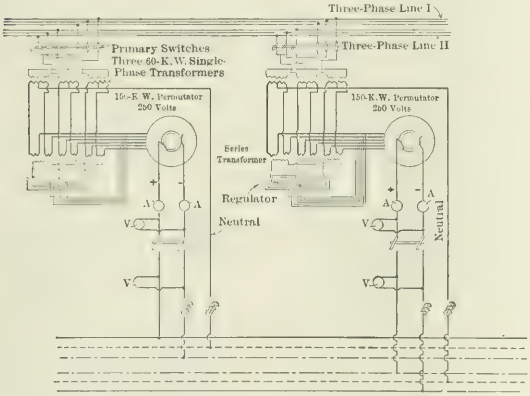


FIG. 4.—DIAGRAM OF CIRCUITS FOR TWO PERMUTATORS, THE TRANSFORMERS AND THEIR REGULATORS.

At the Liege Exposition three of the permutators have been in service. Each is a 150-kw machine in which 50-cycle, three-phase current at 3,000 volts is transformed into direct current at 250 volts, and this voltage is subdivided into 2 × 125 by the use of a neutral wire tapped from the secondaries of step-down transformers, as shown in Fig. 4. Two machines can be operated separately for feeding a three-wire, direct-current system, or two machines can be connected in series and feed a five-wire, 4 × 125-volt system, the third machine being held as a reserve.

Each permutator is provided with three single-phase transformers for decreasing the primary pressure from 3,000 to about 200 volts, the secondaries being connected in "double-star," six-phase for feeding the permutator. A single set of polyphase closed-coil windings in each machine serves as both the input side and output side of the permutator, the six leads to the secondaries of the transformers and the numerous leads to the stationary commutator being joined to this one set of coils, so that the neutral point of the transformers is simultaneously the neutral point of the direct-current system.

A diagram of the circuits of two permutators arranged for operation either in parallel or in series is shown in Fig. 4. In the secondary circuits of each machine there are placed series transformers which allow a possible variation of the direct e.m.f. from 230 to 270 volts. The regulation of voltage is obtained as follows: The three auxiliaries have their secondary windings in series with the alternating-current circuits of the permutator, their primary windings being connected to a three-pole commutating switch. When this switch is in its middle position, the primary windings of the auxiliary transformers are short-circuited, and the machine operates as though it were connected directly to the main transformers. When the switch is in its other positions the primary winding of each phase is connected to one or the other pole of the secondary corresponding to that phase or to one of the other phases, which adds in series or in opposition a voltage of a corresponding phase or +60 or —60° apart, with the result that the five positions give the variations noted above.

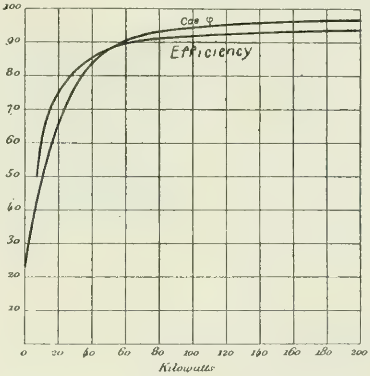


FIG. 5.—PERFORMANCE OF 150-KW PERMUTATOR.

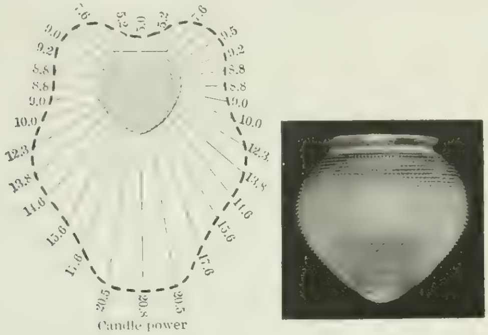
The performance of a 150-kw permutator is shown in Fig. 5. Experiments have shown that the permutators can be synchronized in about three seconds. The rapid acceleration and synchronization is due to the small inertia of the revolving parts, and to the strong synchronizing currents produced in the brush rotating winding. The currents in the rotor at starting are not considered as dangerous as are the currents in the field windings of a rotary converter. The starting current, with the load circuit open, has been observed to be about 75 per cent of the full-load current.

It is evident that when the rotor is brought up nearly to synchronism as the secondary circuit of an induction motor, and then synchronized by means of current from the revolving brushes, the machine may assume a polarity opposite to that desired. The polarity can easily be reversed, however, by simply opening and closing the switches and allowing the machine to slip one pole. The inconvenience of such interruptions and re-establishments of the current is not noticeable at the machine or at the alternator supplying current to the machine, even when the comparative capacity of the generator is small as is the case at the Liege Exposition. If the permutator in service should fall out of step there would be no injurious effect on the remainder of the installation. As a matter of fact, however, the synchronizing power of the machine is so great that there is no danger of its dropping out of step even when working under heavy loads of irregular character.

Reflectors, Shades and Globes.—V.

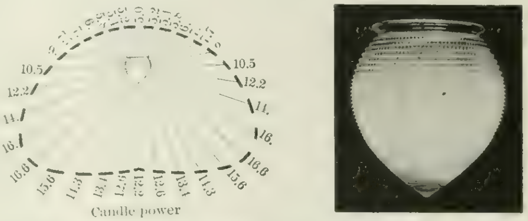
By J. R. Cravath and V. R. Lansingh

THE globes known as "Holophane" are designed with two objects in view. One of these objects is to redirect rays of light, thus accomplishing some of the things accomplished by a reflector in taking light which would otherwise be useless and directing it in useful directions. This redirecting of the light rays as they pass through the "Holophane" globe is accomplished by reflection and refraction of the rays by means of prisms pressed on the outer surface of the globe. The other object accomplished by this type of globe is the diffusion of light to avoid the glare of the arc, incandescent filament, Nernst glower, or gas flame, as the case may be. That is, it accomplishes the same thing as the frosted bulb or globe, only to a much greater degree. The rays of light are broken up by prisms on the inside of the globe so that the eye does not meet the direct light from the filament of the lamp. The rays are so successfully broken by passing through these inner prisms that the whole globe appears to glow with a mild light. The light, therefore, instead of coming from a small, intensely lighted filament, comes from the whole surface of the globe. This reduces materially the blinding effect which has been spoken of frequently before, and enables a person to see better because the pupil or iris of the eye is not contracted to such an extent in an involuntary effort to shut out the intense blinding light. The absorption or loss of light in passing through "Holophane" globes is remarkably low considering what they accomplish. Probably the most extensive tests ever made on this glassware were conducted by Professor W. L. Smith of the Massachusetts Institute of Technology, who found that the loss of light by absorption in this type of globe amounted to from 10.0 to 16.8 per cent, with an average of 12.3 per cent. On account of the deep corrugations which form the prisms on these globes, unnoticed dirt is likely to collect on them and they should be brushed off at frequent intervals with a dry, stiff brush, brushing lengthwise of the prisms. At longer intervals they should be taken down and scrubbed with a brush in soap and water. Like all other enclosed globes, the opening around the shade holder should be filled with a mica or asbestos gasket to keep out dirt. The amount of light likely to be absorbed by the collection of dust on the prisms is not as great as might be anticipated, amounting in one test made at the Electrical Testing Laboratories with a "Holophane" globe thickly coated with dust to about 13 per cent.*

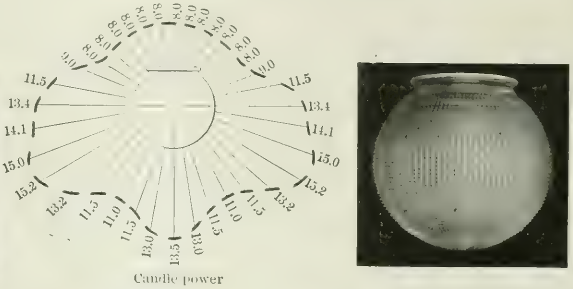


FIGS. 28 AND 28A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" GLOBE.

Fig. 28 shows the distribution of light about a 16-cp incandescent lamp enclosed in a "Holophane" globe shown in Fig. 28A. As seen from the test, this globe is one designed to direct the rays of light so as to give a maximum candle power immediately under the lamp. For a distance of 10 degrees each side of the vertical, the candle power is over 20. This is, of course, much less than is obtained with most types of reflectors, and for this reason a globe of this pattern is not to be recommended, unless for artistic reasons where a large amount of downward light is wanted and a diffusing globe is not necessary. There are many locations, however, where it is necessary to use a diffusing globe in order to avoid the glare of the bare lamp filament, and at the same time to direct the light in downward directions. The principal application of this globe is on chandeliers for the general lighting of rooms where the sockets on the chandeliers are placed at an angle of 45 degrees, as is very common. On such a chandelier, this globe will throw the light down into the various parts of the room instead of letting it escape toward the ceiling, and it will, at the same time, do away entirely with the glare from bare lamp filaments. Were reflectors of any kind used for this same purpose, frosted bulb lamps would be necessary and the diffusion or softening of the light could not be as well accomplished as with the "Holophane" globe. This type of globe, which is designed to give a concentrated downward light, should not be used on a chandelier having the sockets pointed straight down if the general lighting of the room is the thing desired; but if it is desired to create a light space for reading immediately under the chandelier and at the same time obtain a fairly good light in other parts of the room, use of these globes on downward pointed sockets will give good results.

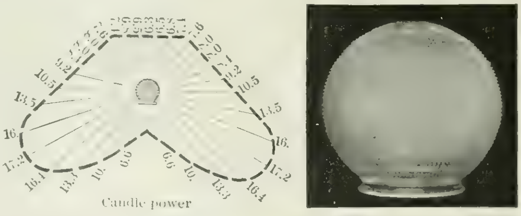


FIGS. 29 AND 29A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" GLOBE.



FIGS. 30 AND 30A.—DISTRIBUTION OF LIGHT FROM SPHERICAL PENDANT "HOLOPHANE" GLOBE.

Fig. 29 gives the distribution of light about a 16-cp incandescent lamp enclosed in a "Holophane" globe the general shape of which is the same as that shown in Fig. 28A, the only difference being in the angles of the prisms and the size. This is the smaller of the two globes. This type is designed to distribute light in all directions below the horizontal, giving a good general illumination of a room when they are placed in the pendant position.



FIGS. 31 AND 31A.—DISTRIBUTION OF LIGHT FROM UPRIGHT SPHERICAL "HOLOPHANE" GLOBE.

Fig. 30 shows the distribution of light about a 16-cp incandescent lamp enclosed in a spherical pendant "Holophane" globe, 5½ in. in diameter, shown in Fig. 30A. In this case the light below the horizontal is not greatly increased as compared to the bare lamp except immediately below the lamp. Aside from this increase in candle power immediately below the lamp, the principal effect of this particular globe is to diffuse and soften the light. It can be compared to the distribution of light around the ground glass ball which is also a good diffuser and softener of light.

---

* "Absorption of Light by Dust," by V. R. Lansingh, *Electrical World and Engineer*, Oct. 7, 1905.

Fig. 31 gives the distribution of light about a 16-cp incandescent lamp enclosed in a "Holophane" spherical globe, placed upright. This should be compared with the illumination obtained from a bare incandescent lamp placed upright and also from an incandescent lamp enclosed in the various diffusing globes before shown. The distribution of light from lamps and globes placed upright can, of course, be easily obtained by inverting any of the diagrams before given. The "Holophane" ball, from which test Fig. 31 was obtained, is shown in Fig. 31A. This globe offers a valuable means of increasing the illumination in downward directions from all kinds of fixtures where the incandescent lamps are placed upright. The majority of bell-shaped shades when placed on such upright fixtures have the effect of robbing the lower part of the room of light and throwing even more light towards the ceiling than would go there if the lamp were bare. This globe distributes the light below the horizontal in such a way as to give a fairly even illumination all over the lower part of a small room.

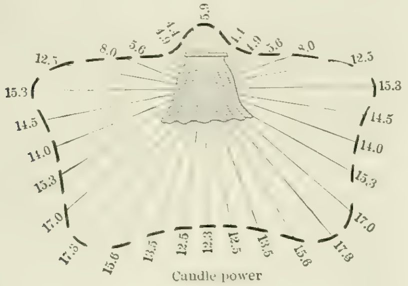


FIG. 32.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" OPEN SHADE.

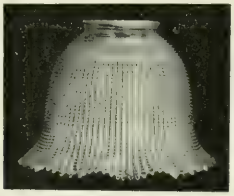
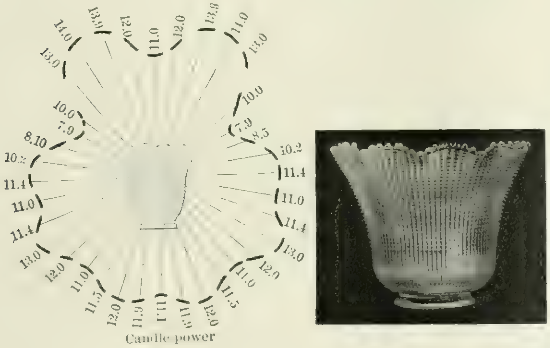


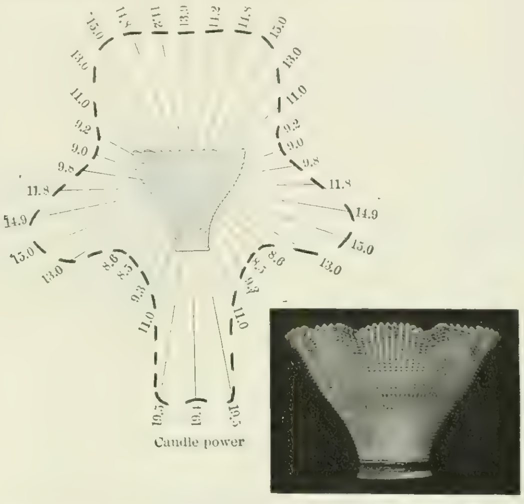
FIG. 32A.—"HOLOPHANE" OPEN SHADE.



FIGS. 33 AND 33A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" OPEN SHADE.

Fig. 32 shows the distribution of light about a 16-cp incandescent lamp placed in a "Holophane" open shade, designed for use as a pendant, and shown in Fig. 32A. As seen from test, this globe is of the type which increases the illumination in downward directions. When such a shade is used on a chandelier, it should be placed on sockets which are pointing straight down only. If used on sockets placed at angles of 45 degrees, it will not only throw more light up than is compared to the distribution of light around the ground glass ball shade.

Fig. 33 shows the distribution of light about a 16-cp, upright incandescent lamp, in a "Holophane" open shade, shown in Fig. 33A. This shade is mainly useful as a diffuser, although it increases the useful illumination immediately below the lamps.



FIGS. 34 AND 34A.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" OPEN SHADE.

Fig. 34 shows the distribution of light about a 16-cp incandescent lamp upright in a "Holophane" open shade, shown in Fig. 34A. This shade is designed to make a marked increase in the illumination immediately below the lamp, in which it succeeds very well, as within a narrow angle below the lamp it gives about 20 candle power. This shade can be used to advantage where it is desired to secure good light for reading or writing under chandeliers or brackets equipped with upright incandescent lamps. Similar globes are made for gas burners, and since the light from a gas burner is distributed in much the same way as from a bare upright incandescent lamp, there is an opportunity to so increase the illumination immediately below a gas burner by use of such a shade just as in the case of the incandescent electric lamp.

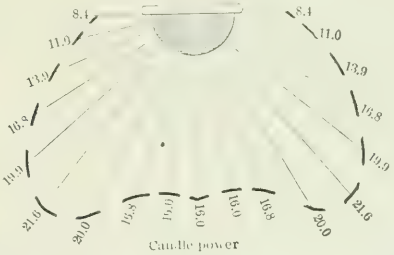


FIG. 35.—DISTRIBUTION OF LIGHT FROM "HOLOPHANE" HEMISPHERE.

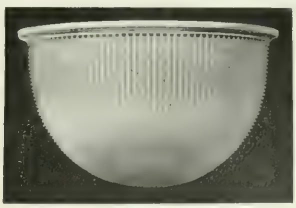
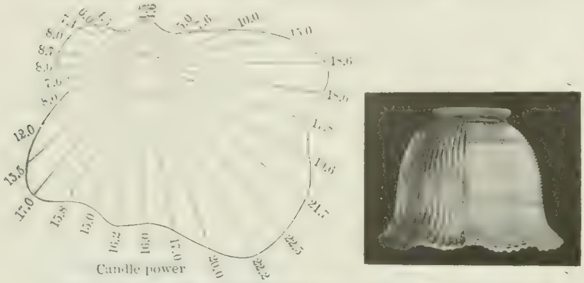


FIG. 35A. "HOLOPHANE" HEMISPHERE.

Fig. 35 shows the distribution of light about a 16-cp incandescent lamp placed in a "Holophane" hemisphere designed for use on ceilings and shown in Fig. 35A. This shows a very decided increase in the amount of useful downward illumination by the use of this hemisphere as compared to the ground glass hemisphere, before shown, the latter being used for the same purposes. The illumination at all angles below the horizontal can be increased in this and all other types of bowls or hemispheres by the use of the proper reflector over the lamp inside the hemisphere.



FIGS. 36 AND 36A.—DISTRIBUTION OF LIGHT FROM COMBINATION "HOLOPHANE" AND "PAGODA" GLOBE AND REFLECTOR.

Fig. 36 shows the distribution of light around a 16-cp incandescent lamp, placed in a combination "Holophane" and "Pagoda" globe and reflector, shown in Fig. 36A. It is designed especially for use on wall bracket fixtures. This globe consists of a "Pagoda" prismatic reflector on one side and a "Holophane" globe on the other, the two features being combined in the one globe. In the use of such globes it is manifestly advisable to take unusual precautions to prevent their being turned around so as to throw the maximum light towards the wall instead of away from it. This globe makes a decided increase in the amount of illumination thrown away from the wall if properly used.

Central Station Operating Points at Kewanee, Ill.

Kewanee, a rapidly growing manufacturing town in central Illinois, to which the 1900 census gave a population of 8,332 and which is now undoubtedly a town of 12,000 inhabitants, has a very well constructed central station operated by the Kewanee Light & Power Company, which company also owns the gas plant of this city. It is unusual to find a small central station so substantially constructed. The building is of brick, with concrete floor in the engine room and brick floor in the boiler room. The roof is of slow burning construction supported on steel trusses.

All the generating units at the station are direct connected. The greater part of the company's load is on a direct-current 110 and 220-volt, 3-wire system. Two 125-volt generators are coupled together and placed in line with two high-speed engines, to either or both of which they can be connected by clutches. The arrangement works fairly well except that there is a little difficulty in keeping engines and generators in alignment, which results in the clutch rattling when they are out of line. No difficulty, however, has been experienced with hot bearings on account of mis-alignment. The advantage of this arrangement is, of course, that a small engine can be used to drive the generators during hours of light load. Besides the 125-volt generators, there is a 250-volt, direct-connected generator. A direct-connected alternator used for supplying the residence and outlying districts is of 150-kw, three-phase, 2,300 volts.

The company is at present considering the matter of the best way to take care of increase in business; whether to put in a storage battery on the direct-current system and put new power business on that system as far as possible, or to extend the alternating-current business. At the present time, the alternator is shut down during daylight hours. Twenty-four hours' service is given on the direct-current system. If the storage battery is put in on the direct-current system, it will be used both to assist at the peak and to carry the load when it is light.

The plant is kept as neat as a pin, and on account of its cleanliness and substantial character, cannot but make a favorable impression on prospective customers, especially those who contemplate depending on the central station for the operation of large motors.

TAR BURNING.

As the company operates the gas works, which is on the same property as the electric light plant, it always has an abundant supply of tar as a by-product, and provision is just being made to use some of this tar as a fuel under the boilers, first to assist in carrying peak loads, and second as a reserve in case of coal blockades or strikes. The company has a tar tank 32 ft. in diameter and 16 ft. deep, which will hold 75,000 gal. of tar. This tank, it is calculated, will hold enough to operate the station for three weeks should the coal supply be cut off. The company, therefore, has in its tar tank a compact fuel storage which is not to be despised; the 75,000 gal. of tar is considered the equivalent of 200 tons of coal. Provision for burning is made by installing some tar burners constructed by the Connelly Iron Sponge & Governor Company, New York. With these burners, the tar is piped to the front of the boilers and allowed to run in a stream into the funnel on top of the burner. In the burner it is mixed with a jet of steam and is ignited as soon as it enters the fire box. It is ordinarily used in connection with coal; a thick bed of coal being kept over the grates. The burners are arranged so as not to interfere with the coal fire, which is replenished about every 30 minutes. It is an easy matter to force boilers during the peak load with the tar burners in operation.

RATE CLASSIFICATION.

The company has a rather unusual method of determining meter rates. This method in general is to classify different lines of business according to the character of the load they afford. Thus, long hour users are put in a classification which gives them the lowest rates. This classification arrives in effect at about the same results as some of the maximum-demand, readiness-to-serve, and two-rate methods. The minimum bill is 50 cents per month. Miscellaneous unclassified customers are charged 15 cents per kw-hour. This includes residences, churches, and miscellaneous customers not long-hour users. The lines of business which are charged less than 15 cents per kw-hour, and the rates are as follows: Grocery stores, 12 cents; dry goods stores, 12 cents; clothing stores, 10 cents; saloons, 7 cents; drug stores, 7 cents. All these rates are subject to 10 per cent discount for payment within ten days from the date of the bill.

The company owns the commercial arc lamps, most of which are of General Electric manufacture. The time allowed between trimmings is about 75 hours. The peak load is about 2,200 amperes direct-current at 110 volts, and about 100-kw in alternating-current.

METER WORK.

Customers' meters are tested once a year ordinarily, although some of the larger customers' meters may be tested as often as once in six months. The company has about 500 meters on its lines. These meters are brought into the station to test, and it is interesting to note that the testing of these 500 meters makes just about enough work for one man, who devotes his time to it from one year's end to another. The meter tester is a man trained at the factory. When meters are removed from a customer's premises for test, they are usually brought back the same day. This saves connecting up a new meter in place of the one to be tested. The meter tester does all the work of taking out, testing and replacing meters, using a bicycle for transportation when the weather permits.

Most of the meters are the Thomson commutator type. For meter testing, the instruments used are a General Electric indicating wattmeter, ammeter and voltmeter.

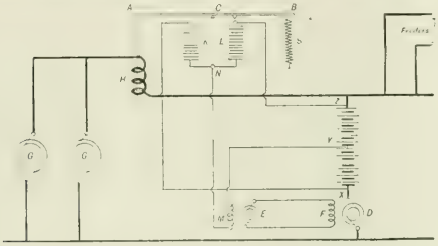
The meter cards are looked over each month after the meters are read, and any unusual readings of meters are noted and the cause at once investigated, no matter whether the readings are high or low. This puts a check on dissatisfaction of customers should the meter happen to be running fast, as the company would find it out before the customer received his bill and make deductions accordingly. It might also in certain cases prevent the burning out of a meter or transformer through increase in the customer's load unknown to the company.

The president of the Kewanee Light & Power Company is Mr. X. Caverno, who is prominent in the Illinois State Electric Association. The office details of the business are looked after by Mr. B. C. Parkinson, secretary and treasurer, while the electrical and mechanical operation is under the charge of Mr. E. W. Smith, superintendent.

December Meeting of the American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers which was held on December 15, there were presented two papers dealing with the general subject of railway sub-stations. The paper by Mr. Sidney W. Ashe, which was given the title "The Relation of Railway Sub-station Design to Its Operation," considered exclusively synchronous-converter sub-stations and treated of the following factors: The best method of starting converters, the protection of converters, the use of oil switches when synchronizing, the regulation of load, the best arrangement of switch gear, the operation of reverse-current relays, the adjustment of load between the sub-stations which feed the same circuit and the noiseless operation of synchronous converters. Outline descriptions were given of the three methods usually employed for starting converters, namely, from the direct-current side, by means of a small direct-connected induction motor and from the alternating-current side.

The author stated that the usefulness of storage batteries in railway work is being more and more appreciated, as evidenced by their recent applications. An interesting development in connection with storage batteries is a carbon regulator put to use during the last year. It consists of a variable carbon resistance which is used in connection with pilot cells and an exciter, to vary the excitation of the field coils of a booster. Referring to the accompanying diagram, *H* is a solenoid carrying the total generator load, which acts on a soft-iron plunger suspended from the lever, *A B*, of the carbon regulator. At the other end of the lever is a spring, *S*, whose tension is adjustable. *K* and *L* are piles of carbon discs on the opposite sides of the fulcrum, *C*, of the lever. The resistance of these piles is altered by slight variation in mechanical pressure, produced by slight fluctuations of current in the coil, *H*. The details of the electrical connections are self-explanatory. The battery booster is represented by *D*, *F* being its field coils. *E* is a small exciter, whose field coils, *M*, are connected to the carbon regulator as shown.



AUTOMATIC REGULATOR FOR RAILWAY BATTERIES.

The operation of this regulator is as follows: As the lever arm is raised or lowered the resistance increases in one arm and decreases in the other, causing wide variations in voltage across the exciter field coils, the direction and intensity of the current in the coils varying accordingly. The action is somewhat analogous to that of Wheatstone's bridge. With the polarity of the booster changing and its field excitation varying in intensity, it is possible automatically to charge the main battery or to raise the battery voltage so as to carry part of the load of the bus-bar. By limiting the motion of the lever arm it is possible to limit the load which the battery will carry under extreme conditions. Experiments have shown that by the use of this system close regulation of the load on the converter is obtained.

In commenting on the criticism which has been directed against continuous reverse-current relays, owing to their sensitiveness, the amount of adjustment they require and their ability to perform their service at all times, the author stated that while these criticisms are partly warranted, the fact remains that such relays are better than no protection at all. If reverse-current relays were not sensitive they would be practically worthless. Hence the features which appear to make the instrument objectionable are necessary elements of its successful application.

The paper by Mr. C. W. Ricker dealt with "Some Considerations Determining the Location of Electric Railway Sub-stations," and tended to show the method by which Kelvin's law may be applied to the selection of the most economical number of sub-stations for a certain railway. It is required to adjust the cost of losses in the primary distribution, the secondary distribution, including the track, and the sub-stations, the fixed charges upon each of these three divisions, and the cost of sub-station attendance, so that their sum shall be a minimum, with due regard to the conditions of regulation and continuity of service. As the density of the load in a system wholly within a large city is very great, the unit of sub-station equipment for such service may be made large enough that at the time of least load one unit per sub-station may be operated at or near its best efficiency. Hence the sub-station losses per kilowatt-hour may be considered constant.

The aggregate capacity of the sub-stations will equal the capacity of the generating station plus the sub-station reserve capacity, which will not exceed one unit per sub-station. The greater the distance between sub-stations, the larger the sub-station unit will be; hence, the cost of sub-station apparatus will decrease as the number of sub-stations increases, until the largest practicable unit is reached. The same is true of sub-station land and buildings. The cost of sub-station attendance will depend only upon the number of sub-stations, as the same number of attendants is required in a small as in a large sub-station, unless the cost of land makes it necessary to double-deck the sub-stations, in which event there will be a sharp rise in the cost of attendance when the number of units becomes greater than can be placed on one floor.

When direct-current motors are used the secondary voltage is fixed by conditions of standard practice. The secondary conductors may be proportioned by Kelvin's law, subject to the limiting condition that the lowest potential shall be enough to allow the required acceleration. As the number of sub-stations increases, the cost of the conductors will decrease rapidly. The energy losses in the conductors may be constant or decreasing. The primary distribution in this case must be by underground cables. The primary voltage will be determined by the relative cost of copper and insulation, and should be as high as is consistent with safety. Hence the losses per mean kilowatt in the primary distribution may be considered constant. The total weight of primary conductors will be practically independent of the number of sub-stations, depending upon the total energy and the mean distance of distribution, and it may be determined by Kelvin's law.

To obtain the greatest reliability of service, each sub-station should be fed directly from the generating station by at least three cables, and in the case of a wide difference in the number of sub-stations considered, the total cost of cables and conduits would be somewhat greater with the larger number of sub-stations as more and smaller cables would be required. Otherwise the cost of the high-tension distribution, and the losses in it, may be considered constant. Neglecting those quantities which are constant, the fixed charges on sub-station land, buildings and apparatus and the cost of sub-station attendance increase as the number of sub-stations increases; the fixed charges on the secondary distributions decrease and the losses in the secondary distribution decrease or remain constant.

The various losses and charges upon which the solution of the problem depends may then be considered as constants or variables dependent directly upon the number of sub-stations and inversely upon the distance between sub-stations. These quantities may be reduced to a common base of annual kilowatt-hours, and curves representing them may be drawn with respect to the number of sub-stations as one co-ordinate, and a summational curve may be drawn which, if the premises are rightly chosen, will indicate the number of sub-stations at which the sum of the various charges is a minimum.

The discussion was opened by Mr. H. A. Lardner, who called attention to the fact that in rotary converter sub-stations of the average interurban railway, the sub-stations are entirely shut down every night, and unless storage batteries are included in the equipment of these sub-stations, no direct current is available for starting the converters in the morning. Therefore, it becomes necessary to include one other method of starting converters. The method of starting the converters from the alternating-current side has many advantages; among them are great simplicity and the omission of special apparatus. The introduction of taps running from the middle points of the transformers is a very slight modification, and the double-throw switch required is also a small matter. Furthermore, the division of the field coils is not seriously objectionable. Where the size of rotaries is 500 kw and under it is desirable to use the alternating-current, self-starting method for placing the first converter in operation in the morning, when no direct current is available, and to use the direct-current method for the addition of other units at any time during the period of operation.

Mr. W. I. Slichter remarked that in addition to the method involving the application of an induction motor in starting rotary converters, there is another method of indirect starting by the use of a single-phase commutator motor. The alternating e.m.f. of a rotary converter is approximately the voltage which is suited for a single-phase commutator motor, and by putting a reactance in series with such a motor an easy means can be obtained for regulating the voltage and the speed. By this method it would be easy to secure the proper speed for throwing the converter into synchronism.

Mr. John B. Taylor stated that there seems to be a general impression that the purpose of the reactance coil in series with the armature winding of a converter is to permit starting from the alternating-current side. As a matter of fact, however, the reactive coil is used for several reasons: to permit automatic compounding, to compensate partially or wholly for the line drop, and the drop in the transformer and converter itself; and it also allows the converter to run under variable load with comparatively slight changes in power factor, so that it is almost unnecessary for a station attendant to make any changes in the field rheostat at any time during the day. It also readily permits the division of load between converters. All such factors as brush resistance and field resistance become of small importance when reactive coils are installed. Although almost any rotary converter may be started from the alternating-current end with 25 per cent of full voltage and some of them, if the armature happens to be in a favorable position, may be started with from 17 to 18 per cent of full voltage, the usual practice is to employ one-third voltage so as to insure starting under all conditions and to make the practice uniform. It is well to note the effect of the action of the auto-transformer when the rotary is being started. The current on the line varies with the square of the voltage on the secondary taps. That is to say, one-quarter voltage will require current in the ratio of 9 to 16, compared with that taken by one-third voltage.

Mr. H. G. Stott thought that the importance of the line drop had not been properly emphasized. When a synchronous converter is operated with a line drop of 12 per cent, there is difficulty in holding it in synchronism, and its operation generally will be unsatisfactory. This fact is of moment when a converter is started from the alternating-current side. If the line is fairly well loaded and there is a drop approximating 10 per cent, if a converter of relatively large capacity be started, there may be such a drop as to start the other converters hunting, and to cause a flashing at the brushes. This fact also has a strong bearing on Mr. Ricker's paper. That is to say, the limiting conditions in the location of sub-stations is set by the line drop and it must be borne in mind that a maximum of not more than 15 per cent drop can be allowed.

Mr. E. H. Hewlett, in commenting on the possibility of oil switches not working properly, said that, while some of the first switches were defective in this respect, switches are now made with a positive stop and a trip coil, which moves the stop out of the way, so that the "pumping" of switches is unknown where they are given reasonable care.

President Wheeler related some of the early experiences in the paralleling of direct-current dynamos, in which great difficulty was encountered on account of the sensitiveness of the governors of the driving engines. The difficulty was overcome by connecting the levers of the centrifugal governors together so as to compel the engines to run at the same speed and not to "pump." While it is infinitely easier to run direct-current machines in parallel than alternating-current machines, he expressed the opinion that the problem with the alternating-current machines is the same problem much intensified.

Mr. D. B. Rushmore remarked that while in small sub-station installations the compound coils are generally used, such seems not to be the case with large interconnected systems. In regard to the "hunting" of synchronous converters, a considerable portion of it can be attributed to the reciprocating steam engines. As these engines seem to be going out on account of the introduction of steam turbines and the extending use of hydraulic turbines, it is to be hoped that in the future very little will be heard of the hunting of synchronous converters.

Prof. R. B. Owens, of McGill University, called attention to the fact that the main consideration in connection with the location of electric railway sub-stations was omitted by Mr. Ricker's paper, namely, the voltage. Without going into the question of whether or not direct-current generators can be successfully designed of large size, for voltages of 1,000 or 1,500, or 2,000, it is believed that the makers stand ready to furnish rotary converters of 1,000 volts, maybe more, and also at least bi-polar motors that will operate successfully at such voltages. If this is true it affects the whole question of sub-station location most materially, and materially interferes with the field which some people suppose the alternating-current motor system occupies. The gist of the whole matter depends upon the value to which the direct voltage can be increased. The solution lies in the design of direct-current machinery, in large units, at high voltage, to operate successfully under conditions met in traction work.

Mr. William McClellan thought that the method proposed by Mr. Ricker would apply very well where trains move over the road without any particular points of congestion; but in any practical case it is necessary to consider the location of each sub-station in connection with the existing conditions.

Dr. C. P. Steinmetz stated his belief that for a long time to come, if not for ever, the largest number of railway sub-stations will remain converter sub-stations. It is proper, therefore, that much attention should be devoted to the rotary converter. The railway converter sub-stations can be divided into two typical classes: the sub-station in a large high power distribution system and the sub-station in an interurban system. In the former class the loss between generating station and sub-station and the drop of voltage between sub-stations is very small. The sub-stations contain a large number of large units which run practically always at steady full load. The individual momentary variations of load are not perceptible in the sub-station to any great extent, and the daily changes of load are taken care of by varying the number of converters. In such sub-stations the possible variation of voltage due to line drop is insignificant. Automatic control of voltage for variations of load on the converter is not necessary, since the converters are maintained at fairly steady voltage. Therefore, automatic voltage controlling devices, as compound field coils and reactive coils, are not necessary, but the shunt-wound converter is suitable, and therefore it is undesirable to have in such sub-stations series field coils on the converters and reactive coils, since they are an unnecessary source of a possible danger, the danger of racing in case of the direct-current system feeding back into the converter sub-station, which danger, due to the small resistance between sub-stations, is greater than in the interurban sub-station, which is the second class of sub-station.

In the interurban system class moderate-sized sub-stations with two or three units of converters of, say 500 kw or less, are fed from long-distance, high-potential transmission lines with considerable drop of voltage in the transmission lines and very considerable resistance between the sub-stations. In these sub-station systems the variation of load would be impracticably large for any ordinary methods of voltage control to be used. Therefore, these sub-stations utilize powerful series field coils and reactive coils. That is what has been called phase control. In the operation of a converter sub-station the most important matter is the starting of the converters. In the early days the first systems were started from the alternating-current side by throwing full voltage on the converter or synchronous motor and letting it get up to synchronism. The starting from the alternating side gives the severest jolt on the system, especially when using full voltage. The converter may also be started either by a special motor or from the direct-current side, and then synchronized. The methods of starting can, therefore, be divided into two large classes: those methods which require synchronizing devices and those which do not require these devices. There may be some difference in the time required to start; it may take a little longer time to synchronize, but in either case the minimum time is sufficiently short so that either method would be suitable. The method of starting, which requires synchronizing devices, is the least severe on the system. A converter may be put into the system without any trace of disturbance. This method was introduced to a large extent to avoid shock on the system, but recently the tendency has been strongly away from it, and at least in interurban systems, it may almost be said that the methods of starting which require these devices have failed. They have failed because under just those conditions where the utmost rapidity of starting is essential, where there is trouble in the system, or heavy overloads, where the direct voltage cannot be held up and begins to sag down to nothing, and where in the alternating-current system the voltage goes up and down, the machines cannot be synchronized safely. These are the main reasons for re-introducing.the alternating-current, self-starting method. It is true that a specially skilled operator might be able to get the converter in operation in this manner without throwing out the whole sub-station, by closing the switches not at equality of frequency, but when the two frequencies approached each other, while they are yet coming together, because it is impossible to synchronize them while they are together. The speeds cross each other at such rapidity that they are immediately again apart, and there is the danger of improperly estimating the time and thus of short-circuiting the system and throwing out the other converters just when they are most needed. In general the proper moment for closing the switches is not when the machines are in step and in synchronism, but just a moment before they are in synchronism. That means that direct-current starting is of questionable usefulness in interurban systems. In the large metropolitan sub-stations the difficulty is largely reduced, because the voltage is steady on the alternating side as well as on the direct-current side. At the same time in these systems if a machine is thrown in when out of synchronism the result is much more disastrous, because there is almost no resistance between the generating station and the sub-station or between the sub-stations, and all the momentum of the whole system feeds back into the converter, thus reversing the converter at full voltage. Even with the most skilled operator that may occasionally happen. Assuming the efficiency of the operator as very high, that his liability to error is only one-hundredth of one per cent, that he will make a mistake only once in 10,000 times, if one considers a city like New York, where more than 100 converters of 1.000 kw or more have to be thrown into the system daily, it will be seen that one in ten thousand means three times a year some big converter is thrown in wrong, and tears down the whole station, with the usual disastrous results. This fact gives the preference to starting from the alternating side by means of low voltage. A compromise of the direct-current and the alternating-current methods of starting has been developed to reduce the jolt on the system. The start is made from the direct-current side and the machine is brought up almost to synchronism. The direct-current side is disconnected and the alternating-current switch is closed. The converter drops in step almost instantly and there is no appreciable jolt on the system.

In discussing the hunting of converters, Dr. Steinmetz stated that there are several modifications of the anti-hunting devices. One of the most effective is a squirrel-cage induction motor. That is the most effective anti-hunting device, and it is largely used in synchronous motors intended for very severe conditions, as for operating heavy fluctuating loadws at the end of a long transmission line with heavy resistance losses in the line. It is obvious that such a squirrel-cage induction motor is of a great advantage in starting the converters. Two other devices are short-circuits around the field pole and short-circuits between the field poles, each depending for its operation on the shutting of the magnetic flux. When hunting the magnetic flux vibrates across the field pole. The short-circuit current around the field pole is due to the change in the magnetic flux. The short-circuit between the field poles obviously cannot interfere with starting, but they act as self-starting motors, giving a quarter phase winding to the normal pole and produce the effect of a quarter-phase motor. The other arrangement of short-circuiting around the field poles is used to a considerable extent in synchronous motors. There seems to be no good reasons why they should not be very satisfactory in connection with rotary converters.

The storage battery is a very useful and desirable element in a railway system. The only and main objection to a storage battery which has practically killed its introduction in most railway systems, especially in interurban systems, is that the cost of the storage battery as a rule is so great that an interurban railway cannot pay for it, or cannot be sure to earn sufficient money to pay the interest on the investment in the battery.

New Telephone Patents.

SWITCHBOARD CIRCUIT SYSTEMS.

Every little while we find a patent issued which has been held up so long that the invention covered has in the interim become most commonplace. We have this week at hand for consideration two such patents, issued to M. G. Kellogg, the applications for which were filed twelve or more years ago. Both refer to switchboard circuit schemes. One covers a system in which high impedance drops are permanently bridged across the lines for line signals, while clearing-out drops and bells are legged off both sides of the line in parallel to ground. A battery in the clearing-out drop circuit renders that signal automatic in its action.

The second patent covers a divided multiple switchboard arranged in two main sections, and involves the use of the two sides of the lines individually in order to select the line signal at one or the other board. The signals are, of course, legged off one or the other side of the line to ground.

Fig. 1 shows a circuit scheme patented by H. T. Cedergren, of Stockholm, Sweden. With such a system the cords of a common battery system are kept free from current, as are also the jacks. It is unfortunate that no means of signaling is shown.

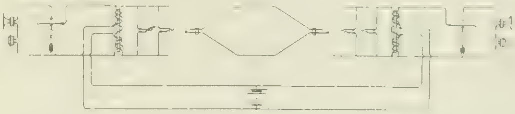


FIG. 1.—CEDERGREN SWITCHBOARD CIRCUIT.

SUB-STATION APPLIANCES.

A telephone shelf for clamping on a wall telephone forms the subject of a patent granted to J. S. Gold, of Jackson, Ohio. This carries the usual writing shelf on the right, and extends to the left as an arm rest. As a novel feature it is provided with a support for holding a receiver when it is not ready to be returned to the hook. This support comprises a notch with a cover so arranged as to close normally the slot and thus warn users against absent-mindedly using it in lieu of the hook.

J. Silverman, of San Francisco, has been granted a patent for a receiver support arm which has rather elaborate adjustments and automatically controls the hook switch, the latter a most invaluable feature. There appears to be little to distinguish this device from many of its predecessors.

A transmitter disinfecting shield has been jointly patented by M. F. and W. B. Hubbard, of Boston. It consists of a disinfecting screen and a clamp for securing it across a transmitter mouthpiece.

From protection against lightning some persons feel that the best form is a manual device for breaking the line and grounding it. Such devices are rarely seen except in sparsely settled districts. Fig. 2 shows one which is typical, this the invention of L. J. Fletchall, of Hatfield, Mo.

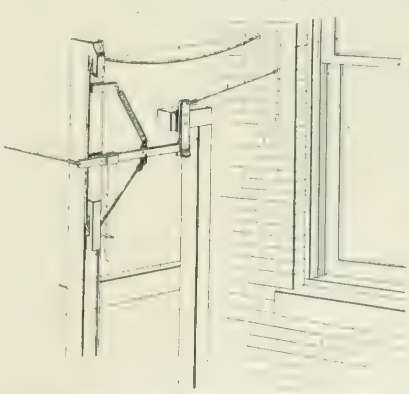


FIG. 2. FLETCHALL TELEPHONE DISCONNECTOR.

TRANSMITTER.

A rather peculiar transmitter has been invented by J. Prince, of [illegible] the usual carbon granules have been abandoned in favor of a mixture of copper, zinc and magnetic iron ore granules. The carbon electrodes, in addition, are supplemented by plates of zinc and copper. The transmitter is designed for use with apparatus for enabling the deaf to hear and is intended to be inexpensive. Unfortunately, the inventor gives no hint of what particular advantage may accrue from his mixed electrode.

PARTY LINE SYSTEMS.

A. R. Hoover, of Pleasanthill, Ill., has brought out a party line system in which all bells are in local circuits and are controlled by relays included in a bell line circuit exclusive of the talking circuits. The bells operate irrespective of the number of stations, the relays alone requiring sensitiveness. The bells are rung on a code system.

Another party system, this of a step by step nature, has been invented by A. J. Farmer, of Detroit, Mich. He selects a nucleus where both main and branch lines are brought and connected to a single switching machine. Through a series of impulses sent out over the main line the switching device may be rotated to connect up the parties in any desired grouping, or to the main line.

LETTER TO THE EDITORS.

The Patent Question.

To the Editors of Electrical World and Engineer:

SIRS:—The editorial in your issue of November 18 on "The Patent Question Again," is one which makes some suggestions which are valuable, and also one which appears to show a misunderstanding of what letters patent purport to be. The opinions based upon this misunderstanding are obviously not of value.

No doubt the statement by a patent lawyer that the last thing he desires is complexity, ambiguity or uncertainty in the patent law will be received by most laymen with incredulity, since they commonly suppose that these characteristics are the very source of the patent lawyer's income. However, the statement is true, and the better the practitioner the more truthful it is. I say this because the best of the patent lawyers have for years given freely of their time and energy (and where needed, their money) to improve and perfect the patent law, both on its theoretical side and in its practical application to existing situations. Every improvement is their work, and in the last ten years many have been made, such as the act making United States patents independent of foreign letters to the same inventor, etc. Those who have been most active in this good work realize most fully its great difficulty and its enormous importance; and those who are not experts in the present status of the patent law are seldom capable of making suggestions which prove of any value, or at least seldom do so.

The idea advanced by you that "a reference over which a patent has been allowed should certainly not be permitted as a citation against it in litigation," contains a germ of valuable suggestion, no doubt original, but very old. To realize it, however, requires that we should upset all of our preconceived notions of general law, which require that no man shall be condemned without a hearing. The practical application of the maxim in this case is that the proceedings in the Patent Office are *ex parte*, and that the conclusions reached between the patentee and the examiner cannot fairly be held to bind a third person who has not been heard upon the question. That no controlling weight should be given to such references, however, seems obvious; in fact, decisions show that the courts are chary of invalidating patents upon only those references cited in the Patent Office, and there overcome.

The proposition, however, that "a patent once issued ought to carry with it the highest presumption of full validity and *should convey to its owner the right of manufacture*" may well be characterized as "revolutionary," though the writer of that sentence could hardly have understood what it would revolutionize, the trouble being that he did not at all understand what letters patent are. They convey *absolutely no right to manufacture*, for it is self-evident that the Government cannot convey a right which it never possessed. In the theory of the patent law the invention is the inventor's secret, which he surrenders in return for the guaranty of its *exclusive* right in himself for a limited term; mark the word *exclusive*, for what the Government gives is not the right to manufacture, but *the exclusive right;* that is, a right to exclude all others, but not necessarily the right to make it one's self.

The effect of such a change in the law, if it were possible and were within the power of Congress, would be very far from salutary. It would effectually and at once put an end to all attempts to disclose to the public through letters patent inventions of importance, since the only effect of the disclosure would be to permit others to make improvements upon the original invention and then (without fear of infringement suits) proceed to manufacture the improvements, thus driving out of the market the original inventor. Dr. Alexander Graham Bell, for example, would have objected to the Government licensing the manufacture of competing (improved?) telephones without accountability to him; or perhaps Mr. Edison would not have been willing to have the various infringing lamps manufactured under the guise of improvements.

The paper of Mr. J. E. H. Hyde and the discussion of it (A. I. E. E., Vol. XVII, p 247) completely disposed of the "independent expert" fallacy. It is not fair to prevent either side proving what it will, or can, relative to the issue. Independent men may err; if so, they must be contradicted—probably by both sides—and thus the short cut simply increases confusion by making a judge choose among three opinions instead of between two.

I fully agree with the undisclosed patent lawyer who commented in your issue of November 25 on the suggestions of Mr. Ludwig Gutmann as printed in the issue of August 26. A part of the difficulty has arisen from the crude notion that the Government by issuing a patent, licenses somebody to infringe the patent of someone else; a further part from the idea that inventions are always broadly distinctive, whereas most inventions, though truly such, are improvements upon broader ones previously patented; and a further part from the differences of opinion among the judges of our nine Circuit Courts of Appeals; for this part of the trouble no doubt the pending proposition for a Patent Court of Appeals would prove a solution. For the others a course of elementary instruction seems to be the only remedy.

NEW YORK T. J. JOHNSTON

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Turbo-Alternator.—REYVAL.—An illustrated description of a turbo-alternator, exhibited at the Liege exposition. It consists of a 600-hp Rateau steam turbine, directly coupled to a 400-kw, three-phase alternator, compounded according to the Blondel system. The number of revolutions per minute is 3,000. In Blondel's compounding system, the exciter consists of a small bipolar converter, mounted on the shaft of the turbine and supplied through three brushes with three-phase currents which are then converted into direct-current for excitation. These three-phase currents are furnished from a compounding transformer, the primary winding of which is in series with the supply network. The potential differences at the secondary terminals therefore increase with the load; and since the e.m.f. of the direct current, produced by the converter, is proportional to that of the alternating-current, the exciting current of the alternator increases with the load. The excitation of the small converter is a double one. One of the field circuits is shunted across the direct-current terminals of the converter so that the current in this circuit varies with the e.m.f. produced. The second circuit is connected to the terminals of a small exciter mounted at the end of the shaft of the converter and excited in shunt. This exciter produces a constant e.m.f. so that in one of the two field windings of the converter the exciting current is constant. The connections are shown in Fig. 1 where *A* is the armature of the alternator and *B* its field coils. *T, C* is the compounding transformer, *i* and *i'* are the field windings of the converter, containing rheostats *Rh,* which are adjusted once for all time. *"Comcc"* is the converter. *"Exc"* its exciter. *I* is a three-pole switch, and *f* the phase lamps supplied by transformers, *T P*, and used for parallel connection.—*L'Eclairage Elec.*, November 18.

The Influence of Armature Reaction on the Wavè Form of Alternators.—BENISCHKE.—A paper illustrated by diagrams and oscillographs. The chief results are as follows: The non-symmetrical distortion of the fundamental wave of e.m.f. (of the phase e.m.f. in the case of three-phase generators) caused by the armature reaction, is essentially due to the energy component of the current, and is the same with leading or lagging current. The wattless component has either no influence on the wave-form at all, or it causes a symmetrical flattening of the e.m.f. curve with lagging current and a symmetrical peak of the e.m.f. curve with leading current. The voltage-drop with lagging current and the rise of voltage with leading current are due mainly to the wattless component and to a less extent to the energy component. The non-symmetric distortion of the e.m.f. wave is the smaller the narrower the pole shoes, other things being equal, and is smaller with three-phase alternators than with single-phase machines.—*Zeit. f. Elek.* (Vienna), November 19.

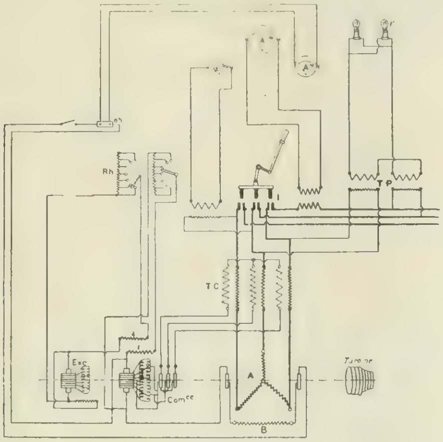


FIG. 1.—DIAGRAM OF CONNECTIONS OF TURBO-ALTERNATOR.

Armature Reaction and Commutation.—In the department of questions and answers a subscriber refers to a turbo-generator with compensating coils electrically in series with the armature and placed mechanically in slots in the pole phases. The object of these coils is to enable the machine to commute sparklessly with a fixed position of the brushes at all loads. He asks for an explanation. There are three answers.—Lond. *Elec. Eng.*, December 1.

Turbo-Alternator.—A fully illustrated description of the new designs of Dick, Kerr & Company, and of large alternators for steam turbine drive. Detailed drawings and dimensions are given of two 3,000-kw turbo-alternators recently installed at Glasgow. The construction is described in detail.—Lond. *Elec.*, November 24.

LIGHTS AND LIGHTING.

New Incandescent Lamp.—"It is reported that electrical firms in Austria-Hungary are making preparations for the manufacture of a new glow lamp which is claimed to possess great advantages over the carbon-filament lamp, the Nernst, osmium and the tantalum lamps. The 'Wolfram' glow lamp, as the new lamp is termed, is said to consume only one-third of the power required by the best glow lamps at present imported into Austria. Most of the patents for the new lamp are held by a Hungarian electrical company, and the introduction of the lamp on the market, the Austrian, at all events, is in contemplation in the near future." (It is not clear whether Wolfram is the name of the inventor or is applied here as the German name of the element tungsten. The melting point of pure tungsten does not seem to have been exactly determined, but is stated to be above 1,900° C. Tungsten is mainly used at present in the form of ferro-tungsten for hardening steel). —Lond. *Elec. Rev.*, November 24.

Temperature and Efficiency of Thermal Radiation.—SWINBURNE.—A (Brit.) Phys. Soc. paper pointing out that it has long been known that various surfaces have different emissivities, and it is generally held that at a given temperature some bodies give off a larger percentage of their total radiation in the form of light. This view is largely based on some experiments by Evans and Bottomley. The researches of these scientists are criticised by the author on the basis of thermodynamical reasoning. Lummer's curves of the distribution of energy for a "black body" and polished platinum are compared, and show somewhat higher efficiency for platinum; but the comparison is difficult. The behavior of flashed lamps and incandescent gas-mantles is explained by the difference of emissivity without any need for selective emissivities. He believes there is no such thing as selective emissivity at all. He pronounces the rule that "in the case of pure temperature radiation, the light-efficiency is a function of the surface temperature only.—Lond. *Elec. Times*, November 16; Lond. *Elec.*, November 17.

Illuminating Engineering.—CRAVATH.—A paper read before the Western Soc. of Engs., on the necessity of better illuminating engineering. This branch of engineering does not concern itself with the production and distribution of light producing energy, but with the utilization of light after it is produced, in order to secure the best illuminating effects from an economical, artistic and hygienic standpoint. The chief problems are the selection of the proper illuminant, the proper location of the lighting units and their proper equipment as regards reflectors, shades and globes. The paper is fully illustrated showing proper and improper methods of illumination.—*Jour. Western Soc. of Engrs.*, October.

Long Filaments.—In notes on the recent Olympia electrical exhibition in London, mention is made of the Maxim system of continuous light, which is claimed to utilize the longest tubular filament yet made. While only quite short lengths—12-in. or so—were exhibited, yet it is said that there are in process of manufacture filaments four ft. long.—Lond. *Elec.*, November 17.

POWER.

Transmission Plant.—MANASSE.—In the conclusion of his illustrated article on the Kaiserwerke transmission plant in Tyrol the switchboard and the equipment of the sub-stations are described. In the latter, cascade-converters (the construction of which has been repeatedly described in the Digest) are installed for converting the three-phase current into direct-current. The frequency is 40. Various curves are given showing the behavior of the cascade converter in actual practice.—*Elek. Zeit.*, November 16.

Niagara Falls.—ADAMS.—An illustrated article advocating the utilization of the power of the Niagara Gorge. The lower Niagara River falls 80 ft. in the length of 2½ miles with the whirlpool located nearly at the center of this length. This descent is substantially half as great as that of the great cataract above, and is made by the entire volume of water that passes over both the American and the Horseshoe Falls. The author thinks that either pipes or tunnels offer an entirely practical means of developing power in the Niagara Gorge.—*Cassier's Mag.*, December.

London.—In an article on new power bills for London a scheme is mentioned involving the establishment of a generating station at St. Neots and power transmission at 20,000 volts, partly on overhead line and partly through underground cables to London. The distance is 40 miles.—Lond. *Elec.*, November 24.

Electricity in Gun Factory.—HOLDEN.—The first part of a fully illustrated paper read before the (Brit.) Inst. of Elec. Engs. and describing the various applications of electric power in the Royal Gun Factory, Woolwich Arsenal.—Lond. *Elec.*, November 24, and December 1.

WIRES, WIRING AND CONDUITS.

A New Process for Covering Wires.—An illustrated description of a process of Phillips and Hutchins for the covering of wires with cotton and silk. Considering the smaller grades of covered wire, for instance, it is usual to apply a spiral winding of yarn, which, critically examined, reveals a corrugated covering, with intervening spaces between the insulating strands; by the new process, however, the inventors have sought to apply a homogeneous felt-like covering to the wire, of a thickness which can, with equal efficiency, be much less than that with yarn or thread. For cotton covering the material used is unspun roving, which is first passed through and attenuated by drawing rollers; these feed the fibres of cotton into a device, which incorporates a rapidly revolving hollow spindle of special construction, through which the wire is pair. The spindle rotates inside a fixed casing connected to an exhausting fan. The combined result of the rotation of the spindle and the air suction is to create an air vortex over the head of the spindle, and the latter, as it rotates, draws out and spins the cotton fibers around the wire as it passes down through the head of the spindle. Fig. 2 shows the general arrangement of the machine; *a* is the cotton roving passing through three pairs of drawing rollers, of which the front pair run at ten times the speed of the back pair, thus attenuating the cotton. The hollow spindle, *b*, through which the wire, *c*, passes, is driven by pulley, *d*, and has a hollow, perforated head, *e*, the top of which is covered with wire gauze, having an eyelet in the center. The spindle, the total weight of which is under 2 ounces, runs at a speed of over 30,000 r.p.m. in a white-metal bearing, *f*, so arranged that there is a continuous circulation of oil, the lubrication being assisted by a spiral groove on the spindle. The hollow framework of the machine, *g*, is connected to an exhausting fan. The top of the rotating spindle is covered in by a fixed case, *h*, provided with a slot, *k*, through which the cotton is sucked. The intense vortex created inside the case, *h*, by the air suction, in conjunction with the rotation of the spindle, causes the fibers of cotton to be attracted to the center of the bronze gauze top of the spindle at *n*, where they are whirled round the wire, being afterwards firmly compacted on to it by a spring inside the slotted head, *e*. The machine is said to cover 85 ft. of wire per minute and at the same time to use covering material which represents a saving of from a quarter to three-quarters of the cost in the case of cotton and of some two-thirds cost in the case of silk, and, further, to permit of the finest grade of covering.—Lond. *Elec. Rev.*, December 1.

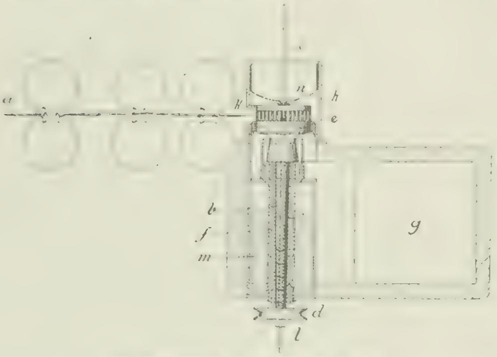


FIG. 2.—PROCESS OF COVERING WIRES.

WIRES, WIRING AND CONDUITS.

Zinc Fuses.—SCHWARTZ AND JAMES.—Zinc and aluminum can be advantageously employed as fuses only in the form of strip. The authors have made some experiments concerning the dimensions of zinc fuses. Fig. 3 gives curves connecting the fusing current and the breadth of zinc strip for various thicknesses, *t*. Fig. 4 gives curves connecting the fusing current of zinc strip and the thickness for different breadths, *b*. Zinc fuses show very little deterioration, even when run continuously at 90 per cent or even 95 per cent of their normal fusing current, the oxidation is very slight and the final resistance is practically the same as the initial resistance. This freedom from oxidation when run at high current density renders zinc a desirable material for fuses which are required to blow with only a slight overload. However, for a given fusing current the mass of zinc fuse is about 3.5 times that of a copper fuse of the same length, while its volume is approximately 4.4 times that of the copper, and this gives a large amount of metal to be disrupted. The metal is disrupted in the form of globules which are not only red hot, but which continue to burn in air, and which are accompanied by dense white fumes which deposit heavily on contiguous surfaces. For these reasons, zinc when employed in enclosed fuse holders would require a larger cartridge than copper. The authors refer to the effect of reducing a fuse strip in breadth at the center for a short distance of its length; this helps to suppress the arc.—Lond. *Elec. Rev.*, November 17.

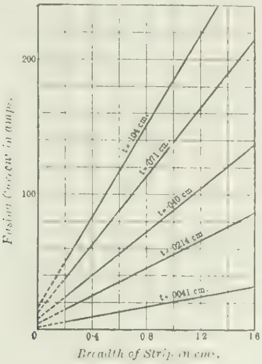


FIG. 3.—FUSE CURVES.

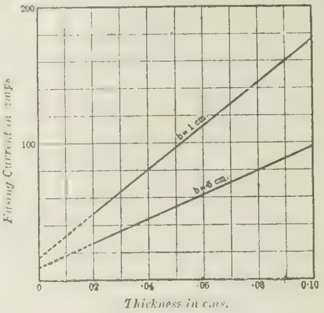


FIG. 4.—FUSE CURVES.

Standardization of Fuses.—SCHWARTZ.—An article giving general considerations on the standardization of fuses. The fire risk in connection with fuses should be greatly reduced, first, by standardizing the length of break not only for various circuit voltages, but also for various carrying capacities. Since the term "short-circuit service" is a relative one, the author suggests that the fuses might be arranged in two classes: One for fuses (usually of large carrying capacity) to withstand the severe conditions of a true short-circuit, the other for fuses (usually of small carrying capacity) for use on circuits of a non-inductive character and of moderate resistance, such as one usually finds in connection with house installation work. The author then deals with the specifications as to the material of the fuse, the rating, testing, contacts, spacing, classification and marking.—Lond. *Elec. Rev.*, December 1.

TRACTION.

Shunt-Wound Traction Motors.—JOHNSTON.—An article in which the author first gives some notes on the possibility of designing a shunt motor so as to get a high starting torque. Comparison curves are given for two motors of exactly the same design and size, one being series wound and the other shunt wound; the curves represent the current and the torque in both cases as function of the speed. It is said that with a shunt motor a great deal depends upon the operator, and if cars fitted with shunt-wound motors are to be run on lines having long heavy gradients, the operator must be well trained and reliable, so that he will not injure the motors by allowing the car to travel too quickly and take too much current when ascending these heavy gradients. The author then refers to the difficulty of parallel operation of two shunt motors. These difficulties may arise on account of the different sizes of the two pairs of wheels to which the motors are connected, but they also arise if the field of one motor is slightly stronger than the other. The latter difficulty may be overcome by leaving the field coils always connected in series, no matter how the armatures may be connected. If shunt-wound tramway motors are to be worked with economy, the shunt circuits must be broken every time the car is stopped in order to prevent waste of energy in them, and each time this is done a destructive arc will be produced at the contacts owing to the high self induction of the coils. Shunt-wound motors can be used for controlling the speed of the car when running down hill, with the return of energy to the line; this action relieves the wear and tear on the wheels and brake blocks considerably, but puts more work on the motor armatures in just the same way as the rheostatic brake, except that in the latter the energy is wasted in resistances. If shunt-wound motors are to be successfully employed to control the speed of the car in both positive and negative acceleration, their dimensions must be carefully worked out, and the size of the cars and steepness of the gradients on which they are to work must be taken into consideration. When a short-circuit occurs on a section of tramway on which shunt motors are running, it will be very violent, owing to the motor acting as generator and the car circuit-breakers having to open in addition to the station circuit-breaker.—Lond. *Elec. Eng.*, December 1.

Air Brakes for Electric Cars.—Bartholomew.—A discussion of the variations of an air brake equipment for electric cars, suitable for different methods of car operation. Seven different schedules are dealt with.—*St. R'y Jour.*, December 9.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Municipal Electricity Works.—Munro.—His presidential address to the Glasgow section of the (Brit.) Inst. of Elec. Eng. He first deals with general considerations on municipal trading and gives figures on the electricity supply in Glasgow. He then discusses the question whether the production of electrical energy should be combined under one management, distinct from the great departments which have to do with its sale, general distribution, and use for traction, light, power, etc. He thinks that in the smaller towns and in earlier electrical stages of all towns it is economical to combine everything as one undertaking. In the larger cities, however, the work is rapidly becoming so great and varied that in this age of specialists it may be found advantageous to sub-divide and put each department under management which bestows all its study and attention upon one great branch. Arrangements should be made for interchange of information or for a certain amount of combined meeting and action. The author does not think that the removal of electrical generating stations outside of the city to coal fields would be financially advantageous. Refuse destructors are said to be most useful santiary appliances; it is stated that the peak figures at Hackney are 105 kw-hours per ton of refuse, which, at 30 pounds of water per kw-hour, works out at 1.4 pounds of steam per pound of refuse.—Lond. *Elec.*, November 24.

Oil Bath Switchgear.—Pumphrey.—While the oil is used in transformers primarily for cooling purposes, in switchgear it is employed for quenching any arcs that may be drawn out. Partly, in consequence of this, it sometimes happens that an oil which gives satisfaction with transformers is not suitable for switches. Experience has shown that well built and expensive gear may be completely ruined in a few weeks if unsuitable oil is used for immersing it. The principal impurities to guard against in oil for switchgear are acid, alkali, sulphur, moisture and dust.—Lond. *Elec. Rev.*, November 24.

Electric Station in China.—An illustrated description of a new electric lighting station in Peking. It contains two gas engines of 80 hp running at 140 r.p.m., and driving two direct-current dynamos. The latter are constructed for an output of 110 amperes at 440 to 480 volts, with a speed of 140 r.p.m. In addition to the ordinary commutator, the dynamo has two slip rings connected to the armature windings for use with static balancers, which practically consist of an inductive coil across the two slip rings with the neutral wire connected to the middle. Each dynamo has a separate balancer which will take 25 per cent of the output. "The station has now been running for a year and not the least trouble has been experienced with these balancers, which certainly would not have been the case with rotary ones and Chinese attention." The distribution is carried out on a three-wire system.—Lond. *Elec. Rev.*, December 1.

ELECTROPHYSICS AND MAGNETISM.

Deflection of Alpha Rays.—Mackenzie.—An account of an experimental investigation. He first studied the magnetic and electrostatic deflection of alpha rays from radium. The value of the ratio of the charge to the mass of an alpha particle from radium was found to be 4,600. Assuming that the charge on the alpha particle is the same as that carried by the hydrogen atom, for which the above ratio is 10,000 in the same units, it follows that a mass of the alpha particle is 2.2 times that of the hydrogen atom or about that of the hydrogen molecule. The author then studied the magnetic deflection of alpha rays from polonium. Under the assumption that the value of the ratio of charge to mass is the same as in the case of radium, he finds that the velocity of alpha particles from polonium is greater than that of those from radium.—*Phil. Mag.*, November.

Theory of Coherer.—Blanc.—A paper in which the author develops an electron theory of the coherer. The author experimented with light pressures produced between a steel plane and a hemisphere, the latter being attached to a lever bearing at its end an armature attracted by an eletromagnet, counterbalanced by a spring. Very light pressures could thus be applied without shock. On increasing the pressure, the resistance diminishes very rapidly at first, and then more and more slowly. On releasing the pressure, the resistance never becomes as high as before, the pressure having increased the adherence. This marked influence of pressure suggests to the author a theory in which diffusion plays the main part. Besides gaseous and liquid diffusion there is also a diffusion of solids in mutual contact, as shown by Barus, Spring and others. A pressure induces this diffusion, and its result is to assimilate the surface layers of the metal to the interior of the metal. In coherence, the pressure is produced by the electric field which induces changes of opposite kinds on the surfaces of two grains facing each other. Now, the interior of a metal contains more free electrons than do the surface layers. The effect of diffusion is, therefore, to give the latter a higher conductivity. The positive ions of the metal would also take part in the diffusion, and the elevation of temperature may aid the transference of ions from one metallic grain to another.—Lond. *Elec.*, December 1; from *Jour. de Phys.*, November.

ELECTROCHEMISTRY AND BATTERIES.

Silicon Alloys.—Albro.—The conclusion of his illustrated paper on the microstructure of ferro-silicon and copper-silicon, with notes on the action of silicon towards carbon and silicon carbide. Potter has found that when silicon and silicon carbide are saturated with each other, the resulting material exhibits remarkable properties. Analysis proves this to contain the element and its carbide in proportions approximating very closely the formula $SiC + Si =$ (perhaps) Si_2C. The material is non-porous, harder than corundum, and so tough that a 3-in. tube withstood heavy blows from a sledge on all its faces without fracture. This substance is called carbosilicon.—*Electrochem. and Met. Ind.*, December.

Chemical Effects of Electric Discharges.—Two Bunsen Society papers. The first by Loeb gives a preliminary account of experiments on the synthesis of sugar by means of silent discharges, the other by Brode discusses the effects in the different zones of an arc discharge for the fixation of atmospheric nitrogen.—*Electrochem. and Met. Ind.*, December.

Analysis.—Smith.—The conclusion of his paper on a cooperative analysis of a copper slag. In the present installment the author deals with the determination of lime, magnesia, manganese, sulphur and zinc.—*Electrochem. and Met. Ind.*, December.

Electrolytic Analysis.—Guess.—An illustrated paper on the electrolytic assay of lead and copper and on a new and improved form of electrodes for such work in works laboratories.—*Bi-Monthly Bull. Am. Inst. Min. Engs.*, November.

Electrochemistry.—Threlfall.—The first part of his inaugural address to the Birmingham section of the (Brit.) Inst. Elec. Engs., on some problems of electrochemistry and electrothermal chemistry. In the present installment he discusses the fixation of atmospheric nitrogen and the production of artificial diamonds.—Lond. *Elec.*, December 1.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Spherical Photometer.—Bloch.—A very long paper on the theory and practice of Ulbricht's spherical photometer which permits to measure the mean spherical candle power of a lamp by a single measurement. The principle is as follows: Within a large sphere, the inside of which is painted white, a source of light is placed in the center, and a certain point of the inside surface of the sphere is chosen which is observed. The light which would fall from this source directly upon this point of observation is screened off so that the point of observation is illuminated only indirectly by the light reflected from the white surface of the sphere. The author first shows mathematically that by a single measurement of the illu-

[illegible] point of observation the eye gets a value which is proportional to the mean spherical candle power of the lamp if this is placed in the center of the sphere. If the lamp is removed from the center to the surface of the sphere so that the radiating center is exactly within the surface, then a single measurement gives a value proportional to the mean hemispherical candle power (the constant of proportionality in the latter case is one-half that in the determination of the mean spherical candle power). These results are derived mathematically by the author. In practice, however, there are two main sources of error. One is due to the lamp not being in exactly the central position in the sphere, the second is due to the solid fittings of the lamp which keep the light of the lamp away from some parts of the inner surface of the sphere. Extended experiments of the author show that the errors from the second source greatly outweigh those from the first one, but that a compromise can be made sufficient for all practical purposes if the lamp is not placed in the center, but is suspended at a distance of from 8 to 15 centimeters from the top of the internal surface of the sphere, the diameter of the latter being one meter. By placing the lamp near the top, the largest parts of the fittings (especially of arc lamps) are then outside of the sphere. Experiments with a great many different sources of light show that the mean spherical candle power can be obtained by this arrangement with an error not higher than about three per cent. The spherical photometer is simply calibrated by first using with the sphere a lamp the mean spherical candle power of which is known accurately.—*Elek. Zeit.*, November 16 and 23.

Street Photometer.—Bloch.—In an article on the Ulbricht spherical photometer the author describes a street photometer by Brodhun. The light of the lamp tested is compared with the light of a small osmium lamp for three volts and 1.5 candles. The current supplied to the osmium lamp from a small battery is kept exactly constant. It has been found that it is better to keep the current constant than the voltage, since in this way no errors are possible from contact resistances. The light coming from the osmium lamp is adjusted by means of a sector device which operates on the law of Talbot. According to this law if the light coming from a certain source is periodically screened off at regular intervals, then the eye gets nevertheless the impression of a continuous light effect if the frequency is high enough, and the apparent candle power of the source of light is then proportional to the ratio of the time element during which light reaches the eye to the total time of one period. The construction of the photometer is shown in Fig. 5. From the osmium lamp, g, the light falls on a frosted glass disc, *d*, the image of which is enlarged by two lenses and projected upon the prism arrangement, *W*. Before the rays reach *W*, however, they are deviated from their path by two Fresnel's prisms, *p p*. These two prisms are revolved by means of a small motor, *M*, driven by power from a 6-volt storage battery. The light rays deviated by *p p* are also thereby revolved. In their path they meet a stationary and an adjustable sector, both separately shown in the lower left hand corner of the illustration. According to the position of the adjustable sector, the sector opening may be changed between 0 and 110°, and by adjusting this opening the light which reaches the prism arrangement may be adjusted. The light of the lamp to be tested falls through the tube, *T*, on a gypsum plate, *S*, from which it is reflected diffusely. The rays which fall on the prism, *k*, are reflected in the direction of the axle of the whole apparatus, and are concentrated by a pair of lenses on the prism arrangement *W*. The comparison of the two lights takes place by means of the magnified glass, *l*, which is shown in the illustration in a vertical position, but is in reality horizontal. The tube, *T*, through which the light from the lamp to be tested goes into the apparatus, may be revolved around the main axle of the photometer so that the candle power of the lamp may be taken in any direction.—*Elek. Zeit.*, November 16.

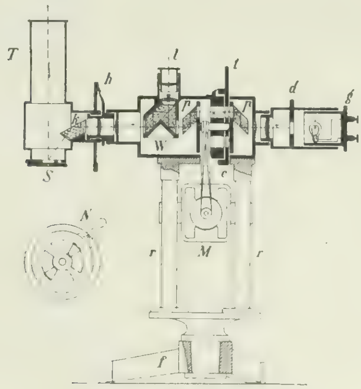


FIG. 5.—STREET PHOTOMETER.

White Walls in a Photometric Laboratory.—Hyde.—Dead black walls for photometer rooms are somewhat of a hardship. The author remarks that white walls with a protection of the photometer by black diaphragms are at present in use to some extent in the photometric laboratory of the German Reichsanstalt. A similar arrangement has been adopted in a room of the Bureau of Standards in Washington. The photometer is placed near the middle of the room and is supplied with a set of diaphragms covered with black velvet. These diaphragms may be so arranged for any position on the bar that no light, except that reflected from the lamps under test or from the diaphragms themselves, can reach the photometer screen, as shown by the accompanying sketches. Fig. 6 is a horizontal section of the photometer through the center of the Lummer-Brodhun sight-box, showing the arrangement of diaphragms, *A*, *B*, *C* and *D*. Elevations of these diaphragms perpendicular to the axis of the photometer are given in Fig. 7. By reference to Fig. 6 it is seen that an eye placed at *P* could see nothing but black velvet diaphragms and the lamps under test. Conversely, no light could reach the screen except from the lamps or from the diaphragms. Special tests have been made to determine the magnitude of the errors resulting from reflected light from the white walls of the photometer room. The results of these measurements show conclusively that the error is entirely negligible. It is, however, entirely desirable to exclude daylight by curtains. The error due to the light reflected from lamps on the walls is negligible in the most refined measurements.—*Bull. Bureau of Standards*, No. 3.

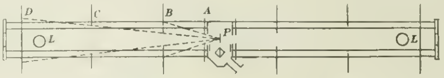


FIG. 6.—HORIZONTAL SECTION OF PHOTOMETER.

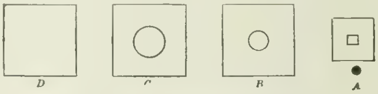


FIG. 7.—PHOTOMETER DIAPHRAGMS.

"Voltascope."—Thornton.—A note on a simple apparatus, the purpose of which is to indicate the state of charge on cables in order to see whether they are safe to handle. The instrument as it is now made consists of a glass tube containing oil and short fine carbon rods. Contact is made across the mains through a heavily-insulated wire having an ebonite or fibre handle with sharp steel points to get good contact. It works equally well with direct and alternating-currents, and in any position. As soon as contact is made the carbon filaments become polarized and form an irregular chain, along which a small current passes, jumping across minute gaps between the particles, and so forming sparks which are instantly extinguished by the oil, their constant appearance and extinction giving the tube the effect of scintillation.—Lond. *Elec.*, November 24.

High-Tension Voltmeter.—Thornton.—A note on a high-tension voltmeter which differs from other forms in the use of a dielectric needle or quadrant. A short ellipsoid of paraffin or sealing wax is suspended by a fine silk or quartz thread between brass plates, contained in a glass globe about 15 cm. diameter. Theory indicates that the torque on the suspension is proportional to the square of the voltage, and experiments prove this to be true. The instrument is read in the same way as the Siemens dynamometer or the Aryton-Mather voltmeter of the same type. The ellipsoid is brought to a balanced position between stops by rotating the torsion head. The lowest voltage to which it is sensitive is about 500, and the author has used it to measure spark-gap voltages up to 100,000. Since specific inductive capacity varies with frequency, a simple correction must be applied for this.—Lond. *Elec.*, November 24.

Measuring Permeability.—Thornton.—The permeability of iron may be measured by the torque on a long ellipsoid, suspended in a magnetic field, and in the same manner this instrument enables one to determine the dielectric constants of all solids, liquids or gases when a litre of the latter can be obtained. The effect is a function of the relative permittivities of ellipsoid and medium, and a comparative series may be readily formed and checked by reference to air. The fact that the results are comparative, and that the zero position of the moving system is the same for all, enables one to work with considerable accuracy. The ellipsoids must be made very carefully. The author remarks that the microscope might be much more used in electrical engineering than it is at present, if, indeed, it is used at all. It is known now that the permeability of iron depends upon the size and distribution of the crystals of carbide of iron in the metal, and that these are changed by the heat treatment this has received. He therefore suggests to estimate permeability by polishing a surface on the metal, observing it through a microscope, and, if necessary, photographing it. After a time, by collecting a set of standards, the quality of any specimen might be assigned in a few minutes by inspection.—Lond. *Elec.*, November 24.

Disturbances from Tramways on Testing Laboratories.—Maurain.—A discussion of the disturbing influences which neighboring electric tramways have on electric and magnetic measuring instruments.—*La Revue Elec.*, November 17.

Measuring Self-Induction by Weighing.—Zipp and Peukert. Two communications with respect to Peukert's method described in the Digest of October 28 (page 743) for determining the self-induction by means of weighing. Peukert corrects the formulas given in his former article. The coefficient of self-induction is

$$\frac{R^2C}{1 + \omega^2C^2R^2}$$

and approximately R^2C, if the value of the denominator is nearly unity; the meaning of the letters being the same is in our former abstract.—*Elek. Zeit.*, November 23.

Telegraphy, Telephony and Signals.

Long-Distance Telegraphy in Australia.—Howard.—Some accounts of experiments of càrrying on long-distance telegraphy almost around the whole of Australia. The messages were transmitted from Cape York to Broome for 15 minutes at the key speed of 20 words per minute without the least sign of lag in the signals. There were 13 repeating stations and the total length was more than 6,600 miles.—Lond. *Elec.*, December 1.

Commercial Wireless Telegraphy in Germany.—Fournier.—Some notes on the commercial organization of wireless telegraphy in Germany. The terms radiotelegram (wireless telegram) and radiotelegraph (wireless telegraph) are mentioned. Stations have been established along the coast to transmit messages over a distance of 200 km. between themselves, and over a distance of 120 km. with ship stations, the height of the mast being 30 meters. The length of the waves emitted by these stations is 365 meters. Some notes are given on the signal codes employed.—*La Nature*, November 11.

Miscellaneous.

Electrical Progress.—Pearce.—His presidential address to the Manchester section of the (Brit.) Inst. Elec. Engrs. He gives a concise review of recent electrical progress. He first deals with the new types of lamps and says that "the application of the intensified or high-pressure system of gas lighting has found favor in many quarters, and is a competition that has to be seriously faced." He expects a more extended use of flame arcs from the successful development of the magazine lamp; a magazine to contain sufficient carbons to obtain 50 hours of burning. Notes are given on progress in electric traction and central station supply. The author says that central station engineers are gradually coming to recognize more and more the value of steam turbine plants, and that the gas engine has hitherto found little favor for central station work in England, and is not likely to oust the steam turbine. The conditions which militate against the adoption of gas plants for large power stations as compared with turbine plants are summarized as follows: (1) The higher initial capital outlay. Taking a station of from 20,000 hp to 30,000 hp, gas plants could not be installed for less than $90 per kilowatt, exclusive of buildings. A modern steam plant could be put down for two-thirds of this amount, and in fact a figure of $40 has been taken in one notable instance. (2) Increased floor space required. (3) Probable higher rate of depreciation and increased maintenance costs. Against this the following advantages of producer gas plants are mentioned: (1) The saving in actual fuel, which, of course, varies under different conditions, but is not likely to be less than 15 per cent to 20 per cent. (2) The saving due to the recovery of the sulphate of ammonia. The combination of the latter, however, with high-tension plants is not one that commends itself to electrical engineers.—Lond. *Elec.*, November 24.

Swedish Association of Electrical Engineers.—Some notes on the recent first annual meeting of the Swedish Assoc. of Elec. Eng. held in Stockholm. Prof. Wallin, the president, and 275 members were present. Papers were read by Ericson on high-tension installations, by Norberg on insulation and voltage rises in transmission lines, by Andreen on the operation in parallel of hydraulic stations at great distance from each other and by Holmgren on tariff and meter problems.—*Elek. Bahnen*, November 14.

Education and Research.—Thornton.—His presidential address to the New Castle Section of the (Brit.) Inst. Elec. Engs. The author first discusses the science and art of engineering and the education of engineers. He then emphasizes that research is a good investment and gives examples showing that "one never knows to where an experiment a little off the beaten track will lead."—Lond. *Elec.*, November 24.

BOOKS RECEIVED.

Gas Engine Design. By Charles Edward Lucke. New York: D. Van Nostrand Company. 254 pages, illustrated. Price, $3.00 net.

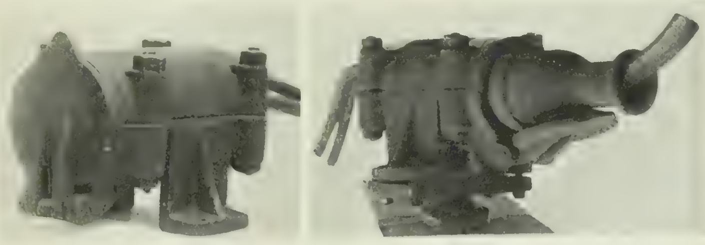
Steam Turbines. With an Appendix on Gas Turbines and The Future of Heat Engines. By Dr. A. Stodola. New York: D. Van Nostrand Company. 434 pages, 241 illustrations. Price, $4.50.

Experimental Researches on the Flow of Steam Through Nozzles and Orifices. By A. Rateau. New York: D. Van Nostrand Company. 76 pages, illustrated. Price, $1.50 net.

Handbuch der Angewandten Physikalischen Chemie. Vol. I: Electrochemie Wasseriger Losungen. By. Dr. Fritz Foerster. Leipzig: Johann Ambrosius Barth. Vol. I, 507 pages, 121 illustrations. Price, 20 marks. Vol. II: Physikalisch-Chemische. By Dr. C. Doelter. Vol. II, 272 pages, 66 illustrations. Price, 12 marks.

Charging Receptacles.

The extensive use of electrically-operated vehicles and the varied application of storage batteries for train lighting, small electric locomotives, storage battery cars, etc., has created a demand for convenient and durable accessories, one of the most important being a charging receptacle that will withstand hard usage and can be handled without danger of short-circuiting the line when inserting or removing the plug. With this idea in mind the Westinghouse Electric & Manufacturing Company has developed and placed upon the market a charging receptacle shown in the accompanying illustration.



FIGS. 1 AND 2.—CHARGING RECEPTACLE.

It consists of a cast metal case, circular in form, and occupying a minimum amount of space. Within the case are suitably mounted contacts for receiving the plug. A hinged lid at one end, held normally closed by a coiled spring, affords access to the interior. The receptacle being entirely enclosed effectually protects it from dirt and water. The plug and contacts within the receptacle are so designed that it is impossible to cause a short-circuit when inserting or withdrawing the plug.

The receptacle may be provided with a swivel attachment, conforming to standard railway practice, which is a decided advantage as it admits the pulling out of the plug when the vehicle or car starts, the receptacle swinging in line with the cable, and allowing the plug to pull out without danger of breaking the cables or contacts. The construction is rugged and all parts well made, thus insuring a long period of service.

◆

Steel Tower Pole Line.

The Hudson River Electric Power Company, of Albany, N. Y., which is constructing a 60,000-volt transmission line from Ballston to Utica, via Amsterdam, has introduced an innovation in the way of steel tower lines, doing away with the old-style wooden poles.

The towers are to be 50 ft. high and will consist of structural iron or steel. The foundations will be made of concrete and crushed stone and bolts will be set in the same, to which the base of the towers will be bolted. They will be set about 550 ft. apart, or 10 to the mile, and will be so arranged that two three-phase circuits can be carried on the same.

The security of this system is very marked, as the towers are not affected by lightning discharges. Special towers are being designed for long crossings and for river work.

The first of these towers will be tested in the Power Company's testing yard at Watervliet, in a few days and, after receiving the engineers' approval, the work will be started at once, on the line extending from Ballston to Amsterdam, and from there to Utica.

◆

The American Electrical Salesmen Association.

Mr. Vincent Gray, the president of the American Electrical Salesmen's Association, with headquarters at Washington Street, Chicago, sends us the subjoined communication:

Only a few months ago the "Field-men" of the electrical interests got together in the city of Peoria while attending a convention of the Illinois State Electrical Association, and organized what they chose to name the American Electrical Salesmen's Association. The few present agreed that the purpose of the organization should be: 1st, Fraternalism. 2d, Uplifting of the standard of salesmanship. 3d, The general advancement of electrical interests. Since then the question has been continually asked: "What is your purpose?" and I have been asked to set forth in this article, "Our Purpose."

Everybody recognizes that up to a few years ago the electrical interests were far from the standard of other commercial and professional vocations. Every branch of the business seemed to be on "one grand spree," metaphorically speaking, and this is easily accounted for when considering the fact that it was more or less in an experimental stage. Now that the public in general has joined the parties at interest in the faith of its stability—like the school children after a recess—electrical interests have settled down and are "hard-at-it."

Thus the business is organized. The "Field-men" have played no small part, as I believe will be admitted, in this result coming about as quickly as it has, yet, they, as a body, have had no organization; consequently have drifted along with the "current of time," taking matters just as they came. Now, they have come out of their "Rip Van Winkle sleep," and have organized, and their purpose is strength.

If, as we propose, we can harmonize or fraternize, we have accomplished the second and third clauses in "Our Purpose"; for in fraternizing we uplift the standard, and in uplifting our standard, the interest of the electrical business in general is undoubtedly advanced.

I believe I am not stretching a point when I say the electrical field-men, as a whole, are above any other class of men constantly on the road; and it is a noticeable fact that their conduct at all times is governed by the consciousness that they are the representatives of their employer and have no desire to blot the escutcheon of their concern.

We are not a union in the sense the word is commonly applied. We are not banded together to discuss the methods of the firms we are connected with, but we purpose at our meetings to bring up such matters as will be to our mutual interest, and discuss them. Again, we hope from time to time to have "Lights" in the business appear before us and give us talks on such subjects as can be appropriately addressed to us. We feel that this opportunity will be sought after when we are well under way, if not now.

We have in mind, too, that through our organization we can keep in touch with "our friends" in the business, which we are unable to do at this time; and this same purpose affords the employer the opportunity to do likewise.

We also believe that we can help members out of position to obtain employment, and it is understood that such members can file their names with the secretary, who will answer correspondence from those seeking men.

I have briefly outlined "Our Purpose," and if this association will make more efficient salesmen and beter citizens through its influences, it will have succeeded in elevating commercial interests generally. At our meeting, at Chicago, January 20, 1906, more specific information will be outlined. Those who are eligible will find it materially to their interest to file their application with the secretary.

◆

The Trolley at Leith, Scotland.

An interesting trolley equipment has recently been made at Leith, Scotland. The authorities of Leith purchased last year from the Edinburgh Street Tramways Company the horse tramways in Leith. These tramways were the portion of the Edinburgh Street Tramways Company's property in the burgh of Leith. The greater part of this company's lines were originally in Edinburgh, but about the year 1892 the corporation of Edinburgh purchased the lines in that city, and about 1896 converted them for cable traction. Since that time there has been a break in traffic at Pilrig Street, the boundary between Edinburgh and Leith, and passengers have had to change from the cable into the horse cars. The Edinburgh officials are still sticking to the antiquated cable, but the Leith authorities have electrified right up to the boundary, and have put in about 6½ route miles of trolley with side and center bracket construction.

The number of types of the cars is as follows: Ordinary double-deck, thirty, and covered top double-deck, six, making thirty-six cars in all. The contract was equally divided between the British Thomson-Houston Company and the Brush Electrical Engineering Company, each supplying fifteen ordinary double-deck cars and three covered top cars.

Two types of cars were supplied by the British Thomson-Houston Company, of Rugby, and they differ from those supplied by the Brush company. The bodies and trucks were made at Preston at the United Electric Car Works. The over-all length of the bodies is 27 ft. 6 in.; the over-all width, 6 ft. 9 in., and the height from the rail to the trolley plank, 9 ft. 7 in. on the double-deck cars and 15 ft. 8 in. on the covered top cars. Each has four side windows. The seating capacity of the double-deck cars is twenty-two inside and thirty-six outside, a total of fifty-eight; and of the covered top cars, twenty-two inside and thirty-four outside, a total of fifty-six. The trucks are Brill 21-E type with wrought-iron center wheel with steel tires 31¾ in. diameter, made by John Baker & Co., of Rotherdam. The wheel base is 6 ft.

The equipment consists of two motors, General Electric 54 type, with four-turn armatures, two controllers of the B-18 type, with rheostatic brake of five notches, with the necessary resistances, circuit-breaker, fuse, lightning arrester and trolley earth indicator, etc. On the ordinary double-deck cars there are eighteen 16-cp incandescent lights, and on the covered top cars, twenty-two lights. The covered top cars have sash side windows and sliding panels on the roof similar to those at Liverpool. The system is also supplied with one training car, which is equipped with B. T. H. type General Electric 54 motors and B-18 controllers, and one water cart and sweeper combined, equipped with General Electric 58 motors and B-18 controllers. All the equipments are double-motor.

The Brush cars, made at Longborough, have an over-all length of 28 ft., width 6 ft. 9 in., with a seating capacity of 22 inside and

34 outside, for the double-deckers. The covered top cars carry 22 inside and 32 outside. The motors are Brush and the equipment includes Garton lightning arrester and trolley earth indicator.

The New York Electrical Show.

The Madison Square Garden Electrical and Mechanical Show, which has been in progress since December 12, ends this week. For the purely technical mind in search of something new, the exhibition had little to offer; but for the general public, which is concerned with the more popular electrical apparatus that is rapidly adding to the comforts of home life, the show has had much of interest.

The opening of the exhibition was made auspicious by the fact that President Roosevelt used the Greeley gold telegraph key in the act formally inaugurating the show. The key was made by the late firm of E. S. Greeley & Company, of which General E. S. Greeley, of New Haven, Conn., was president, and through whose courtesy the key was loaned to the management for the opening ceremonies. The key was first used by President Cleveland for the World's Fair, Chicago, 1893, and again by Governor Morton for the Electrical Show of 1896, by President McKinley for the Electrical Show of 1898, and by President Roosevelt for the St. Louis Exposition, 1904.

The exhibit of the New York Telephone Company situated in the main aisle formed the central atraction of the show. The exhibit consists of a working telephone exchange, which is typical of the private exchange system of supplying telephone service which is in such general demand. To the switchboard, situated in the company's exhibit in the center of the Garden, are connected lines running to telephone stations in the spaces of exhibitors. No charge is made for messages sent between telephones inside Madison Square Garden. A "theatrophone" installation is a part of the exhibit and at certain hours the popular musical attractions of the city theaters are transmitted by telephone and may be heard by visitors without charge.

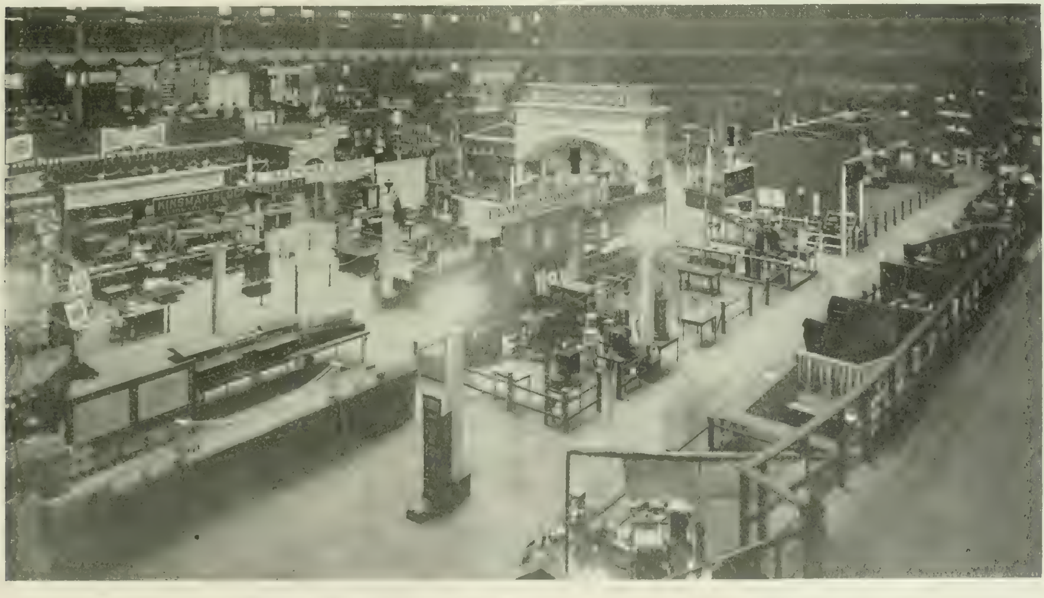


Fig. 1.—General View of Electrical Show, Madison Square Garden, New York.

The American De Forest Wireless Telegraph Company exhibited a portable wireless telegraph outfit and a wireless signal equipment, such as was used by the Japanese during the late war.

Felix Hamberger, New York City, had on exhibition twelve Siemens flame arc lamps, which attracted much attention. The lamps burned with a golden yellow, red, brilliant white and other colors, according to the carbons used, the carbons being impregnated with the coloring material.

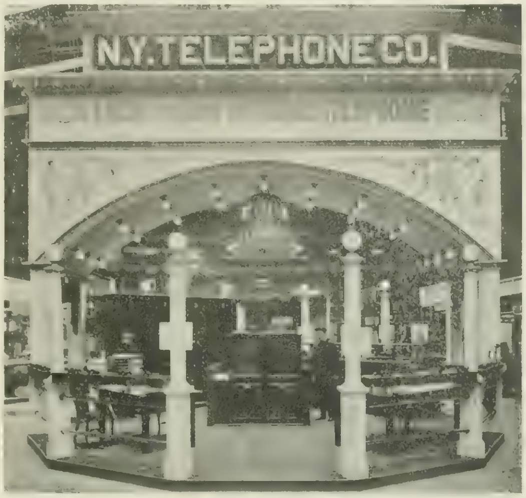


FIG. 2.—NEW YORK TELEPHONE COMPANY'S EXHIBIT.

The Gold Car Heating and Lighting Company, New York City, showed by actual demonstration the practicability of the adaptation of electricity to the heating of cars and buildings. Typical pieces of electric heating apparatus were on exhibition.

The Vandyck-Churchill Company, New York City, showed a geared head lathe which it is claimed will do three times the work of a cone driven lathe. A motor-driven saw fitted throughout with steel or bronze gears and a 4-ft. arm plain radial drill completed the outfit. All of the machines were in operation demonstrating the advantages of motor-driven tools.

[illegible] Company, New York City, had a [illegible] exhibit of [illegible] that [illegible] used in [illegible] New York Subway. A short section of track was equipped with [illegible], and a full size semaphore [illegible] brake equipment. The automatic cutting off of power and the instantaneous application of air brakes, when for any reason a train entered a danger zone, was shown by actual demonstration.

The [illegible] Railway Safety Company, New York City, [illegible] the [illegible] or electric detector by means of which [illegible] managers or others interested in electric light work may be kept informed of the condition and operation of the wire circuits, generators, etc. The device is said to be applicable to street railway work in detecting defective motors on the line. The auxiliary car-lighting system of the company was also on exhibition. The apparatus consists of a number of lamps, a storage battery, a [illegible] switch and an automatic change-over switch. When the current is shut off for any reason, the change-over switch throws the lamps and battery in circuit so that the cars are never without light. When the current is again turned on, the battery and auxiliary light are automatically cut out of circuit.

The Wireless Electric Company, of Philadelphia, Pa., showed a working model of the Pullen surface contact system of electrical propulsion, and also an electric battery and new type of arc lamp. The operation of the surface contact railway was shown by a miniature railway car running back and forth on a trestle, and a running locomotive utilizing the same system was also shown in operation on tracks on the floor.

[illegible] & Company, New York City, had an interesting exhibit of electrical supplies and novelties.

Waterbury & Company, New York City, made a very interesting exhibit and one of the largest in the show. Mr. Francis Granger designed the exhibit, in the center of which was the complete switchboard for the New Harlem Hospital, which will be installed at the close of the exhibition. This is a seven-panel board of white marble with copper finished instruments. The company showed a complete line of rubber-covered wire, lead-covered telephone wire, several varieties of manila rope, a complete line of panel boards, new switchboard wire, flame proof wires, etc. The space was enclosed in a marbleized fence, each upright being different and made of a section of the company's lead covered cables; a large knife switch was used as a bar across the doorway. A number of the company's new switches were on exhibition. The demonstration of the marbleizing process attracted much attention. Paints of different colors were floated in a tank of water and manipulated so as to obtain the veined effect of marble; when the proper effect was obtained a piece of board was placed face downward on this floating paint for an instant and then removed and dried by electricity. This simple method of obtaining an imitation marble naturally elicited favorable comment. Mr. T. J. Murphy, the company's switchboard engineer, and about a dozen salesmen were in attendance.

The [illegible] Dynamo Company, New York City, had as a feature of its booth an "interpole" motor driving a similar machine as a dynamo, the current being used to light the sign over the booth. Demonstrations were given showing how the motor stood up under [illegible] current overload without sparking even when instantly reversed under overload. Messrs. Peck, Pell, Van Doren and Norton were in attendance.

The [illegible] Company, St. Louis, Mo., occupied the same booth as the Electric Dynamic Company. [illegible] transformers were on exhibition. Mr. J. J. [illegible], of St. Louis, was in charge.

Caldwell & Ousterhoudt, New York City, manufacturers' agents, made an exhibit displaying products manufactured by the companies they represent. The Century Electric Company, of St. Louis, Mo., showed a self-starting single-phase motor; the American Vibrator Company, St. Louis, Mo., exhibited a vibrating machine for massage work; the Crescent Electrical Manufacturing Company, of Rochester, N. Y., displayed a line of panel boards, knife switches, and [illegible] specialties, and the Kirkpatrick Manufacturing Company, of Philadelphia, Pa., a new "self-wiring" moulding.

The Standard Vitrified Conduit Company, New York City, had an [illegible] in charge of Mr. R. S. [illegible]. The Philadelphia Electric and Manufacturing Company also exhibited a line of [illegible].

[illegible] frigerating Company, New Brunswick, N. J., [illegible] electrically driven refrigerating machines in actual operation and they naturally called forth much comment. The advantages of the outfit over the ordinary ice-box were pointed out. It not only acts as a refrigerator but also manufactures ice in small quantities for the table. The outfit requires little attention, occupies but a small space, and the cost of maintenance is said to be slight.

The Prometheus Electric Company, New York City, showed a complete line of electric heaters and cooking utensils in operation, and the booth was a center of attraction for those interested in electric cooking. The ease and rapidity with which meals could be prepared by electric cooking utensils were clearly demonstrated.

The George L. Mason Company, New York City, occupied a booth near the door, where the "Mason" jewel signs were on exhibition. The jewels may be of any color, and by using varied colored lamps in the box, beautiful effects were produced. The large changeable signs on the Fourth Avenue wall of the Garden were installed by the Mason Company. The exhibition was in charge of Messrs. G. L. Mason, D. McCullagh, F. Sutton and W. H. L. Edward.

The Niagara Tachometer & Instrument Company, Niagara Falls, N. Y., displayed a very complete line of hand-spring tachometers, bi-fluid tachometers and bi-fluid tachographs. The bi-fluid tachometer consists simply of a containing vessel holding two liquids, one the lighter and indicating liquid resting on the heavier liquid mercury. The operation of the instrument depends upon the action of centrifugal force. As the instrument is hermetically sealed after calibration, there is no evaporation of the indicating liquid. The tachograph, or recording tachometer, is based on the same principle, a pen recording directly from the mercury upon a rotating drum which is operated by clock work. The exhibition was in charge of H. A. Hageman and R. H. Hendrick. A number of instruments were shown in operation.

The Clark Electric Manufacturing Company, New York City, displayed a number of its clamps for high-tension transmission lines. Numerous forms of interlocking and underlocking clamps, copper splicing sleeves for splicing hard-drawn copper wires and cables, angle locking insulator clamps, and ball-and-socket insulator clamps were shown. Clamps of this description are used on the transmission lines of the Mexican Light & Power Company, Necaxa, Mexico, Transmission System, Guanajuato Transmission System, Durango (Colo.) Transmission System, Winnipeg (Ont.) Transmission System and the Rio de Janeiro Transmission System. The booth was in charge of Messrs. Wilson, Clark and White.

The Stow Manufacturing Company, Binghamton, N. Y., had a working exhibit in charge of Mr. R. Pollock, assisted by C. S. Netzorg and C. F. Hotchkiss. An example of the use of the Stow multi-speed motor for driving a printing press was clearly demonstrated, and in addition to this, there were on exhibition the electric hand drills, electrically-driven emery grinders and motor-driven flexible shafting built by the company.

The Enos Company, New York City, occupied a large space in which were exhibited gas and electric fixtures and portables of the very latest and most artistic designs, and also of the finest workmanship. These fixtures called forth much favorable comment.

The Chicago Pneumatic Tool Company, Chicago, Ill., had in operation a number of air-cooled Duntley electric drills of different sizes for drilling holes from the smallest up to 2½ or 3 in. diameter in iron or steel. The exhibit also included "Little Giant" storage batteries for automobile and power purposes, and also storage batteries for internal combustion engines particularly adapted to automobile service. The exhibition was in charge of Thomas Aldcorn, general sales agent. Mr. Aldcorn was assisted by Messrs. C. B. Coates, A. B. Innes and W. J. Blake.

The American Electric Novelty & Manufacturing Company, New York City, had a large space in the main aisle, where it had on exhibition hundreds of different electric novelties. Among these were pocket search lights, electric cigar lighters, electric stick pins, medical batteries, electric candles and candelabra, watch stands, gas lighters, electric Christmas tree outfits, etc.

The Peerless Electric Company and Magnet Wire Company, New York City, showed an interesting line of electric specialties. Among these were [illegible] vibrators for use in massage treatment.

The National Battery Company, of Buffalo, N. Y., had on exhibition a number of National storage batteries with all their accessories.

The Gray National Telautograph Company, New York City, attracted much attention. The telautograph was shown in operation, transmitting writing in its original form instantaneously and secretly.

The Tacony Iron Company, Philadelphia, Pa., had on exhibition the Franklin turbine pump, which was direct-driven by a Westinghouse electric motor. The pump is particularly adapted for use as a house-tank pump, requires but little attention, and the cost of operation is slight.

The General Storage Battery Company, New York City, had on exhibition a number of Bijur "high-duty" storage batteries. There was shown a miniature application of the Bijur high-duty storage battery absorbing fluctuations of variable loads as used for electric elevators, electric hoists, etc. There was also shown a generator charging a F-15 cell and also supplying current to the line. A load in excess of 2,000 amperes was suddenly thrown on the line, and almost the entire fluctuation was taken by the storage battery, the generator load not increasing more than 10 per cent. A number of Bijur cells were on exhibition, as well as a charging booster, a standard battery case for railway signals, constant-current booster, yacht-type switchboard, yacht lighting battery, main switchboard for controlling the motor booster and field currents for two motor-driven booster sets, etc. The exhibition was in charge of the office force of the General Storage Battery Company, presided over by General Sales Manager J. B. Cowen.

The Electro-Radiation Company, Boston, Mass., had in operation X-ray and electro-therapeutic apparatus. The use of this apparatus for the treatment of various diseases was demonstrated.

The Simplex Electric Heating Company, through its New York representative, Roger Williams, displayed what was probably the most complete line of electric heating and cooking appliances ever shown at an exhibition. The display included smoothing irons of all sizes, chafing dishes in six or more different designs, curling iron heaters, heating pads, nursery milk warmers, water cups for boiling water, stoves of all sizes from 4½ to 15 in., ovens of four different designs in which biscuits were baked and meats roasted, glue pots of all sizes, soldering irons, radiators, hair driers, electric ranges, griddles, and waffle irons. The use of almost every article on exhibition was demonstrated in a practical way, and the whole display proved of great interest to the visiting public.

The Clifton Manufacturing Company, Boston, Mass., had a booth in which various sizes of Clifton conduit were shown.

Charles E. Dressler & Bro., New York City, made an exhibit which comprised some interesting features. The specialty of the concern is experimenting on scientific problems, the development of inventions, the making of models of patentable machines, devices, etc. Models of some notable pieces of electrical and mechanical apparatus were among the exhibits.

The Eastern Carbon Works, Jersey City, N. J., exhibited their Atlantic dry cell, Eastern dry cell, battery connectors and carbon specialties in general. The pocket flash lamp manufactured by the company was also shown. The dry cells are made up in various forms for different classes of work, such as telephones, electric bells, annunciators, gas lighting, etc.

Waite & Bartlett Manufacturing Company, New York City, exhibited examples of the electro-therapeutic apparatus built by the company. The larger motor-driven influence machine attracted the attention of almost every visitor to the show. The X-ray coil exhibited had combined with it a Tesla high-frequency apparatus for the treatment of various skin diseases and cancers.

Charles A. Thompson Company, New York City, representing the St. Mary's Incandescent Lamp Company, of St. Mary's, Pa., and the Sun Porcelain Company, Trenton, N. J., made an interesting display of electric specialties and incandescent lamps. In the same space were exhibits of McLeod, Ward & Company, Atlas Electric Manufacturing Company and W. E. G. Mitchell, all of New York City.

The "Navalite" Conduit Company, New York City, occupied part of the booth of the C. A. Thompson Company, where it had a bootblack dressed as a sailor who polished the shoes of visitors free of charge.

The National Meter Company, New York City, had on exhibition a 50-hp multiple cylinder Nash gas engine of the self-oiling enclosed type, direct-connected to a 30-kw C. & C. generator, the output of which was consumed by the incandescent lamps used in the sign over the booth. The U. S. ignition outfit, built by the U. S. Battery Company, New Rochelle, N. Y., was used in connection with this exhibit.

The Magneta Company, New York City, exhibited a complete line of Magneta electric clocks. A number of clocks about the Garden were all operated from and controlled by a master clock located in this booth.

The National Carbon Company, Cleveland, Ohio, exhibited a complete line of primary batteries and carbon products. The new "Columbia" igniter cell for automobiles and ignition work, the "Stand By," "Globe," "Laclede," "New Century," "Hercules," "Solar," "Ravenna" and "Columbia" signal dry cells, and the "Trojan," and National "Fuller" wet cells were on exhibition, as well as flash lights, carbon brushes, arc light carbons, specialties, etc. A special feature of the exhibit was the Hallberg expansion pigtail brush attachment, which was described in these columns some time ago. The exhibit was in charge of Mr. A. E. Carrier and Mr. A. C. Henry.

G. M. Gest, New York City, occupied a booth with the H. B. Camp Company and the American Vitrified Conduit Company, where a number of different kinds of conduit were displayed, and photographs of a number of subways constructed by Mr. Gest throughout the country exhibited.

Dossert & Co., New York City, exhibited a complete line of Dossert connectors, which attracted the attention of electric contractors and central station men.

The Safety Electric Elevator Company, New York City, had on exhibition a miniature elevator. The elevator machine is bolted directly to the platform of the car and consists of a horizontal drum revolved by an electric motor. On the periphery of the drum is fitted a spiral track which engages and travels on two series of rollers set in the guide posts. The motor causes the drum to revolve, and the car ascends or descends according to the direction of rotation of the motor. The exhibit was in charge of Messrs. E. Schroenkeisen and M. J. Kane.

The American Telegraphone Company, New York City, had in operation a number of Poulsen telegraphones in charge of Mr. W. M. Miner and Mr. S. Rodgers. The instrument records and reproduces the most delicate sounds. The record is made upon a fine wire or thin disc by passing the wire or disc between electromagnets whose intensity varies with the intensity of the telephonic current, and while this magnetic record is of great permanency it can be immediately "wiped off" by passing the record between the poles of a small magnet. The telegraphone may be used for every duty ordinarily assigned to the phonograph and possesses an advantage over the latter in that the dictator need only be in telephonic communication with the apparatus. A number of special applications of the telegraphone were explained during the show.

The Cooper Hewitt Electric Company, New York City, had two converters in operation changing alternating to direct-current for charging a set of storage batteries, as well as a number of mercury vapor lamps of both the direct and alternating current types. The exhibit was in charge of Mr. A. S. Hubbard, assisted by Messrs. J. P. O'Shea, C. W. Denny, W. A. D. Evans and F. C. Chapman.

The Sarco Company, New York City, exhibited two flame arc lamps of German manufacture. These arc lamps, for which it is the American agent, use impregnated carbons having a wire core. Either a white, deep red, or golden yellow light is produced, according to the grade of carbon used. The lamps burn two in series on either direct or alternating-current, and use either 8, 10 or 12 amperes according to the volume of light desired. The 10-ampere lamps give approximately 3,000 hemispherical Hefner candle power, and naturally make an extremely efficient form of illumination. The mechanism of the lamp is of simple and durable construction, and the carbons are placed at an angle and feed downward. The lamp is provided with an automatic cut-off, which cuts the lamp out of circuit when the carbons have reached their limit of consumption. The casings are waterproof and the lamps are furnished with or without enameled iron reflectors. The carbons burn from ten to seventeen hours, according to their length, the carbon consumption being about 1 in. per hour.

William Green & Co., New York City, exhibited a number of electric lathe motors for polishing, buffing, drilling and grinding; also electric clocks and electric chimes.

The Street Cleaning Department of the City of New York, exhibited a complete working model of the light refuse crematory, or rubbage incinerator, which was recently described in these columns. In connection with this exhibit there was also a model of the Williamsburg Bridge.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The principal feature was the holiday trade, which surpassed all records. This activity in specialties, however, had little effect in the movement of staples, and in [illegible] and in manufacturing departments there are unprecedented preparations for the spring season. Little machinery is idle and the outlook for the future is brightened by several announcements of higher wage scales to become effective Jan. 1. The reports coming from the iron and steel industry are gratifying. New business continues to come forward, raising the rate of production above all previous records, while conservatism prevails as to quotations. The demand for finished products continues undiminished, particularly for structural material. Some Western mills have their entire rail production of 1906 already sold. Cars are still scarce, especially in the iron, lumber and grain trade, from which loud complaints are made. Basic conditions of the textile markets are still sound because production shows no indication of surpassing requirements. Money is still in active demand, with somewhat easier rates and collections are irregular, varying with weather and transportation conditions. November export trade, despite its being a short month, is second only to December, 1903, in the value of total shipments. This is caused by the long awaited expansion in breadstuffs, which furnish the entire gain shown in exports over November a year ago. November, 1905, exports exceed October, 1905, by 10 per cent and November, 1904, by 7.8 per cent. Imports show a decrease from October, but a small gain—3.7 per cent—over a year ago. For eleven months exports, imports and total foreign trade exceed all previous records for that period. November gross railway earnings show a gain of 8.6 per cent for 1904, following a gain then of 9.9 per cent of 1903. The great strength of copper prices is the subject of much interest at the present time. Prices in New York are 18¾ and 19 cents for Lake copper. Sales of small lots were reported to have been made for immediate delivery at as high as 20 cents per lb. These are the highest quotations for the metal for at least six years. In 1899, 19¼c was paid and prices were well sustained, when they broke to 13c. The prevalent view of the present movement is that it is natural and legitimate. *Bradstreet's* reports 226 business failures during the week ending Dec. 14 against 203 the week previous and 239 in the corresponding week in 1904.

VICTOR CHAIN GRATE STOKER.—The American Stoker Company, of Erie, Pa., has acquired from the McMyler Manufacturing Company, of Cleveland, Ohio, their chain grate stoker business, which has been operated under the trade name of the Victor chain grate stoker. The acquisition includes patterns, patents, drawings and good will. Mr. F. Girtanner, the designer of the stoker and the mechanical engineer under whom it has been developed, enters the employ of the American Stoker Company. The Victor stoker has been in successful operation for some time past in various parts of the country, notably in Indianapolis, Cleveland and Erie. One of its distinctive features is a rear attachment consisting of clinker breaker and dumping bars. The special merits of this attachment are that the fires can be forced and the capacity of the boiler increased without any extra wasting of fuel and positively without smoke. The commercial development of the Victor stoker has been somewhat retarded from the fact that the McMyler Manufacturing Company were so extremely busy with their own special line of ore handling machinery they could not give the stoker department the attention which it required; but the aggressive management of the American Stoker Company combined with the merits of the Victor stoker will undoubtedly soon make this machine an important factor in the field of automatic stoking. Hereafter it will be known as the American chain grate stoker. It will be handled by the American Stoker Company concurrently with its well known "underfeed stoker." By the acquisition of this device the American Stoker Company is thus enabled to offer users of power stokers of any type desired.

THE HUDSON RIVER ELECTRIC POWER COMPANY, which is supplying power to the Utica & Mohawk Valley Railway Company for the operation of its electric car lines, between Little Falls, Frankfort, Utica and Oriskany, is installing on the boilers in its new steam turbine plant at Utica, what is known as the "Balanced Draft System," by means of which the blower and damper are automatically controlled and the heated gases are retained and consumed before they escape to the flue. A much cheaper class of fuel can be used and better results obtained in the system. This system has already been installed in several large plants throughout the country and the results obtained at the plant of the Hudson River Electric Power Company, at Utica, will be watched closely by all engineers interested in this class of work, as well as those interested in the subject of fuel economy and low cost of power production. The plant, when completed, will have a capacity of 10,000 horse power and will consist of the latest and most modern apparatus of its kind in the country. Steam turbines, of the Curtis type, are used with Deane condensers and in the boiler room Franklin, and Babcock & Wilcox water tube boilers are in use.

ELECTRIC RAILWAY BATTERIES.—A contract recently closed by the Electric Storage Battery Company with the Spokane & Inland Railway Company, Spokane, Wash., forcibly illustrates the flexibility of the storage battery and its adaptability to meet special conditions. In this instance the battery is installed to regulate the fluctuations of a single-phase railway load. Power is purchased as 3-phase, 60-cycle current from the Washington Water Power Company on the maximum demand basis, and delivered, through motor generator sets, to the single-phase line. Each motor generator set will be provided with a direct current machine mounted on the same shaft and connected to the terminals of the battery circuit. The battery charge and discharge will be effected by two boosters in the battery circuit operating in parallel with each other, each having a capacity equal to one-half the maximum output of the battery. These boosters will be controlled by the Electric Storage Battery Company's carbon regulator, which in this case will be made responsive to fluctuations of the alternating current supply, thus causing the battery to keep those fluctuations within narrow limits.

IMPORTATION OF LEAD.—Owing to the large demand for lead, and the scarcity of the American product, arrangements have been made for the importation of several thousand tons. The European lead, which is to be shipped from England, Belgium and Germany, will be delivered here at lower prices than the ruling rate for the domestic material, notwithstanding the duty and freight, amounting to 40 per cent of the initial cost. The ordinary quotation in Europe is about 2½ cents per pound, but, owing to the present demand, the price has risen about a cent. The import duty is 2⅛ cents and the freight about ⅛ cent. The present price for American lead, which is controlled by the American Smelting & Refining Company interests, is 6 to 6.10 cents per pound.

HARDY LAMP FAILURE.—Salem M. Hardy, of Pittsfield, Mass., manufacturer of electric lamps, has filed at Boston a petition in bankruptcy. His liabilities are scheduled at $37,517.11, and are all unsecured. There are no assets. There are nearly 100 holders of unsecured claims, some of the larger being the Gilmore Electric Company, of Boston, $6,631; Colorado Security Company, of Denver, Colo., notes, $9,000; E. H. Rollins & Sons, of Denver, Colo., notes, $3,000; F. P. Stevens, of Denver, Colo., notes, $3,000; Wyoming National Bank of Wyoming, $5,000, and Charles W. Beacon, of Cambridge, $2,500.

LARGE EXPORTS.—The report of the Department of Commerce and Labor on the exports of domestic products from the United States in November shows an increase of $11,202,165 over the exports of the corresponding month of 1904. The items which show the largest gains are breadstuffs, the exports of which increased $10,000,000, and provisions, which showed an increase of $3,300,000. The principal offset to these increases was the decrease in cotton exports, which were smaller by $1,000,000. The amount for the month were $99,340,072 and for the eleven months, $702,968,182.

ELECTRICITY IN SARNIA TUNNEL.—A Canadian correspondent writes that it is learned on good authority that the Grand Trunk Railway Company has let the contract for the equipment of the Port Huron-Sarnia tunnel with electric power for the operation of trains. The contract involves the building of large power houses in Port Huron and Sarnia. The total cost of the proposed improvements is said to be about $700,000. The third-rail system and electric locomotives will be used

BALL & WOOD ENGINES have been installed by the Northern Westchester Lighting Company at Ossining on the Hudson. There are two tandem compound condensing of 425 hp each, driving generators of 250 kw capacity each. An Aultman Taylor boiler of 420 hp has also been added and a new switchboard. Mr. Stuart Wilder is the active vice-president and general manager.

WILKINSON STEAM TURBINE.—The International Power Company has obtained the exclusive manufacturing rights for the Wilkinson steam turbine, for both marine and stationary work, for the entire world. The 7,500-hp unit now building at the Providence works will be tested Feb. 1.

AN ECUADOR RAILROAD.—A special correspondent of the *Iron Age* notes that a new railroad is to be built in Ecuador under American engineers and with American material. Surveys have already been made and construction work is expected to begin inside of three months. The line will be called the Ferro Carril al Curaray. Charles H. Moore, first assistant engineer of the Erie Railroad, will be the chief engineer, and Walter G. Fox, formerly of the New York Central, is to be the first assistant engineer. They have made surveys of the road at the instance of the government which is to construct the system. The line will run from Ambato to San Antonio, a distance of about 125 miles. Ambato is the point where the trade from the interior of Ecuador concentrates. It is on the route of the Guayaquil & Quito Railroad, which system is now nearing completion to that place. It is located in the Andes at an altitude of some 8,500 feet above sea level. San Antonio is situated at the head of navigation of the Amazon River. It is about 2,700 feet above the Pacific Ocean. In the first instance wood fuel will be used on the road, but eventually electricity will be employed to operate the system, there being an abundance of water power along the route. One of the falls on the Pastaza River measures 198 feet in height and is estimated to have a capacity of upward of 250,000 hp, even in the dry season. There are three falls on tributaries of the Pastaza which are capable of developing 10,000 hp each

PHILIPPINE RAILWAYS.—Bids were opened last week for the concessionary grants for Philippine railroads. Speyer & Company, of New York, offered to construct about 425 miles of railway in the Island of Luzon without Government guarantee of bonds. It was explained that this offer was made in connection with the existing Manila Railway Company, Limited, which now has in operation over 200 miles of railway in Luzon (the Manila and Degupan line and branches). Morris McMicken, G. Gresskens, G. Poncin, Jacob Furth and E. C. Hughes, of Seattle, offered to build 100 miles of railway in southern Luzon, designated in circular as land No. 6, under 4 per cent guarantee for thirty years on 95 per cent of the cost of construction. They agreed to complete the road in three years instead of one. Keam, Van Cortlandt & Company, J. G. White & Company, Charles M. Swift (president of the Manila trolley system), with whom are associated Cornelius Vanderbilt, R. T. Wilson & Company, and the International Banking Corporation, offered to build 100 miles on the Island of Panay, 100 miles on the Island of Negros, and 95 miles on the Island of Cebu, under a 4 per cent guarantee for thirty years on 95 per cent of the cost of construction. Their bid stated that the construction would be done by J. G. White & Company.

ELECTRICITY IN THE CEMENT INDUSTRY.—Cement is divided into two classes, slag and natural cement. In the manufacture of natural cement the rock is taken from the quarry or mines and burnt in a kiln. It is then run through a conical crusher or between rolls and ground into a powder, after which it is conveyed to screens which separate the cement which is fine enough to be packed. The coarser particles then go to fine grinding machines, which are ordinary mill stones or emery-faced stones. Considerable power is required in these cement plants, for which electricity is coming into general use. Either the alternating or the direct current system is adopted, the choice depending on local conditions. The plant of the Iola Portland Cement Works at Dallas, Texas, is equipped with Westinghouse type S direct current motors, and a contract just closed with the Santa Cruz Portland Cement Company, San Francisco, Cal., gives a good idea of the size of some of these plants. This order calls for one 800-hp type C motor, ten 250-hp, fifteen 150-hp, one 75-hp and one 30-hp type CCL motors. These are all alternating current motors of the induction type and aggregate a total of 5,655 hp.

STANLEY ELECTRIC COMPANY.—President Chesney, of the Stanley Electric Manufacturing Company, said last week after a conference of its officers: "If nothing happens and present plans are followed we will build an iron foundry on the recently purchased Read land in Beaver Street. There is absolutely no truth in the statement of a morning paper that we are to build electric locomotives here." The foundry building, which will be built in the spring, will be 400 feet by 200 feet in size, and will be the second largest foundry in the State. The company, of course, expects and doubtless will receive decent treatment from the city in improvements in the matter of roads and fair treatment in the matter of taxes. The city recognizes that the growth of this company, the leading industry of the city, is a great factor in its growth. At the works business is rushing. Small contracts are pouring in, and last week a sizable contract for generators, switchboards, etc., was received from the California Gas & Electric Company, of San Francisco. The contract aggregates $65,000. The company is an old and large customer of the Stanley Company. The contract was secured by the San Francisco office.

COPPER AWAY UP.—Last week copper went to the highest price at which the metal has sold since May, 1899, when the Amalgamated Company's stock was floated. The metal sold then at 19¼ cents a pound; this week it touched 18¾ cents. Last year's high level was 15⅛, against 15⅛ in 1903, 13½ in 1902, 17 in 1901, 17 in 1900, and 19¼ in 1899. This month's extraordinary rise has led to much bewilderment, and no satisfactory explanation has been advanced. It cannot be accounted for by the export movement, because November shipments aggregated the lowest month's total of the year, being 9,099 tons below the November movement a year ago. When war broke out between Russia and Japan, in the first week of February, 1904, copper was selling at 12⅞ cents a pound. That was the year's low level. Within ten months it advanced nearly two cents, selling at 15⅛ cents in December, 1904. This year the market has ruled very firm, being influenced during the first six months by the unprecedented foreign shipments.

NATIONAL CARBON.—President James Parmelee of the National Carbon Company, is quoted as follows: "I have never seen such healthful conditions attending a period of great prosperity as at the present time. The copper market is a fair index of the situation with our company, and its activity is well known. From all the information we can gather, the conditions, which make it so are stable ones, and the year 1906 probably will be the best for business ever known. National Carbon earnings this fiscal year will be the best in its history, but just what they will be I am unprepared to say at this time. They will be sufficient, however, to assure dividends on the common and perhaps at a better rate than the shares have been paying."

ROBINS CONVEYING CONTRACTS.—The Robins Conveying Belt Company, New York City, has recently secured a large order for a series of conveyers for ore bedding purposes for the Garfield plant of the American Smelting & Refining Company. Among other orders now on hand is one from the Western Engineering & Construction Company, of San Francisco, for a 34-inch conveyor to be installed on a gold dredge in the Oroville district. This conveyer will be equipped with the Robins new style five-pulley troughing idlers. The Robins Company has also received an order from the Pittsburg Reduction Company for a belt conveyor intended for their East St. Louis works.

ELECTRICAL EXPORTS.—The statistics of exports for the month of October show a total for electrical machinery for the month of $527,669 as compared with $661,267 in October last year. For the ten months the total is $6,002,712 as compared with $5,342,064. Exports to Japan and Great Britain account for the bulk of this gain. The exports of electrical instruments, including telegraphs and telephones, was $454,224 as compared with $352,404, and for the ten months $4,416,151 as compared with $3,470,835 in 1904. The total for the ten months under the two heads is $10,418,860 in 1905 as compared with $8,812,899, a gain of well over a million.

ENGINE WANTED.—The Farmington Electric Light Co., of Farmington, Ill., Theodore Bass, manager, will be in the market in the early spring for a 125 hp high speed engine.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock prices receded at the end of the week after the renewed advances and bullish manipulation during the earlier part. New high record quotations were made in a number of leading railroads and industrials, the features of the market including the United States Steel stocks and Amalgamated Copper. Other copper stocks, both at Boston and New York, also displayed great strength on the further rise in the prices of the metal. The fact that the decision of the New York Court of Appeals denying the application for a reopening of the ballot boxes in New York City served as occasion for a sharp spurt in Metropolitan Street Railway, Metropolitan Securities, Brooklyn Rapid Transit and Interborough Stock on the "curb." Of the electric stocks, Allis-Chalmers, both issues, were the only ones to show inactivity and weakness. Common lost 1⅝ and preferred 3¼ points net, the closing prices being 21⅝ and 62, respectively. General Electric was strong on limited trading and in closing at 176½, ex-div., made a net gain of 3½ points. Westinghouse closed at 175, which is a net gain of 2 points. American Locomotive common closed at 68½, a net decline of 1¼ points, and preferred at 116½, a loss of ½ point. There was active trading in Brooklyn Rapid Transit which advanced to the highest figure of the year—91⅝—and closed at 90¼, this being a net gain of 4¾ points. The sales of this stock aggregated 382,200 shares. Metropolitan Street Railway closed at 120, with a net gain of 1½ points, and Interborough Rapid Transit made a gain of 8 points on the "curb" market, closing at 219, after having touched 224. Western Union Telegraph closed at 92⅝, a fractional advance, and Mackay Companies 51½, ex-div.

[illegible] stocks [illegible] Interborough Rapid Transit [illegible] the Metropolitan Securities Company [illegible] Dec. 19.

NEW YORK

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
Allis-Chalmers Co	22	21⅛	General Electric	183	174
Allis-Chalmers Co. pfd	62	61	Hudson River Tel		..
American Dist. Tel	37	37	Interborough Rap. Tran	208	217½
American Locomotive	70	68	Mackay Cos	50¼	54⅝
American Locomotive pfd	116½	116	Mackay Cos. pfd	73	72
American Tel. & Cable	84	87	Marconi Tel		
American Tel. & Tel.	133	134	Metropolitan St. Ry	118⅛	120
Brooklyn Rapid Transit	85	88	N. Y. & N. J. Tel.		
Electric Boat	25	28	Western Union Tel	93	93¼
Electric Boat pfd	65	70	Westinghouse com.	171	173
Electric Vehicle	12	12	Westinghouse pfd		
Electric Vehicle pfd.	17	15			

BOSTON

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
American Tel. & Tel.	135	136¼	Mass. Elec. Ry. pfd	60	58
Cumberland Telephone	.		Mexican Telephone.	1½	
Edison Elec. Illum.	239	.	New England Telephone.	132	134½
General Electric			Western Tel. & Tel.		
Mass. Elec. Ry.			Western Tel. & Tel. pfd		

PHILADELPHIA

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
American Railways	52¼	52	Phila. Electric	8⅝	8⅝
Elec. Co. of America.	11⅛	11	Phila. Rapid Trans	32⅞	30¾
Elec. Storage Battery	82	81½	Phila. Traction.	100¼	100⅜
Elec. Storage Battery pfd.					

CHICAGO

	Dec. 12	Dec. 19		Dec. 12	Dec. 19
Chicago City Ry	200	197¾	National Carbon.	75	76
Chicago Edison			National Carbon pfd	117	120
Chicago Subway			Union Traction.		
Chicago Tel. Co	...	...	Union Traction pfd	..	...
Metropolitan Elev. com	26½	26⅛			

* Asked.

DIVIDENDS.—The Ridge Avenue Passenger Railway Company has declared a regular quarterly dividend of $3 a share, payable January 2. Directors of the Railway Equipment Corporation have declared the regular monthly dividend of 1½ per cent. Westinghouse Air Brake Company's directors have declared the regular dividend of 2½ per cent quarterly and 2½ per cent extra, payable January 2. The directors of the Consolidated Traction Company of New Jersey have declared the regular semi-annual dividend of 1¾ per cent, payable January 15. The regular Western Union Telegraph quarterly dividend of 1¼ per cent is payable January 15 to stockholders of record December 20. Books close December 20 and reopen January 2. The Boston, Revere Beach & Lynn R. R. has declared a dividend of $2 per share, payable January 1, 1906. This is an increase of $1 over the last semi-annual dividend. The directors of the Westinghouse Machine Company have declared the regular quarterly dividend of 2½ per cent, payable January 10. The Cumberland Telephone & Telegraph Company has declared a regular quarterly dividend of 1¾ per cent, payable January 1, 1906. This dividend makes the eighty-ninth declared by the company. The directors of the Twin City Rapid Transit Company have declared a quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2. The directors of the United Traction & Electric Company of New Jersey have declared a dividend of 1¼ per cent on the capital stock, payable Jan. 2.

WESTERN UNION EARNINGS.—The Western Union Telegraph Company's statement for the December 31 quarter (partly estimated) compares with the actual figures of the corresponding quarters of 1904, 1903 and 1902, as follows:

	1905. (Estimated.)	1904. (Actual.)	1903. (Actual.)	1902. (Actual.)
Net revenue	[illegible]	[illegible]	$2,000,060	$2,117,330
Bond interest	331,300	[illegible]	286,300	[illegible]
Balance	[illegible]	[illegible]	[illegible]	[illegible]
Dividends	1,217,021	[illegible]	[illegible]	[illegible]
Surplus	$351,676	[illegible]	$406,743	$647,769
Previous surplus	16,433,481	[illegible]	[illegible]	[illegible]
Total surplus	[illegible]	[illegible]	[illegible]	[illegible]

The actual returns for the September 30 (1905) quarter follow: Net revenue, $2,007,593; bond interest, $331,300; balance, $1,676,293; dividends, $1,217,021; surplus, $459,272; previous surplus, $15,974,209; total surplus, $16,433,481.

NEW YORK CENTRAL DEALS.—New York Central interests, which comprise the Vanderbilt-Andrews traction syndicate, have purchased control of the Rochester Railway & Light Company, thus practically completing a chain of trolley lines across the State from Albany to Buffalo. The New York Central interests began several years ago the policy of absorbing the electric traction systems paralleling their lines across the State. The Vanderbilt-Andrews syndicate made its first entrance into Rochester last spring, when it acquired the Rochester & East Rapids Railway, running southeast as far as Geneva, a distance of forty-eight miles. The system of the Rochester Railway & Light Company covers 105 miles of track in Monroe and Wayne counties. The concern has $14,926,000 capital [illegible] which $5,526,000 is bonded indebtedness and $3,000,000 preferred and $6,400,000 common stock. The syndicate buys control of the company by purchase of the common stock at 125. The deal was concluded Saturday, but it will be a matter of weeks before the new ownership gets control of the system.

INDUSTRIALS IN LOANS.—Reports have been circulated that large lending institutions were cutting down industrials in loans where they represented more than 25 per cent of the collateral offered. This action was taken, it was said, as a precaution to offset the extraordinary advance in the price of some shares. As a rule, however, the banks have not pursued any such course, the restrictions applying only to certain few banks and in exceptional cases. Most of the banks continue to accept 35 per cent of active industrial shares as collateral for loans, and, where the borrowers were of the highest standing, even a larger proportion was allowed. One of the largest banks allowed borrowers to give industrial shares for half the collateral required, and an official of another bank admitted that they had taken 75 per cent industrials as security for "over night loans."

INCREASE OF CAPITAL.—The Detroit, Ypsilanti, Ann Arbor & Jackson Railway at a meeting of its stockholders held in Detroit, Dec. 4, authorized the issue of $600,000 additional 5 per cent bonds, the proceeds to be used in the building of a spur from its main line to Dexter, and in the purchase of additional equipment made necessary by its rapidly increasing business. Including this latest issue, the bonded indebtedness of the company will be $3,200,000 upon 104 miles of road, doing a very prosperous and rapidly increasing business, both in its passenger and freight departments, the last year, according to the reports of the treasurer, being the most prosperous in the history of the company.

MOHAWK VALLEY STOCK.—The Mohawk Valley Company, of Utica, N. Y., which was incorporated last February, has filed with the Secretary of State a certificate of increase of capital stock from $100,000 to $10,000,000. The certificate is signed for the stock control by Horace E. Andrews. Edward L. Rossiter, as treasurer of the company, certifies that Mr. Andrews is the owner of all the capital stock of the company. This increase is supposed to have direct reference to the proposed electrification of the West Shore Railroad in the Mohawk Valley, in connection with the recent absorption of the Mohawk Valley trolley lines by New York Central interests.

PHILADELPHIA BELL TELEPHONE.—The Bell Telephone Company of Philadelphia will earn around $1,250,000 net for the fiscal year ending Dec. 31, 1905. The large amount of new capital invested in recent years is now yielding returns. The net earnings this year will be nearly 8 per cent on $16,000,000 stock, as compared with less than 7 per cent on $14,000,000 stock last year. The company has invested the proceeds of $10,000,000 more share capital than it had five years ago, the present amount being 2⅔ times what it was then. The net earnings have been more than doubled.

SOUTHERN BELL TELEPHONE.—At the special meeting of the Southern Bell Telephone Company an increase of the capital stock from $1,000,000 to $30,000,000 was authorized. The majority of the outstanding stock is owned by the American Telephone & Telegraph Company.

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company's increase in capital of 25 per cent is to provide for next year's new business. Rights accue Jan. 10, 1906. The stock will be issued Feb. 1, payable then or beginning then and quarterly thereafter.

B. R. T. BONDS.—The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to list $3,042,000 additional first refunding convertible mortgage 4 per cent bonds of 2002. This brings the total of that issue up to $20,042,000.

DEAL IN OHIO.—It is stated from Cincinnati that plans have been completed enabling the Widener-Elkins interests to secure control of the Zanesville Railway, Light & Power Company and the Mansfield Railway, Light & Power Company.

MILWAUKEE BONDS.—Spencer Trask & Company and N. W. Harris & Co. are offering $2,000,000 Milwaukee Electric Railway & Light Company refunding and extension mortgage 4½ per cent bonds, due Jan. 1, 1931.

DETROIT TROLLEY BONDS.—The Detroit United Railway Company has applied to the New York Stock Exchange to list $525,000 additional first consolidated mortgage 4½ per cent bonds of 1932.

BEAVER BONDS.—The Beaver Traction Company recently acquired by the Philadelphia Company will issue $175,000 5 per cent bonds.

General News of the Week

The Telephone.

DECATUR, ALA.—The Intercounty Telephone Company, which is an independent concern, is completing its system in this section. The capital stock of the company is $20,000.

OAKLAND, CAL.—The Home Telephone Company, of Alameda County, has secured a franchise in this city, bidding therefor $35,431.30.

LOS ANGELES, CAL.—The Adams-Phillips Company has begun the erection of a large power plant to generate electric power for the town of Ventura. The plant will utilize the water from the Matilija.

SAN FRANCISCO, CAL.—The Home Telephone Company's petition for an immediate hearing on the question of its application for a franchise in this city has been denied by the joint finance and public utilities committee of the Board of Supervisors. This will throw the responsibility of such action on the incoming Board next year.

LOS ANGELES, CAL.—The waters of Kern River will be completely utilized by August 1, 1906, if the plans of the Edison Electric Company, of this city, and the Risdon Iron & Locomotive Works, of San Francisco, are carried out. To the latter concern the Edison Company has let the contract for the steel lining of the pressure tunnel. It will require 800 tons of steel to supply the 1,800-ft. tunnel, which will be 7 ft. 6 in. in diameter. The drop is 900 ft., which, it is believed, will develop 25,000 horse-power.

DANBURY, CONN.—The Southern New England Telephone Company has purchased land in this city on which to erect a new exchange building. The new exchange will be equipped with the common battery system. L. W. Robinson, of this city, is the architect.

DOVER, DEL.—The Central Home Telephone Company, of Wauseon, Ohio, has been incorporated here with a capital stock of $5,000,000. The incorporators are Edwin L. Barber, Wauseon; Joshua D. Powers, Louisville, Ky.; John C. Montelrith, Bloomington, Ind.; James E. Bergin, Nanticoke, Pa.

WASHINGTON, D. C.—As a result of negotiations between the district electrical engineer, Mr. Walter C. Allen, and Mr. F. H. Bethell, general manager of the Chesapeake & Potomac Telephone Company, the District Commissioners have received a proposal from the telephone company to change the present magneto system to the common battery system.

WEISER, IDAHO.—A franchise has been granted by the Council to the Independent Long Distance Telephone Company to establish a system in this city.

QUINCY, ILL.—The Quincy Long Distance Telephone Company has been incorporated with a capital stock of $2,000 by F. J. Pennick, J. R. Pearce, and S. Scott.

FORRESTON, ILL.—The Forreston Mutual Telephone Company has been incorporated with a capital stock of $5,000 by Henry Zumhall, Henry Radner and Joseph Duetzman.

GALESBURG, ILL.—The Galesburg Union Telephone Company has petitioned the City Council for a perpetual franchise, similar to the one held by the Bell Company. The former company recently increased its capital stock from $150,000 to $250,000. It promises to make some improvements for the betterment of the service.

CHICAGO, ILL.—The Chicago Telephone Company's new directory shows that a new office, Humboldt, has been opened on the northwest side of the city on Western Avenue, near North Avenue, being made necessary by the rapid growth of telephones in that part of the city. About 2,800 West, Ashland, Ogden and Seeley subscribers have been transferred to the new exchange and are being operated under the name Humboldt. On the south side the office names South, Brown and Green have been abolished and the single name Calumet is used. This change has been made to reduce the number of office names and principally in connection with doing away with the word South.

CONVERSE, IND.—The petition of O. L. Barger of this place for a franchise in Marion to install and operate an automatic telephone system has been passed upon by the Board of Public Works and recommended to the City Council. The rates for residence are not to exceed $1.50 per month and for business houses $2.50 per month. No charge shall be made until 1,000 telephones have been installed. Thirty telephones are to be provided for city offices free of charge. A tax of 66⅔ cents per telephone is to be paid to the city annually.

MUSCATINE, IA.—The Mississippi Valley Telephone Company will place all its wires in this city underground.

MAXBURG, IA.—The Madison County Mutual Telephone Company has been incorporated with a capital stock of $2,500.

REINBECK, IA.—The United Exchange Company has been incorporated to do a telephone business, the capital stock being $35,000.

RUSTON, LA.—The City Council has passed an ordinance granting permission for the use of the streets of the city for the construction of a new telephone service.

PORTLAND, ME.—A bill in equity has been filed before the Supreme Court by the local minority stockholders of the Northeastern Telephone Company, to prevent carrying out the resolution passed at a special meeting of the stockholders to convert $400,000 of common stock into 5 per cent accumulative preferred stock, and the issue of $350,000 of new stock in exchange for $250,000 of outstanding mortgage bonds. The Northeastern Company was organized in this city several years ago, purchased the charter of the Dirigo Telephone Company and has established an automatic system here.

SOUTH HADLEY, MASS.—The New England Telephone Company has made arrangements to establish an exchange in this city.

EVELETH, MINN.—The Mesaba Telephone Company contemplates erecting a new exchange building in this place.

COOKSTON, MINN.—The Northwestern Telephone Exchange Company will erect a new building here at a cost of $2[illegible],000 and will install a central energy system.

MT. ZION, MO.—The Mount Zion Mutual Telephone Company has been granted articles of incorporation. The incorporators are J. D. Snyder, J. W. Stanton, T. H. Good, J. N. Butler, E. P. Edwards, T. J. Bilderlack and others. The capital stock is $4,800.

LINCOLN, NEB.—The Johnson County Home Telephone Company, with an authorized capital stock of $5[illegible],000, has filed articles of incorporation. Incorporators are J. H. Luneman, W. D. Waganer and others.

ALBANY, N. Y.—The Independent Union Telephone Company of this city has secured possession of the Independent Telephone Company of Herkimer County, which operates a rural line out of the village of Herkimer.

HAMMONDSPORT, N. Y.—The Niver telephone lines have been purchased by the subscribers for $700, and a company has been organized to conduct the business. The capitalization is $5,000, and the officers are: President, J. W. Brundage; vice-president, William Dildine; secretary, Pierce Brundage; treasurer, James H. Smellie.

LINTON, N. D.—The Dakota Central Telephone Company of Aberdeen proposes to establish a local exchange here.

LOWELL, OHIO.—The L. H. W. Telephone Company has been formed in this place by W. D. Davis, C. F. Shinn, John Mattern and others, the capital stock being $10,000.

MARYSVILLE, OHIO.—Mr. J. L. Sayre, of Richwood, is organizing a $10,000 telephone company to build a system in Ostrander to cover the rural districts between Marysville and Delaware.

DOYLESTOWN, OHIO.—The Marshallville & Rittman Telephone Company and the Millersburg & Orrville Telephone Company will be consolidated in the near future, negotiations with that end in view having been practically completed.

SALEM, ORE.—The Automatic Telephone Company has been granted a franchise by the Council of this City. The Pacific States Telephone Company has filed a suit against the city to vacate the franchise.

OLNEYVILLE, R. I.—The Providence Telephone Company has made plans to erect a new telephone exchange in this place.

SPRINGFIELD, TENN.—Officers have been elected by the directors of the Springfield Home Telephone Company, as follows: President, Thos. Pitt; vice-president, John McMurry; secretary, A. L. Dorsey; treasurer, H. T. Stratton, Jr.

MONTGOMERY, TEX.—The Montgomery Telephone Company has been incorporated with a capital of $10,000. The incorporators are: F. W. Peynghaus, M. S. Peynghaus and Robert J. Sullivan.

BRENHAM, TEX.—The Brenham & Washington Telephone Company has been incorporated with a capital stock of $1,500. The incorporators are John M. Mathis, E. P. Curry and D. C. Giddings.

TACOMA, WASH.—Edward E. Webster, of Seattle, has been granted a franchise to install an automatic telephone exchange here.

WALLA WALLA, WASH.—The Council has granted a franchise to the Automatic Telephone Company for a term of 25 years.

BELLINGHAM, WASH.—The Home Telegraph & Telephone Company has been granted a franchise to operate a system in this city.

SPOKANE, WASH.—The Seward Co-operative Telephone Company, which was incorporated in this city last year, contemplates extending its lines in several directions from Nome.

OLYMPIA, WASH.—Charles E. Sumner, of Portland, has been granted a franchise by the City Council to operate an automatic telephone system in this city. The stipulated rates are $3.25 per month for business telephones and $1.75 for residences.

MONROE, WIS.—The assets and plant of the Independent Consolidated Telephone Company have been sold at public auction by Receiver John E. Riley.

MADISON, WIS.—The Wisconsin Telephone Company and the Door County Telephone Company have entered into an agreement by which the latter company will connect with the central office in this city of the Wisconsin Company, and there will be an interchange of business between the two concerns.

VANCOUVER, B. C.—The British Columbia Electric Company will erect a telephone service in North Vancouver during the winter.

BRANTFORD, ONT.—Three telephone companies are struggling for a franchise in the city of Brantford. The Bell Company desires to hold what it has, which is an exclusive franchise, while the Canadian Machine Company and the Ontario Telephone Company are looking for competitive franchises. The Canadian company desires a 21 years' agreement, with an option for municipal ownership and prices to be $25 for business and $15 for residence telephones. The Ontario company wants a 20-year franchise at $25 for business and $18 for residence, with certain reductions for party lines.

MONTREAL, QUE.—The recorder of the city of Montreal has rendered a judgment by which the Bell Telephone Company will hereafter be compelled to pay the civic tax of $5 on each of the company's slot telephone machines.

Electric Light and Power.

ENTERPRISE, ALA.—The [illegible] & [illegible] Company, of [illegible], has been [illegible] by [illegible] E. L. Reeds, [illegible].

POCAHONTAS, ARK.—S. [illegible], of Walnut Ridge, is interested in the construction of an electric light plant at this place.

POMONA, CAL.—The [illegible] Power Company [illegible].

LOS ANGELES, CAL.—Hon. H. E. Huntington [illegible] San Luis Rey River. [illegible] Pasadena Light & Heating Company, which furnishes the power for the street railway lines in Los Angeles. Mr. Huntington [illegible] power company, and [illegible] is now little [illegible] the proposition to build a power plant near the San Luis Rey River. It is expected that the articles of incorporation for the new company will be filed within the course of the next three weeks, and that work of construction on the plant will begin inside of the next 30 days.

BOULDER, COL.—Harry D. [illegible], of Pittsburg, Pa., is interested in the development of the water power here, and has asked the City Council for a franchise.

WALLINGFORD, CONN.—The municipal electric light plant [illegible] a business [illegible] in August [illegible] on the [illegible].

RICHLAND, GA.—[illegible].

AUGUSTA, GA.—[illegible] looking to the construction of [illegible].

ATLANTA, GA.—The [illegible] Light & Power Company has presented a [illegible] to the Council [illegible]. The recommendation [illegible] per month for each arc light, and [illegible] per month for [illegible] to be not more than [illegible] cents per kilowatt.

MOLINE, ILL.—A. A. [illegible], of East Moline, has asked the village board of East Moline for an electric light franchise. It is stated that Chicago capital is interested.

MONMOUTH, ILL.—W. [illegible] and S. [illegible], of Oshkosh, Wis., and W. J. [illegible], of Chicago, Ill., are interested in the construction of an electric light plant here, to be conducted under the title of Monmouth Gas & Electric Company. O. G. [illegible], of Oshkosh, is the engineer.

RICHMOND, IND.—The municipal electric light plant, it is stated, earned during the month of November [illegible] in excess of the operating expenses.

MICHIGAN CITY, IND.—The Michigan City Light & Power Company has been incorporated, with a capital of $15,000, by Robt. J. Garrettson, and others.

CEDAR RAPIDS, IA.—The City Council has passed a resolution directing the mayor and recorder to enter into a contract with the Cedar Rapids and Iowa City Railway & Light Company for the lighting of the streets of this city after Nov. 1 this year at [illegible] per light per year, according to the Philadelphia moonlight schedule.

BELLEVILLE, KAN.—The question of establishing an electric light plant in connection with the water works is under consideration here.

QUINCY, MASS.—The report of a special committee in favor of a municipal lighting plant has been tabled by the City Council.

CROSWELL, MICH.—The citizens have voted to issue [illegible] bonds for water works and a lighting system.

CRYSTAL FALLS, MICH.—A preliminary injunction has been served on the members of the Village Council of Iron River, restraining them from issuing the [illegible] of bonds, recently voted at a special election, for the purpose of rebuilding the water works station and installing an electric light plant.

BAY CITY, MICH.—The Bay City Traction & Electric Company takes the position that under the charter Bay City, as a municipality, has no authority to do commercial lighting on the [illegible] side of the river. The traction company proposes to test the matter in the courts. It has been decided that a friendly suit be instituted to decide whether the city must stop furnishing its electric lights for commercial purposes on the east side. The company offers the city [illegible] per lamp per year. It is alleged that the actual cost per lamp per year under the city system is over [illegible].

AITKIN, MINN.—The Council [illegible] for the city lighting plant.

FARMINGTON, MINN.—The question of constructing an electric light plant and water works here, at a cost of [illegible], is under consideration.

CROOKSTON, MINN.—A committee has been appointed to look into the advisability of constructing an electric plant to light the court house and jail. N. A. [illegible] is the county auditor.

HARLEM, MONT.—This town has [illegible] the construction of an electric light plant.

JOPLIN, MO.—The Consolidated Light, Power & Ice Company has been reorganized with a capital of [illegible], by [illegible] M. [illegible], [illegible] and others.

MARCELINE, MO.—The Marceline Electric [illegible] Company, of Marceline, has been incorporated with a capital of [illegible] by [illegible].

MIDDLETOWN, N. Y.—The State Electric Light & Gas Commission has granted permission to the Consumers' Light & Power Company, of Middletown, to transfer its plant and franchise to the Orange County Lighting Company, free from [illegible], for a consideration not exceeding $43,000, with the condition that the price to consumers shall not be changed during the next five years.

ALBANY, N. Y.—The State Gas Commission has received an application from the [illegible] County Electric Light, Power & Gas Company for consent to increase its capital stock from $100,000 to $250,000, and for permission to issue [illegible] of preferred stock, $100,000 common stock and $100,000 first mortgage bonds of the authorized issue. The application will be heard in Albany on Dec. [illegible]. The commission has denied the application of the Clyde Gas & Electric Company for a certificate of approval of incorporation and consent to [illegible] of capital stock. The Clyde Gas & Electric Company was [illegible] of the gas and electric plant of a company by the same name which has not been operated for three or four years. The application was opposed by the Wayne County Electric Company, of Lyons, which company furnishes power to Clyde. The commission has granted the application of the [illegible] Gas & Electric Company for consent to issue bonds to the amount of $10,000.

GOLDSBORO, N. C.—The Board of Aldermen has refused all offers for the [illegible] of the electric light plant and has decided to secure the services of an expert to determine what is needed to put the plant in first-class condition. There were several offers to buy the plant outright and some offers to lease it. It is probable that the city will furnish the necessary apparatus and continue to operate the plant.

SANTA FE, N. M.—The Rio Grande Land, Water & Power Company has been incorporated with a capital stock of $1,000,000. The incorporators are A. W. [illegible], F. W. [illegible] and W. B. Childers.

EL RENO, OKLA.—The El Reno Gas & Electric Company has been incorporated, with a capital of [illegible], by Geo. J. Hickox and F. D. Howell, of El Reno, and others.

PORTLAND, ORE.—The Mt. Hood Electric Company, which has established a power plant on the Sandy River, has decided to ask the City Council for a franchise. The company was formed a year ago with a capital stock of $1,000,000. S. B. Cobb is president; J. E. Davis, vice-president; Samuel Connell, secretary, and C. W. Nottingham, treasurer.

EDGEFIELD, S. C.—A committee has been appointed with J. C. Sheppard as chairman to consider the question of constructing water works and an electric light plant. [illegible] J. May is the mayor.

CHATTANOOGA, TENN.—The Chattanooga & Tennessee River Power Company will issue bonds to the amount of $3,500,000. To secure these bonds a first mortgage on all the property of the company has been registered. The bonds are to run for 50 years.

PROVO, UTAH.—Frank C. Kelsey, of Salt Lake City, willl be engineer for the proposed water works and electric light plant for which the city recently sold $91,000 bonds.

LURAY, VA.—The Shenandoah River Power & Light Company has been organized at this place. The officers are: President, T. J. Borey; vice-president, Charles S. Landram, both of Luray. The company is building a dam across the Shenandoah River, two miles west of this place.

PORT TOWNSEND, WASH.—The City Council has granted John Siebenbaum a franchise for an electric light plant.

RITZVILLE, WASH.—The Ritzville Electric Company has purchased the lighting plant here and will erect a new central station, arrangements for which have already been made. Mr. H. Warner is secretary of the company.

EVERETT, WASH.—The City Council has granted to Clay Allen, of Seattle, representing the Snoqualmie Light & Power Company, a three-year franchise; also a contract for lighting the city for the same period, at $6.50 per light per month. The system will be installed at once and be completed by Mar. 1, 1906.

NORTH YAKIMA, WASH.—The Northwest Light & Water Company will commence its power plant about April 1. Foundations will be laid this winter. Water wheel, steam and electric equipment for 5,000 horse-power will be installed. There will be ten miles of transmission line to this city.

OLYMPIA, WASH.—E. A. Kerr, of Seattle, has filed articles of incorporation for the Hanford Irrigation and Power Company, which proposes to reclaim 25,000 acres of land by irrigation near Priest Rapids. The principal backers of the company are C. J. Smith, J. H. McGraw, Judge C. H. Hanford, H. K. Owens and Manly B. Haynes. Priest Rapids is in Yakima County, where the Columbia River cuts through the sage-brush plains of Central Washington. The project will involve an expenditure of $500,000.

BARRE, VT.—The Consolidated Lighting Company has asked for bids for the construction of a substation in this city.

PRINCE ALBERT, CAN.—Willis Chipman, of Toronto, has prepared plans to develop the water power situated 12 miles from here and to convey it to the town for light, heat and power purposes. Address Mayor Cowan.

SYDNEY, N. S.—The Dominion Coal Company has decided to operate its plant from the central electrical station, to be located at Dominion No. 2. The longest distance over which power will be transmitted will be to Dominion No. 6, eight miles from the proposed station.

EUGENIA, ONT.—The Georgian Bay Power Company, of Toronto, Ont., will construct a power plant at Eugenia, to cost about $250,000. Bids will be called for about April 1. H. von Schon, of Detroit, Mich., is the engineer.

OTTAWA, ONT.—Mayor Ellis, of the city of Ottawa, has prepared a detailed statement of the working of the civic electric plant since it was taken over on July 1 last. On its business since then, a gross profit of $3,253 was made, which leaves a deficit of [illegible] when the interest and sinking fund on the $200,000 invested is provided for. As the most profitable portions of the year are yet to come, the mayor thinks that, at the end of the first year's operation, a net profit will be shown.

The Electric Railway.

LOS ANGELES, CAL.—The City Council of San Diego has sold a street railway franchise in the eastern part of the city to Lloyd S. Ackerman, of San Francisco, for $6,000. Two other franchises for street railways have been sold in San Diego recently—one to E. B. Webster and another to H. A. Howard, both of San Diego. The franchise of the San Diego & Eastern Railroad Company has been extended for one year.

NORWICH, CONN.—It is reported that the Consolidated Railway Company is considering a proposition to centralize the electrical generating plants for the four divisions in southwestern Connecticut, comprising the Norwich and Willimantic, the Norwich Street Railway, the Montville Street Railway and the New London Street Railway systems, by doing away with the four separate power stations and substituting for them a central generating station at Thamesville, in this city.

BELLEVILLE, ILL.—The McKinley syndicate is attempting to get a right of way for an electric railway through Belleville. A petition is being circulated among property owners. If enough signers are secured the petition will be presented to the city council. The representative states that the company intends constructing an electric railway from East St. Louis to Cairo. If the franchise is granted, the company, it is said, will pay the city a yearly compensation for the franchise.

EVANSVILLE, IND.—Articles of incorporation have been filed for the Louisville Northern Railway & Lighting Company. The capital stock of the company is $5,000,000.

INDIANAPOLIS, IND.—The Indianapolis, Newcastle & Toledo Electric Railway Company has filed a mortgage with the recorders of Marion, Hancock, Henry, Wayne, Madison, Delaware, Randolph and Jay counties to secure a bond issue of $4,500,000. The company expects to build a line from here to Newcastle and Winchester, from Newcastle to Richmond, from Newcastle to Muncie and from Shirley to Anderson. It is also making plans for a line from Indianapolis to Toledo, and for a belt line around this city. D. M. Parry, of Indianapolis, is president, and C. S. Hernly, of Newcastle, secretary.

OSKALOOSA, IA.—The Oskaloosa & Buxton Electric Railway Company is securing right of way for its proposed line between Oskaloosa, Beacon, White City and Buxton, work on which will be begun early next spring. The line will be 18 miles long. Power will be rented from the Oskaloosa Traction & Light Company. The officers of the company are: President and general manager, Harry E. O'Neill; vice-president, W. R. Lacey; secretary, C. E. Lofland; treasurer, George Kolback, all of Oskaloosa.

WINFIELD, KAN.—At a meeting of the Commercial Club a resolution was passed asking the city council to call an election to vote $20,000 in bonds for the interurban railway to connect Winfield, Arkansas City and Chilocco.

AUGUSTA, ME.—Articles of association have been filed by the Portland & Brunswick Extension Railway for a line to be operated by electricity or compressed air in the towns of Yarmouth, Cumberland and Falmouth and the city of Portland, a total length of 12 miles. The capitalization is placed at $48,000. The directors are E. J. Lawrence, A. B. Page, S. A. Nye and Amos F. Gerald of Fairfield, and Cyrus W. Davis, of Waterville.

BOSTON, MASS.—The Railroad Commissioners have authorized the Old Colony Street Railway to issue $200,000 additional capital stock, at par, of which $141,000 is to complete the payment for the alternating current system and the remaining $59,000 for improvements.

WARE, MASS.—Authority has been granted by the Railroad Commission to the Ware & Brookfield Street Railway Company to issue capital stock to the amount of $100,000 for the purpose of securing control of the street railway bought from the receiver of the Hampshire & Worcester Street Railway Company.

BOSTON, MASS.—The Boston Transit Commission has just issued its annual report for the fiscal year ending June 30. It says that the trains now run through the subway will pass through the Washington Street tunnel as soon as it is completed, and the subway will be restored to its original use as a route for cars from the surface system. Work on the tunnel has been carried on in five sections without interference with the convenience of the public. The Commission states that the Boston Elevated Railway Company, which leases the present subway, has paid to the city of Boston $3,950.81 as excess rental on account of having run a greater number of trips than would amount to the rental, charged at 5 cents a single trip. The payments on this account previously amounted to $10,169.40, making a total of $14,120.21. Chief Engineer Howard A. Carson says that 50 per cent. of the tunnel will be straight and 40 per cent. will be built level. The report says the income of the city from the East Boston tunnel should amount to about $80,000 per year.

MUSKEGON, MICH.—Eastern capitalists have an option on the property of the Muskegon Traction & Lighting Company and it is said its sale is about to be consummated. It is said that the option gives the parties buying the right to purchase the bonds of the company at par and accrued dividend and the common stock at $75 a share. The company is now bonded for $600,000 and has an issue of $600,000 common stock. It means cash valuation of $1,110,000 for the entire properties of the company, which comprise the street railway, electric lighting and gas plants. It is said that under the new owners provisions will at once be made for an extension of the street railway lines and the gas and electric lighting systems.

SYRACUSE, N. Y.—The stockholders of the Syracuse & South Bay Railway Company have approved the plans to increase the capital stock from $120,000 to $1,000,000, to be divided into $100,000 preferred and $900,000 common.

NEW YORK, N. Y.—At the annual meeting of the Metropolitan Securities Company the following directors were elected to hold office until December, 1908: Charles A. Conant, Thomas P. Fowler, Frank S. Gannon, Richard W. Meade and Edward W. Saxe.

NEW YORK, N. Y.—It is stated that the Belmont interests, which own the New York & Queens County Railway, have acquired control of the Long Island Electric Railway Company, of Jamaica, N. Y. This line is about 27 miles in length and is successor to the New York & North Shore Railway and connects Brooklyn, Queens, Jamaica and Far Rockaway. The president of the company is Charles A. Porter, of Philadelphia.

CLEVELAND, OHIO.—The South Lorain & Eastern Traction Company has been incorporated by A. B. Stuber, A. A. Lederer, D. T. Miller, R. C. Linden, Sigmund Lederer and others of Cleveland. The company proposes to build a line from Cleveland to South Lorain.

SALEM, ORE.—The City Council has granted a franchise to the Willamette Valley Electric Railway Company to operate a system in this city.

YORK, PA.—The Lewisberry & Shrinestown Electric Railroad Company has been organized to build a trolley line from Lewisberry to York. The company is capitalized at $150,000, and is backed by York county capital.

SCRANTON, PA.—Negotiations are reported to be in progress for the purchase of the Scranton Railway Company and its allied lines by the American Railways Company. E. W. Clark & Company, bankers, control the Scranton Company. It is understood that the deal involves a lease of the Scranton properties by the American Railways Company on a graduated scale of annual interest payments, ending after a term of years at 6 per cent.

BETHLEHEM, PA.—At a general meeting of the stockholders of the several companies interested, it was decided to merge the following roads in this county into one company: Bethlehem & Bath Street Railway Company, Nazareth & Bath Street Railway Company, Bethlehem & Siegfried Street Railway Company; Cement Belt Street Railway Company, Alliance, Bath & Nazareth Street Railway Company; Alliance & Bath Street Railway; Township Line Street Railway Company; Allen Street Railway Company. The main office of the new concern will be located here. The lines concerned in the deal belong to Howard Mutchler, of Easton, and J. S. Moyer, of this place.

FAIRMONT, W. VA.—Directors of the Fairmont & Fairview Traction Company have elected the following named officers: President, E. L. Rutherford, Scottsdale, Pa.; vice-president, S. L. Dillinger, Baltimore, Md.; secretary, Charles E. Conaway, Fairmont, W. Va.; treasurer, B. F. Overholt, Scottsdale; attorney in fact, T. J. Conaway, Fairmont.

STURGEON BAY, WIS.—J. A. Becker, of Milwaukee, has petitioned for a franchise to operate an electric railway in this city.

VANCOUVER, B. C.—The British Columbia Electric Company has completed the plans for a street railway in North Vancouver and work will be commenced as soon as possible. R. H. Sperling is general manager.

TORREON, MEX.—The Torreon Electric Street Railway Company will hold a meeting early in January for the purpose of increasing its capital stock. The company will erect a modern electric power plant. Other important improvements are to be made, including the building of extensions of the lines of the system so as to cover all parts of the city. At a recent meeting of the company Carlos Gonzalez was elected president, and W. B. Mitchell, secretary.

OTTAWA, ONT.—The Ontario Electric Railway Company, which has secured a franchise from Cornwall to Toronto and from Cornwall to Ottawa, has made an official offer to the city of Toronto to bring a radial road into that city on a franchise absolutely terminable in 1921, when the Toronto Railway Company franchise expires. It desires no renewal clause and the city may purchase that part of the road within its limits at the expiration of that franchise.

◆

New Industrial Companies.

THE CHICAGO NUMERICAL TELEPHONE INDEX COMPANY, of Chicago, Ill., has been formed; capital, $2,500. The incorporators are J. W. Arnett, Alfred J. Terry and Earl Harper.

THE TELEGRAPH SIGNAL COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $1,000,000. The incorporators are J. G. Halleran, John McGarvey, Rochester, and M. J. Storer, Morton.

THE MIDDLESEX LIGHT AND EQUIPMENT COMPANY, of New Brunswick, N. J., has been incorporated with a capital stock of $50,000. The incorporators are William Wolfson, Louis Wolfson and William Schlesinger.

THE DIRECT-DRIVE POWER TRANSMISSION COMPANY has incorporated at Los Angeles, Cal., with a capital stock of $500,000. The directors are G. T. Hackley, A. C. Lusby, E. E. Chapman, F. H. Edwards and D. E. Spangler, all of Los Angeles.

THE SYRACUSE ELECTRIC LIGHT EQUIPMENT COMPANY has been incorporated at Syracuse, N. Y., with a capital stock of $100,000. The directors are William Darrone and C. E. Darrone, of Syracuse, and A. A. Buck, of New York.

THE RIVAL GAS & ELECTRICAL FIXTURES SUPPLY COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are G. R. Webster, Brooklyn; Joseph Baumel and Henry Feldman, New York.

THE COLONIAL AUTOMOBILE COMPANY, of St. Louis, Mo., has been granted articles of incorporation. The capital stock is [illegible], all paid. The incorporators are: Frank B. Smiley, Samuel J. [illegible], [illegible] Diebold, C. E. Lane and Lora B. Lane.

THE JERSEY ELECTRIC COMPANY has been formed at Jersey City to take over the business of R[illegible] & Moller, manufacturers of telephones and telephone appliances at [illegible] to 93 Maple Street, Weehawken. The capital is $250,000. The incorporators are Frank W. Walton, Newark, Frank F. Groff and H. W. Hodenberg, of 141 Broadway, New York.

Legal.

HUDSON RIVER SUBWAY.—A [illegible] Public Service Corporation [illegible] with the Hoboken & Manhattan Railroad Company [illegible] Hudson Place, Hoboken. The Public Service Corporation [illegible] year [illegible] purposes.

ROCHESTER TELEPHONE DEAL.—Suit has been begun to compel the promoters of the United States Independent Telephone Company to carry out its agreement with the stockholders of the Rochester (N. Y.) Telephone Company, which the United States concern was to take over. The action is in the name of Robert A. Chandler against the Alliance Bank, which was used as the depository of stock by the old stockholders. In the test action stock was deposited by [illegible] Reed, who owned three shares of the Rochester Telephone Company's stock. The bank gave him a receipt for the stock, which receipt stated that he was to be paid [illegible] per share under the option agreement. Later Mr. Chandler bought Reed's interest in the stock deposited. He demanded the payment of the stock due, and payment was refused. His action will test the power of the United States Company to call off the deal in which it secured the options.

◆

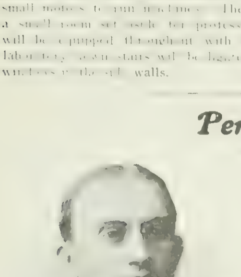
Educational.

PURDUE UNIVERSITY MEN known as the Eastern Association of Purdue Alumni celebrated their second annual banquet at the Rensselaer, Troy, on December [illegible]. There was a large gathering of the graduates from Schenectady and the toasts were appropriate.

UNION COLLEGE.—The new electrical laboratory at Union is advancing rapidly. The front portion, seventy-three feet east and west, and twenty-seven feet deep, extends up two stories. The rear portion, thirty-five feet in width and seventy-four feet front to back, is but one story high. The ground floor is divided into three bays called east, west and main laboratories, besides two small bays, one of which will be used as coat room and the other as an entry, toilet and stair room. In the east bay will be the 100,000-volt transformer and other machines for high potential work. Here also the auxiliary apparatus will be kept. In the west bay will be the receiving and transforming apparatus for power supply to the laboratory and college. The college lighting system will be regulated from that point. This bay will also be used for storing electrochemical apparatus and glass. Both the east and west bays will be lined with shelves to facilitate the storing of all auxiliary apparatus. The main bay will be divided into two laboratories, and in the rear a few small rooms for thesis and graduate work. In the centre of one of these main laboratories will be a gas engine for driving a direct-current generator, for supplying power to the laboratory, which will be fed from a system of wiring on the ceiling with connections running down to the different apparatus. Most of the apparatus, such as direct-current machines, motors, dynamos, etc., from 60 to 500 volts, two alternators, three rotary converters, and a number of induction motors of different sizes, and the different kinds and types of transformers, etc., will be arranged along the walls. The college has an unusual amount of apparatus for electrical work, no characteristic machine being absent. Several machines need duplicating on account of the increased size of the class in electrical engineering, but in variety, Union has an equipment equal to that of any college in the country. The appropriation of [illegible] for maintenance has hardly been touched this year and this will probably be used to duplicate some of the apparatus and for purchasing small motors to run machines. The entire upper floor, with the exception of a small room set aside for professors will be used as a drafting room and will be equipped throughout with new drafting tables. This and the main laboratory room stairs will be lighted by skylights as well as by the numerous windows in the side walls.

◆

Personal.



[illegible] DAVENPORT.

MR. [illegible] R. DAVENPORT has tendered his resignation as assistant general manager of the Edison Electric Illuminating Company of Brooklyn, and the Kings County Electric Light & Power Company, the same to take effect January 1, [illegible] to assume the position of general manager of the Narragansett Electric Lighting Company, Providence, R. I. Mr. Davenport has been connected with the Brooklyn lighting interests for the past ten years. During several [illegible] that time [illegible] private secretary to the late Mr. [illegible] A. Leslie, and [illegible] to Mr. W. W. [illegible], president of the Edison Electric Illuminating Company of Brooklyn and the Kings County Electric Light & Power Company. His new duties at Providence will offer an excellent opportunity for the [illegible] of the experience which he has gained with the Brooklyn company, and his [illegible] in the electrical [illegible] in his new field [illegible]. The [illegible] of the [illegible] electric light and power [illegible] in such [illegible] as his.

MR. W. [illegible] GILBERT [illegible], the Philadelphia engineer and contractor, has moved [illegible] commodious quarters in the Heed Building, [illegible] Filbert Street.

MR. L. B. STILLWELL, the consulting electrical engineer, and his associate, Mr. [illegible] Van Vleck, announce the removal of their offices this week to 100 Broadway, New York City.

MR. JOSEPH C. BELDEN, president of the Belden Mfg. Company, Chicago, manufacturer of magnet wire, telephone cords, braided sleeving and other electrical specialties, was a visitor to New York last week.

MR. JOHN LUTHER PUTNAM, district superintendent of the Central Union Telephone Company, with headquarters at South Bend, Ind., was married at Milwaukee, Wis., on November [illegible], to Miss Marion Brown Traver, of Providence. They have now returned home to South Bend. Mr. Putnam is well known in telephone circles in New York and New England.

MR. ROBERT T. LOZIER, the well-known and successful electric sales manager, has been appointed district sales manager for the gas machinery department of the Power & Mining Machinery Company, with offices at [illegible] William Street, New York City. He will represent more particularly the American Crossley engines, the products of the same name, and the Loomis-Pettibone gas generators.

MR. W. K. VANDERBILT has confirmed the report that the New York Central had contracted with the Niagara, Lockport & Ontario Power Company for electricity to be used in the electrification of the New York Central lines in Western New York. Mr. Vanderbilt inspected this week the Ontario Power Company's plant on the Canadian side of the river, and left Niagara Falls on Monday following the transmission line of the Niagara, Lockport & Ontario Power Company from that city to Syracuse. The Falls Branch, the Auburn Road, and parts of the West Shore will be electrified.

MR. H. E. ANDREWS.—President Horace E. Andrews, of the Cleveland Electric Railroad Company, who has been closely associated with New York Central interests in the acquisition of electric traction lines, may soon resign his position with the Cleveland company to take active charge of the New York Central's electric lines. Mr. William K. Vanderbilt, Jr., is now in charge of the financial affairs connected with the New York Central's electric lines. He is the treasurer of the subsidiary companies which control the traction properties. He is not in charge of the actual operation of these electric lines, and it is this work that Mr. Andrews is expected to do. The plan is for a continuous electric line from Albany to Buffalo.

MR. E. J. KULAS has been appointed secretary and general manager of the Brilliant Electric Company, of Cleveland, Ohio. He was for some years connected with the Buckeye Electric Company and was later with the Bryan-Marsh Co. for a number of years. In taking the management of the Brilliant Electric Company it is his intention to make a tipless lamp, at the same price as charged for the ordinary tipped lamp and under a special patented method of exhaustion. The tipless lamp has had somewhat of a handicap in the high price paid for it, but Mr. Kulas aims to equalize the conditions. At the same time the Brilliant Company is not limited to the manufacture of tipless lamps, but will make a high grade tipped lamp for regular competition.

MR. C. F. BRUSH has written as follows to the *American Shipbuilder*: "I have yours of the 15th concerning windmill storage battery plants for lightships. I have no doubt the scheme is practicable if well designed, and it may be economical where fuel for motors is scarce or costly. A lightship is well adapted for a windmill plant because being far from wind obstruction, a low tower would suffice; and complicated tail mechanism may be dispensed with, the ship at anchor always heading to the wind. Your idea of using compressed air as a medium of power transmission from the wheel to the dynamo, strikes me as an uneconomical and unnecessary complication. The dynamo may be driven directly from the wheel, regulation of output made necessary by speed variation being effected electrically."

MR. A. W. LEONARD, manager of the Electric Light and Street Railway companies at Houghton, Mich., will succeed A. M. Robertson as manager of the Minneapolis General Electric Company. This change was forecast in our columns several weeks ago. Mr. Robertson's resignation is announced, and he retires immediately. He has been with the company for many years. Mr. Leonard, who succeeds to the management, has been with Stone & Webster for eleven years and is a young, vigorous man. The Taylors Falls improvement will greatly extend the scope of business of the Minneapolis company and increase the responsibilities of management. Mr. Leonard has been with the Houghton companies [illegible] years, and has established an excellent reputation as [illegible] manager. Mr. Robertson will engage in business in Minneapolis.

MR. W. S. HALL.—Mr. Walter S. Hall, general manager of the Lehigh Valley Transit Company, formerly of the Public Service Corporation of New Jersey, predicts that [illegible] will be an increase in trolley fares throughout the United States. He says that it is bound to come in great metropolitan centres [illegible] long cross-country lines. Mr. Hall bases this [illegible] cost of all materials for electric railways. [illegible] price of copper. It has gone up to [illegible] cents a pound, and [illegible] surprised if it were soon to cost [illegible] cents. Fifteen [illegible] ties could be bought for [illegible] cents apiece. Most [illegible] years ago are being reconstructed, and [illegible] cents. Poles for the overhead construction [illegible]. Rails which formerly cost [illegible] to [illegible] [illegible]. The prices of engines and boilers have [illegible] higher."

MR. COLOMAN DE KANDO, of Budapest, Austria-Hungary, director [illegible] & Company, is at present visiting this country [illegible]. [illegible] the recommendations of Mr. de Kando [illegible] the Ganz firm with reference to the proper type of motors for heavy traction, and to him belongs the distinction of having first [illegible] the adoption of three-phase induction motors on the Valtellina [illegible]. It is [illegible] in this connection to note that Mr. de Kando visited [illegible] studied the various traction schemes which were in use and being proposed in America. On his return to his own country, he suggested the advisability of using three-phase motors for heavy electric railway work, and it was largely on account of his report that Ganz & Company undertook the development of polyphase traction. As an inventor and designer, Mr. de Kando has been exceptionally active, numerous patents having been granted to him both in his own country and abroad. Our columns of the present issue contain a description of his latest United States patent, which deals with the multiple cascade operation of polyphase induction motors.

MR. HUGH J. McGOWAN.—Because of the increase of duties that have come with the direction of the traction merger plans of the Philadelphia syndicate which he represents, Hugh J. McGowan, president and general manager of the Indianapolis Traction and Terminal Company, will relinquish the active management of the local street car lines. His successor has been named in Robert I. Todd, of Providence, R. I., now general manager of the Rhode Island Company, which controls nearly all the traction lines of Rhode Island. The change in management of the local company will take place January 1. Since the plans of the Dolan-Morgan-McGowan syndicate for the formation of a great merger of Indiana traction lines have assumed definite shape, Mr. McGowan, who is to be president of the merger company in Indiana, has had more work crowded upon him than he could hope to care for and retain his health. Mr. McGowan, however, will remain in the office of president of the Traction and Terminal Company, though Mr. Todd will take over the active management of the local lines. Mr. Todd is one of the best known traction operating men in the East. He is a graduate of Johns Hopkins University, and has had an experience in traction work that is said to have amply fitted him for the important work he will soon take up in Indianapolis. He was formerly connected with the street railway system of Washington, D. C., in an important office, and was later assistant general manager of the Cincinnati Traction Company, under W. Kesley Schoepf. From Cincinnati he went to Providence for the position he is now about to leave. He is thirty-six years old.

Trade Publications.

MILLING MACHINES.—Catalogue No. 42 of the Newton Machine Tool Works, Philadelphia, Pa., describes horizontal slot milling machines. Numerous views are given of milling machines and slotters arranged both for belt driving and for direct connection to electric motors.

METALLIC CONDUITS.—The Bossert Electric Construction Company, Utica, N. Y., has issued an illustrated catalogue dealing with plugged steel conduit boxes, "Monitor" conduit bushings, "Erickson" conduit insulators, flexible conduit bushings and armored conductor bushings.

INSULATING VARNISHES.—The Macon-Evans Varnish Company has issued catalogue B dealing with insulating varnishes for use by the electrical trade. The descriptive matter covers light colored baking and air drying varnishes as well as a complete line of black materials. Full directions are given for the use of these varnishes. This company has also issued descriptive folders treating of paraffine insulating compound and insulating varnishes especially prepared for street railway repair shops, electric light stations and isolated power plants.

PRINTING-PRESS MOTORS.—The Stanley-G. I. Electric Company, Pittsfield, Mass., has issued bulletin No. 42, describing a line of high-grade motors which have been developed for driving "cylinder" and "job" printing presses, feeders, folders, cutters, auto-plates and various types of casting machines. The printing-press motor outfit consists of a motor mounted on a pedestal, in combination with a reversible idler and a rheostat for controlling the speed of the motor. To the lever of the rheostat is attached a cable, which serves the double purpose of moving the lever over the contact points of the rheostat, and also releasing the catch which holds the lever in contact with the points on the rheostat. This is accomplished by pressing a push button which is electrically connected to the release magnet.

STEAM TURBINE.—The Kerr Turbine Company, Wellsville, N. Y., has issued bulletin No. 1, describing the Kerr steam turbine. This turbine is built on the principle of the Pelton water wheel, and is, therefore, of the nozzle and bucket type. The Pelton or double-cup form of bucket gives a nearly complete reversal of the jet of steam, and the proper velocity of the bucket for complete absorption of the energy of the jet is one-half the velocity of the jet. When steam of high pressure is expanded down to atmosphere or into a vacuum, however, the velocity may be from 3000 to 4000 feet per second. One-half this speed is much too high for practice. By compounding or dividing the drop of steam pressure into several steps or stages the steam velocity is lowered enough to secure an efficient turbine. An advantage of the nozzle and bucket type is that by varying the number of stages, the size and number of nozzles and the bucket velocity a wide range of speed and power conditions can be met with a turbine of best efficiency for each case.

HIGH-TENSION INSULATORS.—The Locke Insulator Manufacturing Company, Victor, N. Y., has issued some interesting literature dealing with the guarantees which can be met by well-constructed insulators. Sheet No. [illegible] of the strength of dielectrics and capacity of insulators. Sheet No. 2 tells of the guarantees which can be met by well-constructed insulators. Sheet No. 3 shows numerous views of the plant of the Locke Insulator Mfg. Company, at Victor, N. Y., and describes the processes involved in the manufacture of high-tension insulators. Porcelain glazes for high-voltage insulators are dealt with at great length in sheet No. 1, while sheet No. 5 illustrates and describes colored glazes for insulators. Experience has shown that the majority of delays on high-potential transmission lines are caused by insulators being broken by bullets. The light slate, blue-gray slate or green slate glazes have been produced with the idea of having the color blend, not only with the poles but with the sky and foliage so as to render the insulators less conspicuous.

STURTEVANT BULLETINS.—The B. F. Sturtevant Company, Boston, Mass., will hereafter issue most of its publications periodically, under the title "Sturtevant Engineering Series." Each individual bulletin will treat of some particular product or its application. The series will also include reprints of pertinent articles or technical papers. All publications will be issued in uniform style and size suitable for binding consecutively or in classified volumes. By this means the Sturtevant literature will be kept up to date and immediate presentation will be made of new designs or typical applications in a form which will be of the greatest service. Bulletin No. 125, the first of this series, has just been published. It describes in detail the line of automatic vertical engines manufactured by the B. F. Sturtevant Company. These engines, ranging from 5 x 5 in. to 12 x 10 in., are entirely enclosed and all bearings are provided with positive forced lubrication under 15 pounds pressure. This method has proved greatly superior to older splashing devices, and is not to be confounded with oil pumping systems in which the oil is only lifted into a reservoir from which it merely flows to the bearings. These engines, primarily designed to meet the exacting requirements of dynamo driving, are capable of continuous operation without skilled attention and represent the highest standard of material, workmanship and efficiency.

MOODY'S MAGAZINE.—The first number of this new publication justifies its title, "A monthly review for investors, bankers, and men of affairs." The "Critical Comment" covers a wide range of industrial, financial, economic and political subjects, all treated freely, fairly and fearlessly. These short editorials discuss the bond market, fiduciary institutions in stock speculation, franchises in New York, municipal ownership in Chicago, foreign investments, insurance scandals, conditions of credits, probable future of interest rates, railroad rate legislation, tariff and reciprocity legislation, conditions in Russia and Japan, etc. Amongst the special articles, "The Pitfalls of Speculation," by Mr. Thomas Gibson, is most noteworthy. This analyzes five hundred actual accounts, shows clearly the errors made by ordinary speculators and draws many valuable conclusions. Mr. Charles A. Conant tells where most of the capital for big undertakings comes from. The inquiry department contains many valuable answers to important questions. The correspondence department includes letters from experts in the leading financial and industrial centres. By far the most noteworthy feature of the first number of the magazine, however, and one that distinguishes it and indicates the new field which it occupies, is the symposium on the effects of the rapidly increasing output of gold upon prices, wages, interest, securities, etc. Moody's Magazine is edited by Byron W. Holt and published by The Moody Corporation, at 35 Nassau St., New York City.

◆

News of the Trade.

EDWARDS & CO., electrical manufacturers, of East One Hundred and Forty-fourth Street, New York City, are to put up a new factory 40 x 90, at Exterior Street and Cheever Place.

BRUCE & JOHNSTON, 42 Broadway, New York City, have as publicity managers for the Electrical Show, at Madison Square Garden, done some admirable newspaper work, the quality of their matter and the space secured for it being far beyond the average. It shows a good deal of ability in that direction.

THE WESCO SUPPLY COMPANY, of St. Louis, Mo., announces that it has made arrangements for the southwestern agency for one of the largest and oldest manufacturers of telephone cable, and is prepared to quote the lowest prices on any quality of cable to meet any desired specifications and to make immediate deliveries from a large stock which it will carry at St. Louis.

SAFETY INSULATED WIRE & CABLE COMPANY on December 11 moved its general offices to the large works at West First Street, Bayonne, N. J., where all correspondence should be addressed. This is in line with the centralization of its business, just as the offices of the General Electric Company are maintained at Schenectady. The New York offices of the Safety Company will continue at 114 Liberty Street.

THE WILLIAMS GAUGE COMPANY has recently opened two new offices as follows: At 610 Tremont Building, Boston, which is conducted by Mr. A. S. Uhler, at 810 Continental Trust Building, Denver, Colo., which is in the hands of R. B. Pratt. The Williams Gauge Company has now 14 branch offices located throughout the country, and it will be pleased to receive inquiries for its feed water regulator, steam trap and pump governor, which specialties are used in the largest power plants throughout the country.

THE ELECTRIC COMPANY, with general offices at the Continental Building in Baltimore, desires to be informed of the names and addresses of makers of electric machinery, such as air compressors, motor-driven coffee mills and meat grinders, drills, lathes and other machine tools, refrigerating machinery and pumps. The information is desired in connection with the new edition of the Baltimore Electrical Directory published by the Electric Company, which is soon to go to press. Information is requested from those firms who either build and sell appliances provided with the motors, or that are especially arranged for electric drive.

STERLING MOTOR COMPANY.—The Eastern office of the Sterling Electric Motor Company is now at 143 Liberty Street, New York City. Mr. Allen, formerly consulting electrical engineer of the Marine Engine Company, and Mr. J. L. Estabrook, and others have formed a company called The Engineering Specialty Company, which will have the handling of the Sterling machines in that territory. Mr. Estabrook was formerly manager of the New York office of the Holtzer-Cabot Electric Company. The new firm is well equipped with experience to cover the field for the Sterling line. A complete stock of machinery will be kept at the New York end for immediate delivery in that territory.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED [illegible]

[illegible] St., N. Y.]

[illegible] ADJUSTABLE SUPPORT FOR TELEGRAPH LINE WIRES; [illegible]

[illegible] CONTROLLING MEANS FOR ELECTRIC MOTORS; [illegible]

[illegible] MAGNETIC CLUTCH; George A. [illegible] A yielding [illegible]

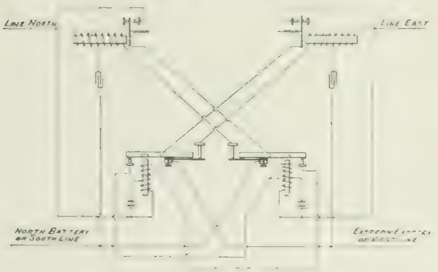
[illegible] JOINT FOR ELECTRIC CONDUCTORS; [illegible]

[illegible] TELEGRAPH REPEATER; [illegible] St. Paul, Minn. [illegible]

[illegible] DOUBLE JACK FOR TELEGRAPH CIRCUITS; [illegible]

[illegible] ELECTROLYZING APPARATUS; [illegible]

[illegible] MANUFACTURE OF VAPOR ELECTRIC APPARATUS; [illegible]



806,884.—Telegraphic Repeater.

[illegible] wheel.

806,881. ALTERNATING-CURRENT ELECTRICITY METER; Sebastian Ziani de Ferranti and William Hamilton [illegible] England. App. filed [illegible] (See Current News and Notes.)

[illegible] TELEGRAPHIC REPEATER; [illegible] are differentially wound and the local circuit traver[illegible] The [illegible]

[illegible] INSULATOR PIN; [illegible]

[illegible] TELEGRAPHIC APPARATUS; [illegible]

[illegible] INSULATED WIRE SUPPORT; [illegible]

[illegible] SELECTIVE SYSTEM FOR PARTY-LINE TELEPHONES; [illegible]

[illegible] WIRELESS TELEGRAPH SYSTEM; L[illegible] ends.

[illegible] SIGNALING APPARATUS FOR RAILWAYS; [illegible] N. Y. [illegible] to the various block sections, each having a pair [illegible] The train has lateral arms contacting therewith for [illegible] to indicate the condition of the block.

[illegible] STEEL MAKING PROCESS; Paul Louis Toussaint Heroult, La Praz, France. App. filed [illegible] 19, 1905.

[illegible] SYSTEM OF ELECTRIC RAILWAYS; Joseph H. Hoadley, New York, N. Y. App. filed Sept. 16, 1904. The air inlet of a gas engine [illegible] trolley pole so that when the pole is lowered, the [illegible] to operate a separate generator.

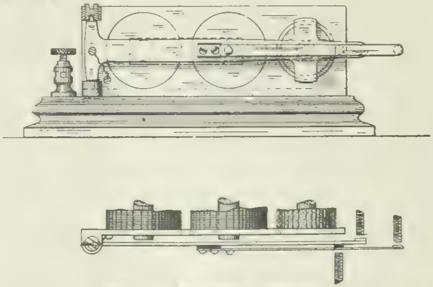
[illegible] PROCESS OF DECARBURIZING; Franz von Kugelgen and George O. [illegible] Holcombs Rock, Va. App. filed Jan. 16, 1904.

[illegible] ELECTRIC ATTACHMENT PLUG; Frederick [illegible] Strong, Boston, Mass. App. filed [illegible] 3, 1905. In order to secure the advantages of [illegible] shell and avoid the passage of the plurality of turns [illegible] makes use of a broken or breach plug screw which requires only a quarter of a turn.

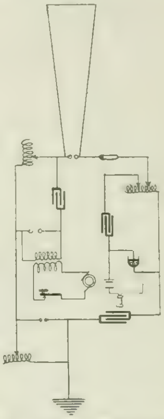
[illegible] SWITCH SIGNAL; John C. Wigman, Greenbay, Wis. App. filed [illegible] movements of the switchpoint are transmitted to a circuit [illegible] which makes an alarm circuit in case the switch is opened.

[illegible] SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed Dec. [illegible] The fuse is of the cartridge type, the space around the fuse wire being filled with chalk, plaster-of-paris or soapstone in a granulated form.

[illegible] MULTIPLE CASCADE DRIVING SYSTEM OF ROTARY CURRENT MOTORS; Coloman de Kando, Budapest, Austria-Hungary. App. filed [illegible] (See Current News and Notes.)



[illegible] Telegraphic Apparatus.



[illegible] Wireless Telegraph System.

807,199. MAGNET CONTROLLED THIRD RAIL SYSTEM; Henry J. Palmer, Philadelphia, Pa. App. filed Oct. 3, 1904. A plan for railway underground conduit in which an iron cable reposes on a wholly enclosed conductor plate or rail. When the car passes, the iron cable is magnetically drawn up so as to make contact with a sectional rail over which the car is passing.

[illegible] RAIL BOND; William G. Stuart, Newburyport, Mass. App. filed July 24, 1904. The bond is laminated and has its ends offset from the plane of the main portion so as to be more conveniently soldered into counterbored holes in the rail web.

807,235. ALARM AND TELEPHONE SYSTEM; Garrison Babcock, Chicago, Ill. App. filed Dec. [illegible] 1903.

[illegible] JUNCTION BOX; Edwin T. Greenfield, Monticello, N. Y. App. filed Jan. 23, 1904. The box has a series of inleading necks and a series of closing disks therefor cast integral with the walls of the box and in planes parallel therewith, the thickness of the disks being less in each instance than that of the corresponding wall of the box.

[illegible] JUNCTION BOX FOR ELECTRICAL CONDUCTORS; Edwin T. Greenfield, Monticello, N. Y. App. filed June 21, 1904. The box is provided with clamping means concentric with the inner surface of the box and [illegible] means for causing the same to act simultaneously upon all of the ends of the inleading conduits.

[illegible] THERMAL CUT-OUT FOR ELECTRIC CONDUCTORS; Bryson Dexter Horton, Detroit, Mich. App. filed Mar. 13, 1905. The fuse wire, [illegible] enclosing case, is bent at the middle into S shape. [illegible] serves to rupture the fuse when it becomes heated.

[illegible] HIGH VOLTAGE SPARK-ARRESTER; Fritz Jordan, Frankfort-on-Main, Germany. App. filed Jan. 6, 1904. Comprises two vertically-[illegible] from each other. One of the bars is of [illegible] so that when an arc is struck between [illegible] the metal bar and a depression is formed [illegible] maintaining the spark gap constant.

[illegible] Boston, Mass. App. filed Feb. 18, [illegible] mass of molded insulating composition [illegible] surrounds the supply wires of an incandescent lamp [illegible] supporting bracket.

[illegible] SYSTEM; Robert H. Polk, Birmingham, Ala. App. filed [illegible]

807,345. FUSIBLE CUT-OUT; George Baehr, McKeesport, Pa. App. filed Jan. 14, 1904. Details.

[illegible] CHANICAL DEVICE FOR ELECTRIC TRAC-[illegible] App. filed May [illegible] 1905. A [illegible] motors are [illegible] of the steering head vary [illegible] with the value [illegible]

[illegible] PURIFYING, STERILIZING AND AGING [illegible] App. filed July 28, 1905.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLVI. NEW YORK, SATURDAY, DECEMBER 30, 1905. No. 27.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....1139 Monadnock Block
PHILADELPHIA OFFICE.....Real Estate Building, Broad and Chestnut Streets
CLEVELAND OFFICE.....403 Cuyahoga Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION.

United States, Canada, Cuba and Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	$6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

Copyright, 1905, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding date of issue. New advertisements will be accepted up to noon of Tuesday for the paper dated the following Saturday.

The exact circulation of the Electrical World and Engineer each week is stated in this column. Of this issue **13,000** *copies are printed. Total circulation for 1905 to date,* **712,500.**

NEW YORK, DECEMBER 30, 1905.

CONTENTS.

Editorial 1099
Society of Illuminating Engineering..... 1102
Consolidation of New York Traction Interests..... 1102
Electrification of the Atlantic City-Philadelphia Line..... 1102
The Electrical Equipment for the New York Central 1103
Pittsburgh A. I. E. E. Meeting..... 1107
Allowance for Depreciation at Holyoke, Mass..... 1107
Brush and Thomson at the Cleveland Club..... 1107
The Public Lighting of Berlin and Paris..... 1108
Power and Preservation of Niagara..... 1108
Electrical Engineers of the Times. XLII. Dr. Lee de Forest..... 1109
Current News and Notes..... 1109
A 10,000-Volt Transmission System Without Transformers 1114
Municipal Ownership vs. Private Ownership. By R. S. Hale..... 1116
Long Distance Power Transmission by Direct Current. By Frank J. Sprague..... 1117
Hydro-Electric Lighting and Power Plant at Harrisonburg, Virginia. By F. F. Coleman..... 1120
The Orling-Armstrong System of Wireless Telegraphy and Telephony. By A. Frederick Collins..... 1122
The Jones Phantoplex Telegraph System 1124

LETTERS TO THE EDITORS:

Wire Calculations by the Slide-Rule. By M. S. Howard..... 1125
Swedish Government Electric Traction Experiments. By R. Dahlander. 1126
Belgian Single-Phase Railway. By M. Latour 1126
Practical Vector Diagram for Induction Motors. By H. C. Specht.. 1126
The Metallized Filament Lamp. By Albert G. Davis 1126
The Patent Law Situation. By Ludwig Gutmann..... 1126
Digest of Current Electrical Literature..... 1127
Book Reviews 1131
Transformer for Thawing Frozen Water in Pipes..... 1132
Vertical Pump Motors 1132
Industrial and Commercial News..... 1133
General News of the Week..... 1137
Index to Volume XLVI.

CHRISTMAS LIGHTING.

Never before was the electric light so much in evidence as it was during the past Christmas week, or the ten days immediately preceding the great festival of the year. The shopping districts were flooded with electrical illumination in all the big cities and most of the small ones, and the effects secured were often of a most charming nature, and while profusion was the keynote, we venture to opine that it "paid." There was noticeable also a good deal of special sign lighting, which must have been profitable, even if it did drive up the peak a bit and strain things. Moreover, in spite of the temporary nature of much of the work, we have not heard of a single instance of serious loss or damage due to electricity. Now that the holiday season is over, we trust that central station managers, who are well entitled to a rest, will not take it, but will get after the business that was new or merely temporary and make a very large proportion of it permanent. We expect to see them make 1906 a banner year in the sale of current.

AN ENGINEERING CENTER.

The engineering papers have given their readers recently an illustrated description of the beautiful new United Engineering Building, which is now rising rapidly from the ground, and which if strikes do not hinder will be ready for occupancy in the autumn of 1906. Last week saw also the laying of the corner-stone of the adjacent Engineers' Club, and as that handsome building already has its steel work up to the ninth floor, the hope of occupancy in the early fall seems quite reasonable.

When these two buildings are finished they will represent endowment and investment of not far from $2,500,000, possibly that full amount, in behalf of engineering, at the heart of the city and in a most attractive spot. To-day New York has no professional engineering center, in the sense for example that London has, and we shall be very much surprised if the existence and propinquity of these two buildings, subserving so felicitously the technical and social necessities of engineers, do not create quickly a professional center in which it will be worth the while of engineers and their professional allies to locate in and around West Thirty-ninth Street and Bryant Park. Up to the present moment, engineers and engineering firms have shown somewhat of a preference for the Wall Street district, near the great railway headquarters and the banking houses that are so closely associated with large industrial, engineering and mining enterprises; but travel up and down town nowadays is swift, and the vicinity of the New York Central and Pennsylvania Railroad termini is sure to be very inviting. Certain it is that these splendid homes of engineering activity and club life will act as a great magnet in drawing men together of like professional requirements.

THE METRIC MOVEMENT.

We are glad to see that conservative and influential daily papers like the New York *Herald* and the Boston *Transcript* are lending their weight to the steadily progressing movement in favor of metric weights and measures. It is a good sign of intellectual progress when the exponents of enlightened public opinion take up an important matter like this and push it forward. Our country to-day is growing more cosmopolitan and its interests to-day are world-wide interests. They must not be circumscribed by useless traditions and petty prejudices. At the beginning we borrowed from our English ancestors a helter-skelter collection of weights and measures and we are using it to-day to our commercial disadvantage. In spite of our decimal coinage we remain hampered by as inconvenient and unpractical a scheme of weights and measures as the world has ever seen. The waste of time in learning it has become a serious matter in these high-pressure days. If it were in itself good and useful one might forgive the sad mischief it makes in elementary education, but on the contrary it is peculiarly objectionable and should be reformed on its own account even if the world at large had nothing better to offer. The world, however, has much the better of us in its use of the metric system, which is simple and convenient and logical. Discussion of the subject has been too much in the hands of scientific men and of manufacturers. It is a matter in which the people should have a keen interest since they and not merely a few isolated classes are the sufferers by our present clumsy scheme. One only needs to look over a school arithmetic to see the source of the child's wasted energy. The time required for learning the strange mixture of illogical units now in use, and for juggling with the common fractions that are entailed by using non-decimal weights and measures, is a real and serious loss that falls heavily upon those whose time for schooling is of necessity short. The time saved in the early years of school life by adopting the metric system could be put to such use as would make better and more intelligent citizens. It is little short of a crime to take so much from the brief school days of the children of the masses that they may wearily acquire the details of a system that has been cast out by science and rejected by the world at large.

THE TESTING OF ELECTRIC GENERATORS AND MOTORS.

In the Digest will be found an abstract of an interesting article from London *Engineering* by Dr. C. V. Drysdale upon the testing of electric generators and motors. The article points out that whereas the Hopkinson method of testing a pair of similar machines, coupled together as motor and generator respectively, is very convenient when large machines are to be tested, yet what is measured in such cases is the joint loss of power, and the proper apportionment of the shares of this loss to the motor and generator respectively becomes a nice question, often easier put than answered. Again, large generators or motors are undoubtedly best tested for efficiency by the method of determining the separate losses of power. In fact, there is no other method available for the large machines in the factory. But in small machines of, say, 5 kw or less, the stray power method is very unsatisfactory. It becomes easy to provide a load for such machines, and it is desirable to measure their mechanical power mechanically. For this purpose it is necessary to observe both the speed of rotation and the torque, received by a generator, or delivered by a motor. There are various ways of measuring a torque transmitted in this manner. One is to connect the two shafts by a spring coupling, and to measure the distension of the spring during rotation. A second is to mount the coupled auxiliary machine in a cradle and so balance it that the torque transmitted can be equilibrated gravitationally. The third is to float either the auxiliary machine, or the tested machine, in a flat boat in such a manner that the torque transmitted disturbs the balance of the boat, as indicated by a spirit level, and calls for gravitational equilibration.

All of these three methods have been used at different times, and with satisfactory results. There is, therefore, nothing novel in any of these three methods, considered broadly. The article here considered, however, describes a number of interesting details in the application of the cradle method. The auxiliary machine is mounted on trunnions containing ball races, and by means of an elevating screw, the weight of the machine is taken off the balls, and floated on knife-edges. The torque transmitted through the coupling is then capable of being equipoised gravitationally, and read off in pounds-feet, gramme-centimetres, or other appropriate unit. The details of the coupling, the bed for the tested machine, and the means for alignment, are very interesting. It is on the perfection of such details that the success of any mechanical method of torque measurement manifestly depends. The boat-and-bath method is perhaps simpler mechanically than the cradle method, and is susceptible of a very high degree of accuracy. Either a flexible spring coupling or a universal joint coupling is necessary, however, in the use of the boat, so as to permit of a slight deviation from true alignment of the shafts when the boat swings horizontally between its stops. Four sizes of boat-and-bath are desirable for the testing of motors from 1/16 kw to, say, 16 kw in power. So sensitive is the balance of the boat method, as indicated by a spirit level, that great care has to be taken with the leads in going on board the boat, lest they introduce unbalanced tensions about the rotating shaft. It is convenient to make the boats square in plan, and flat-bottomed, with only a centimetre or two of free draught or clearance between the bottom of the boat and the bath surface. The curves printed with the article are excellent illustrations of the sensibility of such torque tests. The variations between the losses occurring under a given load when the tested machine is changed from generator to motor or vice-versâ, are very readily followed in such a device.

SPHERICAL CANDLE-POWER PHOTOMETERS.

The *Elektrotechnische Zeitschrift* has recently devoted some attention to a particular form of spherical candle-power photometer described by Dr. I. Bloch, as has been noted in the Digest. There are three different kinds of spherical candle-power photometers. The first employs stationary mirrors at different angles of inclination in a vertical circle about the tested lamp, and so arranged that all the mirrors contribute in adequate proportion to the illumination of a test surface in the photometer. The second rotates a single mirror rapidly in a vertical circle around the tested lamp, and thus gives an average illumination in the photometer proportional to the mean spherical candle-power. The third encloses the source at the center of a globe in such a manner that the light becomes uniformly diffused therein by continual reflections, and a small sample of the light thus diffused is let into the photometer. The first two kinds require that the lamp to be tested should be rotated about a vertical axis. The third kind of spherical candle-power photometer dispenses with any such rotation. It is, therefore, much the simplest structurally, but may run into large dimensions where arc-lamps are concerned.

The importance of spherical candle-power measurements is constantly increasing industrially, because in no other way can lamps be properly compared. It stands to reason that the light-giving power of a lamp can only be correctly assigned on the basis of all the light it emits in every direction, and that any attempt to compare only the light emitted horizontally must be grotesquely in error where the distributions in the vertical differ materially. One might as well rate barrels solely on the basis of their diameters without the least regard to height. A real difficulty with the standardization of incandescent lamps upon a spherical candle-power basis is the apparent reduction of their rating. A 16-cp lamp, as determined from a mean horizontal rating, would only have, say, twelve or thirteen candles, as determined from a spherical rating. This would depress the commercial value of the lamp in competition with gas, or other illuminants, not rated in the same way. For the present, at least, it seems desirable to retain the mean horizontal rating, but to record in addition the reduction factor to mean spherical candle-power. The reduction factor would be substantially the same for all lamps having the same globe form, and filaments of the same loop form. All comparisons for trade purposes could then remain on the horizontal rating, while all references to luminous efficiency could be referred, as in strict reasoning they must, to the mean spherical candle-power. Until recently a serious difficulty with spherical candle-power ratings was the labor and time involved in the measurement, the time required for a mean spherical determination being manifold that required for the ordinary mean horizontal determination. But now with good spherical candle-power measurers available, or lumenometers as Blondel calls them, this objection is removed, and one rating becomes just as easy as the other.

Direct-Current Power Transmission.

We take pleasure in publishing this week a paper from Mr. Sprague upon this topic, especially pertinent in view of the present discussion of the Victoria Falls project. While the majority of engineers do not consider constant-current transmission seriously, it cannot be denied that it has made sufficient headway upon the continent to at least entitle it to a fair hearing. Mr. Sprague attacks the subject from the standpoint of practicable cost of the combination of plan and line for given efficiency, thence obtaining the variation in cost of power delivered with varying loss in the line. As in every case of such computations, certain assumptions have to be made, of which some are usually unjustifiable. In constant-current working one is no more likely to do this than elsewhere, and one condition usually neglected is here of no consequence. Ordinary calculations for minimum cost of power delivered do not include any condition of maximum voltage loss for the necessary regulation, an omission which is commercially serious. At constant current the line loss is stable, so that regulation need not be considered as affected by it. On the other hand, Mr. Sprague neglects the relation of line voltage to the practicable sizes and outputs of the units employed in distribution, which is one of the serious questions regarding the method. His equations deal with transmitting and receiving units unconditioned by size and voltage, so that while the results are most interesting they are very difficult to apply to a concrete case unless well within present experimental limits. Hence one must be cautious in applying his formulas save to the simple transmission here assumed as a type of the system. Another weak point in the discussion, here as elsewhere, is the treatment of K, here the cost of plant per hp. as a constant with respect to the voltage of the system. Even assuming that for each machine the voltage is as high as the state of the art permits, high voltage on the line means extreme sub-division of the capacity with the added cost which that implies.

Passing over these matters, however, as secondary to the main facts of the case, Mr. Sprague's figures give an excellent synopsis of the situation as regards the economic side of direct-current transmission, and lead, as might be expected, to the same broad relations of voltage, distance and amount of power found in the general discussion of power transmission. In applying his equations to the Victoria Falls project, for instance, Mr. Sprague finds that conditions of economy require at any reasonable value of the efficiency about the same voltages assumed in considering the matter from the alternating-current standpoint as these have been from time to time determined. The fact is that no amount of dodging will keep Ohm's law from extracting its due tribute of copper, and whether one works at constant current or at constant potential, one has to face the inevitable energy loss in the conductor. To make any headway in very long distance transmission by whatever system, the voltage must be pushed up as far as possible, and the main theoretical advantage of constant potential as against constant current working is that in the former case the voltage is at its maximum value all the time irrespective of the load. And this advantage carries with it the difficulty of imposing at all times the maximum insulation strain upon the system. At equal maximum voltage for a given amount of energy transmitted, the full load current on the line will be the same whether one works at constant current or constant potential, but at constant current the energy loss is constant at all loads, while at constant potential the insulation strain is constant. The relative importance of these two conditions as one nears the working limit of voltage remains to be determined. We wish that Mr. Sprague had gone further and taken up this phase of the situation.

Of course, this practically means a comparison between direct constant-current and alternating constant-potential working. The latter undeniably labors under the disadvantage of a greater maximum voltage for the same working voltage, while the former suffers from the necessity of operating many machines in series for both ends of the main transmission. As the magnitude of the project increases and the necessary working voltage rises, one enters a region of new conditions. The alternating-current side of the problem is fairly simple aside from the line insulation, for one can certainly build transformers of large output for a working voltage of even the 200,000 volts or so that seems necessary for a transmission like that from Victoria Falls to the Rand. But for a direct constant-current transmission the situation is not so clear. Even at 5,000 volts per machine, which is far higher than anything yet reached for generators for the current required, forty generators would be needed to secure the necessary total pressure. With 200 amperes per machine one would be using 1,000-kw generators in a case where with alternating-current units one would be dealing with 8,000 or 10,000 kw per machine. This is a pretty serious difference, and the real question hinges on the maximum line voltage that can be insulated. If the alternating current were limited to the same maximum voltage as the direct current, the cost of the line assuming a maximum of 200,000 volts would be so largely in favor of direct current as to put it decidedly into the game. The whole matter of such work resolves itself into a question of possible line insulation, and as we have before intimated in these columns, it would be the part of wisdom for the projectors of the Victoria Falls scheme to make a reconnoissance on a very large scale before entering upon their campaign. It is no joke to undertake work at 150,000 or 200,000 volts when the maximum now in use is a scant 60,000, and with too low a factor of safety on the insulators at that. And as Mr. Sprague's figures plainly indicate, constant-current working cannot be turned down offhand, whatever may be one's preconceived notions as to its fitness. Our own tendency is to believe that alternating-current working at the required voltage can be successfully carried out, but we think Mr. Sprague's careful consideration of the other side of the question is very timely and will do good by setting engineers to thinking. Certainly a scheme of working which has done commercial work at voltage comparable with the highest alternating-current voltages in use cannot be put aside without thorough investigation, which we earnestly hope it will get.

Society of Illuminating Engineering.

One of the notable developments of the past few years has been the rapid growth of interest in the subject of efficient artificial illumination as related to the selection of lighting units for different service, modification of the natural distribution of light therefrom by the use of globes and reflectors, the disposition of the lights for the best effect, both utilitarian and æsthetic, and the production of a given illumination with the highest economy. The knowledge necessary to a consideration of all the various details entering into the design of the more complicated illuminating layout is to a very considerable extent of a technical nature, which justifies the use of the term "engineering," and already the term "illuminating engineer" has come to be recognized as a proper designation for those who specialize in the art of illumination.

The strength of this movement is shown in the steps taken in New York last week toward the formation of a society to advance the practical art of illumination and to bring about co-operation between the illuminating engineer, the gas engineer, the electrical engineer, the architect and the designer of electric and gas fixtures. A meeting called for this purpose on December 21 was attended by representatives of the several interests above noted, and after discussion the opinion was unanimous that the formation of such a society was justified. Several names were suggested for the body and this finally, together with the drafting of a constitution and by-laws, fixing of annual dues, etc., were left to a committee which was instructed to report at an adjourned meeting to be held early in January, when the society will be formally organized.

Among the objects of the society, in addition to those above noted, will be to promote the arts and sciences connected with illumination and illuminating engineering; to hold meetings for the reading and discussion of suitable papers and to publish and distribute such papers, discussions and communications as may seem fit; to gather authoritative data on lamps, lighting and illumination; to bring about the standardization of methods of measuring light and illumination and of rating lamps, and the general acceptance of such nomenclature with reference to illumination as may be adopted by the society; and to co-operate with other institutions such as the American Institute of Electrical Engineers in work common to both.

The meeting was called in a circular signed by Messrs. L. B. Marks, E. L. Elliot and V. R. Lansingh. Among those in attendance were, in addition to these gentlemen, Messrs. Waldo S. Kellogg, architect with Carrere & Hastings; W. D'A. Ryan, illuminating engineer General Electric Company; A. D. Page and F. W. Wilcox, Edison Lamp Works; Major E. L. Zalinski, illuminating engineer; Dr. C. H. Sharp, Wilson S. Howell and Preston S. Miller, Electrical Testing Laboratories; Charles A. Barton, Nernst Lamp Company; J. S. Codman, illuminating engineer, Boston; O. A. Nygatt, V. R. Lansingh, H. M. Lauritzen and A. A. Ernst, Holophane Glass Company; Arthur Williams, A. A. Pope, Walter R. Boyd, E. A. Norman, Charles K. Nichols and John Lloyd Price, New York Edison Company; F. N. Olcott, with Black & Boyd, gas and electric light fixtures.

Consolidation of New York Traction Interests.

The long expected has occurred at last. Mr. August Belmont has purchased all the bonds and stock of the Metropolitan Street Railway and Metropolitan Securities Co., held by Thomas F. Ryan. This carries control of the Metropolitan companies and gives the Belmont interests complete control of the transportation systems of Manhattan and the Bronx.

The combined capital stock of the New York street railways now controlled by August Belmont is $206,000,000. The New York City Railway Company, including the Metropolitan and the Bronx lines, has a total capitalization of $101,000,000. The Manhattan Elevated has a capital of $55,000,000; the Interborough Rapid Transit Company a capital of $35,000,000, and the Queens County trolley system a capital of $15,000,000.

The plan of consolidation, in a $222,000,000 holding company, is announced this week as follows: "Mr. Belmont and Mr. Ryan, after consultation with their respective associates, have approved a plan for the union of the Interborough and Metropolitan interests, which will be formally submitted to the stockholders of the corporations involved as soon as the lawyers have completed the necessary papers. The plan contemplates the organization of a new company which shall issue its securities in acquiring the shares of the Interborough, Metropolitan Street Railway, and Metropolitan Securities Companies, upon the following terms:

For every share of Interborough stock:	
New collateral trust 4½% bonds, secured by the deposit of Interborough stock	200
New common stock	90
For every share of Metropolitan Street Railway stock:	
New 5% cumulative preferred stock	100
New common stock	50
For every share of Metropolitan Securities stock (with $75 per share paid).	
New common stock	85

"It is confidently believed that the proposed arrangement will not only be beneficial to the stockholders of the corporations involved, but that it will be advantageous to the city and to the public. It is admitted in this connection that the transportation facilities in this city are already superior in rapidity, comfort, character of equipment and low cost of travel for long distance to those of any other city in the world. Yet they should be further greatly improved by reason of the greater opportunity now offered to co-operate harmoniously with the city in providing for important extensions and additions to the facilities of travel within the Boroughs of Manhattan and the Bronx."

Electrification of the Atlantic City-Philadelphia Line.

Note has already been made in these pages of the decision of the Pennsylvania Railroad to equip electrically that part of its system lying between Atlantic City and Philadelphia. We are now glad to be able to give details as to this interesting important enterprise. That portion of the Pennsylvania Railroad to be electrified, comprises some sixty-four miles of steam road lying between Camden and Atlantic City, New Jersey, being a portion of the West Jersey and Seashore branch of the Pennsylvania system. It is proposed to utilize the Cape May line of this system from Camden as far as Newfield, this line being double tracked with 100-lb. rails, and to build an additional track from Newfield to Atlantic City, making the lines double track throughout. Over this roadbed an express service will be established. The initial installation will provide for a three-car train every fifteen minutes between Camden and Atlantic City, making the sixty-four miles in eighty minutes without stops. The maximum speed of the cars will be between 55 and 60 miles per hour.

In addition to this through service to Atlantic City, a half-hourly schedule is planned, consisting of two-car trains between Camden and Millville, 40 miles, and ten minute service of single cars between Camden and Woodbury, 8½ miles. Full service will call for 58 cars in operation, each equipped with 200-hp, direct-current motors. These motors will be similar to those now being manufactured by the General Electric Company for the equipments of the New York terminal of the New York Central & Hudson River Railroad. The motors will be controlled by the Sprague-General Electric automatic multiple unit system.

Current will be furnished to the cars by the third rail system, except on the sections between Camden and Woodbury, and Newfield and Millville, where the cars will obtain the necessary current by an overhead trolley. The speed on these sections is less than on the main line. At Camden, the power house will be located. Power for the operation of the cars will be furnished by three 2,000-kw General Electric Curtis turbo-generators of the three-phase alternating current type, having a frequency of 25 cycles. From this power house transmission lines will be run to six sub-stations between Camden and Atlantic City, and a seventh sub-station at Millville to supply that section of the road lying between Millville and Newfield.

The transmitting potential will be 33,000 volts. At the sub-stations a total capacity of 11.000 kw in rotary converters will be provided, delivering direct current to the third rail at 650 volts. The individual units will be of the standard General Electric type and will have a capacity of 750 kw. They will be started from the alternating current and by means of taps on the stepdown transformers. The contract with the General Electric Company calls for the completion of this road by July 1, 1906, in order to take care of the heavy summer traffic. The total amount of money involved is about $3.000,000.

The Electrical Equipment for the New York Central.

Subjoined will be found an extremely interesting correspondence which is in a sense self-explanatory, and the origin of which, our readers will see at once, refers back to letters and articles already appearing in these pages with reference to the question of direct versus single-phase alternating-current apparatus upon the New York Central terminals. In the case of the New York Central Railroad direct-current apparatus built by the General Electric Company has been adopted; more lately single-phase apparatus built by the Westinghouse Electric & Manufacturing Company has been adopted by the New York, New Haven & Hartford Railroad, to operate over the same section, south of Woodlawn and into the vast new double-decked terminal depot at Forty-second Street. Mr. Frank J. Sprague, member of the New York Central Electrical Commission, but in his individual capacity, gave out a criticism or discussion of the subject, arguing against the feasibility and propriety of using the two electrical methods together, under the difficulties involved. To this some of the officials of the other road replied publicly, but the Westinghouse officials made no public rejoinder. There was issued, however, in private circulation a correspondence between President W. H. Newman, of the New York Central, and Mr. George Westinghouse, which until the close of last week was unavailable for general publication, at the request of both parties. It has now been "released," and with it we are able to give a further letter of Mr. Westinghouse to one of our steam railroad contemporaries, somewhat enlarging the area of controversy and introducing one or two new considerations. The correspondence follows:

October 27, 1905.

W. H. Newman, Esq., President New York Central & Hudson River Railroad Company, Grand Central Station, New York.

Dear Sir:—There can be no more important questions before you and your officers than those involved in the present electrification plans for your New York terminal and adjacent suburban lines. When your company, under public pressure and legislative enactment, undertook the change in your terminal facilities involving the use of electric power for your cars and trains, there had been not so much development of the single-phase system now actively under discussion as could warrant its adoption, and therefore the selection of the continuous-current system by your commission of engineers was an obvious outcome of the situation as it then existed, notwithstanding there had been enough progress made with alternating-current single-phase traction to warrant frequent references in my conferences with you and your officials to the possibility of that system being perfected in time for a change in your plans.

The business relations existing between your company and those I represent, and the consideration you and your officials have always given my personal views on the subject of the electrification of your railway, seem to demand the prompt fulfilment of my recent promise to set out to you in a letter the reasons why, because of the possible much greater use of electricity upon many of your lines of railway, your company could and should now change your plans providing for the use of the continuous-current, third-rail equipment, to those employing the alternating-current single-phase overhead system.

These are some of the controlling facts as they have been developed:

1. Motors can be as successfully and economically operated by single-phase alternating currents as by continuous current, with the advantage in favor of the use of the alternating current, in that the great variations in speed requirements of a railway can be more easily and economically met thereby than by continuous current.

2. Single-phase electric locomotives larger than you require have already been constructed and operated by current from overhead lines.

3. Electro-pneumatic multiple-unit control has been perfected whereby trains fitted with alternating-current motors can be better operated than those propelled by continuous current.

4. Both locomotive and car equipments with multiple-unit control have been evolved, whereby either the alternating or direct-current systems of distribution can be used.

5. If there is any desire for the use of the storage-battery system, such batteries can, with rotary transformers, be as well utilized in connections with the single-phase system as with the direct-current system.

COMPARATIVE COST.

Bearing upon these great questions are the comparative costs of the line equipment of the two systems.

As an example, the comparative cost of line and sub-station installation for alternating-current single-phase and direct current to meet the conditions of traffic now existing on the section of the New York, New Haven & Hartford Railway from Woodlawn to Stamford, based on the following:

(a) Single-phase alternating current, high-tension transmission transformer sub-stations, 6,000-volt overhead line supported by catenary construction from bridges spanning four tracks.

(b) Direct current employing high-tension alternating-current transmission, rotary converter sub-stations and third rail at 600 volts.

COMPARATIVE COST PER MILE OF FOUR TRACK LINE.

	Single-phase Alternating system.	Direct-current system.
Sub-stations	$1,714	$16,150
Contact line	12,436	18,872
Transmission line	1,815	2,181
Track bonding	308	308
	$16,273	$37,511

Difference per mile in favor of alternating-current, single-phase, $21,238.

COMPARATIVE COST PER MILE OF DOUBLE TRACK LINE.

	Single phase Alternating system.	Direct current system.
Sub-stations	$1,542	$13,840
Contact line	6,750	9,436
Transmission line	1,815	2,181
Track bonding	154	154
	$10,261	$25,611

Difference per mile in favor of alternating-current single-phase, $15,350.

These figures mean, assuming that your company may in the near future electrify its main lines from New York to Buffalo, that the extra cost of the line equipment with the continuous-current system for 450 miles of four-track road of the New York Central main line would amount to $9,000,000, and for the double-track of the West Shore road, $6,750,000. From these figures you can easily compute what the additional cost would be upon the entire mileage of the New York Central's other lines east of Buffalo and those west of that point.

This great difference in the first cost of the continuous-current system, with the almost absolute certainty that traffic depending upon the third rail will be subject to many interruptions during your severe winter months, coupled with the constant danger from live third rails upon the surface, would seem to make most fortunate the advent at this moment of the complete system of overhead single-phase apparatus, before any great quantity of car and locomotive apparatus has been constructed on your order, or the line and overhead construction has been begun under your extensive plans.

Stated briefly, your situation seems to be this: Your power house and its equipment now under construction is suitable, without substantial change, as are also your sub-station rotaries and storage batteries, for the operation of single-phase equipment. Orders have been placed for 35 electric locomotives, costing, say, $900,000, and 180 electric car equipments with multiple-unit control, involving an additional $775,000. Neither the locomotives nor the cars and equipments will be needed before September of next year, according to your present desires, but most probably not before April in the year following, because of the inevitable delays in the carrying out of so important a work as you now have in hand.

Had the order for the locomotives and equipment been placed with the Westinghouse Electric & Manufacturing Company, that company would have been very glad to have taken up with you a change in programme on a reasonable business basis, and I assume that your contract relations with the General Electric Company are of such a character that you can also ask them to discuss the change in the character of equipment or arrange with them for a specific sum to cover the amount they have already expended, with such profit as they are likely to make from the completion of the work. Such sum ought to be an unimportant item as compared with the costs which may result from the completion of the work along the lines of your present plans. We are aware that the General

Electric Company have admitted their inability to produce locomotives of the character which the Westinghouse Company has contracted to supply the New York & New Haven Railway, but such admission on their part does not really affect the question of the Westinghouse Company's ability to produce such apparatus in the necessary quantity and in the time required.

You know of the diametrically opposed views and interests of the Westinghouse and General companies and of the strife between them. You also know of my full recognition that the works of the former company being upon your line at Schenectady, it is natural that your company should give the General Electric Company at least a preference in the placing of contracts for electrical machinery.

The greatest difficulty in arriving at a conclusion is likely to be due to the commercial rivalry between the two electric companies, but there seems to be no good reason why your company should be a victim of such commercial strife. I feel confident that my recommendation that you now take steps to effect the change from your present plans will be found to be based upon the best of reasons, and that that recommendation will in all probability prevail if the matter is most carefully investigated, as I am sure it will be.

I am sending Mr. Wilgus a letter with some technical correspondence, of which I have the pleasure in enclosing you herewith a copy, with a hope that you may find time to read the same.

Inasmuch as many of your directors know only the one side of this important situation, am I asking too much of you to have my letter placed before them? I ask this because of my very great desire to have my suggestion that your company now make a change fully understood and appreciated by your associates. Believe me,

Very truly yours,
Geo. Westinghouse.

The letter inclosed by Mr. Westinghouse follows:

October 27, 1905.

Mr. E. M. Herr, First Vice-President:
Westinghouse Electric & Manufacturing Company,
Pittsburg, Pa.

I have noted H. H. Westinghouse's letter addressed to you, in which he gave the result of a conversation with Mr. Wilgus, of the New York Central, in which Mr. Wilgus brought forth certain reasons, which, in his opinion, militated against the use of single-phase apparatus in the New York Central terminal.

It would appear, from the statements advanced by Mr. Wilgus, that he had drawn his conclusions on incomplete or unrealiable information, as we have not yet given out sufficient data to anyone except our customer that would enable comparisons of this nature to be drawn which would be of any value.

While the comments in Mr. Westinghouse's letter are under certain more or less definite heads, for the purpose of clearer discussion, I will set forth my views under somewhat more general headings:

LOCOMOTIVES

As to Production.—It has been assumed in the communication referred to that owing to the apparent novelty of the design of the New Haven locomotives, insufficient time is available to produce a successful single-phase locomotive in order that it may be ready for the date set for the proposed operation by electricity of the New York Central terminals. Our opinion on this matter is that this single-phase locomotive operated as a direct-current equipment comes much nearer to standard, well-accepted direct-current practice than the locomotive adopted by the New York Central for its service.

The type of mechanical construction, using swivel trucks, is very similar to that universally used on heavy electric traction cars, while the method of control, involving series parallel operation of the motors, is common practice everywhere.

The type of motor used is not a radical departure from direct-current practice except in minor features of construction. The motors are extremely well protected from dirt and moisture, and they possess certain features which make them superior to any large direct-current motors yet built by any concern, more especially as regards entire freedom from "flashing," "bucking," and difficulties of commutation, not to speak of the great advance which has been made in the application of forced ventilation.

If the Westinghouse Company had been asked to build passenger coaches fitted with four motors of the capacity used on this locomotive, these motors to be operated with the usual electro-pneumatic series parallel-control system, there would have been no hesitancy in undertaking the contract, and it would not have been considered necessary to have made a long test on a trial equipment. The problem would have been considered as merely a further development of the type of equipments now operated on the Pennsylvania, New York & Long Island Railroad.

On the other hand, the long time taken by the New York Central Railroad for testing and experimenting was but a natural precaution, in view of the many radical departures from standard practice which were incorporated in their locomotive. For instance, the type of motor used on the New York Central locomotive is entirely open, and exposed to dirt and weather conditions. This construction is a radical and questionable departure from what experience in railway work has taught us is good practice, and it would have been folly to have attempted to put such machines in operation without very long and extended tests. Aside from the mechanical features of this equipment, the motors electrically and magnetically are such as had never been tried out by the experience gained by long service.

The result of all previous experience in electric traction has apparently been abandoned in the New York Central type, and I consider that that locomotive is an infinitely greater experiment than any that the Westinghouse Company could be considered as offering in the New Haven type.

In the course of our consideration of this problem, nothing has developed which leads us to have any doubt as to our entire ability to meet the requirements of delivery with an entirely successful locomotive.

As to Operation.—It is interesting to note that these locomotives have been pretty generally referred to as "single-phase" or "alternating." We, among ourselves, have used these terms, and perhaps are responsible for the nomenclature. In reality, however, the equipment of these locomotives is simply a high-class direct-current arrangement adapted for operation on alternating-current as well.

The motors are not primarily designed for alternating current and adapted for operation on direct current, but knowing the problem which we had to meet, they were in reality designed for the very highest class of direct-current service, and they will operate successfully on alternating current. In accomplishing this result, the fundamental features which make for a good direct-current railway motor have not been slighted, but on the contrary they have been amplified in order that the motors may work successfully on alternating current. We may take it as a fundamental condition in this class of work that in order that a motor work successfully on alternating current it must be an extremely good direct-current motor.

Method of Control.—It has apparently been assumed, although this example of many of our single-phase roads is to the contrary, that a multiple-unit system of control is not possible or feasible with the types of equipment which we are building for the New Haven road. This is, of course, an error, but it is probably brought about by the fact that only the electric system of multiple-unit control has been kept in mind, whereas the system which we use is the electro-pneumatic. It has further been assumed that with any system of control duplicate apparatus is necessary for direct-current alternating-current operation, which, of course, is another misconception, as the type of control which we are building for the new locomotives, and which is also in use on other of our installations, involves the employment of the same controller for both alternating-current and direct-current service.

This assumption has also called forth criticisms of the complications and difficulties in passing from direct current to alternating current, or the reverse, and much stress has been laid upon the awkwardness of having to employ two systems of control. As a matter of fact, roads now using this system pass from one current to the other at speeds as high as 50 m.p.h. without the slightest delay or any indication to the passengers that such a change has been effected. The whole mechanism to accomplish this is of the utmost simplicity and reliability.

It should be borne in mind that when multiple-unit control is referred to, we do not mean that form which depends for its operation upon the use of the line current, but upon the form used successfully and exclusively by our company, namely, the electro-pneumatic system, which depends for its operation upon the use of compressed air.

The type first mentioned, that is, the straight electric control, is obviously but ill-suited to use on alternating-current direct-current systems without additional prohibitive complications.

If the New Haven road should decide that it wishes to operate its suburban or any other service by multiple-unit trains, there is no reason why we cannot furnish entirely suitable equipments for direct-current alternating-current operation.

POWER CONSUMPTION.

Locomotives.—In Mr. Westinghouse's letter it is stated that the single-phase locomotive, when on direct current and running at low speed, requires double the amount of energy compared with a locomotive designed for direct current only. This statement, when read by itself and without any other consideration of the conditions, is apt to lead to very erroneous conclusions. The statement is true only when the direct-current alternating-current locomotive which we have sold to the New Haven road is compared to the case of a direct-current locomotive equipped with four direct-current motors, where all four can be thrown in series on the low speeds. Where the ordinary series-parallel control is used, such as on the Interborough system and the New York & Long Island road, and which also is proposed for the New York Central multiple-unit cars, there will be no essential difference in current consumption between the direct-current alternating-current and the straight direct-current, provided the equipments are designed for the same normal car speed.

In criticising the apparent disadvantage in economy of the direct-current alternating-current locomotive at low speeds, it would be only fair at the same time to show its superiority on higher speeds, which, as I will point out later, more than offsets this apparent disadvantage in power under which it operates at the very low speeds.

It is true that the direct-current alternating-current locomotive equipped with four motors, will, at certain very low speeds, consume what appears to be a large percentage excess of current over the straight direct-current locomotive equipped with four motors, but it should be remembered that this condition of lowest speed also means the point of least power consumption. This being kept in mind, it can readily be seen that a large percentage increase of current actually means only a small increase in power requirements.

At higher speeds the conditions, when comparing the two types of locomotives, is exactly reversed, the locomotives which we are building being of greater economy at the various higher speeds than those with which they have been compared to their disadvantage.

At one-fourth speed the total power consumption of the direct-current alternating-current, or the straight direct-current locomotive, is in no sense a controlling feature. It is the power required to accelerate the locomotive up to its full speed that is of importance, and also the power consumption when running at high speeds.

The New Haven service up to Woodlawn may be considered as consisting of three sections: First, a short section where the speed may possibly be 6 m.p.h.; a second section where the speed may possibly be 26 m.p.h., and a third section, where the speed may possibly be 45 m.p.h. The total energy consumption of a train on the first section, whether with direct-current alternating-current or straight direct-current equipments, will be small, due to the shortness of this section of the tracks, and to the fact that the input of the motor at these lower speeds is a minimum.

On the second section the direct-current, alternating-current will be very nearly at a par.

On the third section, where a high-speed service is required, the direct-current alternating-current locomotive, as designed for the New Haven road, will present considerable economies over the straight direct current as adopted by the New York Central.

It should be remembered that the higher economy gained with the utilization of larger amounts of power will offset a very large per cent loss in economy at the low speed when very small amounts of power are required.

The results of a comparison of a typical run on the New Haven service, showing in the first case the direct-current alternating-current locomotive which we propose to furnish, and in the second case, a straight direct-current four-motor locomotive adapted to handle the same train service, are shown in the table below:

NEW HAVEN LOCOMOTIVE.

Speed M.P.H.	Time, seconds.	Kw.	Distance, feet.
0 to 6	13	654	59
6	58	130	570
6 to 21.5	30	654	....
21.5 to 25	12	654 420	1715
25	52	240	3632
25	Momentary	720	3632
25 to 45	240	720 324	17470
45	88	303	....
45 to 25	14	0	23749
25	25	240	24649
25	Momentary	720	....
25 to 32	28	720 486	....
32 to 25	5	0	25906
25	23	240	26761
25	Momentary	720	26761
22 to 46.6	404	720-312	....
46.6 to 0	262	0	62357

30 Watt-hours per ton mile.

FOUR MOTOR, DIRECT-CURRENT LOCOMOTIVE EQUIVALENT TO NEW HAVEN.

Speed M.P.H.	Time, seconds.	Kw.	Distance, feet.
0 to 6	13	327	59
6	58	75	570
6 to 9.5 9.5 to 21.5	29	654	....
21.5 to 25	12	654 420	1517
25	52	240	3632
25	Momentary	420	3632
25 to 30	209	420-210	....
30	182	210	....
30 to 25	8	0	23749
25	25	240	24649
25	Momentary	420	24649
25 to 29	28	420 304	....
29 to 25	4	0	25906
25	23	240	26761
25 to 44.8	45	1392	....
44.8 to 61.4	183	1392-570	....
61.4 to 0	382	0	62357

30.1 Watt hours per ton mile.

From which it appears that the actual energy per ton mile required by the direct-current alternating-current locomotive is almost identical with that required by a straight direct-current locomotive under the same conditions of service.

Effect on Power House and Sub-Stations.—If reference is made to the foregoing table, which shows the relative power requirements of the two types of locomotives at various speeds, it will be seen that as regards the fluctuation in the power supplied the direct-current alternating-current will represent an easier condition than the straight direct-current locomotive, as the load will be very uniform. While the minimum load will be greater than the straight direct-current, the maximum or peaks will represent less power. Such a condition is in reality more ideal and much easier on the power house or sub-station than one where the same total power represents greater maximum and minimum values. The ideal condition as regards efficiency at generating and sub-stations would be a constant power or a constant load, and we come nearer to this condition with our direct-current alternating-current locomotive than is obtained by the New York Central type, on the basis of the same total power consumption in each case.

In conclusion, I believe that the statements made herein are a sufficient refutation of the views set forth in Mr. Westinghouse's letter. The New Haven road, however, in adopting apparatus adapted for single-phase operation, is looking further than the limitations imposed by the terminal requirements. The engineers of the New Haven road recognize that the extension of electric operation was absolutely prohibited, both for physical reasons and reasons of economy, if direct current were adhered to.

The necessities of economical high-speed railway service require that power shall be drawn by the system in proportion to the work it has to do. The trains must at times run at full speed, at intermediate speed, and in emergencies at extremely high speeds, to make up for loss of time. The single-phase alternating-current locomotive or equipments are the only feasible type which draw power in exact proportion to the work to be done. Direct-current equipments have but two or three points of maximum economy. They have no ability to go beyond a certain maximum speed, which is a frequent requirement of railway service. At all other speeds, except these few economical points, power is wasted in regulating the speed. The single-phase alternating-current equipments utilize power at all speeds at maximum economy. I believe that this feature alone is sufficient justification, aside from the many other advantages of the system, for its adoption by the New Haven Railroad.

B. G. LAMME,

Chief Engineer Westinghouse Electric & Manufacturing Company.

As bearing on this general subject, Mr. Westinghouse also contributes the following letter to the current issue of the *Railroad Gazette:*

THE SINGLE-PHASE ALTERNATING AND THE DIRECT-CURRENT SYSTEM.

111 Broadway, New York, Dec. 19, 1905.

To the Editor of the *Railroad Gazette:*

The railroad officials of the country are so deeply concerned in all that relates to the electrification of their lines that I deem it important now to take notice of an article which appeared in your issue of October 20, as well as of the article in the *Street Railway Journal* of October 21, written by Frank J. Sprague, one of the important engineers upon the Electrical Commission of the New York Central, which thereby precipitated a far-reaching controversy as to the relative advantages and disadvantages of the two systems of electric traction, namely, the alternating single-phase, which can be operated with overhead conductors, and the direct-current system, which, for railroad purposes, requires a third rail.

In dealing with this subject, it is well to recall that when the alternating-current system was first introduced into this country by the Westinghouse Company in 1886, the advocates of the direct-current system, feeling that their particular business and their efforts to secure a monopoly of the electric light and power industry of the country might, as they really have, become abortive, left no stone unturned to accomplish the suppression of this new and comprehensive electric system. Legislatures in several States were invoked to pass laws to prohibit any use whatever of the alternating electric system, and the present method of killing criminals in New York State was the direct outcome of the organized efforts of the business rivals of the Westinghouse Company, who were also enemies of the public, to use that company's make of alternating-current generators for this base purpose in the hope that their legislative efforts referred to might be crowned with success.

The triumphant success of the alternating-current system, without which none of our great railroads could have had the benefit of electric traction, needs no words of mine to emphasize it; but there are arrayed to-day against the alternating-current single-phase system of electric traction many of the same men and the same interests, actuated by the same commercial spirit and using the same methods and tactics as were employed by them in the days referred to when they began their "peculiar" opposition to the alternating electric system.

Public discussion and the facts already demonstrated will bring discomfiture to that organization which has made a long and losing fight to acquire a monopoly of the electric light and power business of the country, and will insure the acceptance in this country of the single-phase system as the only solution of the electric traction problem on main railroads, as has already been the general result of a most intelligent consideration of the subject in Europe.

In 1886 it was said by some influential people that I was making a mistake in attaching so much importance to the efforts being made at that time to discredit the alternating system. The beneficial results which have followed my efforts in that and other cases, in the true interests of users of electric apparatus, impel me to believe that I would be remiss at this moment to accede to like suggestions which have been recently made to me.

Mr. Sprague, while disclaiming that he was speaking officially for the New York Central Company, seems to have left no doubt in the minds of a large number of people that his views were those of the members of the New York Central Electrical Commission. In his haste to create for his clients a strong public opinion calculated to induce the officials of the New York & New Haven Railroad to give up their plan to use the single-phase alternating system and to take exactly the same kind of apparatus as the New York Central had already contracted for, namely, the third-rail direct-current system, and in pleading the great need for uniformity, Mr. Sprague forgot to inform the public, probably as he would have done had he had more time, that he is receiving a very large retainer under a contract of years' duration, whereby, though he may become consulting engineer for a railroad, yet he cannot do so if, in the opinion of the officials of the General Electric Company, such work or obligation may be in conflict with the interests of that company; and having a particular personal interest in his own form of control, which is suitable for direct currents only, he equally overlooked the fact that the electro-pneumatic multiple-unit control made by the Westinghouse Company had been fully perfected for the operation of locomotives and multiple-unit trains when operated by the alternating single-phase or the direct current.

Your article above referred to also tended to mislead its readers upon most important railroad questions, because it seems to have been written with a knowledge of only one side of a situation, and thus under an impression that the action of the New York, New Haven & Hartford road might prove not helpful, as it will, but rather disadvantageous to electric traction in general.

Believing that a great effort had been inaugurated to fasten upon the railroads the direct-current third-rail system as a standard, through a specious appeal in this particular case for uniformity, and knowing that nothing more harmful could happen to railroad interests than to extend that system, I wrote a leter, after a conference on the subiect, to President Newman, of the New York Central, and inclosed therein a letter from Mr. B. F. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, in criticism of observations made respecting the action of the New York, New Haven & Hartford Railroad. Copies of these letters are inclosed herewith for your perusal and publication.

An intelligent public discussion of these important questions cannot fail to be of the utmost benefit, and in saying this I have in mind the rather harsh criticisms made of my letter published in the *Railroad Gazette* of January 17, 1902, written in a spirit of friendliness and helpfulness to the New York Central officials, who were in my opinion, being misjudged with reference to the accident which had shortly before occurred in the New York Central tunnel. The result of that discussion has, as all know, been the development of the steel car, so that there are now a number of firms ready to supply non-combustible cars, which are superior to the old form; in fact, the Interborough, the Pennsylvania, and the New York Central have all ordered steel cars in large numbers, and no one would now think of doing otherwise.

In conclusion, I wish to say that the single-phase alternating-current system not only equals the direct-current system in every particular, as fully set out in Mr. Lamme's letter, but in several respects has advantages of supreme importance, two of which I will particularly refer to.

No problem is of higher importance than that relating to the avoidance of the destruction by electrolytic action of all underground metallic work, such as employed in the great improvements of the New York Central, the Interborough and other underground work yet to be undertaken, and the water and gas pipes of New York. These works have been created, not to last a decade, but are intended to, and should, endure for ages. It has been shown fully and completely that the direct current is working all of the time in the destruction of some of the metallic structures, especially water and gas pipes, adjacent to electric conductors, which metallic structures invariably act as conductors for some of the current escaping from the uninsulated rails forming part of the electric circuit in railroad operations.

In illustration of this electrolytic action of continuous currents, I enclose a photograph with memorandum of explanation showing the electrolytic action due to the leakage of electric current from a street railway line in East Pittsburg. I do not pretend that the rapidity of action in his case is likely to occur, except under extraordinary conditions. However, had the alternating current been used, there would have been no electrolytic effect whatever. This electrolytic difficulty is a well known one. It cannot be hid or covered up and must be surmounted, because the sum involved in this phase of the electric problem is so great as to justify every possible effort to avoid its rapid depreciation or loss.

In the matter of the regulation of the speed of trains upon standard railroads, the single-phase system will have it all its own way, because with the continuous current no speed can be attained greatly in excess of the predetermined one. In railroad practice it often happens that speeds of 70 m.p.h. and 80 m.p.h. are necessary to make up for time lost. If the direct-current motors are constructed for this speed, then at the ordinary speeds of 40 miles, or 50 miles, there would have to be introduced a dead resistance in the motor circuits to reduce the voltage, which condition can be maintained only for a short time, and is in effect not unlike applying a brake to hold the speed down. The only other way to maintain an average low speed would be to put the current on and off, an intolerable and uncomfortable practice one frequently observes when a motorman is obliged to move a street car at a slow speed. In the single-phase system, the auto-converters used in connection with the locomotive and car equipments provide for continuous running at any desired speed in a manner equivalent to the placing of the throttle and reverse lever in appropriate positions.

My reference to Mr. Sprague and his article and his interests are reluctantly made, and are not to do him an injustice, but to prevent an injustice being done to vast interests by the forgetfulness referred to. GEO. WESTINGHOUSE.

The electrolytic action referred to in the preceding communication of Mr. Westinghouse occurred in one of the natural gas wells on the property of the Westinghouse Electric & Manufacturing Company in East Pittsburg. The action was found to be due to electrolysis, caused by stray currents from the street railway system. This gas well was in operation for several years with 2-in. tubing, consisting of bare steel pipe with no preservative or other protection. The well suddenly gave out, and upon pulling the tubing it was found that for 30 ft. or 40 ft. above the rubber packing (located about 1,800 ft. down for preventing access of water to the gas-bearing strata), the pipe was greatly reduced in thickness, more or less uniformly but broken entirely through in several places, thus causing the well to be "drowned out." As the well goes through salt-water strata and there is some sulphur in the surface waters, this was believed to be the case. As a supposed remedy, new tubing was installed, protected by a japanned coating inside and outside, known as "Loricated" tubing. Photographs of this tubing, taken after thirty days' use, show numerous pit holes. The action was immediately diagnosed as electrolytic entirely, and was, of course, aggravated because a very slight defect in the coating concentrated electrolytic action at these spots, thus causing an aggravation instead of a remedy. To cure the trouble, careful observations were made as to the source of current, and a slight flow of current was found at all times with very heavy flows during the busy hours of the street car line. After installing the new tubing, several insulating joints were inserted in the casing in the hope that these will prove a remedy.

Pittsburg A. I. E. E. Meeting.

The monthly meeting of the Pittsburg branch of the American Institute of Electrical Engineers was held on December 12. The subject of the meeting was "Electrolysis," the programme having been arranged by the chairman, Mr. S. P. Grace. The principal speaker of the evening was Mr. E. E. Brownell. The following gentlemen each contributed five-minute discussions: Messrs. S. M. Kintner, on "Alternating-Current Electrolysis;" W. H. Fisher, "The Electrolysis Problem from the Cable Manufacturer's Standpoint;" F. Uhlenhaut, Jr., "What the Electric Railways are Doing to Prevent Electrolysis;" R. A. L. Snyder, "Electrolysis of Telephone Cables," and S. P. Grace, "The Ultimate Solution of the Electrolysis Problem." Mr. Brownell, who read the main paper, is a consulting engineer in Chicago, who has worked quietly during the past ten years for large gas and water companies throughout the country in the protection of their lines against electrolysis.

The Pittsburg section, of which Mr. S. P. Grace is chairman, is now in a very flourishing condition, and the meetings are well attended. It is expected that the interest will be still further increased this year, due to the fact that the new Carnegie Technical School has invited the section to hold its meetings in its new auditorium, and this meeting was held there.

Allowance for Depreciation at Holyoke, Mass.

We printed in our issue of December 16 the decision of the Board of Gas & Electric Light Commissioners of Massachusetts, refusing to allow a lower rate of depreciation on the Holyoke municipal gas plant. This decision, while final and governing, was not unanimous, Mr. Morris Schaffhaning filed a minority report. As this is interesting, in view of the importance of the subject of depreciation, we give it in full below:

The sole question involved in the petition for the board to consider is what is a fair rate of depreciation; in other words, what amount should the consumer pay in addition to cost, including interest on investment, for the gas or electricity the city supplies him. Obviously he must provide for the wear and tear, which is usually a charge in the operating expenses, but also such a sum yearly as will, if compounded, provide for a complete renewal of the property employed. When he has discharged this obligation, he has discharged all. He is not, in my judgment, to have to carry the burden for losses in litigation and over-values that the city was put to in buying the plant; that is for the whole municipality to bear, he as a taxpayer along with all other taxpayers. For it seems elementary that municipalities cannot make up out of a few, or a class of their citizens, losses that the city itself incurred, and which, as in this case, it could not have avoided—any principle of justice disapproves the application of such a theory. And it is equally consistent with reason that whatever view be taken of a consumer's obligation, the plant which is devoted to a public service for all time should have its cost distributed over as many years as may be wisely possible. It is unfair to consumers and taxpayers of to-day to not only pay, as they must, the bonds issued for the purchase price, but also a rate of depreciation in excess of the actual amount which experience has determined is necessary.

The logical effects of this decision are serious. For if, no matter how much more a municipality has to pay than the property is worth, it has to pay five per cent depreciation not only on the actual property, but on the excess of what it is worth, corporations inclined to a policy of high prices will feel themselves more strongly entrenched in their policy since the average man will hesitate between exorbitant prices and exorbitant taxation in the way of depreciation.

If it be sound policy for a consumer in a municipality to make up losses in purchase price, is it not a sound policy for a consumer of a private corporation to make up losses? Depreciation is an incident of physical things, and its limit for every part of a gas or electric plant is so well known that the determination of the amount in this case is all that is before the board; and the moment the board passes beyond that question it becomes a party to the question of public policy involved in municipal ownership. For the above reasons I dissent from the opinion of my colleagues.

Brush and Thomson at the Cleveland Club.

The Electric Club of Cleveland held a smoker on the evening of December 15 which was thoroughly enjoyed by a large number of members and their friends. In addition to music by a colored quartette, a "Dutch Lunch," etc., there was a special and unique feature which incidentally was considered as a joke on the majority of those present. The announcement stated that the meeting would be addressed by Mr. Charles F. Brush and Prof. Elihu Thomson, and a number attended with the expectations of meeting these gentlemen. As a matter of fact the addresses were delivered via a phonograph, and at the same time the phonograph was in operation, portraits of the speakers were thrown on the screen. The idea was conceived and carried out by Prof. E. P. Roberts, who was recently elected president of the club, and in order to embody the idea consistently Prof. Roberts introduced the speakers through the same medium.

In the course of his phonograph remarks, Mr. Brush said: "The old, old question, 'What is electricity,' is more to the front than ever before, but we need no longer make the old, unqualified and humiliating answer, 'we do not know.' We are now fairly on the way to finding out. The brilliant researches and speculations of J. J. Thompson, and others, seem pregnant with knowledge. We are told that the flying particles, or ether corpuscles of the Crooke's tube, are far smaller than the chemical atom; that their mass is little more than the thousandth part of that of the hydrogen atom; that they move with a velocity of the order of the velocity of light, and that each corpuscle carries a definite, and invariable, charge of negative electricity. Inasmuch as the corpuscle always carries the same charge, whatever gas is the source of the corpuscle, some physicists hold that the corpuscle consists wholly of electricity. If this view is correct, then electricity, or at least negative electricity, must be regarded as a form of matter, and not a phenomenon of the ether, as hitherto supposed, because the corpuscle is certainly endowed with the properties of mass and inertia, the most fundamental attributes of matter. The same physicists advance the hypothesis that all forms of mater are composed wholly of electrical corpuscles, grouped in various ways to form the chemical atom. This is an exceedingly interesting speculation, but cannot be verified or refuted until we know far more than we do now about positive electricity, and how it is associated with the negative corpuscle to form a neutral combination."

Prof. Elihu Thomson's remarks were as follows: "Were it not for the distance which separates us, and the time taken in going and coming, it would be better to greet the Cleveland Electric Club personally, and not by machine. Cleveland will always be associated with the pioneer work in series arc lighting by Mr. Charles F. Brush. The carbon industry remains as a testimony of his early work. We had then only the open carbon arc, and the volume of business done in the early eighties was not very large when compared with that of arc lighting alone in recent years. Now we have many forms of arc light, series and constant potential, open and enclosed, carbon crater, luminous flame and mercury arc, varying in adaptability and efficiency. What we have to look forward to, is higher efficiency of light production. We now waste too much energy in heat, and get the light only as a sort of by-product.

"The luminous flame arc is almost twice as economical as the carbon arc, but has the bad habit of smoking incessantly, a condition which relegates it to open places only.

"The field is open for further advance, and this reminds me of an incident. A man called to see me a few days ago about a wave motor. My secretary told him I did not believe in them, and would not waste time in discussion. 'Good,' said he, 'I am greatly encouraged when such men leave wave motors alone—the field is open and I have the whole field.'"

The Public Lighting of Berlin and Paris.

In view of the controversy in New York some months ago over the price of public lighting, when the instances were cited of various European cities, the following figures from the British *Journal of Gas Lighting* as to Berlin and Paris, are of special interest. It will be seen that the statements made in these columns as to the greater cheapness of the arc light prices in New York were strictly true:

M. Lauriol, the chief engineer of the Public Lighting Office of the Municipality of Paris, and the chief of the "Direktion" of Public Lighting in Berlin, have forwarded the statistics referring to those cities on comparable lines to those which have been published in these articles for London. We will take the figures from Berlin first, as the lighting of that city has been so frequently the subject of allusion in writings and discussions on public lighting questions. The area of Berlin, our courteous correspondent informs us, is 15,235.3 acres. In all there are in the city streets 23,903 lamps; and of these only 576 are electric arc lamps and 112 electric incandescents. The incandescent gas lighting is of a diversified character; and what is more high-power and cluster lighting is far more prevalent there than it is in London. In Berlin there are a total of 23,215 incandescent gas lamps, of which 117 are high-power, fitted with two burners, and 31 similar lamps each supplied with only one burner. Cluster lighting bulks very largely; there being 6,071 lamps with two burners, 239 with three burners, and 8 with five burners. There are also 16,749 lamps fitted with single burners. The average cost of the arc lamps per annum is 424.92 marks, which (taking the mark at the approximate exchange of 20 marks to the pound) represent £21 4s. 11d.; the average cost of the electric incandescent lamps is 70.98 marks, representing £3 10s. 11¾d., while the average cost of the incandescent gas lamps per burner (including maintenance) is 59.70 marks, or £2 19s. 8d., the average consumption of gas being 18,435 cubic feet per annum.

In Paris we are dealing with a city of 3.02 square miles; and within its streets are to-day to be found 1,710 electric arc lamps, only 100 incandescent electric lamps, 40,204 incandescent gas lamps, and 2,552 flat-flame gas lamps. Intensive incandescent gas lighting greatly exceeds both London and Berlin; there being no less than 5,300 burners, each consuming from 5.3 to 9.5 cu. ft. of gas an hour. In 1,325 lamps, too, there are grouped clusters of two, three, four and five burners, with a total consumption of from 7 to 49.4 cu. ft. per cluster per hour. Of single incandescent burners, there are 42,669, consuming 3.5 cu. ft. of gas an hour. Against this considerable number, there are only 2,552 flat-flame lamps, burning from 3.5 cu. ft. to 8.5 cu. ft per hour. Taking the whole of the incandescent burners, the average consumption would work out to 4 cu. ft. an hour; and similarly averaging the consumption of the flat-flame burners, it comes to 4.16 cu. ft. The average cost of the gas supplied to the incandescent burners is 65 frs. 81 c. (say £2 14s. 10d.), and the average cost for the flat-flame lighting is 66 frs. 37 c. Gas is charged for at the rate of 16 c. per cubic metre, which is equal to 3s. 5d. per 1,000 cu. ft. For the lighting, extinguishing, maintaining, and cleaning of the old flat-flame burners 6.5 c. per lamp per day is charged. For the incandescent burners there is an extra charge of 12 frs. per annum for the renewal of mantles, chimneys, additional work in cleaning, etc. The average cost of the electric arcs is 30 c. per lamp-hour, including maintenance, carbons, etc.

Power and Preservation of Niagara.

The American Civic Federation in its latest bulletin has the following with regard to the situation at Niagara, and the effect of power development on the beauty of the scene, quoted from the *Country Calendar*: "It may be that we ought to shut our eyes to the impending destruction of the glory of Niagara Falls. It may be that the hope of cheaper production of considerable quantity of electrical power, of breakfast foods, of chemicals, of utensils, is a more worthy object in our national life than the rescue of a noble and stupendous work of nature. To get at the exact situation, we have taken the facts recently presented by Dr. Clark, the New York State geologist, and other eminent special pleaders for Niagara, and we have had these facts verified by the expert hydraulic engineers most prominent in the work of installing the industrial plants that now threaten the Falls.

"The generally accepted volume of the Niagara River at the brink of the Falls is 224,000 cu. ft. per second. There are at present two power companies operating on the American side and three at work, or preparing for work, on the Canadian side. The process of using the power of the river produced by its sheer plunge of 161 ft., is to convey water by tunnels, canals or pipe lines from some point above the brink to the lower level below the Falls. It is obvious that if all the water were thus conveyed around the brink of subterranean passages or canals there would be none to make a Falls. But it seems that the American Horseshoe Falls will probably disappear when very much less than half the water is subtracted, for the brink of the hard dolomite rock over which the river plunges is no less than ten feet higher on the American side than on the Canadian, the greater bulk of the water passing on the British side of Goat Island. Dr. Clark estimates that when 40,000 cu. ft. of water per second has been subtracted from the river, there will be but a thin and pitiful apron of water remaining of the American Horseshoe Falls. He predicts that when 80.000 cu. ft. of water are used in the power plants, one may walk dryshod along the brink of these Falls and an arid waste of rockbed will be left between Goat Island and the mainland. These five companies now in operation are allowed by their charters to take 48,000 cu. ft. of water per second. So that there is clearly impending a contraction of the American Falls to a pitiful remnant. But the danger does not stop here. During the past winter and spring a sixth power company has been making the fiercest of efforts at Albany to renew an old charter which would allow it to take away a further quotum of Niagara Falls to be carried by canal across country to Lake Ontario. Dr. Clark estimates that this company would use not less than 10,000 cu. ft. of water per second, bringing the total to 58,400 cu. ft. Over and above this, the engineer of the commissioners of Queen Victoria Niagara Falls Park has suggested feasible sites for four additional Canadian companies, to consume 29,996 cu. ft. of water per second, bringing the total to 88.396 cu. ft. of water per second demanded by the work now going on, plus the contemplated operations. Finally, engineers point out that even if the power development is at once halted at the Falls, there is a strong probability that great quantities of water will be taken from the Great Lakes above the river, which would have the same deadly tendency to reduce the volume of water at Niagara Falls. With a difference in level between Lake Erie and Lake Ontario of 327 ft., and the distance between the two lakes only 27 miles, the engineering opportunity is obvious. Then there are the additional draughts of the Welland Canal, the Erie Canal, and the Chicago drainage canal."

Power in Arsenals.

The Army Ordnance report, which has been recently issued, states with regard to the Watervliet Arsenal, Troy, N. Y., that the application of individual motors to the gun lathes in the north wing of the sea-coast gun shop has been completed and the results have more than fulfilled expectations. The output of the lathes has been increased, the control has been made more simple and the increase in efficiency has been considerable. A motor-generator set of 160 kw capacity has been installed, the Hudson River Electric Company furnishing the current. The service has thus far been very satisfactory. The extension of electric motor plant throughout the gun shop will be completed during 1906.

Electrical Engineers of the Times.—XLII.

DR. LEE DE FOREST.

Lee de Forest was born in 1873 at Council Bluffs, Iowa. His father, Henry S. de Forest, a Yale man of the class of 1857, and for a time tutor in the college, was a Congregational minister who had served as chaplain to the 11th Connecticut volunteers during the war between the North and the South. Mr. de Forest's early boyhood was spent in Alabama, where he received his primary education. After spending two years at Mt. Hermon School, Massachusetts, and graduating at the head of his class in 1893, he entered Yale University in the class of 1896 and was graduated from the Sheffield Scentific School with the degree of Ph. B. He then took three years of graduate work under Professors Wright and Gibbs, and in 1899 received the degree of doctor of philosophy. His thesis for the doctor's degree dealt wth the properties of electric waves propagated along two parallel wires. An account of this work was published in the *American Journal of Science* for July, 1899, under the title of "Reflection of Hertzian Waves at the Ends of Parallel Wires."

After taking his doctor's degree Dr. de Forest was employed in the telephone experimental laboratory of the Western Electric Company in Chicago, where he continued to experiment with Hertzian waves, especially on the electrolytic detector for use in wireless telegraphy. He was also at this time employed on the editorial staff of the *Western Electrician* in Chicago. In 1900 he and Edwin H. Smythe filed an application for a patent upon an electrolytic detector of Hertzian waves, which in due time was granted. This patent is regarded by Dr. de Forest as basic, and as covering all electrolytic wireless telegraph detectors. Following this he developed a system of wireless telegraphy which differed radically from those theretofore used. In 1901 he demonstrated its successful working during the international yacht races, and in February, 1902, formed a company known as the De Forest Wireless Telegraph Company to put his system into commercial use. Among the most prominent characteristics of the De Forest system may be mentioned the use of the commercial alternating current as a source of power at the sending station, and the use of an electrolytic detector in combination with a telephone for receiving at the receiving station. In the fall of 1903 Dr. de Forest went to England and sent messages across the Irish Sea, demonstrating the successful operation of his system of wireless telegraphy to the satisfaction of representatives of the British Government. There are at present over 50 land stations and about 25 ocean steamships equipped with the De Forest system.

DR. LEE DE FOREST.

Dr. de Forest has taken out many patents in wireless telegraphy, the more important being on the electrolytic detector and a complete system of electrical tuning based upon the principles of the Lecher wires. He has contributed articles upon the subject of Hertzian waves and wireless telegraphy to this journal, the *American Journal of Science, Physikalische Zeitschrift*, the London *Electrician*, etc. In 1903 he read a paper by invitation before the Franklin Institute of Philadelphia upon "Electrolytic Wireless Telegraph Detectors," and at the International Electrical Congress at St. Louis in 1904, he presented another important paper upon the same subject. The Jury of Awards of the World's Fair at St. Louis in 1904, in addition to granting the de Forest system the grand prize and gold medal, awarded a diploma of honor and gold medal to Dr. de Forest for his work at the fair, especially in establishing wireless communication between St. Louis and Chicago.

Dr. de Forest is a member of the American Institute of Electrical Engineers, the New York Electrical Society and the National Geographical Society.

CURRENT NEWS AND NOTES.

NIAGARA POWER.—The Canadian Niagara Power Co. is seeking the privilege of carrying transmission cables across the Niagara River at Fort Erie into Buffalo.

PHILADELPHIA OFFICE.—The Philadelphia office of the Electrical World and Engineer, which for so many years has been located at 929 Chestnut Street (City Trust Building) will be removed on January 1 to the Real Estate Trust Building, Broad and Chestnut Streets.

INVERTED GAS BURNERS.—The advertising columns of gas journals are teeming with announcements of inverted gas burners and globes, accompanied in some cases by illustrations which at first sight might be taken for electric light brackets or electroliers. The gas burner is of the inverted or under-burning type, and the globes and fixtures are made to resemble closely those used with electric incandescent lights, a lesson apparently being taken from the exploitation of street gas "arcs" made to resemble as nearly as possible the electric arc lamp.

MOVING PLATFORMS.—Moving platform loops, with stations in different parts of Brooklyn, the system extending to the North River in Manhattan, were proposed to the New York Board of Estimate last week, as a solution of the bridge transit problem. After a hearing in which J. Edward Swanstrom, ex-Borough President of Brooklyn; Henry Sanger Snow of the Brooklyn League, Calvin Tomkins of the Municipal Art Society, and others opposed the transit and terminal plans of the Bridge Department, the board adjourned to the Governor's room in the City Hall, where the platform machine people showed kinetoscope views of their moving platform in operation. The board referred the entire terminal plan back to the bridge department with instructions to consider it in the light of the showing made by the moving platform advocates.

TELEPHONES IN CHURCHES.—The London *Chronicle* remarks with regard to a recent item in our columns: "It is not necessary to go across the Atlantic to the Presbyterian Church at East Orange, N. J., to find telephone receivers in the pews. They are to be found in 'The Scotch Church' in Regent Square, the church to which, in the days of Edward Irving, members of both Houses of Parliament flocked to learn the art of oratory. Only a few receivers have so far been placed in communication with the pulpit, but for the small cost of laying a wire any one may have a receiver in his pew. The 'dull of hearing,' who are not able to worship with comfort in their own church, might do worse than attend the Cathedral of Presbyterianism." This misses the point. Lots of churches have had the telephone installed, but at East Orange they were placed in the "way back" pews so as to put the occupants there on an equality with those in the front pews.

FEAR NIAGARA POWER.—According to up State newspapers, several small local gas and power plants in the western part of New York are afraid that the Niagara Power Company will put them out of business. State Gas and Electricity Commissioner John C. Davies stated that, while no formal complaints had been filed with the commission against the Niagara Power Company, several of the small local light and power companies had written to inquire whether the commission could not protect them against threatened aggressions by their larger rival. Officers of such companies in Medina and Palmyra, said Mr. Davies, have sent word that the Niagara Power Company is seeking to invade their territory and force them out of business by cheaper rates. They say that in so doing the Niagara company would exceed its charter rights. The commission intends to ask the advice of the Attorney-General.

PARIS-NICE TELEPHONE.—The French telephone administration announces that a direct telephone line from Paris to Nice will be inaugurated the coming season, in January probably. The total cost involved is 1,000,000 francs ($200,000).

ELECTRICITY AT KIMBERLEY, S. A.—We are advised by Mr. J. M. Bridge, chief clerk of the Electricity Department of the Borough of Kimberley, South Africa, that the council having entered into an agreement with the De Beers Consolidated Mines, Limited, for a supply of current in bulk, for the next twenty years, the municipal generating station will be closed down for that period. No plans are projected for subsequent work.

PURDUE UNIVERSITY.—About forty alumni of Purdue University living in or about New York met on Monday evening, December 18, and perfected the organization of the Purdue Alumni Association of the City of New York. P. E. Fansler, of J. G. White & Co., was elected president, and L. M. Grant, of the C. W. Hunt Company, secretary-treasurer. The association will meet on the second Wednesday of every month. The list of charter members numbers about 100.

WORK AT WORCESTER.—The Worcester (Mass.) Electric Light Company had, on December 17, a very effective full-page advertisement in the local *Telegram*, announcing the fact that that journal gets all its light and power from the company, and suggesting that others might well do the same thing in house, store or factory. The border of the "ad." is a "motif" of incandescent lamps and flexible cord, with the corners occupied by cuts of fan motors, power motors and arc lamps.

AMERICAN ELECTRICAL SALESMEN.—The first regular convention of the American Electrical Salesmen's Association will be held at the Grand Pacific Hotel, Chicago, Saturday, January 20. This is the first Saturday after the opening of the Chicago Electrical Show. This association was formed at a meeting of salesmen at the Illinois State Electric Association's Convention, held in Peoria, last October. Since then the membership has increased greatly. Mr. George H. Erich, Room 52, 88 Washington Street, Chicago, secretary, can furnish any further information desired about the association.

GASOLINE MOTOR CAR.—A Chicago dispatch states that a test was made on the Chicago & Alton Railroad on December 27 of a gasoline motor car which has been designed to meet electric railway competition. Between Chicago and St. Louis, the dispatch adds, it is proposed to build an electric railway parallel to the Alton tracks. The Alton company has determined to furnish between these points as good service as would be possible on an electric road. During the test runs the car, loaded to its capacity, attained a rate of forty miles an hour. It takes much less time in reaching full speed from a dead stop than the light trains drawn by steam engines. As a result of the tests the Alton will, it is stated, substitute gasoline motor cars for steam trains, which have been in the company's interurban service.

RAILWAY SIGNAL ASSOCIATION.—The next meeting of the Railway Signal Association will be held at the Grand Union Hotel, New York City, January 9, 1906, at which time the following papers will be presented: "Signaling on the East Bengal State Railway," by George K. Rogers, signal engineer. "The Care of Storage Battery as Used for Signaling Devices," by H. W. Lewis, supervisor of signals, L. V. R. R. "Preliminary Report of Installation and Maintenance of Storage Batteries," by I. S. Raymer, chairman, Committee No. 4. "Line Wire," by F. F. Fowle, special agent, American Telephone & Telegraph Co., New York City. Chairman Ames, of Committee No. 12, "Rubber Covered Wire," will take up for discussion the feasibility of a system for inspection of rubber covered wires. In addition to this an amendment of the Constitution and one to the by-laws is to be voted on.

ADVERTISING FOR POWER BUSINESS AT PORTLAND, ORE.—The Portland General Electric Company, of Portland, Ore., has reprinted for free distribution a paper read by F. G. Sykes before the electrical transmission section of the Pacific Coast Engineering Congress, held at the American Inn, at the Lewis & Clark Centennial Exposition, at Portland, Ore., June 29 and 30, 1905. In place of a preface are inserted a few words to manufacturers stating the advantages of electric power for manufacturing purposes. The article is a finely illustrated description of the large water power and steam plants, and sub-stations of the company. This article, although written originally for another purpose, is also well calculated to inspire the confidence of the power users, in the service given by the Portland General Electric Company. The company is furnishing 20,000 hp to the manufacturing establishments at Oregon City, where its largest water power stations are located, and over 15,000 hp in Portland, for lighting, manufacturing and operating street railways.

FRANKLIN IN FRANCE.—Mr. John Hay's "Franklin in France" article in the January *Century* says: "An interest which we can scarcely comprehend was taken in that day in natural science. Franklin was, by universal consent, the greatest natural philosopher of his time. He was hailed as the confidant of nature —the playmate of lightning, a Prometheus unpunished. The brightest constructive and critical energies of the best minds were devoted to the solution of political problems. And here, they said, was a man who had founded many states upon the principles of abstract justice, and had consolidated them at last into a superb model republic. For this hasty generalization had seized the foreign mind, always too apt to regard leaders instead of masses, and it was long before the millions of Americans got their due abroad. Thus it came that the great heart of liberal France went out at once in a quick rush of welcome to Franklin. He was the point that attracted the overcharged electricity of that vast and stormy mass of active thought. He became the talk of the town. They made songs about him. They published more than one hundred and fifty engravings of him, so that his fur cap and spectacles became as familiar as the face of the King on the louis d'or. The pit rose when he entered a theater. These are not trivial details. Those spontaneous honors, paid to an alien citizen by a people so long the victims of degrading tutelage, showed the progress they had made toward liberty. In honoring him they honored themselves. They vaguely felt he was fighting their battle. They read in his serene and noble countenance the promise of better times."

"SHE LIGHTS UP WELL."—M. Jules Huret, one of the leading French journalists, has just issued a very interesting book on his recent experiences in the United States. A large amount of space is given to New York, its hustle, bustle, noise, the electric cars on the bridge, the nightly scramble for the Brooklyn trolleys and the Jersey ferries—and much other unloveliness. But this is what he saw at night: "I was at the center of the river. There is no twilight in this country. Night falls immediately. Already the lights were shining on the New York side. For a long time I gazed at the rows which were lighting up as though by enchantment. Presently a magnificent sight spread itself out before my eyes. And this was the first sensation of true beauty that I had found in America, but so powerful and so grandiose! On my left the whole town is lit up. Night has suppressed the architecture; one sees no longer whether the houses are ugly or not. Only hundreds, thousands, one might say millions, of little squares of glass glitter from earth to sky. Scores of rows of lamps extend side by side until lost to sight. The very smallest houses, surpassed by the larger, themselves dominated by those higher still, give one the impression of a colossal perspective, like a giant climbing toward inaccessible heights. One has the vision of innumerable palaces en fête! Paris seen at night from the heights of Montmartre has nothing to compare with this! One would say that all the stars of the sky, more intense, had suddenly come to group themselves symmetrically 300 yards away. The colossal and the immeasurable arrive at beauty, a beauty which is titanic, crushing and splendid. And this profound impression of beauty which arises from the very number of these fires, from the mathematical order of their lines, imposes itself against every rule of æstheticism and art; it is force, incalculable energy, from which there is born a powerful and precious emotion. I remained stupefied with surprise and joy, and when I felt the cold which was piercing me I left with regret, sorry to abandon this new emotion which I was afraid of losing, as though it were a dream which awakening would chase away."

PLATINUM IN VERMONT.—According to a despatch from Burlington, Vt., a company has been formed there to work mines in Plymouth, whch are said to contain platinum in paying quantities.

LIGHTING THE STATUE OF LIBERTY.—A Washington despatch states that a bill is to be introduced in the House of Representatives providing an appropriation of $25,000 a year to light the Statue of Liberty in New York Harbor. The funds available for this purpose at present are only $3,500 a year.

RUSSIAN TELEGRAPHS.—The Russian telegraph strike continues to add its quota to the troubles in the Czar's dominions, and is the cause of immense inconvenience and loss, but appears to have been broken at some points. A special dispatch from Warsaw of December 25 says: "The strike of the post and telegraph employes here is at an end. The strikers have accepted the conditions of the Government. The telegraphers resumed work to-day. The railroad men to-day resolved to resume work unless their comrades in St. Petersburg should join the strike."

THE ENGINEERS' CLUB, of St. Louis, held its annual banquet at the Jefferson Hotel on the evening of December 20. The election of officers resulted as follows: President, W. A. Layman; vice-president, E. R. Fish; secretary, R. H. Fernal; treasurer, E. E. Wall. The speakers and their topics were: "The Engineer's Opinion of Himself," Robert Moore; "The Engineer in Print," William Marion Reedy; "The Engineer in Public Life," Andrew J. C. Reilly; "The Engineer in Trouble," Frederick W. Lehmann; "The Engineer and the Architect," William B. Ittner.

ELECTRIC MOTOR CONTROLLER.—Two patents granted December 19 to Mr. H. D. James have for their common object to provide a system of motor control that embodies separate protective means for the starting and the running positions, respectively. The circuit that is employed for carrying the starting currents to the motor is distinct from the path provided for the currents that normally operate the machine, so that the motor may be independently protected to suit the respective conditions. The controller is of the drum type. The drum is provided with an interlocking device which permits the progressive rotation of the drum in one direction and prevents rotation in the other direction. By means of this device the controller passes directly from the running position to the off position without passing through the starting positions.

STOPPING TRAINS.—According to *Railway & Locomotive Engineering,* Mr. J. A. Peabody, signal engineer of the Chicago & Northwestern Railway, has investigated the cost of stopping certain trains on the Chicago & Northwestern Railway and got others to make similar investigations on other western railroads. The cost of stopping a train of 530 tons, and returning it to a speed of 50 miles an hour, he found to be 42 cents. The cost of stopping a 2,000-ton train from 35 miles an hour he estimated to be one dollar. Another road estimated each stop of a six-car passenger train from 45 miles an hour to be 35 cents and for a 1,500-ton freight train from 15 miles per hour as 56 cents. The time lost for making a stop on a straight level track was estimated at 145 seconds. The aggregate of this extra cost for stopping trains is considerable and the possibility of saving this expense is worthy of more consideration than it has ever received. Many expensive investigations are made of things that have no money saving possibilities.

OIL LAMPS IN MAIL CARS.—The oil lamp seems to be a perpetual source of danger and trouble in these days, and it is certainly surprising that it finds a place for responsible service in situations where electricity is obviously superior to all other illuminating agents. The latest catastrophe is chronicled in press dispatches describing the explosion of an oil lamp in a United States mail car at Erie, Pa., where the car was set afire, the mail clerk slightly burned and a large amount of valuable mail matter destroyed. To anyone familiar with fire hazards it would seem that the interior of a swaying car is one of the last places in the world desirable for the use of an explosive illuminant, provided something better can be had. Aside from the fire risk, the flexibility of the electric light renders it unusually advantageous in mail car service, and the better distribution of light invariably results in greater speed and ease in deciphering addresses upon letters—a consideration of no small importance in the trying work of the railway postal clerk. It is to be hoped that such accidents as that at Erie will only serve to hasten the extension of electric train lighting into a field where it is so evidently sorely needed.

ELECTRIC TRACTION ON CANADIAN PACIFIC.—A move of considerable importance in connection with the motive department of the Canadian Pacific Railway is the decision of the management to take up actively the idea of using electricity as a motive power. For some time the officials of the electrical department have been working on the matter, and have investigated the experiences of other railways in that connection. It is understood that electricity will first be installed on some of the branch lines in the Province of Quebec, and a motor car for this purpose is now being constructed in the company's shops. If the trial trips with it are satisfactory, it is expected that electricity will be used for nearly all the company's suburban and branch lines. In a recent interview, Sir Thomas Shaughnessy, president of the Canadian Pacific Railway, stated that the company intends adopting electricity for some of its shorter branch lines, and, casting his eye into the future, he foresaw the day when electricity would take the trains from coast to coast. He pointed at the same time to the extraordinary advantages that Canada possesses in her unrivaled waterfalls, which could be used for the development of electric power all the way from the Atlantic Ocean to the Pacific.

LAYING FOUNDATION STONE.—The foundation stone of the new building of the Engineers' Club, on West Fortieth Street, New York City, opposite Bryant Park and the new Public Library, was laid on December 23, at 2.30, by Mrs. Andrew Carnegie, whose husband declared the task well and truly done. The ceremony was quite informal, but the club was well represented by its officers and committees, including President W. H. Fletcher and Past President John C. Kafer. The architects, Messrs. Whitfield & King, were also present. Fortunately the weather cleared during the afternoon, and thus the party were enabled to inspect the building, now up to the ninth story in the steel work and to the third in marble and brick casing. The records deposited in the stone included a Bible of 1905, a club book of 1905, copies of the *Herald, Tribune, Sun* and *Times* of December 23; a copy of the certificate of incorporation; a booklet of the old clubhouse at 374 Fifth Avenue; a half dollar, quarter dollar, dime, nickel and one cent; a card of W. L. Crow, the builder; a copy of Mr. Carnegie's letter of gift to the Engineering Societies and the Engineers' Club; a chronological history of the club; a list of members elected since the publication of the club book this year; a list of the incorporators of the club; the programme of competition for the selection of architects for the two buildings; and floor plans of the new house.

CROWDED TROLLEY CARS.—Advices from Cleveland, Ohio, state that the new health code, which will probably become a law by the first of the year, will contain regulations governing the sanitary condition of street cars, including the question of the number of passengers that shall be carried on each. A resolution presented to the health board for adoption into the code recites that an unsanitary condition is created by the overcrowding of cars, creating a dangerous menace to health through the lack of ventilation by such overcrowding, and suggests six rules governing the subject. These rules are: "No street car operated within the city limits shall at any time have on board, as passengers inside the car, more persons than can be seated upon all the seats of said car and half as many again standing in the aisle or aisles thereof. The foregoing regulation shall not apply to persons standing upon the rear platform of such car. The company or companies owning or operating street cars in the city of Cleveland shall put in a conspicuous place in each car the number of persons permitted therein, in conformity with this regulation, and take such measures as shall be necessary to enforce the regulation hereby established, and each car containing more than the number of persons herein allowed shall constitute a violation of this regulation. The conductor of each street car shall enforce the regulation hereby made and the failure on the part of any such conductor to so enforce this regulation shall constitute a violation by him and he shall be, on conviction, subject to the penalties provided by the revised statutes."

SUBMARINE TRANSMISSION AT FT. SMITH, ARK.—The Ft. Smith (Arkansas) Light & Traction Co., which is controlled by H. M. Byllesby & Co., of Chicago, has purchased the electric lighting plant at Van Buren across the river from Ft. Smith. The present lighting station in Van Buren will be abandoned and the load will be carried by a 6,600-volt transmission line from the railway and light station in Ft. Smith. This will necessitate a 6,600-volt, two-phase submarine cable 2,500 ft. long under the river.

CONSTANT CURRENT SYNCHRONOUS CONVERTER.—In order to provide a system by means of which the load upon a synchronous converter which delivers power to a storage battery and supply mains may be maintained approximately constant within a large working range regardless of the variations in the load upon the direct-current circuits, Messrs. B. G. Lamme, C. F. Scott and F. Conrad, according to a patent issued December 19, would place a constant-current regulator in the alternating-current supply leads, and would use a booster in the direct-current delivery circuits.

PUBLIC GOOD WILL.—These pages contained recently two articles relative to the campaign of education carried on by the gas company in Chicago and commending the work to the attention of electric light companies. The Iowa Electrical Association has reprinted these in circular form and sent them to all the local lighting companies in the State. Mr. G. S. Carson, the secretary of the association, in forwarding us copies, says: "The question of State legislation, controlling all public service corporations, is sure to come, and it is the writer's opinion that the companies had best welcome it with good grace and live up to the laws. It will place the control of the business in the hands of competent commissioners, instead of the aldermen of each town attempting to judge of a business of which they know practically nothing, or else attempting to use the corporation as a means to further their own political aspirations."

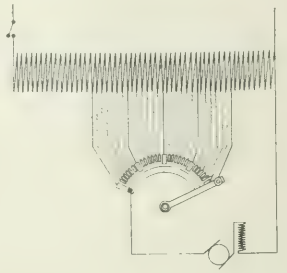
CHRISTMAS GREETINGS.—Admiral Dewey's greeting to the officers and men of the navy, bespeaking a united stand for the good of the country and the service, was communicated on Christmas Day to the officers and men aboard the vessels throughout the world wherever they could be reached by telegraph. To the men along the Atlantic Coast there was also sent a Christmas greeting by means of wireless telegraphy, which served as an elaborate and practical test of this auxiliary of the naval service. The wireless messages went by direction of Admiral Manney, Chief of the Bureau of Equipment. They were dispatched from the wireless station at the Washington Navy Yard, and were relayed from place to place. Early responses came from the officers nearest Washington, and before midnight of Christmas Day many of the stations had replied, including New Orleans, Colon and San Juan, the Colon reply coming by way of Guantanamo. The test was satisfactory to Admiral Manney.

GERMAN PATENTS.—The Boston *Pilot*, commenting on a recent matter in these pages, says: "The latest number of The Electrical World and Engineer contains a sensible article on the status of American inventions in Germany. Dr. Alfred Muller, a solicitor for foreign patents in New York City, has taken pains to examine into this subject with a view to finding out whether the frequent complaints of American inventors, with regard to the difficulty of obtaining patents in Germany, were well founded. The conclusion reached is that American inventors are largely responsible for their own difficulties. They imagine that procedure in Germany with regard to obtaining patents should be identical with that in the United States. This, of course, is an entirely erroneous view. Germany has her own methods, which she must insist upon. Reference is made to the report of Consul-General Frank F. Mason, in Vol. LXVII of Consular Reports. With all respect to the weighty authority of these gentlemen, we cannot help feeling that the German Government does not fail to take advantage of her procedure to the detriment of foreign, especially American, inventors. But we are not entirely sure that we have very just ground of complaint, when we consider the fact that American competition is a very dangerous matter in the German business world."

A BOON TO SHIPPING.—It is stated from Washington, D. C., that demonstration of the practical worth of wireless telegraphy has been the object sought by Rear Admiral Manney, of the Bureau of Equipment, ever since the time the charge of the wireless work of the government was concentrated in his office. Principally this work has been along the line of making the system which now extends on the Atlantic coast from northernmost Maine to Key West and then jump across to Guantanamo, to Culebra and Colon on the isthmus, a practical means of communication just as accurate and reliable as would be a system of land wires and ocean cables. A secondary matter, and a very important one in the view of the bureau, is the work done by wireless telegraph in the way of saving life and property at sea. In order to definitely ascertain the present value of the wireless stations of the navy in this matter, Rear Admiral Manney recently sent a request to the wireless station at Newport, R. I., Commander Albert Gleaves in charge, asking for a report. In reply nine recent instances of information were reported, and commenting upon this record, Commander Gleaves writes: "This shows what a tremendous factor wireless telegraphy is destined to become in ameliorating and, in many cases, altogether averting disasters on the high seas."

CENTRAL STATION DATA.—The *Live Wire*, issued by the Wesco Company, of St. Louis, has the following excellent suggestion: "Our attention has been called to what we consider an excellent plan adopted by some central stations. On their letter heads these lighting companies have printed data concerning their plants that will be very useful to supply houses in filling orders. The most useful information is in answer to these questions: Is the system direct or alternating current? What voltage (give both primary and secondary if alternating)? Phase and cycles? Is there a day circuit? What incandescent lamp base is used? As most letters written by central stations are concerning purchases it will be seen readily how this information would aid the supply house in filling an order. Facts which the station man might fail to state in his letter, because so familiar to him, would be told by his printed letter head, and in very many cases would save the purchaser the time and annoyance of making an explanation by mail or telegraph. If all central stations would adopt this plan, it seems to us it would be of mutual advantage to the purchaser and his supply house." This information is given in our "Central Station List" for some 4,000 plants, revised every six months, but it would certainly be a great convenience if it were carried on the "letter-heads" or on enclosure slips. This is even more desirable as to foreign central stations.

POTENTIAL CONTROL FOR ALTERNATING-CURRENT MOTORS.—One of the greatest difficulties encountered in the use of variable voltage in controlling the speed of alternating-current motors resides in the fact that either the individual coils of the transformer will be short-circuited or the motor circuits will be opened when passing from one voltage to another. A scheme disclosed by Mr. Giorgio Finzi, of Milan, Italy, in a patent issued December 19, is shown in the accompanying illustration. Between the five main contact pieces connected directly to the auto-transformer, there are inserted six other auxiliary keys also connected with the intermediate points of the winding through suitable resistances in such a manner that the brush will invariably remain in contact with two keys. Mechanical devices are provided so that the brush is not able to remain on one of the auxiliary keys, but is carried rapidly to the main keys. It is possible, therefore, to proceed from one working voltage to the next without interrupting the main circuit or providing short-circuit currents, and without entailing any considerable heat loss in the resistances.



CABLEMEN STARVE.—The difficulties of maintaining remote cable stations in mid-ocean are illustrated in the following special dispatch from Victoria, B. C., of December 24: "The steamer *Miowera*, which arrived yesterday from Australia, reports that when she arrived at Fanning Island the cable staff were without provisions and were living on cocoanuts."

TELEPHONE NEWS SERVICE.—Mr. James F. Land, general manager of the Michigan State Telephone Company, plans to establish a system in Detroit, with an independent circuit, over which will be supplied at the touch of a key sermons, baseball returns, theatrical programmes, concerts, weather reports, stock quotations and news bulletins. Already Mr. Land is conducting a service with a few acquaintances as subscribers, to experiment with the scheme before organizing a company to lay wires and establish a complete system with the best copper wire circuit, transmitters and receivers.

CONDUITS AT SYRACUSE.—The Central New York Telephone Company has proposed that the city of Syracuse pass an ordinance requiring the Central and a new competitor to put their wires in conduits in a large part of the city. It would cost the old company about $200,000 for its share of the work. This plan appears to meet with popular approval. The franchise of the new company provides that it shall place its wires in subways, but the common council, urged by the mayor, has rescinded an ordinance requiring the new company to live up to the terms of the franchise, and has passed an ordinance in favor of poles to be located by the commissioner of public works.

BIRMINGHAM (ALA.) TELEPHONY.—The growth of telephony has been such at the southern iron center, Birmingham, Ala., that the Southern Bell Telephone Company finds it necessary to put down at once 36 miles of cable, 200 and 100 pair, to connect up its main and suburban exchanges. It is said that the telephone system in Birmingham covers a greater territory than that of any city in the country of four times the size. Atlanta's system is not nearly as large, although Atlanta is much larger in population. Richmond is supposed to be twice the size of Birmingham in population, but its system covers about one-fourth the territory covered by the local exchange. There are over 6,000 telephones connected with the Birmingham exchange through the main exchange and the suburban exchanges.

GOVERNMENT SERVICE.—The following is from *Harper's Weekly*, but really contains nothing new to those who have used the service: "The telephone system of Paris leaves considerable to be desired, and meets with constant complaint on the part of the subscribers. One of the latter endeavored to test the speed of the various means of communication of the city, sending messages in different ways from his rooms in the Rue Richelieu, in the center of the city, to a friend on the Avenue de la Grande Armee near the Bois de Boulogne. He found that a bicycle messenger made the trip in 11 minutes and 15 seconds, as compared with 23 minutes for a cab. A message sent via the metropolitan railway required 31 minutes, by omnibus 34 minutes, a telegram 35 minutes, a message by the pneumatic tube 3 hours, while the message sent by telephone did not arrive at all."

WIRELESS NEWS SERVICE.—A special cable dispatch from London of December 23 says: "The use of wireless telegraphy in the transmission of news has recently been the subject of consideration by some of the newspaper owners in England, and at least one syndicate is contemplating the adoption of the system. Mr. Cuthbert Hall, managing director of the Marconi Telegraph Company, said to a *Daily Express* representative: "We have been approached by a number of newspapers in the north of England with the suggestion of forming an agency for the transmission of news to them by wireless telegraphy from London. We could erect a high power station here, from which we could send messages to any part of the country, and they would be received simultaneously in different towns. We can work to any distance over land. We sent messages from England over Europe to the *Renown* when she was taking the Prince of Wales to India and was within 100 miles of Port Said.'"

PROVINCIAL BOSTON.—Mr. Frederick P. Fish, president of the American Telephone & Telegraph Company, after the stockholders had ratified, at a special meeting, an issue of $150,000,000 of convertible bonds, took occasion to say: "Our company's condition is satisfactory," said Mr. Fish, "and better than it has ever been before, but one thing which I do not like is that it is a matter of common gossip that we are a Boston concern. Boston and New England, much as I dislike to say it, are in a way provincial and not able to handle with entire satisfaction big enterprises which require large sums of money and which need a broad market for the securities." Mr. Fish's remarks attracted much attention and provoked discussion among the New England stockholders who had come to New York to attend the meeting. It was pointed out that in the early days of railroad building Boston and New England capital had built many of the great roads of the West, which are now controlled in New York. The truth from the financial standpoint seems to be generally admitted, although Boston is to-day one of the wealthiest cities in the world.

PROVIDENCE LIGHTING PLANT.—The report of the committee on lights of the Providence City Council recommends a contract with the Narragansett Electric Lighting Company. The report makes an elaborate analysis of municipal figures in New England and elsewhere, and insists very strongly that the data show it to be advisable to stay out of the municipal plant business. The contract accompanying the report provides for the carrying out of the agreement with the electric lighting company for street lights at a reduction of $4.75 per light per year, beginning January 1, 1906; the maintenance of the 1,908 arc and 2,185 incandescent lights now furnished, in addition to such others as may be ordered, from the date of the contract to June 15, 1912, at 2,000 cp and 32 cp, respectively; the erection and maintenance of poles, wires, conduits and appliances for the same; the burning of all lights all night and every night, except as otherwise provided, and the making of a rebate for failure therein; the maintenance of conduits by the company in any street wherein it has or may have the right to erect poles and wires, upon filing a plan with the commissioner of public works, and the erection of poles and wires in any street where there are no conduits. The price of lights is fixed as follows: Arc, to burn all night and every night, 28.7 cents per night from January 1, 1906, to June 15, 1909, and 27.4 cents for the succeeding three years, ending June 15, 1912. Arc lights extinguished at midnight, 55 per cent of above prices. Incandescent lights to burn all night and every night, $24 per year, as at present, to June 15, 1912. Incandescent lights extinguished at midnight, 55 per cent of this price. The company agrees during the term of the contract to allow the city 75 per cent discount from current rates on all incandescent lights furnished the city for any other purpose than under the provisions of the contract.

ACTIVITY IN HARTFORD.—The following "local item" from Hartford, Conn., is rather amusing: "The rivalry between the Hartford Electric Light Company and the Hartford City Gas Light Company for business sometimes leads to amusing situations. Since the agitation began for an ordinance permitting electrical signs of various sizes and dimensions extending from the fronts of business buildings, the gas company has got busy and is now installing a large number of Welsbach arc lamps in front of store windows, more or less over the street line in many places, the service being rendered for the price of the gas consumed. They brighten the street and make the sidewalks as well as the fronts of the stores quite brilliant. This week several employes of the gas company made preparations to light the front of the stores in the Linden Building by that method under agreement with occupants of the stores. Pipe was cut and fitted and bent to fit the conformation of the building, and it was the intention of the gas company to have the lights in operation to-day or to-morrow. Somebody, however, forgot that the building was owned by the secretary of the Hartford Electric Light Company and just when things were apparently reaching consummation, Custis C. Cook interposed with a veto. Being the owner of the building, he had the right to say what should be attached to it and he did. The result is that the operations of the gas company on that building have been discontinued and the Hartford Electric Light Company is about to install outside electric lights. They will be of the Nernst pattern and the service is guaranteed to the occupants of the stores to be as cheap as gas would have been In addition, not to indicate that he owns the building or to show that he lives there, Mr. Cook has arranged to light up the tower of the building, so that the Linden will be a blaze of light at night hereafter."

A 10,000-Volt Transmission System Without Transformers.

In a paper presented by Mr. W. H. Patchell before the British Institution of Electrical Engineers on December 7, 1905, much interesting information was given concerning the equipment of the Bow generating station of the Charing Cross Company of London. The generators of this station are designed to deliver 10,000 volts directly without transformers. The power from the generators is transmitted by way of underground cables to the various substations, main transformers have been eliminated, the 10,000-volt current being fed directly to motors which are direct connected to direct-current generators.

The power house contains a boiler room 75 ft. wide, with two rows of boilers facing each other; and an engine room parallel to the boiler room, also 75 ft. wide, with 36.5 ft. clear under the traveling crane. The boilers are of two types, horizontal and vertical, each equipped with its own superheater.

A novelty was introduced in the case of the larger horizontal boilers, where a grate was arranged in the ordinary way at the front and another at right angles to it, which could be fired from the side. These second grates have proved to be of enormous benefit when sudden fog or a thunderstorm has called for an extra supply of steam at very short notice. The ashpits for the two grates are quite separate, and are provided with the usual doors. At times of light load the boilers are fired from the front only, and the doors in connection with the side grates are all closed. A little dust falls on the bars at the back which are not otherwise protected, but do not suffer from the high temperature to which they are exposed. As soon as the demand arises coal is thrown on to the side grates, the ashpit doors opened, and the extra fires are got under way with surprising rapidity. The large heating surface in proportion to the grate worked at light loads is an advantage, and the large size of boiler adopted gives much less radiating surface per square foot of heating surface than in the small sizes usually adopted.

The boilers of the upright type are arranged in pairs, each operated as a single steam unit. The author stated his belief that they form the largest steam-producing unit in existence. A single pair of upright boilers has been steamed at the rate of 100,000 pounds per hour, so that it can easily supply steam to a 4,000-kw generating set.

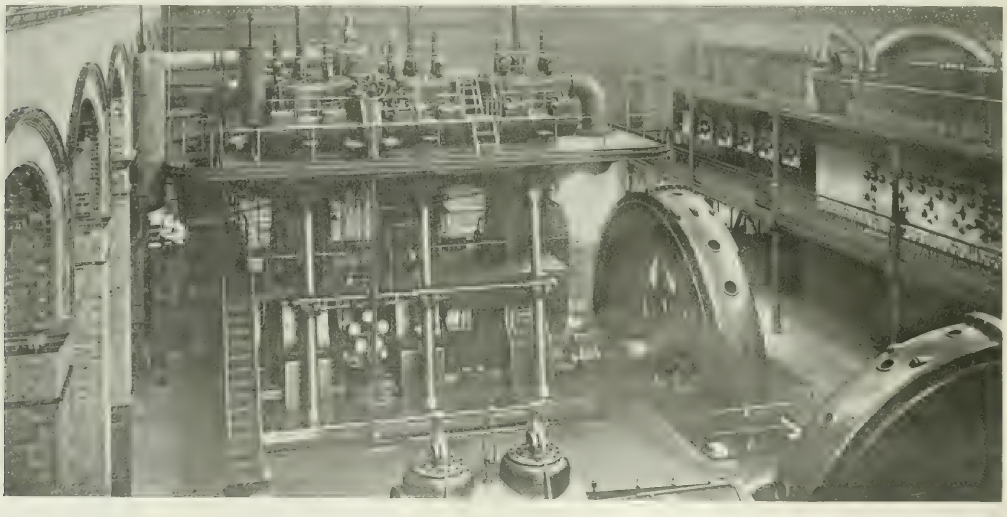


Fig. 1.—View of Interior of Bow Station, Showing Vertical Sets.

The type of setting to be adopted was very carefully considered. Owing to the difficulties likely to be experienced, due to the expansion of such large walls in brickwork, it was felt that even if they could be kept upright they would not be air-tight; a modification of the wrought-iron casing used for marine boilers was therefore adopted. The brickwork between the grates, which is honeycombed and carried up about 6 ft., becomes incandescent during working, and its effect, combined with the ample combustion chamber, ensures a much more perfect combustion than is obtained in the horizontal type of boiler. Coal which might give heavy smoke when burned under the horizontal boilers can, with no more care taken in the hand-firing, be burned without smoke in the "upright" boilers.

The water supply is derived from two 13-in. Artesian wells on the premises, 400 ft. deep, each of which yields 15,000 to 20,000 gallons per hour as required. The method of pumping adopted is the air-lift system, and the water raised is discharged into a large reservoir in the basement below the pump-room. From this reservoir the water is pumped by slow-speed compound steam Woodeson pumps to a tank at the top of the building, from which it runs back by gravity through the water-heaters at the various engines to a tank over the pumps into which their exhaust steam is discharged and to which all the feed-pump suction-pipes are connected. There are also alternative suction pipes direct into the reservoir in the basement.

Fig. 2.—Interior View of Bow Station.

The electric generating equipment consists of two 800-kw sets, four 1,600-kw sets and two 4,000-kw sets. The engines driving the 800-kw generators are three-cylinder, triple-expansion, high-speed, enclosed engines of Messrs. Belliss & Morcom's type. They exhaust into jet condensers in the basement, the air and circulating pumps for which are driven by electric motors.

The engines driving the 1,600-kw generators are horizontal cross-compound engines by Messrs. Sulzer Bros., of Winterthur. In details they differ materially from the usual type of slow-speed engine, inasmuch as the connecting rods and cranks are enclosed, and the oil supply is continuous and under pressure.

The valves are of Messrs. Sulzer's latest four-seated pattern.

The pistons are provided with tail-rods, and are supported outside the cylinders by special bearings. The cranks are set at 108 degrees instead of the more usual 90 degrees, with the low-pressure crank leading. The exhaust steam from the low-pressure cylinder is divided in an oil separator and taken to two jet condensers, one on each side of the engine. These condensers stand on their air-pumps, which are driven from the high and low-pressure crank pins respectively.

The engines driving the 4,000-kw generators are vertical three-cylinder compound, with the high-pressure cylinder in the center and a low-pressure on each side of it driving on to cranks which are equally divided. By this arrangement excessive weight or dimensions of any of the parts is avoided, and an even turning moment is obtained.

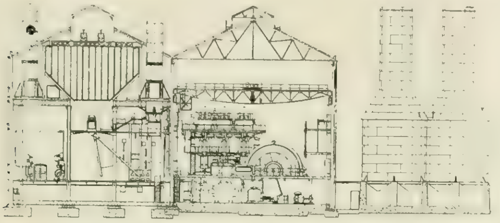


FIG. 3.—CROSS-SECTION OF BOW GENERATING STATION.

The principal interest in connection with the three-phase, 10,000-volt generators naturally resides in the insulation employed. The armature winding is in mica tubes embedded in slots which are nearly closed. Crossings of the wire are as far as possible avoided, and where the coils leave the iron core they are carefully wound over templates and covered over with insulating tape to prevent breakdown between adjacent coils or between coils and the frames. The coils are further protected from accidental contact by a strong perforated cover, which also enhances the appearance of the machine. If some of the theories which have been advanced in connection with the discovery of nitric acid in high-tension machines are correct, evidences of such acid might reasonably be expected in these machines, and it is interesting to note that even careful dissection and examination has revealed no signs of it.

The switchboard is at one side of the generator room. It is arranged in two distinct halves, which, however, may be connected by an emergency switch. The generating plant is numbered consecutively, each of the odd numbers being connected to one half of the switchboard, and the even numbers to the other half. The switchboard is practically a three-decker. The rheostats for the field circuits of the machines stand on the main engine-room floor underneath the principal switchboard gallery. The panels carrying the controlling gear are upon the principal gallery. The high-tension switches are placed on the upper gallery, and are worked positively from the principal gallery by levers.

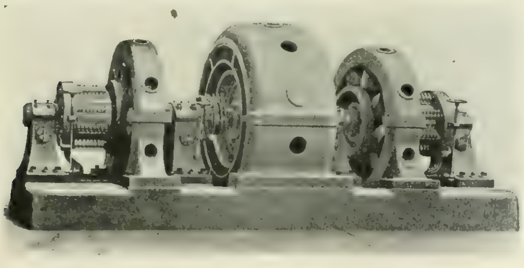


FIG. 4.—LAHMEYER'S INDUCTION MOTOR-GENERATOR.

Ten trunk feeder mains at present leave the generating station; they are three-core, paper insulated, lead-sheathed cables. The cables are laid on the solid system in steel troughs, which are heavily bonded to comply with the Board of Trade requirements.

There are four sub-stations in the City, each provided with motor-generators, and a storage battery. A striking feature of the sub-stations resides in the fact that no stationary transformers or rotary converters are used. The author stated in this connection that the small size of a rotary converter as compared with a motor generator is very striking and seems much in its favor, but it must be remembered that the necessary transformers are, like the condensers for turbo-generators, generally out of sight in a large basement, and the mind, if not the eye, must grasp them both together. After investigating the various types of rotaries and considering the respective merits of synchronous and induction motors for the particular case, the choice fell upon synchronous motors for the majority of the machines with one or two induction motor sets in each sub-station. In all cases the motors are wound for the full pressure of 10,000 volts, with a uniform size of motor of 500 hp and a speed of 300 r.p.m.

Induction motors are preferred in some quarters because they can be started up more quickly, and it is believed that in the event of an accident they will maintain their load better than synchronous machines, which, however, are preferred by some engineers because of their better power factor. The regulation of the direct-current side can be managed equally well with either type of machine under normal conditions. Each motor-generator has its own standard panel complete. Main switches, ammeters, voltmeters, also field switches and ammeters, are provided for both the motors and generators. A synchronizing gear of voltmeter and lamps combined is provided for the synchronous motors, and the motor field switches are omitted on the panels for induction machines. The synchronous motors are all started up from the generator side, and the starting switch is used as the main switch for one pole of the generator, while the induction motors can be started alternatively from the generator side or from the motor side, and are fitted accordingly.

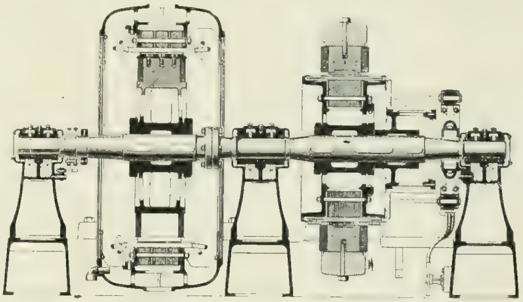


FIG. 5.—LAHMEYER SYNCHRONOUS MOTOR-GENERATOR.

Extreme solidity of construction was called for and heavy insulation to ensure freedom from interruptions either mechanical or electrical. The results have so far quite realized the highest expectations. The motors in some cases drive 350-kw generators wound for the full pressure, 400 to 440 volts, across the "outer" wires, and in some cases they drive two generators each of 175-kw capacity, which are wound for 200 to 220 volts, and are used as balancers on the three-wire system.

Practically no movement of the brushes is required from no load to full load of 1,200 amp. The latest construction is even better, as in it the generator machines are provided with compensation poles, and can be run from full load in one direction to no load, and up to full load in the other direction, without moving the brushes or showing any signs of sparking.

For regulating the pressure delivered by the batteries when the generators are disconnected and for governing the flow of current into them when the generators are in operation, reversible boosters are used. The pressure from the "outers" of the network is used for running the booster motors. The regulation is done manually and no automatic devices are installed. The most prominent feature of the supply network is the use of 2 × 220 volts in the three-wire lighting circuits instead of 2 × 110 volts as formerly employed and as corresponds to the practice in America.

On account of the fact that the 10,000-volt cables possess considerable electrostatic capacity it was found that under working conditions in the event of a circuit being opened through, for instance, the action of a fuse, a surge was likely to occur, and that it would be safer to provide spark-gaps. A spark-gap in itself, although a safety-valve for a surge, may start a rush of current which will cause further surges. The use of spark-gaps as a remedy may easily be worse than the disease, it is therefore very important to carefully consider the amount and form of resistance to be used in series with them. The common form of horn type spark-gap was experimented with, and abandoned in favor of a spark-gap of the type which has carbon on the one side and copper on the other. The traveling of the spark up the parallel portion of the horns is increased by the chimney action of a glass enclosure, and the result of many tests has been to show that they may be calibrated and set with much greater accuracy than the ordinary bent-wire horn type. As regards resistances, a non-inductive type must of course be used, and after many experiments an extended trial was given in the form of liquid resistance which consists of earthenware vessels filled with a solution of glycerine and water. What at first appeared to be unaccountable changes took place in some of the resistances; investigation showed that they were due to the action of sodium or other salt in the air. Alternative solutions have also been tried with sodium in [illegible] which were found to be more constant. Further experiments have been made and are still being made in the direction of dry resistances, as no matter how good it may be, a liquid resistance always has the disadvantage that it is liquid and may leak.

The width of spark gap employed is 4.5 mm. for 10,000 volts working pressure, i. e., 5,800 volts between each phase and earth with the center of the star earthed. A spark will jump the gap at 12,000 volts when the horns are clean and the atmosphere normal.

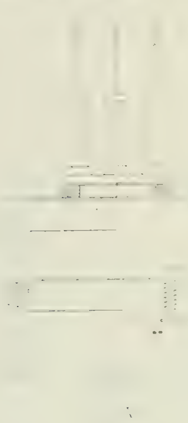


FIG. 6.—DIAGRAM OF SPARK-GAP DISCHARGE DETECTOR.

Occasional and irregular working of the spark-gaps soon attracted attention. For the purpose of determining the causes a detector was installed with the gap, as shown in Fig. 6. The apparatus consists of a small transformer with its primary inserted in the earth wire of the spark-gap resistance, without adding appreciable self-induction to the circuit, and a relay which is actuated by the secondary and rings a bell. When a discharge occurs, the relay shutter falls, causes the bell to ring, and so calls the attention of the switchboard attendant, who notes on a report form the exact time, and whether any change in switching or alteration in the conditions of running was made. These reports are then collected and examined with the running logs of the other stations, when frequently the effect in one place can be directly traced to the cause in the same or other place. But again there are many occasions when no cause can be assigned.

Irregularities when starting up machines, although not sufficient to affect easy synchronising or switching in, are prolific causes of spark discharges. Experiments showed that it was dangerous to connect a cable directly to the high-potential circuits, and that the safer procedure was to switch it in at a low voltage and then raise the pressure.

A so-called "charging gear" is provided in the shape of a small motor-generator and two transformers with suitable connections, so that it may either be used to run up the pressure of the cables to working value or to test them at 15,000 volts. A three-phase generator is driven by a direct-current motor, and produces current at a normal 2,000 volts pressure. This pressure is then stepped up by a bank of two three-phase oil-transformers, and is varied by varying the field of the 2,000-volt generator. Special bus-bars and switches are provided in connection with the charging gear, so that a cable may be put in parallel with other working cables, or a working cable may be taken off the main bars and discharged for testing or other purposes.

◆

Municipal Ownership vs. Private Ownership.

By R. S. Hale.

The usual discussions of whether one cent street fares with an average cost of two cents per mile, as in Glasgow, or five-cent fares with an average charge of one cent per mile, as in Boston, are better, are of theoretical interest. The final test, however, of municipal and private ownership, as of all problems of government, is the happiness of the people and the best test of the happiness of the people in a particular locality is whether the people prefer to go to that locality to live, i. e., whether the population is increasing, or, on the other hand, whether the people that live there go somewhere else, so that the population decreases.

We have all heard of the fox who lost his tail, and the glowing accounts of the advantages of municipal ownership in Australia and New Zealand as compared with the rapacity of private corporations in the United States are rather dimmed when we note that Australasia is, if anything, losing in population while millions of immigrants come every year to the United States.

In England a statistical investigation was made a short time ago in which the increase of population of the large cities between 1896 and 1901 was compared with the amount of municipal trading done by these towns. The result may be most easily stated by dividing these various cities into four classes:

First, we have the class of cities that did very little trading, as shown by the amount of their debt that was incurred for trading purposes. Taking first the towns that had a trading debt between nothing and 50 per cent of their ratable value, we find eleven such towns where the average increase in population was 19 per cent.

Next, taking the towns that did a little more municipal trading, but not so very much more, we find six towns where the investment in municipal trading was between 50 and 100 per cent of their annual value and the increase in population of these towns was 14 per cent.

Taking next the towns that did rather more trading, whose investment was between 100 and 200 per cent, we find 19 such towns whose average increase in population was 15 per cent.

Taking next the towns that did a great deal of trading, whose investment in trading ventures was over 200 per cent of their annual value, we find 22 such towns and these towns had an average gain in population of only 10 per cent.

The smallest gain in population of any of the 11 towns that did very little trading was greater than the average gain of all the 22 towns that did a great deal of trading. Only two out of the 22 towns that did a great deal of trading gained as much in population as the average of the towns that did but very little trading.

Undoubtedly the advocates of municipal ownership will say that English experience is not trustworthy, and will point with pride to the progress made in the United States in the towns that have gone in for municipal ownership. For instance, Richmond, Alexandria, Wheeling, Bellefontaine, Charlotteville, Hamilton, Duluth, Wakefield and Holyoke are, by means of their municipal gas plants, giving such good service to their citizens, that the people who live in New York, Boston, Chicago, etc., etc. are fleeing from the rapacity of the private gas companies in the metropolis to live in these cities.

The check in the growth of Philadelphia and the way in which it is losing in position as a leader of American cities since it gave up the control of its gas works to a private corporation is very marked. When the Philadelphia gas plant was run from City Hall, Philadelphia never needed reform. But now, under private ownership, they have had to elect a reform administration.

There cannot be the slightest doubt that it is the private ownership of their gas, electric light, street railway and other public utilities that has destroyed the chance of New York, Brooklyn, Chicago, San Francisco, St. Louis, Baltimore and Boston's becoming in the future the leading cities of the United States, any more than there is any doubt that the municipal ownership of their gas and electric plants will make Taunton, Holyoke, Dunkirk, Jacksonville, South Norwalk, Allegheny, [illegible], Austin, Logansport, Peru and the other 815 towns, villages and cities that do trade in electricity and gas the centers of population in the future.

Long Distance Power Transmission by Direct Current.

By FRANK J. SPRAGUE.

THE views reported as having been expressed at the meeting of the British Association at Johannesberg by an eminent English scientist, the installation and successful operation of two high-potential constant direct-current power transmission systems in France and Switzerland, the 60-kilovolt proposal for Lyons, and the announcement of a project to transmit power from Zambesi to the Rand, a distance of 700 miles, also by direct current, are announcements which naturally arrest attention, because counter to conclusions reached by the majority of electrical engineers, including myself, and generally of late considered as beyond debate.

I will not at the moment express any special opinion as to the commercial character or technical possibilities of the Zambesi project —which seem at first glance most doubtful—nor to discuss the pros and cons of an alternating-current and direct-current transmission at high potentials, the former because of its simplicity and great flexibility having peculiar and great advantages hard to offset; but it may prove of theoretical interest to call attention to some plans I proposed some years ago, certainly at that time novel, before the alternating-current system had come into vogue, and to discuss the potential requirements of long-distance transmissions on a special plan of direct-current operation.

In a paper read before the Franklin Institute of Philadelphia in 1889, the substance of which was repeated at the Cornell University two years later, I advocated an automatic system of direct-current power transmission, using single machines at moderate potentials, and batteries of machines in series with each other at each end when the demands of the transmission required an increase of potential beyond the limits of practical construction for a single machine. I will quote at length from that paper as follows:

"The transmission to one point from another, with a single generator and a single motor with variable loads, presents two solutions. The first is the use of the compound dynamo and differential motor; but a far more interesting solution is the use of two series machines which, when properly proportioned, become perfectly self-regulating. I will briefly touch upon the theory of this method of transmission. We have the condition that the same current passes through each field and armature, and also the condition that the speed is constant, while the work is variable. Since work may be expressed as a product of speed and torque, and since the speed is constant, it follows that the motor torque must vary directly as the work. Again, we have as an expression for the work done the product $e\,C$. Since the speed of the motor is constant, e must vary directly as the strength of the field, which, where the magnetization is low, will vary directly as the current, and when more highly magnetized in a much less degree. E being the e.m.f. of the generator and K the resistance of the circuit, we have:

$$C = \frac{E - e}{K}.$$

and, as already stated,

E varies as e, as $E - e$, and as C,

and the work

varies as $e\,C$, as C^2, as e^2, and as E^2.

The dynamo likewise being driven at a constant speed, E likewise varies as the strength of its field. If m equals the number of turns of wire in the dynamo field, and n those in the motor field, then the ampere turns or magnetizing forces are expressed by $m\,C$ and $n\,C$. It follows from what proceeds that the magnetizations due to $m\,C$ and $n\,C$ should vary in the same proportion; in other words, the characteristics of the generator and the motor must be similar between the limits of the variation in load. The electrical efficiency of the circuit being

$$\frac{e}{E}.$$

we have the following fact: that the electrical efficiency is a constant for all loads within the limit of automatic regulation. If the machines are of the same general type, then when correctly proportioned the ratio of their weights and watt capacities should be the same as the electrical efficiencies of the circuit."

"As a modification of the proceeding, especially where large powers, long distances and necessarily high potentials are used, it is advisable to divide the generators and motors into a battery of machines of identically the same weight and character, the number of the machines being the ratio of the electrical efficiencies, the generators all to be driven from the same line of shafting, and the motors to drive on to a common line, and the current to pass through all the machines in series."

To take care of the high potentials on the pole line I indicated what seemed to me an advisable practice as follows:

"We can only accomplish this [practically perfect insulation] by the most careful line erection and choice of insulators. It can be materially aided by running the positive and negative leads each on an independent line of poles, and perfectly clear of all trees."

"When a double line of poles is used it is advisable to wrap the lower ends with bare wire for a distance of about six feet above the ground, and to connect these bases together; or, if the poles are close together, a galvanized-iron or copper wire should be taken around each pole at the distance given and joined together. This is to avoid the possibility of a serious shock in wet weather, which might be received by a person leaning against a wet pole if any accident should occur to the line insulators when very high potentials are used."

In such a system the drop on the line, the e.m.f's of the generator and motor, and the current vary alike as the square root of the work done, and inasmuch as on a large system the variation of work is progressive, the automatic changes in current necessary to get constant speed regulation would not introduce any special electrical troubles on the line.

Assuming that such power transmissions would very likely be from a water source, and bearing in mind the necessity, from a commercial standpoint, of keeping first cost at a minimum under any given condition of unit cost of materials and efficiencies, I developed a number of equations which established certain curious facts bearing upon a minimum first cost of installation. These seem particularly pertinent in considering some of the potential possibilities of an equipment similar in distance to that under consideration. To illustrate them I will abstract from my papers as follows:

Let l = distance in feet between the generating and receiving station, plus the sag.
E = e.m.f. at motor terminals.
v = volts fall on line, $E + v$ being the e.m.f. at the terminals of the generator.
e = e.m.f. of motor and E' that of the generator.
α and β = the commercial efficiencies of the motor and generator, and λ that of the line.
$c\,m$ = circular mils of the conductor.

Then for any horse-power, n, we have

$$C = \frac{746\,n}{E\,\alpha}.$$

Allowing m ohms as the resistance per mil-foot of copper, the total line resistance would be

$$\frac{2\,m\,l}{c\,m}$$

for a complete metallic circuit. Hence the drop or fall of potential on the line

$$v = \frac{746\,n}{E\,\alpha} \times \frac{2\,m\,l}{c\,m} = \frac{1{,}492\,n\,m\,l}{E\,\alpha\,c\,m},$$

or

$$c\,m = \frac{1{,}492\,n\,m\,l}{E\,v\,\alpha}.$$

In a transmission system the cost of installation may be divided into four parts, the generating plant complete, the conductors, the poles, insulators and line erection, and the motors, general expenses being apportioned. We may assume the leakage as practically nil, and the cost of motors a constant per unit capacity within the potential limits considered.

With any given motor potential, the greater the loss on the line the less the cost of the conductors, but the greater the cost of the generators. On the other hand, the less the loss on the line, the greater its cost, but the less the cost of the generators. It follows, then, that the least cost to the contractor is determined when the variation in the cost of the generating plant is equal to that in the cost of the line.

We have the formula:

$$C\,M = \frac{1{,}492\,n\,m\,l}{E\,v\,a}.$$

If d = weight of one mil foot of copper, the weight per foot of the copper of conductor would be

$$\frac{1{,}492\,n\,m\,l\,d}{E\,v\,a}. \qquad (3)$$

and the total weight for $2\,l$

$$\frac{2{,}984\,n\,m\,l^2\,d}{E\,v\,a} \qquad (4)$$

If b is the cost in cents per pound of copper (including freight and handling), we have for the cost of the wire in the line

$$\frac{2{,}984\,n\,m\,l^2\,d\,b}{E\,v\,a}. \qquad (5)$$

Evidently

$$\frac{e}{E'}$$

is the ratio of the capacities of the motor and generator.

$$\frac{n}{a}$$

the horse-power of electrical energy delivered to the motor terminals,

$$\frac{E+v}{E}\cdot\frac{n}{a}$$

that delivered to the line, and

$$\frac{E+v}{E}\cdot\frac{n}{a}\cdot\frac{1}{\beta}$$

that delivered to the generator.

I make use of the terms horse-power and commercial efficiency, for it is partly from the commercial aspect I wish to look at the problem.

Let us further make K equal the cost in cents per horse-power of the generating plant complete. Then its cost would be

$$\frac{E+v}{E\,a\,\beta}\,n\,K \qquad (6)$$

If M is the cost of motor per horse-power developed, similarly erected in place, the cost of the receiving plant would be $n\,M$.

One element is somewhat indeterminate, and is dependent chiefly upon distance and local conditions, the cost of poles, insulators and line erection, and we will call this P.

Summing up we have the general expressions for the cost per horse-power delivered:

$$C = \frac{E+v}{E\,a\,\beta}K + \frac{2{,}984\,m\,l^2\,d\,b}{E\,v\,a} + \frac{P}{n} + M \qquad (7)$$

It is evident that this is variable, and since the costs of the motor and the poles, insulators and line erection are arbitrary, save for the increase in cost of insulation as potential increases, which may be ignored here on the score that the best would be used, the variation is narrowed down to the cost of the generating plant and the material in the line. It is here apparent, as already pointed out, that if we diminish the cost of the line by increasing the fall of potential, we must at the same time increase the cost of the generating plant, and on the other hand, that if the loss on the line is reduced, its cost will increase, while that of the generating plant will diminish.

Differentiating with C and v as the variables, we have

$$\frac{dC}{dv} = \frac{K}{E\,a\,\beta} - \frac{2{,}984\,m\,l^2\,d\,b}{E\,a\,v^2}. \qquad (8)$$

Equating to zero,

$$\frac{K}{\beta} = \frac{2{,}984\,m\,l^2\,d\,b}{v^2}, \qquad (9)$$

which is the condition of least cost.

From (9) we have

$$v = 54.6\,l\sqrt{\frac{m\,d\,b\,\beta}{K}} \qquad (10)$$

That is, *with fixed conditions of unit cost of generators and copper and efficiency of generators, the number of volts fall on the line to get the minimum cost of plant is a function of the distance alone, and is independent of the electromotive force used at the motor*, a somewhat interesting conclusion.

Substituting the equivalent value given by equation (9) in (7) we now have for the equation of least cost:

$$C = \frac{E+v}{E\,a\,\beta}K + \frac{v}{E\,a\,\beta}K + \frac{P}{n} + M, \qquad (11)$$

the first element representing the cost of the generating plant and the second the cost of the wire, per horse-power developed by the motor. From this equation we have the relation:

$$\frac{\textit{Cost of wire}}{\textit{Cost of generating plant}} = \frac{v}{E+v}. \qquad (12)$$

This is not, however, in the most useful form, and since the commercial efficiency is that with which we are concerned, we will introduce its term, λ.

We have for the horse power delivered to the generator:

$$\frac{E+v}{E\,a\,\beta}\,n,$$

and n that taken out of the motor; hence we have

$$\lambda = \frac{E\,a\,\beta}{E+v}, \qquad (13)$$

or,

$$v = \frac{a\,\beta - \lambda}{\lambda}E. \qquad (14)$$

Substituting the value of v in equation (11), we have a new form for the cost equation as follows:

$$C = \frac{K}{\lambda} + \frac{a\,\beta - \lambda}{a\,\beta\,\lambda}K + \frac{P}{n} + M, \qquad (15)$$

which may also be written

$$C = \frac{2\,a\,\beta - \lambda}{a\,\beta\,\lambda}K + \frac{P}{n} + M, \qquad (16)$$

and

$$C = \frac{2\,K}{\lambda} - \frac{K}{a\,\beta} + \frac{P}{n} + M, \qquad (17)$$

We also have the relation:

$$\frac{\textit{Cost of generating plant}}{\textit{Cost of wire}} = \frac{a\,\beta}{a\,\beta - \lambda}. \qquad (18)$$

That is, *with any fixed couple and commercial efficiency, the cost of the wire bears a definite ratio to the cost of the generating plant, and this is so no matter what the unit cost of materials.*

Referring to equation (10) and substituting for m its approximate value, 10.5, and for d its value, .00000302705, we have:

$$v = .308\,l\sqrt{\frac{b\,\beta}{K}} \qquad (19)$$

Combining this with (13), we have

$$E = \frac{.308\,l\,\lambda}{a\,\beta - \lambda}\sqrt{\frac{b\,\beta}{K}} \qquad (20)$$

We now see what influence the cost of copper has when the commercial efficiency is maintained constant, which is, to vary alike the value of v and E as it increases, as the square root of such increase. It will be noticed also that a variation in K inversely affects E and v, likewise as the square root.

It follows from the above that if we do not limit ourselves in the e.m.f. used, the cost per horse-power delivered, exclusive of poles, insulation and line erection, is with given unit costs of materials, for least total cost and for a given commercial efficiency, independent of the distance.

In order to get a practical idea of what conditions would exist on a long line, we may substitute some permissible numerical values. These of course vary largely with conditions, but are sufficiently near possibilities to be fairly illustrative.

For this purpose let α and β each $=$ 95 per cent, $b = 20$ cents, $K = \$100$, and $M = \$25$. Substituting in equation (10) we have:

$$v = .308\,l\sqrt{\frac{20 \times .95}{10{,}000}} = .0134288\,l$$

irrespective of what is the motor potential or the commercial efficiency. We also have for any commercial efficiency:

$$E = \frac{\lambda}{\alpha\beta - \lambda}\,v = \frac{\lambda}{.9025 - \lambda}\,.0134288\,l.$$

whence we have for say three assumed efficiencies,

$\lambda =$ 50 per cent, $E = .016682\,l$
60 $.026635\,l$
70 $.046421\,l$

Taking the distance from Victoria Falls to the Rand, 700 miles and adding 5 per cent for sag and necessary detours, l becomes 3,880,800 ft. Substituting this, we will have the following results:

With λ	50 *p.c.*	60 *p.c.*	70 *p.c.*
Drop on line would be......	52,114	52,114	52,114
E.m.f. at motor terminals....	64,740	103,365	180,151
E.m.f. at generator terminals.	116,854	155,479	232,265

which figures are rather startling, and illustrate how serious is the problem, especially in attempting at such distances commercial efficiencies above 50 per cent, 20 per cent increase actually doubling the generator potential. Suppose the unit cost of K is lowered, say, to \$60 instead of \$100; then v and e will be increased $\sqrt{\frac{100}{60}} = 1.29$ times if we maintain the condition of minimum cost of installation—and we have another comparative table as follows:

When λ	50 *p.c.*	60 *p.c.*	70 *p.c.*
Drop on line would be .	67,227	67,227	67,227
E.m.f. at motor terminals .	83,515	133,302	232,395
E.m.f. at generator terminals	150,742	200,529	299,622

These potentials are of course for the full load. For all loads lower than this, e, E and C are reduced equally as the square root of the power delivered.

It is interesting to note that when $\lambda = 50$ per cent, the currents are 242 and 188 amperes, and the conductors of 304,637 and 183,457 mils, respectively.

Of course with alternating currents the pressures would run very much higher, and all the problems are much more difficult of determination.

We may now proceed to get costs for the three efficiencies assumed. Substituting in the equation

$$C = \frac{2K}{\lambda} + \frac{K}{\alpha\beta} + \frac{P}{n} + M.$$

we have, for $\alpha\beta = .9025$, when

$$\left.\begin{array}{ll}\lambda = 50 \text{ per cent, } C = & 2.892\,K \\ \quad 60 & 2.225\,K \\ \quad 70 & 1.740\,K\end{array}\right\} K + \frac{P}{n} + M$$

If $K = \$100$ and $M = \$25$, then with

$$\left.\begin{array}{ll}\lambda = 50 \text{ per cent, } C = & \$314.20 \\ \quad 60 & 247.50 \\ \quad 70 & 199.90\end{array}\right\} + \frac{P}{n}$$

For comparison, let $K = \$60$—all other things being unchanged. Then with

$$\left.\begin{array}{ll}\lambda = 50 \text{ per cent, } C = & 198.52 \\ \quad 60 & 158.50 \\ \quad 70 & 129.04\end{array}\right\} + \frac{P}{n}$$

An inspection of the cost equations shows how important the question of the amount of power to be transmitted becomes when the distance is considerable. Up to the point when the poles and insulators must be increased, the greater the amount of power the less of course the total cost per horse-power delivered. A convenient method is to determine the amount of power rated per mile of line to get the increment to be added to the cost of installation per horse power.

Taking the Zambesi project, and assuming 20,000 hp delivered, this would be 28.57 hp per mile of route. With, for example, \$1,000 as the cost per mile of poles, insulators and erection, the cost per horse power would be \$35.

With the \$100 unit the total costs per horse-power delivered would then be for

λ = 50 per cent .. \$349.20
60 .. 282.50
70 .. 234.90

and with a \$60 unit cost for

λ = 50 per cent.. \$233.52
60 .. 193.50
70 .. 164.04

But can full advantage be taken of the reduction of cost due to lower unit costs?

Taking any particular potential as the maximum limit on the line, it will be noted that as the cost per unit of the generating equipment decreases, and likewise the total cost at any particular commercial efficiency, we cannot in practice work at the same commercial efficiency with differing power unit costs and under the conditions of total minimum cost of installation.

By comparing the potential tables for K at \$100 and \$60 it will be seen that the maximum line potentials are about at a parity, say, 150,000 volts, at 59 per cent commercial efficiency for the former and only 50 per cent for the latter.

A practical comparison of costs, then, as determined by this maximum line potential, would, for example, in this particular case, be: \$288.18 for the former, against \$233.52 for the latter.

This is but one of the many questions which arise, for in any long-distance transmission problem a compromise determination must be made which is based upon many co-related elements; and the best selection is one of considerable difficulty.

Among the practical questions which will very properly arise is one something like this:

Admitting a certain maximum possible potential at the motor end, may it not be advisable to cut down the line loss to keep down the maximum potential on it and at the generating station, and also to meet a possible water shortage.

A single comparison is instructive: With $\lambda = 50$ per cent and $K = \$100$, we have $E = 64{,}740$ volts and $v = 52{,}114$.

Let us, for example, double the amount of copper, but assuming that the poles and insulators remain unchanged; then the drop of potential at full load will be 26,057 volts and $E + v = 90{,}797$ volts, instead of 116,854.

The distribution of power will be as follows:

First case.	H.P.	*Second case.*
2.0000	to generators	1.5540
1.9000	to line	1.4763
.8474...	loss on line	.4237
1.0526	to motors .	1.0526
1.000 ..	out of motor	1.0000

Referring to the cost equation,

$$C = \frac{K}{\lambda} \cdot \frac{\alpha\beta - \lambda}{\alpha\beta\lambda}\,K + \frac{P}{n} + M,$$

we find for the two conditions costs as follows:

$C = \$200 + 89.20 + 35 + 25 = \$349.20$
$C' = 155.4 + 178.40 + 35 + 25 = 393.80$

Excess in second case \$44.60

of [illegible] on a plant to deliver 20,000 hp under the specific conditions given.

Referring now to the general problem, the graphic representation of the relation of E, l and λ under the conditions of minimum first cost of installation is a simple matter.

For the assumed values of a, β, k and v we have the equation

$$E = \frac{.0134288\,\lambda}{.9025 - \lambda}\, l$$

Let us lay off on the axis of x the distance in feet, and on the axis of y the e.m.f. at the motor terminals.

Then for any given value of λ the ratio of

$$\frac{E}{l}$$

is fixed, whatever the actual value, and we can draw the efficiency lines $O\,A$, $O\,B$, etc., for

$$\lambda = 70 \text{ per cent}, 60 \text{ per cent}, \text{etc.},$$

which will, with the different values of l and E, give us the required information. This, however, is not in a general form, and so we will find an intersecting efficiency line. By an inspection of the diagram we see that a line can be drawn which will intersect the specific efficiency lines at such an angle that the intersected portions are proportional to the differences of efficiencies. To effect this the differentials of $E \div \lambda$ must be a constant.

Referring to a preceding equation, and transferring, we have

$$\frac{E}{\lambda} = \frac{E + .0134288\, l}{.9025}$$

If the members of this equation are made equal to a constant, then differentiating the second member for E and l we have

$$\frac{d\,E}{d\,l} = -.0134288$$

which determines the intersecting efficiency line laid off with reference to E and l. To find the intersections let $d\,E = 50{,}000$. Then $d\,l = 3{,}723{,}341$ ft., or 705 + miles.

The limiting efficiencies are 0 and .9025 per cent, which should be laid off as indicated. A chart so prepared need consist only of the axes of x and y, on which the motor terminal e.m.f.'s, and the distances are laid off, together with the intersecting efficiency line, and it is then ready for reference, giving at a glance the graphic solution of the basic elements of this kind of a transmission under the condition of minimum total first cost, and with known efficiencies and unit costs of generating equipment and conductor. A line for determining the value of v may of course be added.

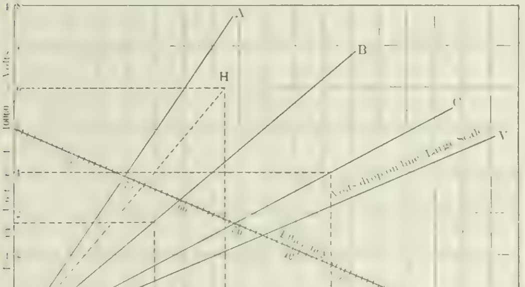


CHART TO DETERMINE ELEMENTS OF LONG DISTANCE DIRECT CURRENT TRANSMISSION FOR MINIMUM FIRST COST UNDER SPECIFIC CONDITIONS.

In engraving, the lines A, B and C were not accurately drawn to pass through the exact points of intersection with the efficiency line, namely, .70, .60 and .50.

To illustrate the use of such a diagram, suppose we wish, under these assumed conditions, to transmit a distance of 100 miles at a commercial efficiency of 60 per cent, what would be the required e.m.f. at the motor terminals? Drawing the efficiency line $O\,B$ till it meets the ordinate erected at 100, we find the e.m.f. to be about 14,000 volts, and the drop on the line about 7,100 volts. On the other hand, suppose we are limited to 40,000 volts at the motor, and must have an efficiency of 50 per cent, what would be the limiting distance? Reversing the above process, we find it to be 456 miles. Suppose, again, that we must operate at a distance of 150 miles, and can work up to an e.m.f. of 30,000 volts at the motor, what would be the efficiency? Through the intersection of the proper e.m.f. and distance lines, we draw the efficiency line $O\,H$, and at its intersection find the efficiency to be about 67½ per cent.

In conclusion, a common sense way of looking at the technical possibilities of a general project of power transmission on the lines indicated is this:

Assuming the largest unit and highest single machine potential practical to have been determined, it follows that if we wish to extend transmission beyond the economical limits dictated by this initial potential, and likewise to increase the amount of power delivered, then if the machines are well insulated from ground and from each other, like increases of capacity and potential, together with like increase of distance, can, with unchanged current and cost per unit of power delivered, be safely attained by simply coupling the machines in series to get potential and capacity, and paralleling the series, connected or not to independent lines, to get additional capacity. The generators, although all connected up in series, may by proper power be independently driven instead of being physically coupled together, but the groups of motors at the receiving station should either be physically connected together, or if there is local power distribution through other machines, they may be independent, and drive local generators connected to a common electrical load.

On such a plan the transmission of a large power at high potential over long distances by a direct current of equally variable pressure and volume cannot be dismissed as entirely visionary. On the contrary, its possibilities may merit careful study and consideration in some cases.

High-Frequency Currents.

In a recent Cantor lecture Prof. J. A. Fleming showed some interesting experiments relating to the measurement of high-frequency currents and electric waves and illustrating resonance phenomenon. The latter phenomenon was made clear to the audience by the mechanical analogy of two pendulums hung side by side from a piece of stretched cord. If the two pendulums were of the same length, the swinging of one caused the other to swing also, but if the pendulums had different periodicities, there was no such inter-action. By placing the pendulums nearer together, or further apart, the time taken for the movement of one to be communicated to the other could be reduced or increased, and this corresponded, in wireless telegraphy, to a strong and weak coupling. The lecturer's cymometer was then explained, and an actual experiment was carried out, in the course of which it was found that there were two oscillations of quite different frequency in the circuit tested. This, the lecturer explained, was the case with every wireless telegraph transmitter. The current flowing in the cymometer circuit varies constantly as the handle of the instrument is shifted from one extreme position to the other, and this change in current can be readily traced by inserting a thermo-junction in the cymometer circuit and connecting it to a galvanometer.

In addition to measuring frequency, the cymometer could be used for the speedy determination of capacity and inductance, and the methods of such measurements were experimentally shown. It was very often thought that the wave length was four times the height of the transmitting air-wire, but it has been found by actual measurement that it approximated more nearly five times the length of the antenna. A very neat illustration of the fact that high-frequency currents occurred on the surface of conductors only, and did not penetrate into the metal, was obtained by measuring successively the oscillation constants of three similar squares of copper, iron and galvanized iron wire respectively. The readings were practically identical in the first and third cases, but in the second case no reading could be obtained because of the magnetizing effect of the iron through which the high-frequency currents had necessarily to pass. Hence galvanized iron wire can well be used as a cheap substitute for copper, but iron wire should not be employed. As a last example of the many-sidedness of the cymometer, it was mentioned that the instrument could be used for calculating the decrement of electric waves.

Hydro-Electric Lighting and Power Plant at Harrisonburg, Virginia.

By F. F. Coleman.

NEAR the town of Harrisonburg, in the Shenandoah Valley of Virginia, there has recently been placed in operation a well designed hydro-electric lighting and power plant which furnishes a good example of the possibilities which lie in the development of the numerous small waterfalls which are to be found throughout the country. The hydro-electric equipment belongs entirely to the municipality. The plant is located on the south fork of the Shenandoah River, 12.5 miles from Harrisonburg. The site was purchased, plans were prepared, contracts were let, and the installation completed and placed in operation all within a year's time.

The dam is located one-fourth of a mile above the plant, where a solid limestone ledge runs entirely across the river. This feature is exceptional, for the geology of this section indicates that the limestone breaks off on the west of the river with quartzite, the typical formation of the Blue Ridge, on the east. The ledge is fairly horizontal, forming a most secure and excellent foundation for a dam.

The dam is 720 ft. long and 15 ft. high to the crest of the spillway, or "river section," which is built of timber on crib work securely bolted to the solid rock with 192 1.25-in. bolts from 3 to 5 ft. long, then loaded with loose stone placed inside of the cribs. The design is such that it may be replaced by a concrete dam without stopping the plant, the present timber-work acting as a coffer dam. The effective fall is 20 ft. The concrete abutments are 20 ft. high, extending 5 ft. above the spillway. They are 488 ft. apart, affording passage for a considerable flood without overflowing the concrete abutments or race banks.

The western abutment contains six large regulation gates, intended to prevent too much water from entering the race during freshets and overstepping the embankments. The head race is one-fourth of a mile long, about 100 ft. wide, and 15 ft. deep.

FIGS. 1, 2 AND 3.—VIEWS OF HYDRAULIC DEVELOPMENTS, SHOWING DAM, CANAL AND TAIL RACE, HARRISONBURG.

The power house is divided into two parts; the generator room, 45 by 52 ft., containing all of the electrical machinery, and the wheel room, 20 by 42 ft. The floor line is 32 ft. above the bottom of the wheel pits and 5 ft. above high water mark of the river.

The wheel room extends across the head race and rests on the solid concrete masonry walls which form the sides and ends of the wheel pits. The end wall is 6 ft. thick at the bottom, 4.5 ft. thick at the top, and is 32 ft. high. It is pierced by three arched openings, each 8 ft. wide and 9 ft. high, through which the water escapes after leaving the wheels. The intake is protected by a wrought-iron rack 13 ft. high and 40 ft. long. Within this are the service gates, which are operated from within the power house.

The power house itself is one story in height and is built of brick. There are three wheel pits. Each measures 12 ft. square. They are divided one from the other by concrete masonry walls 2.5 ft. thick.

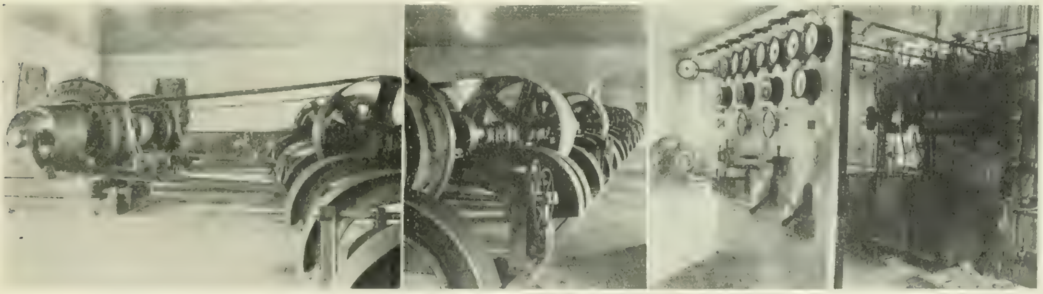
The power is developed by three 50-in. vertical turbines rated at 450 hp each, and a 20-in. turbine of 72 hp. The three larger turbines are connected with a horizontal main shaft which drives the generators by means of belts. The connection to the main shaft is through a bevel mortise gear, with wheels 7 ft. in diameter and 15 in. face. The pinions on the main shaft have 48 in. friction clutch hubs which permits of each turbine being operated or shut down independently of the others. The main shaft is 6 in. in diameter and 85 ft. long, and operates at 280 r.p.m.

Two pulleys each 70 in. in diameter and 38-in. face are provided to drive the generators. The pulleys have 6 ft. quills, and each is equipped with a 48-in. friction clutch to throw it in or out of use as may be desired.

The 20-in. turbine is direct-connected to the exciter generator. In addition to operating the generators, the hydraulic plant furnishes mechanical power for operating the Rockingham mill, situated somewhat more than 100 ft. away, by means of a rope drive placed under the floor of the power house.

A Woodward horizontal speed governor is connected to the gate mechanism of each turbine by means of flexible wire cables.

The electrical equipment of the power house includes two 250-kw alternating-current Bullock type generators, a 20-kw direct-current generator to act as an exciter to the main generators, and a four-panel switchboard. The two large generators are driven by belts from the main shaft at a speed of 450 r.p.m., producing a three-phase current of 60 cycles at 11,500 volts.

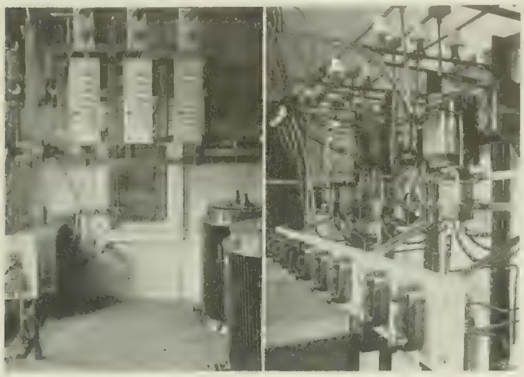


FIGS. 4, 5 AND 6.—VIEWS OF INTERIOR OF GENERATING STATION, SHOWING GENERATORS, COUNTERSHAFT AND SWITCHBOARD.

The exciter runs at 700 r.p.m. and produces current at 120 volts. Although the exciter is direct connected to the 72 hp turbine wheel, provision is also made to run it by a belt from the main shaft in case of any accident to the small wheel.

The switchboard, which was furnished by the Allis-Chalmers Company, is made of blue Vermont marble, and is provided with all standard instruments of the best character. It consists of four panels, each two inches in thickness. There are two generator panels, one exciter panel, and one feeder panel. All the wiring is open, the low-voltage wires being lead-covered, while those for the high-voltage are covered with 30,000-volt rubber insulation and carried on Locke insulators spaced 7 in. apart. An adequate lightning arrester is mounted at the end of the generator room, where the transmission wires leave the building. The transmission lines are carried out of the building through 6-in. tile pipe that is set through the wall, sloping downward at an angle of 35 degrees.

The current leaves the power house at a tension of 11,500 volts and is transmitted a distance of 12.5 miles to the sub-station over three strands of No. 4 bare, hard-drawn copper wire. The line follows generally the public roads. The wires are carried by chestnut poles from 35 to 40 ft. in length, set five feet into the ground at distances of 125 ft. apart. Each pole is provided with cross arms for transmission wires and a short cross arm below on which telephone wires are placed. Provision has been made for the wires for two transmission lines, but only one set has been put up.



FIGS. 7 AND 8.—VIEWS OF INTERIOR OF SUB-STATION.

The top arm carries two pins and the next lower arm four pins. The wires now in use are placed on the top pins of the upper arm and one of the pins nearest to the pole on the lower arm. They are spaced 27 in. apart in the form of an equilateral triangle. Double arms and guys are used at all turns and curves. The line is protected from lightning by means of a barbed iron wire run along the tops of the poles and grounded at every fifth pole.

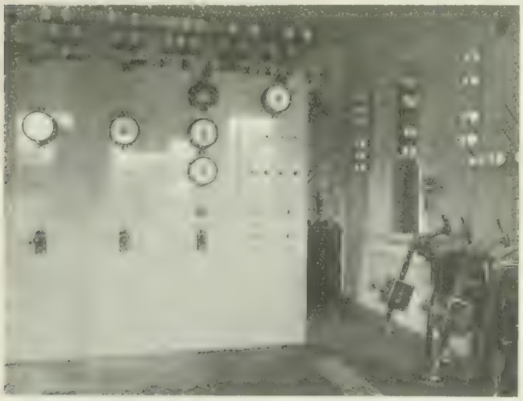


FIG. 9.—SWITCHBOARD AND CONSTANT CURRENT TRANSFORMERS IN SUB-STATION.

The sub-station is a brick building containing two transformer rooms each 12 by 14 ft., a switchboard room 16 by 18 ft. and a store room 18 by 20 ft. The transformer rooms have concrete floors.

The equipment at the sub-station includes one high voltage automatic compartment switch, provided with a small switchpanel, three 100-kw. self cooling, oil filled Bullock transformers, wound for 11,000 to 2,200 volts, connected in delta, and a four-panel switchboard with lightning arresters of the same style as those used at the power house.

The sub-station switchboard is also of blue Vermont marble, two inches thick, and consists of two lightning feeder panels with watt-hour meters, one three phase power feeder panel with a static ground detector, a three phase watt hour meter and volt-meter; the arc feeder panel is unifom with the rest of the board.

There are two arc circuits each provided with a 25-light transformer and a regulator of the "A. B." type which carry 38 2,000-cp Adams-Bagnall lamps. Additional street lighting is provided by 60 50-cp incandescent street lamps. Provision is also made for 5,000 16-cp lamps for private use.

A graded system of charges has been adopted. Electric energy for 16-cp incandescent lamps for domestic use costs 25 cents per month, each, for three or less, 15 cents for the fourth to ninth, 9 cents for the tenth to the twelfth, 4 cents each for the next three, and 1.5 cents per month each for all in excess of fifteen. For stores and offices the rate for the first ten lamps is 35 cents each per month, 30 cents for the next ten, 25 cents for the next ten, 20 cents for the next, and 10 cents a month for each in excess of forty. The rate for churches is 5 cents per month per lamp.

The charge for arc lamps not exceeding 1,200 cp is forty dollars per year, and for those exceeding 1,200 cp, it is fifty dollars per year.

The Orling-Armstrong System of Wireless Telegraphy and Telephony.

By A. Frederick Collins.

THE many different forms of wireless telegraph apparatus devised since the original essays of Marconi have, with one exception, been based, fundamentally, on the indication of electric waves, the variance to the rule in question being that of the "Armorl" system, as its designers, Messrs. Orling and Armstrong, have chosen to name it. The grouping of certain electrical elements into this new arrangement for signaling through space without wires is stated to be founded on the dispersion or conduction of current electricity through the earth and water.

To carry out this idea, they designed a transmitter, Fig. 1, comprising an inductance coil, 1, an interruptor, 2, a condenser, 3, a battery, 4, a key, 5, and two grounded conductors, 6, 7. The receiver is made up of the two grounded conductors, 6, 7, Fig. 2, an electro-capillary relay, 8, a switch, 9, a second switch, 10, a battery, 11, and a Morse register, 12. The inductance coil is constructed like an ordinary sparking coil used for gas lighting and ignition apparatus of the wipe-spark type in gas engines. It is formed of a number of layers of insulated wires wound on an iron core and this is connected in series with the interruptor, the battery and the immersed or buried plates, the object being apparently to take advantage of the effect on the current at the instant the circuit is broken. By this means it is claimed that the energy projected into the conducting medium by the transmitting system is "sufficient to actuate a suitable receiver through very considerable distances and while the earth connections are comparatively near to their respective stations." The distance between the local earth connections is stated to be "only a few yards," contact being made by iron spikes to which are attached the terminals of the base wires when the former are driven into the ground or are immersed in the water as circumstances require.

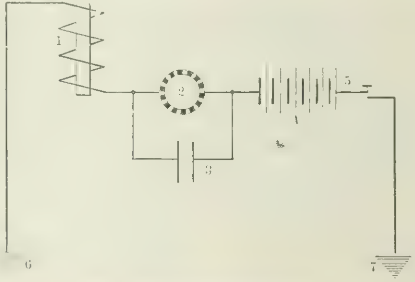


FIG. 1.—ARMORL TRANSMITTER.

Shunted around the interruptor, which is of the revolving type, is a condenser, the function of which is to produce a greater difference of potential at the terminals by permitting the primary current to charge the condenser while the break is taking place at the interruptor. The battery may be supplanted by a direct-current generator except in cases where portability is a requisite. The key is of the ordinary Morse form, although larger ones like those used in European systems of wireless telegraphy are sometimes employed where very heavy currents are to be broken.

The electro-capillary relay devised by Orling and Armstrong is employed in the receiving circuit to pick up the enfeebled impulses received through the earth or water and provides means for augmenting these by closing a circuit in which there is interposed a battery and an ordinary Morse register; or the relay and register may be replaced by an electro-capillary recorder. The relay consists of a bent-tube syphon of which the shorter leg, *a*, Fig. 3, stands in a vessel of mercury, *c*, the longer leg, *b*, dipping into a vessel of acidulated water, *d*; the point of this leg is so finely drawn that the mercury is prevented from passing out of the orifice. But when even a minute current flows through the leg and out from the vessel of water, the mercury follows the current and falls from the bottom of the syphon in exceedingly fine drops. These fall on a globule of mercury which serves to seal an almost microscopic puncture in the bottom of the vessel of water, and the effect of each falling drop is to cause a corresponding drop to flow through the hole. The globules of mercury in thus passing through the orifice form a momentary contact between the metallic points of the relay, closing in consequence the operating circuit containing the register.

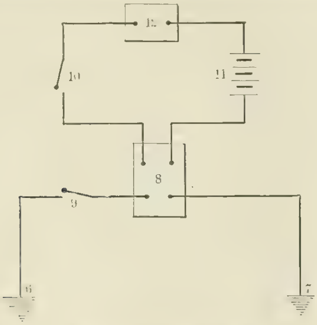


FIG. 2.—ARMORL RECEIVER.

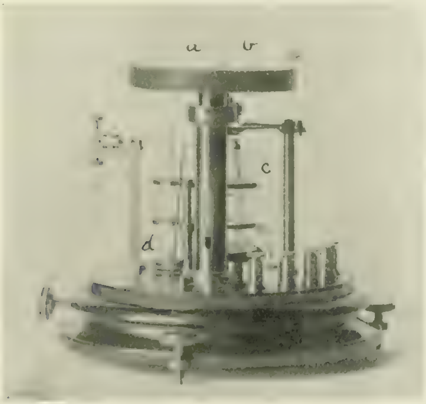


FIG. 3.—ELECTRO-CAPILLARY RELAY.

The electro-capillary recorder, Fig. 4, is constructed somewhat differently, though the instrument likewise comprises conductors of mercury and acidulated water; and as these two dissimilar fluids have no tendency to become either chemically or mechanically associated their surfaces are permitted to make contact with each other at a constricted part of the tube. When the signals are received the tension of one of the surfaces of contact is instantly varied, which causes the fluids in the tube to rise or fall according to the nature of the impulses. A beam of light is arranged to fall normally upon a moving photographic, i. e., sensitized tape, and when the electric currents are received, the beam is more or less screened by the movement of the opaque fluid and in this way a permanent record is produced. The electro-capillary recorder is also arranged for sight reading, as shown in Fig. 5.

The relay and recorder described possess, according to the inventors, an extremely high sensitivity, for, different from the ordinary relay and syphon recorder, there are no heavy moving masses such as armatures or coils of wire, and consequently there is no inertia to overcome; while the elimination of electromagnets reduces its resistance to a practically negligible point. The only moving part in the electro-capillary instruments consists simply of a fine thread of mercury the weight of which may likewise be considered nil.

The visible action of the Orling-Armstrong system may be summed up by saying that when the key of the transmitter (5) is made to close the circuit, the interruptor is set into action and the signals, whether dots or dashes, are made and broken in rapid succession through the inductance coil. The current from the battery energizes the inductance coil whenever the interruptor completes the circuit and induces an indirect extra current; while at every break a direct extra current is induced, the result being that the induced extra current is caused to discharge itself through the conductors and into the earth. The conductors making contact with the earth are connected, as a reference to the diagram will show, on either side of the interruptor, and as a result the earth is put in series every time the circuit is broken by the interruptor; at every make the resultant of the low-tension current and the inverse high potential extra current will be conducted to the earth while at every break the direct extra current, together with the maximum energy from the battery, will likewise be led to earth. In the transmitter, then, the high potential extra current induced in the inductance coil by the break is projected into the earth simultaneously when the battery current is completed through the earth.

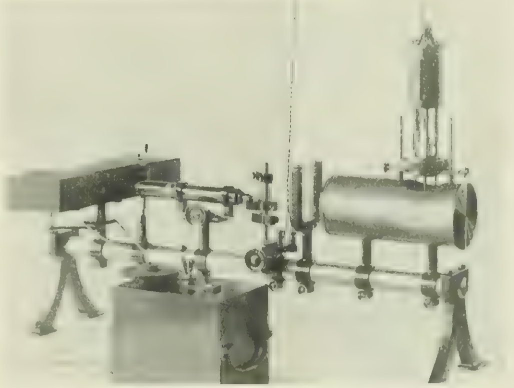


FIG. 4.—ELECTRO-CAPILLARY RECORDER WITH PHOTOGRAPHIC ATTACHMENT.

According to Dr. Maurice Ernest the invisible effects that this arrangement produces in the earth are as follows: At each of the points where a circuit is completed through the earth, the latter is charged electrically at one point positively and at the other negatively. Considering such a point by itself and ignoring for the moment the influence of other charges that may be in its neighborhood, it will be found that the electrical energy is continuously supplied to it and spreads out through the ground, radiating in every direction. This takes place owing to the mutual repulsion that every point of the charge has for every other part of the same charge, since all are of the same sign, being either all positive or all negative. This being true, the influence of such a charge may be considered to extend over the whole earth, but its potential at any point will obviously diminish with its distance from the source of supply.

Considering now that there is another similar but oppositely charged point in the neighborhood, in the absence of the first mentioned charge its energy would similarly spread out in all directions, but under the circumstances mentioned each charge would encroach upon the other; however, as these charges are of the opposite sign, they will mutually attract each other. The radiating repulsive lines of each charge that come within the attractive influence of the other will be deflected in consequence and so transformed into curves through which the energy of one charge will pass to the other. If now the terminals of the receiving instrument be connected at points of different potential with the earth where it is traversed by the lines of current flow just described some of the current will pass through it. This will, it is obvious, only be possible so long as there are lines of current flow where the receiver is located, and the latter will only then be able to operate the receiver if a sufficiently strong current is at hand.

What, then, will be the distance at which the radiating lines of force will be sufficiently strong to attract each other and so form lines of current flow from the base lines which join the two charges? This distance, it seems reasonable to assume, will depend upon the potential to which each of the points from which the current lines emanate. But owing to the numerous lines or paths through which the circuit is completed the current that would pass through a receiver would be very small indeed. This will be especially true if the terminals of the receiver are at points only a moderate distance apart, or if they cut one of the more remote lines. In order to produce really good results a current of considerable strength must, therefore, be available at the points whence the lines of force originate, or in other words, at the earth terminals of the transmitter.

This, it is stated by the inventors, is effected in their apparatus by completing a battery circuit through the earth simultaneously with a high-potential discharge at the earth connection, when lines of current flow are propagated that apparently constitute paths of low resistance through which the low voltage battery current passes. In this manner a sufficient quantity of electrical energy is propagated to a distant receiver which would operate a relay, and this in turn would actuate a Morse register or control any other desired apparatus.

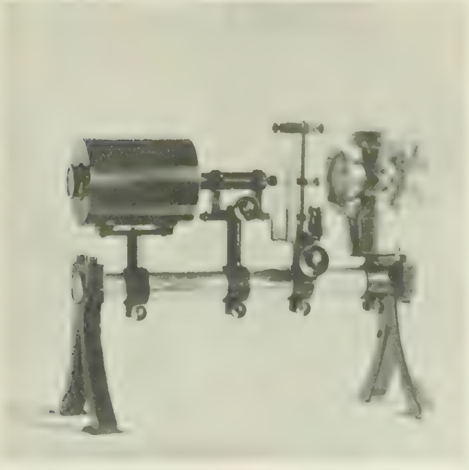


FIG. 5.—ELECTRO-CAPILLARY RECORDER FOR SIGHT READING ONLY.

The Orling-Armstrong system can be adapted to serve a large number of purposes, such as firing mines at a distance, controlling torpedoes, communicating between railway stations and trains in motion and working fire-alarms; in fact any instrument that is capable of being operated by a local battery or spring motor such as clocks, tape-machines and similar devices. By substituting a telephone transmitter for the key and interruptor and a telephone receiver for the relay and register, the arrangement may be converted into a wireless telephone.

Whatever may be the limitations of the so-called conductivity method this much may be said in its favor: it needs no high masts or [illegible] aerial devices; the instruments are not costly nor are they complicated, while they are extremely portable and may be fitted up in a few moments. This being the case, there is no doubt that the Armorl system will find its proper sphere like all other good things electrical, and it would seem to an interested observer on this side of the Atlantic that the army and navy should be the first to put it to a commercial test.

The Jones Phantoplex Telegraph System.

A system employing alternating currents of equal frequencies to be superimposed upon ordinary telegraph wires already being operated by the present Morse systems, either single, duplex or quadruplex, has recently been developed and patented by Mr. Francis W. Jones, electrical engineer, of the Postal Telegraph-Cable Company, for the purpose of adding additional facilities to present telegraph wires for the transmission of messages by the Morse code.

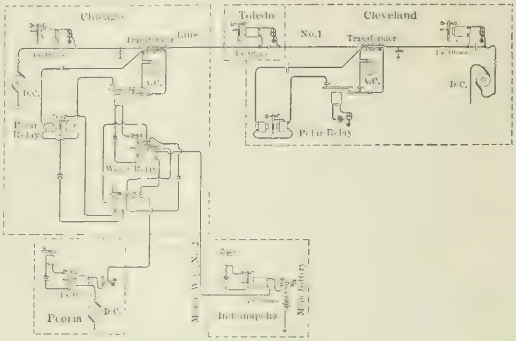


FIG. 1.—PHANTOPLEX REPEATER CIRCUITS.

The utilization of alternating currents, both of equal and unequal frequencies, has been tried for the same purpose by many inventors, commencing many years ago with Cromwell F. Varley, in England. The most successful applications having been made in the United States by Thomas A. Edison, A. C. Crehore and Harry O. Rugh, whose systems have been in practical operation upon telegraph lines with more or less success, but which systems have not proved as satisfactory to telegraph managers as they desired. Elisha Gray's system for a similar purpose employed direct currents and therefore was dependent upon paths of non-inductive high resistance around his Morse apparatus to admit of the passage of his pulsatory signals, and for this and other reasons the Gray system was not put in use by the telegraph company which controlled the patents.

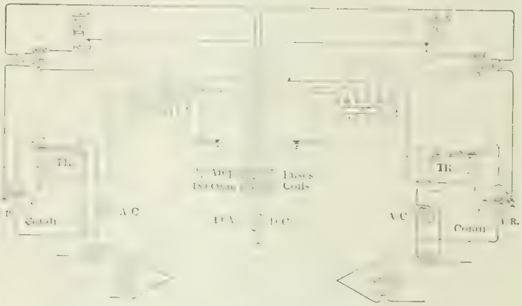


FIG. 2.—PHANTOPLEX REPEATER.

Mr. Jones' system, which has been given the name of the "Phantoplex," on account of its creating what is known as a "phantom" circuit, has been in practical operation upon the wires of the Postal Telegraph-Cable Company for several months, and the results of its operation are stated to be highly satisfactory.

The alternating currents employed have a frequency of about 150 per second, and an effective e.m.f. of about 100 volts, for an ordinary telegraph circuit about three hundred miles long, not including way offices. The transformer has been designed to make a transformation of maximum efficiency, of the alternating currents, in the line wire; a capacity of at least six microfarads has been given to each condenser placed around the relays, and at the ends of the Morse circuit, to furnish an electrostatic path of low impedance for such transformed alternating currents. It is found that the currents used for "Phantoplex" signals, on account of their high rate of alternation do not affect the Morse apparatus, either in the circuit being operated, or in a circuit being operated upon an adjacent wire upon the same cross arms. It is well known that if a speaking telephone circuit is established through the coils of a sensitive astatic galvanometer, that the mirror of the latter will not be set in motion by the operation of the telephone, the electric sound waves in the telephone being of high and variable frequencies; but if an instrument as sensitive as the Bell receiver is included in the circuit, the electric sound waves will set its diaphragm into audible motion; similarly the ordinary Morse relays connected directly in the "Phantoplex" wires, or which are being operated in a wire adjacent thereto, are immune from the effect of such currents, but they are likely to produce a hum or note corresponding to their rate per second in any unbalanced telephone wire running parallel within a short distance of the "Phantoplex" circuit.

The Jones system was worked satisfactorily between New York and Hartford, 142 miles, upon a wire that was being worked quadruplex between New York and Boston, 260 miles, and not the slightest interference could be detected between one system and the other. In fact, the operators working upon the quadruplex could in no manner be aware when the "Phantoplex" was in operation; neither could the operators upon the "Phantoplex" circuit tell when the quadruplex was being operated.

A "Phantoplex" circuit is being operated between New York and Utica, 300 miles, upon a wire that is duplexed between New York and Buffalo, 450 miles, in the most perfect manner and without the slightest interference. This wire contains about ten miles of underground, and one mile of submarine cable. There is no reason to believe that this system will not work through much greater lengths of underground and submarine cable than the speaking telephone, on account of its containing no overtone alternations for the purpose of reproducing speech. Many other circuits under similar conditions are being operated with the same results.

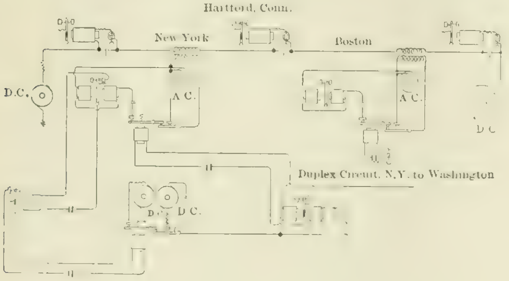


FIG. 3.—PHANTOPLEX CIRCUITS NEW YORK TO BOSTON.

A number of patents have been granted to Mr. Jones on this system. One broadly covers the particular combination and means for "Phantoplex" sending and receiving; also for superposing the system upon the ordinary polarized Morse duplex circuit, by which two "Phantoplex" communications can be made simultaneously in opposite directions, at the same time that two Morse messages are being transmitted in opposite directions. Another shows the connections for the superposition of the "Phantoplex" upon a duplexed or quadruplexed wire. In this case, the wire between the stations is utilized for "Phantoplex" transmission in either direction, while the duplex or quadruplex apparatus is being operated for the transmission of messages by the Morse system in the usual manner. Still another shows a means for repeating from a "Phantoplex" circuit upon one Morse wire directly into another Morse wire not equipped with "Phantoplex" apparatus. The second Morse circuit, marked No. 2 in Fig. 1, should be equipped with keys which open and close the line at the under side of the rear end of the lever, instead of at the contact point, as shown under the end of the lever upon which the knob is mounted; and the sounders of the relays should be operated from the back contact points of the Morse relays that are worked in this circuit. This can be easily arranged by the use of special keys, and three-point switches to change the key contacts and local sounder contacts from front to rear.

Fig. 2 shows a "Phantoplex" repeater for carrying the signals from an eastern duplexed wire at any repeater station, over a western duplexed wire, and vice versa, with switches for separating the "Phantoplex" sets, so that they may be worked independently both east and west from the repeater station. The same repeater answers for wires that are being worked single or quadruplex. Fig. 3 is a plan for connecting a "Phantoplex" circuit, being worked upon a way wire between New York and Boston, with a duplexed circuit in the New York office, operated by the Morse system between New York and Washington, as shown. When Boston is sending by "Phantoplex" to Washington via the New York "Phantoplex" repeater, it is necessary for Washington to keep his key open, instead of closed, as is the case at present when Morse wires are connected to duplex circuits through half repeaters.

LETTERS TO THE EDITORS.

Wire Calculations by the Slide-Rule.

To the Editors of Electrical World and Engineer:

SIRS:—The formula for calculating with the slide-rule the size of wire required for given distance, current, and drop, as given by Mr. W. F. White in the issue of *Electrical World and Engineer* for October 14, may be greatly simplified by replacing the unwieldy constant term by a simple and easily remembered constant factor, and at the same time the addition required by his formula is eliminated so that the result as read from the logarithm scale is the number of wire sought. The following explanation will make clear the change suggested and the manner of using the formula:

Mr. White's formula (5)

$$2^{\frac{n}{3}} = 5{,}000 \frac{V}{D \times I} \qquad (1)$$

may be written approximately

$$\frac{n}{10} = log\left(\frac{5{,}000 \times V}{D \times I}\right) \qquad (2)$$

or

$$n = 10\ log\left(\frac{5{,}000 \times V}{D \times I}\right) \qquad (3)$$

To solve a problem with this formula it is only necessary to substitute values and solve the fraction within the parenthesis, using the *C* and *D* scales, then turn the rule over and read the number directly on the logarithm scale. To illustrate, take the conditions given by Mr. Austin Burt in the issue for November 25:

$V = 3.5 =$ drop in volts,
$D = 74 =$ distance in feet,
$I = 95 =$ load in amperes.

substituting in formula (3)

$$n = 10\ log\left(\frac{5{,}000 \times 3.5}{74 \times 95}\right)$$

After performing the operations indicated within the parenthesis, using the *C* and *D* scales, the ten of the *C* scale will be found to be opposite 2.47 on the *D* scale and the logarithm of this number, which is .396, may be read on the *L* scale opposite the left hand index, or, if the rule has no index line at the left hand end on the back, the slide may be advanced its length to the right and the logarithm read opposite the right-hand index. Therefore,

$n = 10 \times .396 = 3.96$, or approximately No. 4 wire.

If the load in the above problem were 9.5 amp. and the other conditions the same the quantity within the parenthesis would be 24.7 and the logarithm would be 1.396; hence.

$n = 1.396 \times 10 = 13.96$, or approximately No. 14 wire;

or again, if the current were 400 amp., the distance and drop remaining the same the quantity within the parenthesis reduces to .591, the logarithm of which is $\bar{1}.772$ and the number of the wire is

$n = (\bar{1}.772$ [illegible] 2.28, or between No. 000 and No. 0000. Nos. 00, 000 and 0000 are taken as −1, −2 and −3.

Account must always be taken of the characteristic of the logarithm of the quantity within the parenthesis as it becomes the tens digit, if there is one, of the number representing the size of the wire, or if it is negative shows that the wire is larger than No. 0.

WATKINS, IOWA. M. S. HOWARD.

◆

Swedish Government Electric Traction Experiments.

To the Editors of Electrical World and Engineer:

SIRS:—Will you permit me to make several corrections in the report in your issue of November 11 of the paper on Swedish Government Electric Traction Experiments, which I presented at the recent Congress of Swedish Engineers.

In comparing the three-phase and single-phase systems with respect to cost of feeders, I pointed out that it is most equitable to assume the same voltage in both cases between the conductors and the grounded neutral point, rather than between the conductors themselves. With the same voltage to ground, the same amount of copper is needed in both cases, and as the single-phase line requires less transformers, my conclusion was that the total cost of the feeders is rather less for single-phase than for three-phase. I therefore expressed the opinion that with respect to the line the advantages are on the single-phase side. In my general conclusion in favor of this system, I pointed out that for certain railroads with conditions differing from those of Swedish lines, the three-phase system might perhaps show up more favorably in the present stage of the art.

Concerning the Oerlikon system, I stated, in direct contradiction to the report, that I should like to have a part of the line constructed according to that system, and that I had made a great effort to this end and had good hopes of seeing it realized.

In your editorial you remark that in view of the Zossen work, one may be permitted to doubt whether higher voltage in the contact line can be used with single-phase than with three-phase current. Allow me to point out, as I stated also in my paper, that the Zossen line is a special case, as there was [illegible] and no switches were used. The line construction of the Zossen line cannot be employed for ordinary railroads, certainly not for our Swedish roads, and it seems quite clear to me that a single wire in narrow tunnels, at street crossings, on bridges and at switches is better than two wires, and that a higher voltage can be used on a single-phase trolley conductor.

STOCKHOLM, SWEDEN. R. DAHLANDER.

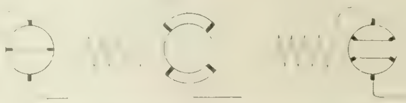
[We regret the error noted with reference to the comparison of the cost of feeders for single-phase and three-phase railway systems. We find that this error is not chargeable to our correspondent, the words in his report "for the same voltage to ground" having been omitted in setting up the type. The reference to the Oerlikon system, which is criticized, reads in the report, "Mr. Dahlander stated that this system had been taken into consideration, but for many reasons it had not been decided to use it in the present experiments." We are glad to learn from Mr. Dahlander's letter that it is part of the Swedish programme to take up this system later for experimental investigation.—EDS.]

◆

Belgian Single-phase Railway.

To the Editors of Electrical World and Engineer:

SIRS:—In a letter that appeared in your issue of December 9, 1905, the Allgemeine Elektricitáts Gesellschaft, of Berlin, claims that the Belgian Latour patents which it controls "cover, at most, some details of its system." To show the nature of these details I wish to state that these Belgian patents cover three forms of single-phase motors, represented diagrammatically in the accompanying sketches, Figs. 1, 2 and 3. Fig. 1, in particular, represents a series motor possessing a distributed winding on the stator and two brushes displaced 90 degrees from the brushes introducing the line current into the rotor. The series connection may be made at will by means of a current transformer. To my mind, these peculiarities in the construction adopted for the Borinage motors are sufficient to justify these motors being called motors of my type, if the name of any person is used at all. However, I never had any intention to produce the impression of having designed the particular motors in question or having patented the other details of the system exterior to the motors. This will be sufficient to make the situation in Belgium clear.



FIGS. 1, 2 AND 3.—DIAGRAMS OF SINGLE-PHASE MOTORS.

As to the question of the absolute priority of the invention of the form of single-phase motor (Fig. 1) it would be useless to discuss it here. My opinion naturally differs from that of the engineers of the Allgemeine Elektricitäts Gesellschaft.

NEW YORK. M. LATOUR.

◆

Practical Vector Diagram for Induction Motors.

To the Editors of Electrical World and Engineer:

SIRS:—I should like to call attention to some misprints in my article entitled "A Practical Vector Diagram for Induction Motors," which appeared in your issue of February 25, 1905.

Page 391, column 1, line 16, should read "See Fig. 13."

Page 394, column 1, line 9, should read:

$$\tan \epsilon \; [illegible] \; \phi_0' \Big] = .2c.$$

And line 17 should read:

[illegible]

WILKINSBURG, PA. H. C. SPECHT.

◆

The Metallized Filament Lamp.

To the Editors of Electrical World and Engineer:

SIRS:—Several articles have appeared of late in the technical journals showing a very considerable misunderstanding of the nature of the invention underlying the new metallized filament incandescent lamp of the General Electric Company.

I do not care to take your space to discuss patent matters, but I think it only fair to other manufacturers of incandescent lamps to state that we are of the opinion that the statements above referred to are based on an entire misunderstanding of the lamp and of the invention.

SCHENECTADY, N. Y. ALBERT G. DAVIS.

[In absence of specific reference by Mr. Davis, we can perhaps help our readers by directing their attention to one article on this subject, appearing in our issue of November 25, 1905, by Mr. E. P. Thompson, page 892, entitled "Graphitizing Filament Patents Expired."—EDS. E. W. AND E.]

◆

The Patent Law Situation.

To the Editors of Electrical World and Engineer:

SIRS:—The communication from an unnamed patent attorney under the head, "The Patent Law Situation," which appears in your issue of November 25, is interesting as well as valuable. However, a great divergence of opinion may exist according to experience. The attorney's experience given in the first paragraph leads one to believe that there are few, if any, evils to correct, and that since the two judges which did not come up to the requirements are not practicing, everything is lovely, and the courts leave nothing to be desired. The electrical engineering profession would be happy if this state did exist, but unfortunately it has met many color-blind judges.

The second paragraph of the article does not appear quite logical. People with patents obtained fraudulently cannot stand any chance before any court and hence cannot extort money; and the rich defendant can hold out longer probably than a poorer plaintiff. A court may not understand everything about the contents of a patent, but if it knows the same to be fraudulent, would dismiss the case.

Paragraphs 3 and 4 will, no doubt, be upheld by all who are able to judge. Paragraph 5 reveals a misunderstanding by your correspondent, and the communication in your issue of November 18 fully explains the expert assistance desired.

With regard to paragraph 6, I may say that it is not necessary that the lower court or advisory board mentioned in the issue of November 18 should be a department of the Patent Office. If necessary or desirable, it may be entirely separated therefrom. The features desired are: First, that the judges should have been Patent-Office examiners; second, that they should know the state of the art; and third, that they should have access to the Patent Office Library and have all the privileges a Patent Office examiner enjoys.

Regarding paragraph 9, it may be true that this "subject has been repeatedly threshed out by the parties who know most about it." If I am not mistaken the threshing has been going on for the last fifteen years, but we are yet anxiously awaiting the harvest.

St. Louis, Mo. Ludwig Gutmann.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Theory of Single-Phase Induction Motor.—Thomaelen.—The first part of a theoretical paper on the theory of the single-phase induction motor, discussing the resolution of the magnetomotive force of the single-phase motor into two magnetomotive forces revolving in opposite directions. After a general introduction the author deals with the conception of a "revolving excitation"; he then assumes a sinusoidal winding and discusses the substitution of two excitations revolving in opposite directions for the single-phase excitation. He then passes to the discussion of the single-phase motor with a rotor of zero resistance at synchronism, and finally calculates the rotor current (taking into account the rotor resistance and the slip), the loss in the rotor, the e.m.f. of the stator and the energy supplied.—*Elek. Zeit.*, December 7.

Single-Phase Commutator Motors.—Hoerburg.—The first part an article, illustrated by diagrams, giving a review of the different types of single-phase commutator motors.—*Dingler's Polyt. Jour.*, November 25.

Small Direct-Current Motor. Colfman.—A fully illustrated article giving detailed drawings of the design of a small motor for operating railroad semaphore signals. The armature is entirely enclosed and the motor runs at the speed of 2,256 revolutions per minute when supplied from a battery at the potential of 11 volts, using ½ ampere.—*Am. Electrician,* December.

Tests of Transformers.—Drucbert.—The conclusion of his mathematical article illustrated by diagrams. The author shows how the behavior of a transformer may be determined by two simple tests at no-load and on short-circuit, whereby it must be considered that the accuracy of the results depends essentially on the curve of the applied e.m.f. A sine curve appears to be the most suitable for testing.—*L'Eclairage Elec.*, November 18.

Magnet Windings.—Underhill.—An article giving charts which enables one easily to determine, without calculation, the proper size of wire to use in the windings of electromagnets.—*Am. Electrician,* December.

Lights and Lighting.

Arc Lamps—Some notes on arc lamps made by the Gilbert Arc Lamp Company of England. The diagram of a complete end-post with lowering gear, as shown in Fig. 1, indicates the various appliances for which room must be found inside the post, and is self explanatory. Reference is then made to a flame-arc lamp made by this company. The lamp is made on the lines of German flame arc lamps so far as its general arrangements are concerned, but, in place of a clockwork feeding mechanism, there is a rocking lever and brake wheel such as is employed in a large number of ordinary English lamps. To get over the difficulty of short-life of carbons, the lamp is of the double-carbon pattern, and the two pairs of carbons are connected to the same holders. In this way, as soon as the first pair of carbons has burned away a certain extent, the second pair come together and strike an arc, and they take up the running until in their turn they have burned away sufficiently. It is claimed that there is only a flicker and no serious "pumping" when this occurs. The mechanism is placed in the top of the V formed by the two carbons so that the length of the lamp is reduced as much as possible.—Lond. *Elec.*, December 8.

Power.

French Water Power Station.—Steens.—A description of the hydro-electric station at Champ which furnishes electric power to various industrial establishments in the vicinity of the Fure and Morge valleys, not far from Grenoble. There are five 1,350-hp generating units, giving three-phase, 50-cycle currents at 3,000 volts. For transmission the voltage is raised to 15,000 or 26,000, according to the method of connecting the transformers. Current is furnished to 57 consumers, the main line being 30 km. long with various branches. At 11 sub-stations the voltage is reduced to 2,000 or 1,000. Certain consumers utilize the 1,000-volt current without further change, but the majority prefer to reduce the voltage to 120. The company owning the works has a capital of 5,000,000 francs, invested in the installation, equivalent to approximately 1,200 francs per electric horse power at the consumers' works or 550 francs per water horse power. A syndicate of leading manufacturers in the district supplied with power agreed to take 3,000 hp before the construction of the works, and at the expiration of thirty years will take over the plant. With 3,300 hp already contracted for, there is assured an annual income of 475,000 francs, which will rise to 600,000 francs when the entire output is taken. In spite of the amortization in the short period of thirty years, it seems probable that the investment of the company in the plant will yield about 8 per cent.—*Eng'ing Record*, December 9.

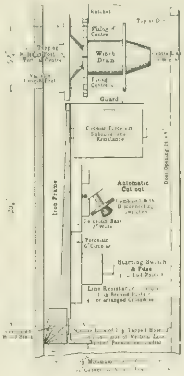


FIG. 1.—ARC LAMPS.

Refuse Destructors.—Watson.—A paper read before the Leeds section of the (Brit.) Inst. of Elec. Engs., giving many useful points as to the operation of refuse destructors and their by-products, especially the methods of taking off the gases of combustion, and the methods of applying forced draught to the furnaces. The author says that when all proper precautions have been taken in the construction and working of the plant, a destructor is a source of no nuisance whatever, and the only inconvenience of which the neighbors could possibly complain is that due to the carting of the refuse through the streets. Details are given of an official 12-hour test of the Batley destructor, 1.60 lb. of steam being produced per pound of refuse. In a one week test at Bradford the total electrical output for the week was 50,638 kw-hours, and the refuse burned was nearly 833 tons, so that the output per ton was 60 kw-hours, which is good for a continuous [illegible] of the steam used by the engines and blown off through the safety valve, was also raised by the destructor itself.—Lond. *Elec.*, December 1.

Composite Transmission.—Bruell.—An article on the transmission of alternating currents of different frequency over a line. The author first discusses the general problem of transmitting two frequencies, one N times that of the other one, and then applies it to the case $N = 3$. For motors, low frequency is more suitable, while lamps operate better with a high frequency. Fig. 2 shows his scheme for transmitting three-phase currents with a frequency, n, and single-phase alternating-current with a frequency, $3\ n$. The single-phase alternator and the single-phase lamp load are connected to the three-phase line through the intermediary of transformers.—*L'Industrie Elec.*, October 25.

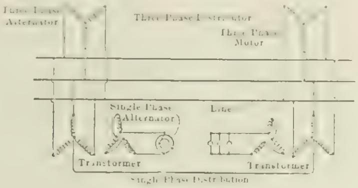


FIG. 2.—COMPOSITE TRANSMISSION.

Italian Power Transmission.—Ramakers.—An illustrated article on the transmission plant at Montereale-Cellina, which supplies Venice with power for lamps and motors. There are four 2,600-hp turbines driving 4,000-volt, three-phase alternators. The transmission voltage is 30,000.—*Am. Electrician*, December.

Electrically-Driven Refrigerating Plant.—An illustrated description of a modern cold storage plant in which the ammonia compressors are electrically driven by means of direct-coupled variable-speed motors, an arrangement naturally tending to extreme compactness and easy manipulation in comparison with that necessary with steam or gas-driven plants; electric driving and lighting has been adopted throughout.—Lond. *Elec. Rev.*, December 1.

Textile Works.—Knowlton.—An article recommending the use of direct-connected motors in textile works. While the first cost is probably higher than the group system of driving, direct-connected motors have distinct advantages, besides the lower cost of power. —*Am. Electrician*, December.

Electricity in Mines.—Mack.—An illustrated article on the best arrangement of the switchboard and wiring in high-tension installations in mines.—*Elek. Zeit.*, November 30.

Direct-Current Motors.—Clark.—An article giving some general points to be considered in the selection of direct-current motors.—*Cassier's Mag.*, December.

Boiler Power.—Hubbard.—An article telling how to estimate quickly the boiler capacity required for heating, lighting and power purposes.—*Am. Electrician*, December.

Gas Engines.—Mathot.—An explanation of the action, efficiency and limitations of various methods of governing four-cycle gas engines.—*Eng'ing Mag.*, December.

Gas Producers.—Richards.—In the continuation of his serial on metallurgical calculations, he discusses mixed gas producers.—*Electrochem. and Met. Ind.*, December.

Steam Turbines.—Marguerre and Anders.—Two communications on graphical methods for determining the efficiency of steam turbines.—*Elek. Zeit.*, November 16.

TRACTION.

Electric Railway Equipment.—Some editorial comments on W. B. Potter's recent paper before the Amer. Street Railway Assoc. "Sparking from uneven wear of copper and mica at the commutator is a rare trouble nowadays in England, and the remedy suggested by Mr. Potter strikes one as being dangerous. Probably the use of a softer quality of mica would be advantageous, but from the remark as to the larger number of commutator segments now used it seems likely that manufacturers have been driven to the use of thinner mica of harder kinds, such as Indian mica. The suggestion of a cooling fan to assist the ventilation of traction motors [illegible] of the near approach to the practical limits of the power that can be applied to standard gauge axle within the usual wheel heights. The space in locomotives is not so severely limited, and it would seem practicable and more economical to make the motor do its own fanning in every case." . . . "The technical Americanese of the whole paper is a development which we trust will not be extensively copied in England, though it has some virtues."—Lond. *Elec.*, December 2.

Belfast.—An illustrated description of the Belfast municipal tramways. The generating station forms an extension of the electrical central station. Its site has been chosen as a suitable point for distributing energy for the city's requirements both for lighting and traction purposes, and the plant has been arranged with this object in view. The generators are provided with compound windings for tramway supply at 550 volts, and when run as shunt machines for lighting they supply a pressure of from 440 to 500 volts for the outers of the three-wire system. The total capacity is now 3,400 kw. To outlaying sub-stations three-phase currents are transmitted at 6,000 volts.—Lond. *Elec.*, December 1.

Swiss Electric Railway.—Guarini.—An illustrated description of the electric trolley line of Gruyeres in the Cantons of Freiburg in Switzerland. Energy is supplied from the water power station at Mont Boven.—*Eng'ing Mag.*, December.

Single-Phase Traction.—Zehme.—An illustrated article on the single-phase traction experiments on a Paris line with the Latour system. The subject has already been dealt with in the Digest.—*Elek. Zeit.*, December 7.

Electric Automobiles.—An illustrated description of the Vedrine electric carriage which is an automobile of French make. Regulation of speed is obtained entirely by the variation of the magnetic field of the motor. The speed range of the motor is from 500 to 1,600 revolutions per minute.—Lond. *Elec. Rev.*, December 1.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Determination of Dynamo-Shunt Rheostats.—An article on determining the amount of regulating resistance for any required voltage variation, and conversely on determining the amount of regulation that may be obtained by using a given regulator resistance in the field circuit of a given shunt dynamo. For the method nothing is required but the magnetic no-load characteristic curve of the machine in question, the machine terminal volts being plotted against actual amperes excitation. Having the desired saturation curve, $A\ B\ C$, in Fig. 3, and taking, first, the case in which it is required to determine the voltage regulation obtained on the dynamo by the use of a certain resistance of known amount, from C, the point on the curve corresponding to the normal voltage of the machine, draw $C\ D$ horizontally. If this line, $C\ D$, is divided at E into two parts proportional to the amounts of resistance of the shunt field coils (hot) and the regulator resistance respectively, as indicated, a straight line joining E to the origin, O, will cut the saturation curve at a point, B, corresponding to the resultant stable voltage of the dynamo with the given resistance in the shunt field circuit. Conversely, to determine the resistance required to obtain a given voltage range, it will be seen that if a line joining the point, O, to a point on $A\ B\ C$ representing the lowest voltage required, be produced to cut $D\ C$, then the proportion between the two parts of $D\ C$ so cut will indicate the necessary proportion between the resistances of the shunt field circuit and the regulator.

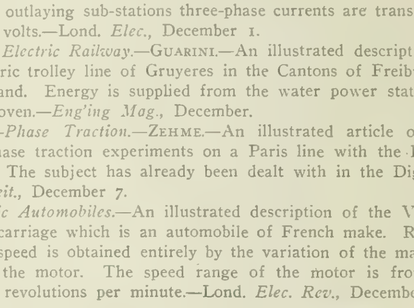


FIG. 3.—DETERMINATION OF RESISTANCE OF SHUNT RHEOSTATS.

The other method of obtaining these results is to calculate from the volt-ampere curve a second curve of ampere-ohms, which shows the total resistance in the shunt circuit corresponding to any point on the saturation curve. This total resistance curve is shown at *G F H*, the distance, *F K*, representing the regulator resistance, and the distance of *H K* from the base-line the (constant) amount of the shunt field circuit. The two methods give identical results.—Lond. *Elec. Rev.*, December 1.

German Central Station.—Seyffert.—Some statistical notes from the annual report of the German Assoc. of Central Stations. One hundred and ninety-three stations belong to the association, of which 73 are municipal and 120 are owned by corporations. One hundred and twenty-seven use direct-current, 23 single-phase or three-phase current and 43 combined direct and alternating-current. One hundred and thirty-nine plants give electric energy for lighting and power, one for traction and 53 for lighting, power and traction. Considerable statistical data are given, and it is pointed out that to get good financial results it is absolutely necessary to make the first cost as low as possible. It is thought that the first cost per kw of capacity should not be more than $325 or $375. One of the most expensive stations is in Liegnitz where the capital invested is $700 per kw, while the lowest values of the capital invested are about $100 per kw.—*Zeit. f. Beleucht.*, November 20 and 30.

Automatic Earthing Devices.—In some notes on the Alexandria-Remleh Electric railway the provision of automatic earthing forks under each line wire upon both sides of each insulator is mentioned. If a high-voltage wire breaks it drops into the fork and is immediately earthed.—Lond. *Elec.*, November 24.

WIRES, WIRING AND CONDUITS.

Wiring.—Auerbacher.—An article on "electric contract work," giving practical rules on the construction of two-wire and three-wire systems, the calculation of the size of conductors, etc. The article is illustrated by numerous diagrams.—*Am. Electrician*, December.

Calculating Net Works.—Soschinski.—A highly mathematical article on calculating net works and on an approximate method of Gauss for solving the series of equations in such problems.—*Elek. Zeit.*, November 23, 30.

ELECTROPHYSICS AND MAGNETISM.

Spark Length and E.M.F.—Hobbs.—In former researches on the relation between the potential difference and spark length the linear relation between spark-potential and distance for comparatively large values of the latter was established, and Peace noticed the existence of a minimum spark-potential. Paschen deduced from a large number of observations the law that for given potential differences the product of the sparking distance and the maximum gas pressure is a constant. Later on some experiments have been made on sparks between very small distances and these have been continued by the present author. He finds that the material of which the electrodes are composed exerts an important influence upon the spark potential at small distances and that the carriers of the discharge for small distances come from the metal and not from the gas. Some of his chief results are as follows: With one spherical and one plane electrode, at constant pressure the spark-potential is directly proportional to the distances between the electrodes, until the potential reaches the minimum value for the gas. In any gas the potential of discharge reaches its minimum value for the gas at distances which are inversely proportional to the gas pressures existing between the electrodes. For the same electrodes the discharge at distances from zero to about 3μ is wholly independent of the gas pressure or of the nature of the gas between the electrodes. For the same electrodes the distances at which the curves assume a horizontal slope are proportional to the minimum spark-potential of the gas between the electrodes. When a discharge of electricity occurs between two electrodes at a lower potential than the minimum spark-potential of the gas in which the discharge occurs, the discharge is produced wholly or in part by the metal ions.—*Phil. Mag.*, December.

Resistance of Selenium.—Coste.—An article pointing out that there are many sources of error in the usual way of measuring the electric resistance of selenium, by fusing it between two metallic plates. By rapid cooling, a vitreous form is obtained, which is insulating. By annealing, it is transformed into metallic selenium, which is conducting. Selenium combines with most metals, and it thus usually contains selenides when fused in contact with them. That this is the case has been proved by the author, who fused selenium on gold leaf and then drove it off by heat, when it left a residue of pure gold. The resistance usually attributed to selenium is untrustworthy for that reason. Carbon electrodes are not open to this objection, and the author has, therefore, operated with these. When the vitreous selenium is transformed into the metallic variety, it shows under the microscope a number of fissures, their number varying greatly with the mode of transformation and the rate of cooling. Hence the different results obtained by various observers. In spite of the fissures, the metallic variety is denser than the vitreous. The contraction commences on the surface, and leaves the fissures as it proceeds inwards. When light impinges on the selenium, some fissures are bridged, and the resistance thus decreased. The author found a resistance of 80,000 ohms in a stick 9 cm. long and of ½ sq. mm. sectional area.—Lond. *Elec.*, December 1; from *Comptes Rendus*, November 6.

Electrostriction.—More.—A paper on the dielectric strain along the lines of force. The author describes very carefully experiments showing that the effects which have been observed by himself and others can be fully accounted for by extraneous effects and that when these are eliminated the distortion of the dielectrics by an electrical charge also vanishes.—*Phil. Mag.*, December.

Electricity Through Gases.—Robb.—A second paper of a highly mathematical nature on the conduction of electricity through gases between parallel plates.—*Phil. Mag.*, December.

Ionization of Gases.—Lewis.—An account of an experimental investigation of the ionization in gases from colored flames The author discusses the specific velocity of the ions, the rate of recombination, the relation between concentration and conductivity, and the total ionization at the boundaries of the flame.—*Phys. Rev.*, December.

Thermoelectricity.—Schmitz.—An account of experiments on thermoelectricity circuits formed of three metals, the three junctions being held at different temperatures. The results are given in tables.—*Phil. Mag.*, December.

Magnetization.—Honda and Shimizu.—The conclusion of their very extended investigation of the magnetization and the magnetic change of length in ferro-magnetic metals and alloys, at temperatures ranging from —186° C. to +1,200° C. Especially extended researches were made with nickel steels, and a general rule is given for the effect of a gradual variation of temperature. A suggestion is made to explain why two strongly magnetic metals may form a non-magnetic metal.—*Phil. Mag.*, December.

Rotating Hysteresis.—Hiecke and Hermann.—Two communications of a mathematical nature on the measurement of the "rotating hysteresis."—*Elek. Zeit.*, November 23.

ELECTROCHEMISTRY AND BATTERIES.

Electric Furnace.—Hutton and Patterson.—An illustrated Faraday Society paper on electrically-heated carbon tube furnaces. The author describes two different constructions, the first being a graphite tube furnace and the second an agglomerated-carbon tube furnace. Experiments were also made with different jacketing materials. One of the chief advantages of this type of electric resistance furnace lies in the fact that the temperature can be very easily regulated and kept constant.—*Electrochem. and Met. Ind.* December.

Estimation of Cadmium.—Flora.—A note on the electrolytic estimation of cadmium with the aid of the rotating cathode. Cadmium sulphate is best fitted for electrolytic analysis.—*Am. Jour. of Science,* December.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing of Generators and Motors.—Drysdale.—A paper profusely illustrated by diagrams. The author describes an arrangement which he has devised for a laboratory whereby small motors of different types, powers and speeds can be rapidly and accurately tested. The chief point is the use of a generator permitting of a very wide range of speed and excitation, and mounted with its armature free to rotate; the excitation is varied until the machine can be switched into parallel with the 100-volt, direct-current mains. Any increase of the excitation loads the generator, and hence the motor coupled to it, by sending the current back into the mains without waste or heating; while if, on the other hand, the excitation is reduced, the load can be reduced to zero or become negative, the generator bcoming a motor and driving the machine to be tested as a generator, either direct current or synchronous or asynchronous, as the case might be. The arrangement is illustrated in Fig. 4. *G* is the generator, a four-pole, 8-kw direct current machine giving 100 volts at any speed between 750 and 1,000 revolutions per minute. This machine is provided with ball races, *B*, *B*, cut on the outside of the bearings and supported on ½-in. balls from a rigid bed-plate. To measure the torque, two gun-metal arms, *A*, *A*, are fitted to the sides of the motor, with knife-edges from which weights can be hung. Each of these arms has two knife-edges, *K*, *K*, one at a distance of 31½ in. from the axis, and the other 28.1 in. When the shaft is running at 1,000 revolutions per minute, a weight of 2 lb. on the outer knife-edge represents 1 hp, while a weight of 3 lb. on the inner knife-edge is equivalent to 1 kw. By having knife-edges on both sides, powers of either positive or negative sign can be measured with either direction of rotation. As the shaft of this machine is necessarily fixed, provision must be made for bringing the motor, *M*, to be tested in line with it. This is done by putting down a cast iron table, *T*, which can be raised or lowered from a pit by screw gear, *S*. The surface of this table is slotted, and has two slide rails, *R*, *R*, on it, which can be adjusted to any position by screwed dogs. Any machine to be tested is slid on to the rails, raised to the proper height and brought into line in approximately a quarter of an hour. The balanced generator is provided with a telescopic shaft, *T S*, allowing of a variation of length of about a foot, and on the end of this shaft is fixed an American self-centering jaw chuck, *C*, taking any shaft up to 2 in. in diameter. The author then describes the connection of the main and shunt terminals of the generator, *G*, with a special switchboard and the electrical arrangement for the machine under test. The mounting of the machine on ball bearings was found not to give sufficient sensitiveness. To increase the sensitiveness recourse was had to the swinging of the generator on knife-edges in a manner similar to that employed in a testing machine. The original article contains very detailed instructions telling how to use the apparatus, and several test curves taken by it are reproduced.—Lond. *Eng'g*, November 24.

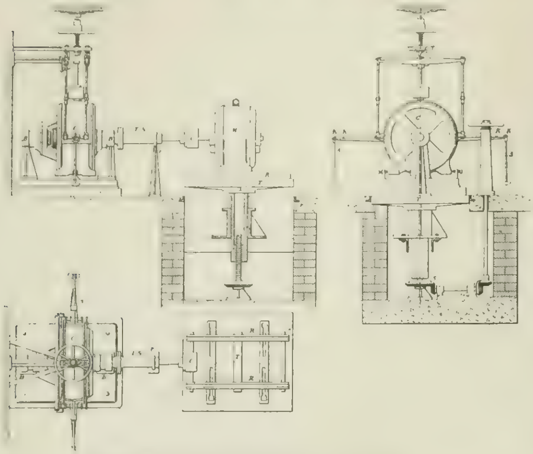


FIG. 4.—TESTING GENERATORS AND MOTORS.

Rendering Quartz Fibres Conductors.—BESTELMEYER.—The advantage of rendering a quartz fibre conducting is that in this way the necessity of charging an electrometer needle by contact is avoided. Himstedt for this purpose silvers fibre, while Dolezalek moistens it with a hygroscopic solution. The disadvantage of the first method is that the elasticity is interfered with, while in the second case the apparatus cannot be properly dried. The present author has devised a third method which is free from both objections. He platinizes the fibre by cathode disintegration. He uses a vacuum tube, as shown in Fig. 5, where *K* is a platinum wire serving as a cathode, *A* is an aluminum wire acting as an anode, and holding the quartz fibre, while *P* is a platinum wire which keeps the fibre stretched and also serves as a third electrode for the purpose of ascertaining whether the fibre has become conducting. The author uses a vacuum of 0.1 mm. Hg, a voltage of 1,280, and a current of 1 to 3 milliamperes. The fibre becomes conducting in about 10 minutes, except the ends which are embedded in sealing wax. It is best to silver the sealing wax by chemical means. The fibres so platinized show no elastic after-effect, and their conductivity appears to be permanent.—Lond. *Elec.*, December 1; from *Zeit. f. Instrumentenkunde*, November.

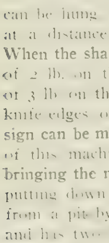


FIG. 5.—DIAGRAM OF TUBE.

Ground Detectors.—COE.—An article describing the construction and use of various types of ground detectors, and showing in diagrams their connections.—*Am. Elec.*, December.

TELEGRAPHY, TELEPHONY AND SIGNALS.

High-Frequency Currents and Electric Waves.—FLEMING.—An account of the first of the series of Cantor lectures. The author drew particular attention to the fact that the capacity is not alone a function of the form of the body itself, but also depends on the surrounding objects. Although it is possible to calculate the capacity of certain simple forms of bodies, the only accurate method for determining the capacity of complicated bodies or bodies surrounded by other objects is by direct experiment. The capacity of the earth is 800 mfd., and that of a single wire 100 ft. long and 0.1 in. in diameter one-five thousandth mfd. Mention was then made of the fact that high-frequency currents flow on the surface of the conductor. The impedance offered to high-frequency currents in a metallic wire is very high. A convenient formula for calculating this impedance (R') is the following: $R' = R \pi d \sqrt{n}/80$, in which R = ordinary ohmic resistance, d = thickness of wire, and n = frequency of oscillations. This phenomenon was illustrated by showing that a high-frequency current would jump across an air-gap rather than flow through a small loop of copper wire of small resistance connecting the two spark knobs. The spark resistance increases with the spark length, but at a somewhat irregular rate. The resistance (beyond a certain small air-gap) is smaller for zinc or brass spark knobs than for iron knobs. This must be put down to the lower melting point of zinc, which volatilizes more readily than iron and thus forms a conducting bridge of metallic vapor at a lower temperature. In order to get the equivalent of a long spark, combined with a low spark resistance, a number of spark knobs, separated by a small air-gap from one another, could be arranged side by side.—Lond. *Elec.*, December 1.

MISCELLANEOUS.

Electrotherapeutics.—JONES.—A paper read before the Hunterian Society in which the author sums up the useful therapeutic applications of electricity and their limitations. High-frequency treatment "has already shrunk into its proper small dimensions," and the light bath "is destined to become a more or less ornamental accessory in Turkish bath establishments." A large part of the paper deals with the introduction of drugs into the human body by electrolysis. For instance, to introduce zinc into a certain part of the body, an electrode is moistened with zinc chloride or zinc sulphate and used as anode. The author has obtained in this way good results in the local treatment of rodent ulcers.—Lond. *Elec.*, December 1.

Ventilation and Warming of Theater.—A note on the system of warming and ventilation of the Theater Royal, Drury Lane. There are used four electrically-driven large centrifugal fans, the aggregate weight of which amounts to about 3 tons. They are driven by four motors representing a total capacity of 33 hp. Fresh air, warm or cold, according to requirements, is being continually pumped into the theater by one set of fans, while the other set extracts air from the building.—Lond. *Elec.*, November 24.

Standardization of Incandescent Lamps.—An editorial referring to a report of the sub-committee of the (Brit.) Municipal Association on standardization of carbon-filament incandescent lamps. The report has not yet been made public. It is doubted by the editorial writer whether the standardization of incandescent lamps is really necessary at present or would be advantageous to the electricity supply industry generally. "It is an open question whether the time and energy which would be expended by the lamp manufacturers in modifying their processes so as to enable each lamp to comply with a close specification, would not be better devoted to experimental research in the direction of improving the existing lamp rather than standardizing it in its present form."—Lond. *Elec.*, November 24.

BOOK REVIEWS.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION. Year ending June 30, 1904. Washington: Government Printing Office. 804 pages, illustrated.

As usual with the annual volume issued by the Smithsonian, this report contains many papers of interest to the general reader of science and also to the specialist. This volume contains a full account of the Rumford spectroheliograph of the Yerkes Observatory, which is attached to the 40-in. refractor, and also eighteen plates of results obtained showing the solar disc, faculæ, calcium flocculi, hydrogen flocculi, etc.

For the measurement of radiant energy, a new form of the Langley bolometer was designed for use at the St. Louis Exposition where expert attention would not be available. The arms of the balance could be adjusted to anything between 1/200 to 1/200,000,000 of the relative value of the resistances.

The distinguished secretary, S. P. Langley, contributes an account of experiments made with his aerodrome in the concluding sentence, of which we are told that "There have been no failures as far as the actual test of the flying capacity of the machine is concerned, for it has never been free in the air at all." The failures which were reported in the papers occurred on the launching ways, so that the question of its ability to fly is yet an untried one. To decide this time and money are both necessary.

Other subjects treated in this volume are: "New Methods of Lighting," by A. Berthier; "Electric Welding," by Elihu Thomson; "Discoveries in Photography," by Robert Hunt, with photographs of Niepee, Fox Talbot and Daguerre. The biographical sketches include Sir George Stokes, by Ernest W. Brown; Karl Alfred von Zittel, by Charles Schacert, and Karl Gegenbauer, by Oscar Hertwig.

WIRELESS TELEGRAPHY. Its History, Theory and Practice. By A. Frederick Collins. New York: McGraw Publishing Company. 300 pages, 332 illustrations. Price, $3.00.

Mr. Collins' book is a valuable addition to the literature of wireless telegraphy. Chapters I to VIII, inclusive, are in the main theoretical in their nature, and treat successively of the ether, wave motion, electric waves, disruptive discharge, electric oscillations, oscillators, capacity, inductance, resistance and mutual induction. Chapters IX to XI treat of the different forms of induction coils, interrupters and oscillating-current generators now in use. Chapters XII to XIX take up wireless telegraphy proper and the various forms of transmitters and receivers used in the art. The last chapter describes the different systems of wireless telephony which have been invented up to the present time.

The book is particularly strong on the practical side and there are many excellent and unusual pictures and diagrams of apparatus now in use by the different systems. There are also pictures of the exteriors and interiors of a number of stations.

Chapter I on the ether gives a good description of the supposed nature of that imponderable medium and Chapter II of wave motion in general. In Chapter III there is a description of Herz's classical experiments. Fig. 35 at the end of this chapter shows the lines of electrostatic force radiating from the top of the antenna, but this diagram is incorrect, as the lines of force are distributed along the length of the antenna from the top to the bottom; also, the peculiar figure (Fig. 36) showing a reflection of the electric wave from the more rarefied strata of air, back to the earth, cannot represent the actual state of things. According to the best modern opinions upon the subject, the electromagnetic waves travel outward from the antenna in ever-expanding circles, like the ripples from the point where a stone strikes the surface of a pond. A slight reflection of the waves from the upper rarefied layers of the atmosphere may take place, but probably does not radically change the ripple mode of propagation. The ether ripples probably differ from the water ripples in one important way, namely, that they increase instead of decrease in height as they go outwards. Fig. 35 in Mr. Collins' book is not nearly as satisfactory as Fig. 93 in Vreeland's recent book on the same subject. In this same chapter Mr. Collins also states that "Lebedew and Fleming have produced electric waves so short as to be measured by the ten-millionth part of an inch." The reviewer believes this statement to be incorrect; in fact, he is not aware that electric waves have been produced less than a few centimeters in length.

The chapters on disruptive discharge and on electrical oscillations and oscillators are good. Those on capacity, inductance, resistance and mutual induction are good and embody many things not usually contained in books on wireless telegraphy; as, for instance, that part of the chapter on mutual induction which contains the elementary theory of the induction coil. The chapters on induction coils, interrupters and generators contain many excellent pictures and much useful information.

The chapters enumerated form about half the book. The rest of the book deals with wireless telegraphy proper and contains descriptions of the different systems and much detailed information. The pictures and diagrams are good. No attempt has been made to give a complete mathematical theory of wireless telegraphy, and only a few scattered equations have been given.

LEHRBUCH DER PRAKTISCHEN PHYSIK. By F. Kohlrausch. Berlin: B. G. Teubner. 656 pages, tables and illustrations. Price, 9 marks.

This is the tenth edition of this text-book on physics, which for over twenty-five years has, in its successive issues, been accepted as one of the standard authorities on its subject. Those who were reared on the immediately preceding editions, or have had occasion to consult them frequently, will recognize this latest revision as following closely along the lines of the others.

It does not pretend to be more than a text-book dealing with principles only, but presents an orderly homogenous assemblage of physical laws and facts with occasional efforts at critical handling. As a treatise on physics it is more or less elementary, to be sure, and in his desire to compact the pill of knowledge to the uttermost the author not infrequently sacrifices clearness to terseness. The result is not all that might be desired for a beginner who has not considerable command of the German language, and would conceivably prove embarrassing even to the German student if not supplemented, as it should be, by much junior laboratory and lecture-room work. The almost exclusive employment of the most skeletonized diagrammatic illustrative figures in pursuance of the writer's plan of avoiding "pictures" might be somewhat criticised, although it must be confessed that it is refreshing once in a while to find a volume whose illustrations are not all familiar contributions "by courtesy" and incidentally for the advertising benefit of apparatus makers.

The reviewer has not taken occasion to dig through this present volume page by page to discover what main differences there may be between it and the preceding 1901 edition. The tables have been increased to some extent, now forming a total of sixty-four, all convenient and many valuable; and there is an interesting two or three pages on the determination of constants by the method of least squares. There are doubtless many who would be glad to have such a text-book in shape for ready assimilation by their students, and others who have left their student days behind who might on occasion find it most convenient to be able to pluck it from a shelf for a hasty refresher on some half forgotten subject.

SUBJECT LIST OF WORKS ON ELECTRICITY, MAGNETISM AND ELECTROTECHNICS. Library of the British Patent Office. London: His Majesty's Stationery Office. 286 pages. Price, 8 pence.

This latest edition of the Subject List of the Electrical Library of the British Patent Office enters 2,374 works, including pamphlets and 131 serials, representing a total of 3,792 volumes. That the library can in no respect be considered a complete one is evident from a comparison with the Library of the American Institute of Electrical Engineers, which has 8,996 volumes and 6,737 titles; the latter figure would, moreover, be increased by several thousand if the titles were included of the separate pamphlets in the Wheeler collection.

Checking a few sections of the list to get an indication as to how fully American publications are represented in the collection, we find that under "Pocketbooks, Tables," neither Foster's "Handbook" nor Hering's "Reference Tables" is entered. A reference to Mottelay's "Chronological History of Electricity," which originally appeared in this journal, only indicates the fragment which appeared in London *Engineering*. Only one of the several American telephone journals is entered, and this not the most important. American electric traction periodicals are only represented by the short-lived *Electric Railway Advertiser* of 1890-91 and the *Street Railway News* of 1891. General works on electricity and magnetism dated before 1880 are included under "Static Electricity." The oldest work is one by Boyle, 1675, the next earliest bearing the date 1744;

and the great rarities in old electrical literature are conspicuous by their absence. As the object of the library appears to be primarily for use in connection with researches into invention, this deficiency is perhaps a natural one. Doubtless the criterion applied in purchasing books has been their probable utility in connection with researches by patent office examiners and inventors, and from this standpoint the catalogue should be a useful bibliography.

BOOKS RECEIVED.

Cams and the Principle of Their Construction. By George Jepson, New York: D. Van Nostrand Company. 59 pages. 37 illustrations. Price, $1.50 net.

The Production of Aluminum and Its Industrial Use. By Adolphe Minet. New York: John Wiley & Sons. 266 pages, 57 illustrations. Price, cloth, $2.50.

Telegraphy. A Detailed Exposition of the Telegraph System of the British Post Office. By T. E. Herbert. London: Whittaker & Company. 912 pages, 509 illustrations. Price, $2.60.

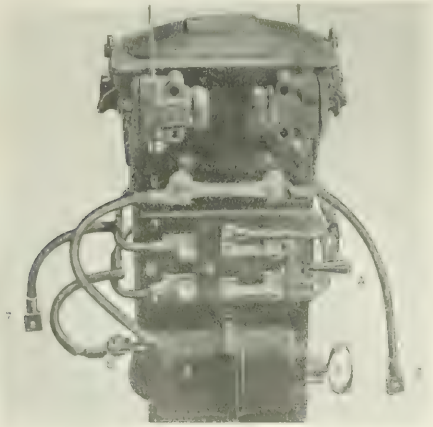
La Separation Electromagnetique et Electrostatique des Minerais. By Desire Korda. Paris: *L'Eclairage Electrique.* 219 pages, 54 illustrations. Price, 6 francs.

Die Moderne Theorie der Physikalischen Erscheinungen. By Augusto Righi. Leipzig: Johann Ambrosius Barth. 152 pages, 17 illustrations. Price, 2.80 marks.

Transformer for Thawing Frozen Water in Pipes.

The illustrations herewith show a thawing transformer recently placed on the market by the Pittsburg Transformer Company, Pittsburg, Pa. This transformer is equipped with primary fuse blocks, a controlling device for adjusting the current, a heat indicator and a large capacity secondary switch. The primary leads of the transformer run through porcelain bushings in the backboard and into the fuse blocks. Within the transformer is a porcelain terminal block, changing the connection of which adapts the transformer to operation on circuits of approximately 1,100 volts or circuits of approximately 2,200 volts.

Four secondary leads issue from the front of the case and pass to the terminals of the double-pole double-throw switch No. 4. Throwing this switch to the left connects the secondary coils in multiple, so that the transformer delivers 37½ volts and has a capacity of about 800 amperes. Throwing switch to the right puts the secondary coils in series, so that a pressure of 75 volts is obtained, the current capacity being 400 amperes.



REAR VIEW OF THAWER.

The secondary line passes through the choke coil, 5, and from there to the heat indicator, 3. The choke coil plunger is shown at 6. The choke coil consists of several turns of copper rod, and has a laminated iron core, supplied with a handle for pushing in and out, thus altering the choking effect to suit the conditions involved.

The heat indicator is simply a short section of lead pipe connected in series with the low-voltage winding, in the same manner as a fuse, its temperature being a guide as to the heating of the pipe under treatment.

The capacity of the thawer is normally 400 or 800 amperes, as stated above, but currents considerably in excess of these values may be drawn for short periods. It should be remembered that usually the temperature of the air will be below freezing point or even many degrees below zero. Under such conditions a temperature rise in the transformer as high as 100 to 125° C. above the air will still be within the usual working limits.

The intermittent nature of the work is also favorable, and it will frequently be found that 500 to 600 or 1,000 to 1,200 amperes can safely be drawn from the thawer. Snow or ice can also be applied to the cast iron case to assist in cooling when running under extreme loads for considerable periods of time.

While pipes exposed to the air generally burst in freezing, yet it has been found that when they are in the ground very few cases of bursting are met with. It has been observed that but one case in 600 shows rupture under such conditions, due perhaps to the fact that the earth first freezes solidly around the pipe, thus preventing its expansion from internal pressure. This is of the greatest importance, for were it otherwise, electrical thawing would be of small practical use.

It is to be noted that ammeters or voltmeters are valueless for this work and are therefore a needless expense. The operator has no interest in the voltage or the current strength, as long as these are sufficient for the purpose. The heating effect is the important feature, and it is a simple matter to judge this by touching the heat indicator with the hand or with a wet mitten. The most unskilled operator knows when this pipe is hot, although he might be entirely at a loss to know whether he should use 200 amperes or 500 amperes were he dependent upon an ammeter. It is claimed that its simplicity makes this outfit the most practical as well as the cheapest successful device of this kind yet produced.

Vertical Pump Motors.

The Electro-Dynamic Company has recently supplied a number of 50-hp and 100-hp "Inter-pole" motors, shown in the accompanying illustrations, to operate centrifugal pumps, built by the Southwark Foundry & Machine Co. The outfits are used in connection with two Weiss central condensing plants, and pump either to the condensers or cooling racks as desired.

The 50-hp vertical inter-pole motors have a speed variation of 2 to 1 and operate 8-in. pumps. The pumps are of the single inlet pressure balance type and are direct connected to the motors by means of flexible couplings. They are equipped with thrust bearings for the pump shaft and have runners on the top side cover. With this equipment pumping is done direct to the condensers. Each pump has a capacity (normal rating) of 1,700 gallons per minute, and has a starting head of 50 ft., with a regular service of 50 ft,. less head due to vacuum, or an average of 25 ft. The 100-hp motors, also illustrated, have the same speed variations, and the same conditions apply as for the 50-hp motors with the exception that they are connected to 12-in. pumps and have a normal rating of 3,200 gallons per minute. . The total head is 45 ft. continuous.

VERTICAL PUMP MOTORS.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The weather conditions favored holiday trade and few of the seasonable goods will remain undisposed of. People had plenty of money and spent it liberally, and the holiday business of this year will hold the record. Retail trade in heavy winter goods still drags, owing to the unseasonably mild weather. Excellent reports are received as to spring business and indicate activity in excess of previous years. Manufacturing is active, iron and steel leading with enormous outputs and record engagements ahead in all crude and manufactured products. Open fall weather still favors building activity, and another big year is indicated by high prices and active demand for material, particularly in lumber. Winter wheat is in good condition. The demand for money is active but collections are reported to be a trifle slow. Cash is moving to the interior. The situation in metals of all kinds is quite unprecedented. During the year 34,000,000 tons of iron ore were sold and shipped, and sales for 1906 aggregate 30,000,000 tons at higher prices. The Steel Corporation is reported to have 7,300,000 tons of material on its books, a gain of 55 per cent over a year ago. Crude steel is scarce. Chicago district mills have their entire 1906 rail output engaged. Prices of pig iron are firm and tend upward. The market for other metals was strong, and copper touched record prices of late years, sales being reported at 19½c. One of the largest metal firms, whose output from its own copper mines and smelting works exceeds 5,000,000 lbs. per annum, has sold the bulk of its estimated output for 1906 at 18¾c. to a syndicate of brass rolling works. This firm is about opening three mines in Mexico, and has contracted for a new smelting plant that will double its output of this year. High prices are stimulating the gatherers of old copper to the utmost. In the old metal trade, copper stock is scanty and fetches 17½@18¼c. for heavy cut and crucible; light and bottom rule at 15¾@16c; machinery composition, 15⅞@16c. Exports of copper through the port of New York from December 1 to 23, inclusive, were 13,000 tons—mainly for account of contracts made six months ago. Orders booked for cars, locomotives and other rolling stock in 1905 largely exceed those of any preceding year. *Bradstreet's* reports 235 business failures during the week ending Dec. 21, against 226 the week previous and 249 the corresponding week last year. The commercial failures so far this year show a large decrease in number and in liabilities, and analysis discloses reason to interpret the figures even more favorably than their face. Manufacturers' failures show a decrease of both number and amount, the total, $46,582,475, being some nine million dollars below 1904. The unsuccessful traders report liabilities of $52,080,400, or fourteen millions below 1904. Brokers and transporters also report a decrease of liabilities by twenty-one millions. In other words, all three great classes make returns which are absolutely and relatively good.

THE COPPER SITUATION. The *Copper Gossip*, of the National Conduit & Cable Company, has the following with regard to the copper situation: "The market for copper is exceedingly strong, and for sometime past has been growing stronger daily. On the positive evidence of the scarcity of available copper for nearby delivery a sharp upward movement set in about three weeks ago. Between November 25 and December 15, electrolytic wire bars advanced from 17½ to 19 cents. The present copper situation is a phenomenal one, and the strong position of the metal cannot be gainsaid. Most of the producers have sold a large proportion of their output for months ahead, and this fact alone is one of the best evidences of the confidence felt in the outlook. Consumption has increased steadily on the rising market, and demand in 1905 surpassed anything previously reached. Domestic wire drawers and melters of copper generally have had an unprecedented volume of orders, and there is no noticeable curtailment in business on the current high prices. The market is obviously strong on legitimate business conditions of a highly favorable nature, and the prospect for a continuance of extremely prosperous times is remarkably good. It is conceded by leading authorities, who have exceptional opportunities to judge of the actual merits of the copper situation, that intrinsic conditions warrant the expectation of market strength for months to come. The trade is on a wonderfully sound basis, and the heavy tonnage required to meet the home and foreign demand justifies the strong tone. Manufacturing plants are rushed with orders, and business already secured insures very active operations for a good part of 1906. Cash copper is very scarce, and the small lots procurable command a premium. A feature of the situation is that consumption goes right on at tremendous rate. Prices have reached a high level, and the tendency continues upward as offerings become more limited. Natural causes thus far have been favorable to stability, and it is to be hoped that conditions will not become so acute as to send prices very much higher. Copper at 25 cents a pound would probably prove too high to maintain all round satisfactory conditions."

THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO. are furnishing equipments for an unusually large number of industrial power plants of a diversified character. Among recent shipments are included one to the Lehigh-Northampton Gas & Electric Company, Catasauqua, Pa., of a 150-kw, 350-volt, three-wire engine type generator and two auto transformers; to the Keystone Coal & Coke Company, Keystone, W. Va., one 350-kw, 550-volt, engine-type generator and a 60-kw, two-phase, 1,100-volt alternator; to the Granite City Hospital, Granite City, Ill., a 35-kw, 250-volt, type S engine type generator, and many others could be mentioned. Owing to the magnitude of the works of the Westinghouse Electric & Manufacturing Company a great many people have received an erroneous impression that the product of this company consisted principally of only the larger types of electrical apparatus, especially so with reference to electrical generating units. The aggregate business of this company, however, in the smaller units far exceeds that of the larger and special types. They manufacture every kind of electrical apparatus for either light or heavy work, and their instruments for measuring electrical energy equal in delicate construction the works of the better class of modern watches. These instruments are recognized standards in their field.

THE NEW YORK, NEW HAVEN & HARTFORD LOCOMOTIVES.—During the past week the first of the twenty-five Westinghouse single-phase electric locomotives ordered by the New York, New Haven & Hartford Railroad for operation on its lines between Woodland and the Grand Central Station in New York City, was received from the Baldwin Locomotive Works, Philadelphia, by the Westinghouse Electric & Manufacturing Co. at its works at East Pittsburg. The Baldwin Co., working jointly with the Westinghouse Co., constructs the locomotives and the Westinghouse Co. provides the electrical equipments. Each locomotive is to be equipped with four Westinghouse single-phase railway motors of the straight series gearless type and also with the unit switch system of multiple control. It is expected that this first locomotive will be ready to run by the middle of January, 1906.

FEED WATER REGULATOR.—That the feed water regulator has become a necessity in modern boiler plants is demonstrated by the recent sales reported by the Williams Gauge Co., of Pittsburg, Pa. Within the last four weeks it has sold equipment for 12,500 hp to the Great Northern Paper Co., 5,000 hp to the National Tube Co., 4,500 hp to the Lehigh Valley R. R., 2,000 hp to the New York Central R. R., 2,500 hp to the Holyoke Street Ry., 4,000 hp to the Pressed Steel Car Co., 2,000 hp to the Buffalo & Susquehanna Coal & Coke Co., 2,500 hp to the B. Altman Co., etc., etc. The entire equipment furnished by the Williams Gauge Co. to date will aggregate 4,100,000 horse power. In some instances these regulators have been in use for upwards of six years without noticeable cost of repairs. Its makers claim that it will pay for itself from two to three times annually in fuel saved and increased boiler efficiency.

SOUTH CAROLINA POWER.—A Charlotte special says the Southern Power Company, capitalized at $7,000,000, has purchased the water power at Ninety Islands on the Broad River in South Carolina, and will proceed to expend $1,000,000 on a 12,000 hp plant. The Southern Power Company is said to control water capable of developing 2,000,000 hp. Dr. W. Gill Wylie, of New York, is president, and J. B. Duke is vice-president of the company.

ELECTRIC AUTOMOBILES.—The Babcock Electric Carriage Co., of Buffalo, N. Y., has purchased the Buffalo Electric Carriage Co., and with increased capital will increase the yearly output to 500 vehicles. F. A. Babcock is president; F. L. Bapst is vice-president, and E. R. Whitney secretary and treasurer.

APPARATUS FOR BOHEMIA.—Mr. F. Ludikar, Jurusalemska ulice, 14, Prague, Bohemia, Austrian Empire, commission agent and merchant in general electrical supplies, desires to communicate with firms manufacturing electrical specialties for power, light, heat, etc.

CURTIS TURBINES.—The General Electric Company is reported to have sold 504 Curtis turbines and to have shipped 315, large and small, up to the middle of December.

CHICAGO PNEUMATIC DRILL.—President Duntley, of the Chicago Pneumatic Tool Co., says: "We are now doing easily 90 per cent of the pneumatic tool business of the world. One-third of our business is done by our foreign companies. The outlook here and abroad is such that I favor an increase in our dividend rate from 4 to 6 per cent. We made a mistake at the beginning in paying 8 per cent. We had to come down to 7 per cent and then to nothing. Later we paid 1 per cent quarterly. This takes a little more than $20,000 per month, which deducted from our surplus earned in October, would leave us a surplus of about $37,000 for that month. October was one of our best months, but not conspicuously so. November was at least as good and indications point to a steady increase month by month without a corresponding increase in operating expenses. We shall continue our policy of charging liberally to depreciation, which item in October was nearly $11,500, and of reducing prices as our business expands. Our foreign policy is to make the rougher grades abroad, leaving the home factories free for work on the finer grades which can be made more cheaply here. In England we make one drill. Here we make twenty-five sizes. In Berlin we also make some drills. Next year we may make compressors in Europe. Foreign governments and shipyards are using our drills and riveters and hammers extensively. Just before I left the Riveters' Union in England accepted a 30 per cent reduction in wages based on the use of our tools. We are now bringing out a line of electric tools, which will create a new industry and a new market that will not infringe on the market for air drills, but supplement it. We have a 40-lb. machine you can attach to the electric light and with it drill a 2½-inch hole in iron or steel. This will be used for the interior work on buildings, drilling in marble and so on. We are selling our goods 40 per cent cheaper than we did four years ago and making more money out of the business than we did then."

THE SOUTHERN POWER COMPANY.—The purchase by the Southern Power Company of an important water power on the Broad River, in South Carolina, makes a total of ten falls now owned by the company. By the time these are all developed they will provide some 150,000 hp which will be distributed to cotton mills throughout the Piedmont region of North and South Carolina. By the acquisition of the stock of the Catawba Power Company, the new company now owns a water power at Charlotte, N. C., which is delivering about 10,000 hp to Charlotte and other towns. Nine of the ten falls are on the Catawba, aggregating about 400 feet of fall and expected to produce from 100,000 to 150,000 primary horse-power. On the Broad River the fall recently acquired is 72 feet. One of the largest plants projected is at the Great Falls on the Catawba, where the company owns a fall of 175 feet. There will be three separate developments and one of them is expected to deliver 30,000 hp by the end of 1906. The Southern Power Company is capitalized at $7,500,000, of which $2,500,000 is preferred, and has issued $2,000,000 preferred stock and $4,000,000 common. Bonds of $5,000,000 have been authorized for construction work, but more have been issued.

GREAT EASTERN TELEPHONE.—Controller Grout began an investigation last week of the Great Eastern Telephone Company, which has announced that it will shortly begin laying conduits, wiring buildings and installing instruments in all the boroughs of New York City. The officers of the Great Eastern Company declare they will do this under the franchise granted in 1883 to the Electric Lines Company, which is now owned by the Great Eastern Company. Inquiry shows that no application has been made by the company for permits to begin the installation of the system. In 1892 the Supreme Court of the United States rendered a decision which was taken to settle the right of the Electric Lines Company to construct these lines under the streets of New York City, and the Controller intends to test the right of the company to begin operations without going before the Board of Estimate to secure a franchise in the regular way. The officers of the company are D. A. Reynolds, president; J. V. V. Olcott, vice-president; Eugene H. Bock, secretary, and W. M. Reynolds, treasurer.

ELECTRICALLY OPERATED VALVES.—An order for 149 electrically operated valves, for the Cincinnati filtration plant, has been received by the Fairbanks Company, Elm and Broome Streets, New York City, and the valves are being manufactured by the Pratt & Cady Company, Hartford, Conn. They will be installed in 29 chambers and electrically operated from the floor above. There will be nine valves in the head chamber and five in each of the others. They will be geared to the floor stand on which is mounted the motor. The valves will be controlled from a distant point, and there will also be a switchboard in each chamber on which will be mounted the controlling device to open and close the valves, which will be designed to take care of overload and underload at any point. The motors will be Crocker-Wheeler and the controlling devices will be manufactured by the Cutler-Hammer Manufacturing Company.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph instrument statement for the month of November and since December 31 last, compares as follows:

Month of November.	1905.	1904.	1903.	1902.
Gross output	183,470	103,022	96,963	93,487
Returned	49,075	39,934	32,297	36,838
Net output	134,395	63,088	64,666	56,649
Since December 31:				
Gross output	1,677,800	1,094,291	1,020,941	994,422
Returned	566,553	465,631	441,013	420,682
Net output	1,111,242	628,660	579,928	573,740
Total outstanding	5,591,811	4,468,177	3,730,248	3,099,346

RECENT STURTEVANT ORDERS.—The new machine and smith shops of the Pennsylvania Railroad Company, Hollidaysburg, Pa., are to be heated and ventilated by apparatus furnished by the B. F. Sturtevant Company, Boston, Mass. The fan is to be electrically driven by a Sturtevant motor. W. A. Choate Manufacturing Company, Wilmington, Vt., is installing a complete heating and dry kiln apparatus furnished by the Sturtevant Company. The machine room of the Piermont Paper Company, Piermont, N. Y., containing over half a million cubic feet of space, is to be ventilated by apparatus furnished by B. F. Sturtevant Company.

BLACK RIVER, WIS., POWER.—At Lacrosse, Wis., the Lacrosse Hydro-Electric Light & Power Company has been incorporated with a capital stock of $1,000,000, to put a water power plant at Mormon Riffles, near Black River Falls, on Black River, with a minimum of 12,000 horse power. Plans call for the immediate expenditure of $750,000 and a further outlay of $500,000. Current will be transmitted to Lacrosse, 55 miles, and to Winona and to other cities and towns within a radius of 100 miles. Col. Orlando Holway, E. G. Boynton and Roy Bingham, all of Lacrosse, are among those interested in the development.

VEHICLE EQUIPMENT CONTRACT.—The board of contract of Rochester, N. Y., has let the contract for the two electric patrol wagons to take the place of the present horse wagons. The contract for the two wagons and necessary batteries was given to the Vehicle Equipment Company of Long Island City for $5,630. It is specified in the contract that the city may order 2,000 pound wagons in place of the 1,000 pound wagons bid on if it wants to. The extra cost will not be over $450.

BIDS FOR NAVY SUPPLIES.—Bids will be received until Jan. 2 at the Bureau of Supplies and Accounts, Navy Department, Washington, to furnish at the navy yards at Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., supplies as follows: Panel boards, cable, conduit and fittings, electrical supplies, incandescent lamps, testing generators, volt-meters, electrical wire, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

Financial Intelligence.

THE WEEK IN WALL STREET.—News of banking troubles in Chicago early in the week caused a sharp break in the stock market, from which, however, recovery was sharp, and further aggressive bullish manipulation in various specialties was afterwards witnessed. The most serious break of the early-week occurred in Amalgamated Copper and other copper mining shares, that group having been unduly bulled of late, so that there was an extended weak long account open in such securities. On Friday the market found additional material for active bullishness in the reports of the closing of negotiations for the sale of the controlling interest in the Metropolitan Street Railway to the Interborough Rapid Transit Company. Local traction stocks became active and advanced sharply on the report of the deal. This, of course, means that the Interborough Rapid Transit Company will control the entire traction situation in Manhattan and Bronx, and it is naturally assumed that this is the first important step toward the still more comprehensive consolidation of the public utility properties in Greater New York so long expected. Metropolitan Street Railway closed with a net gain of 7½ points, at 127½, the range of prices being between 110⅛ and 130½. The number of shares sold was 284,500. Interborough Rapid Transit closed at 237, which is an advance of 20 points. This stock at one time was quoted at 240⅜, and the lowest figure of the week was 218. Brooklyn Rapid Transit did not show any effect of the New York deal, although there was a good business done. This stock closed at 80⅛, which is a net decline of 1⅛ points. Allis-Chalmers common closed at 22, a net gain of ⅜, and the closing price of preferred was 92. General Electric made a gain of 1¾, closing at 176¾, and

Westinghouse common advanced 1 point, closing at 176; preferred closed at 190. Western Union advanced 1⅜ closing at 92¾, ex-div. American Telephone & Telegraph gained 3¾ points, the closing quotation being 137¼. Following are are closing quotations of Dec. 26:

NEW YORK

	Dec. 19	Dec. 26		Dec. 19	Dec. 26
Allis-Chalmers Co	21⅛	21¾	General Electric	174	177
Allis-Chalmers Co. pfd	61	61	Hudson River Tel	..	.
American Dist. Tel	37	37	Interborough Rap. Tran	217⅛	235⅛
American Locomotive	68	70¼	Mackay Cos	54⅝	59⅛
American Locomotive pfd	116	117⅜	Mackay Cos. pfd	72	73¾
American Tel. & Cable	87	83	Marconi Tel	..	.
American Tel. & Tel	134	139⅛	Metropolitan St. Ry	120⅞	126⅛
Brooklyn Rapid Transit	88	89	N. Y. & N. J. Tel	..	.
Electric Boat	28	28	Western Union Tel	93¾	92⅛
Electric Boat pfd	70	70	Westinghouse com.	173	172
Electric Vehicle	12	15	Westinghouse pfd	..	..
Electric Vehicle pfd	15	20			

BOSTON

	Dec. 19	Dec. 26		Dec. 19	Dec. 26
American Tel. & Tel	136¼	140	Mass. Elec. Ry. pfd	58	59
Cumberland Telephone	...	..	Mexican Telephone	.	3¼
Edison Elec. Illum	...	240	New England Telephone	131½	131¼
General Electric	.	..	Western Tel. & Tel	.	..
Mass. Elec. Ry	.	15	Western Tel. & Tel. pfd	.	91¼

PHILADELPHIA

	Dec. 19	Dec. 26		Dec. 19	Dec. 26
American Railways	52	52	Phila. Electric	8⅜	8⅝
Elec. Co. of America	11	11	Phila. Rapid Trans	30¼	31
Elec. Storage Battery	81½	80	Phila. Traction	100⅛	.
Elec. Storage Battery pfd	.	.			

CHICAGO

	Dec. 19	Dec. 26		Dec. 19	Dec. 26
Chicago City Ry	197¼	197	National Carbon	76	79
Chicago Edison	...	..	National Carbon pfd	*120	116⅛
Chicago Subway	..	.	Union Traction	.	.
Chicago Tel. Co	.	..	Union Traction pfd	..	...
Metropolitan Elev. com	26½	26⅛			

* Asked.

MASSACHUSETTS ELECTRIC REPORT.—The pamphlet report of the Massachusetts Electric Companies for the fiscal year ending September 30 makes a materially better showing than for the previous twelve months. The consolidated income account of the controlled railway and electric light companies follows:

	1905.	1904.	Increase.
Gross earnings	$6,734,128	$6,380,863	$353,265
Operating expenses	4,456,303	4,479,520	*23,217
Net earnings	$2,277,825	$1,901,343	$376,482
Interest, rent and taxes	1,543,514	1,462,626	80,888
Net dividend increase	$734,311	$438,717	$295,594
Dividend	372,448	466,003	*93,555
Surplus	$361,863	def. $27,286	$389,149

* Decrease.

The profit and loss statement of the Massachusetts Electric Companies holdings company compares with the previous year as follows:

	1905.	1904.	Decrease.
Dividends stocks owned	$372,540	$466,016	$93,476
Interest received	77,030	105,181	28,151
Total income	$449,570	$571,197	$121,627
Total expenses	17,170	15,222	*1,948
Net income	$432,400	$555,976	$123,575
Charges	127,400	121,500	*5,900
Balance	$305,000	$434,475	$129,475
Dividends	..	616,722	616,722
Surplus	$305,000	def. $182,247	*$122,753
Discounted coupon notes	157,500	......	*157,500
Balance surplus	$147,500	def. $182,247	*$329,747

* Increase.

In his report to the stockholders President Gordon Abbott says: "The usual amount of reconstruction determined by the Railroad Commissioners during the past year necessitated a charge of $311,970 to the profit and loss account of the operating companies. The remaining surplus permitted dividends of only 2 per cent for the year, excepting that in the Hyde Park Electric Light Co., which earned and paid 8 per cent. These dividends were paid into the treasury of the Massachusetts Electric Companies, but after charging off the discount on the coupon notes your trustees have thought it wiser not to declare any dividend on the preferred shares in view of the work still to be done on the properties."

RAILWAYS COMPANY GENERAL.—The Michigan Traction Company securities held by the Railways Company General, of Philadelphia, have been sold, the amount being put at $349,000. The Michigan Traction Company is one of the six companies controlled by the Railways Company General, and is a property which the company has spent several years in improving. The sale made at the Railways Company General places in its treasury, it is stated, cash and assets greater than the market price of its entire capital stock, leaving it five other companies to represent a handsome surplus. The Michigan Traction Company's lines extend from Kalamazoo to Battle Creek, a distance of about 27 miles, and with city lines has a total mileage of 54 miles. The purchase was made in behalf of the same interests which control the Jackson and Battle Creek road, which extends from Battle Creek eastward, a distance of 45 miles toward Detroit. The Jackson & Battle Creek road is believed to have made arrangements with the Detroit, Ypsilanti & Jackson running eastward from Jackson to Detroit, a distance of 105 miles, and connecting there with the Detroit United. In addition to the combination of these three lines, an extension westward from Kalamazoo to Grand Haven on Lake Michigan has been planned, giving finally a through rail and electric route from Detroit to Chicago.

BOSTON ELEVATED.—The growth of electric traction is shown by the figures of the Boston Elevated Railway Co. for the year ended September 30, 1905. The income account and traffic statistics compare as follows:

	1905.	1904.	1903.	1902.
Gross	$12,689,676	$12,391,353	$11,959,514	$11,321,030
Expenses	8,617,653	8,631,553	8,259,860	7,862,572
Net	$4,072,023	$3,759,800	$3,699,654	$3,458,458
Other income	51,893	45,240	59,856	....
Total income	$4,123,916	$3,805,040	$3,759,510	$3,458,485
Charges	3,288,831	2,975,268	2,932,556	2,836,560
Surplus	$835,085	$829,772	$826,954	$621,898
Dividends	798,000	798,000	798,000	600,000
Surplus	$37,085	$31,772	$28,954	$21,898
Rev. miles run	48,069,404	48,317,881	47,476,702	45,772,836
Rev. pass.	246,941,776	241,681,945	233,563,578	222,484,811

The charges above of $3,288.831 are made up of the following items: Interest, $779,757; taxes, $1,047,333; rentals, $1,233,199; subway rentals, $228,540; total, $3,288,831.

PORTLAND TROLLEY BONDS.—Redmond & Company are offering at 100 and accrued interest the unsold balance of an issue of $5,982,000 of the first and refunding mortgage 5 per cent sinking fund gold bonds of the Portland Railway Company. These bonds are a mortgage on the entire property and franchises of the Portland Railway Company, which owns practically all the electric railways in Portland, Oregon. The franchises under which the greater part of the system is operated run beyond 1930, when the bonds mature. The profits of the company show increases year by year, and including the interest on the present issue the net earnings for this year will be nearly twice the interest on the entire funded debt. The gross earnings for 1905 are $1,834,195.

INTERNATIONAL NICKEL.—The earnings for the current year have been in excess of the year preceding, and the payment of dividends on the preferred, based on current earnings, would leave a substantial surplus. The net earnings of the corporation and the surplus over the last three years follow:

	1905.	1904.	1903
Net earnings	$1,285,715	$936,471	$1,090,401
Surplus	668,004	341,102	559,149

A. Monell, formerly metallurgist of the Carnegie Steel Company, is president of the International Nickel Company. The preferred stock is a 6 per cent non-cumulative issue.

SYRACUSE TROLLEY MORTGAGE.—The New York State Railroad Commission has approved the application of the Syracuse & South Bay Railway Company for the authorization of a $1,000,000 mortgage and an increase of its capital stock to $1,000,000. The commission authorized the issue of $750,000 in bonds against the mortgage, but ordered the company to make further application before issuing the $250,000 remaining.

WALTHAM TROLLEY BONDS.—The Massachusetts Railroad Commissioners have authorized the Waltham Street-Railway Co. to issue $100,000 5 per cent 20-year bonds to pay for certain floating indebtedness incurred in the construction and equipment of the railway and in the purchase of property necessary for its operation.

JAMAICA, WEST INDIES. It is stated that Montreal capitalists have formed the Jamaica Light & Power Co., to operate the lighting plant of the city of Kingston in Jamaica The lighting and trolley systems there are Thomson-Houston.

TOLEDO RAILWAYS & LIGHT shows for eleven months a surplus gain of $98,000 over the same period of 1904, and the earnings on the $11,000,000 of stock for the year are expected to reach not far short of 4 per cent.

TELEGRAPH EARNINGS.—The statement of the Central & South American Telegraph Company for the December quarter shows gross of $350,000 and net $246,000; the surplus being $130,616. All are large gains over 1904.

DETROIT UNITED RAILWAY shows a gross for eleven months of $4,685,844, an increase over last year of $531,898; while the increase in the net is $257,390.

DEALS IN IOWA.—The *American Gas Light Journal* notes the following: "An event of much interest in business circles at Waterloo and Dubuque was consummated at the Commercial National Bank, at Waterloo, recently. This was the conclusion of a contract by the terms of which George McLean, of Dubuque, president of the corporation, sold to Rufus C. Dawes, of Chicago, the entire capital stock, both common and preferred, of the Waterloo and Cedar Falls Gas and Electric Light Company. The company's authorized capital stock is $575,000, and the bonds $150,000, making a total of $725,000. The buyers paid the purchase price and interest in cash. The corporation owns the gas and electric light plants of Waterloo, the electric transmission line between Waterloo and Cedar Falls, the electric system of Cedar Falls and the new gas works at Cedar Falls, now approaching completion. Mr. McLean became interested in Waterloo 5 years ago. The city then had the poorest lighting plants, both gas and electric, of any place of its size in the country. To-day it has the best. He first acquired the franchise of the Citizens Light, Heat and Power Company, which was about to expire because the holders, about 15 of Waterloo's most prominent and wealthy citizens had not used it. Next he bought a controlling interest in the Waterloo Gas and Electric Light Company, then supplying the city with both gas and electricity. A new corporation, including the leading business men of Waterloo, and Mr. McLean and Mr. B. F. Harriman, of Dubuque, was then formed, which took over these properties. A new franchise for 25 years was obtained for the new company, a new site purchased, and new and modern plants, both gas and electric, were constructed. The electric property at Cedar Falls was acquired, the generating station there scrapped and current supplied to Cedar Falls from the Waterloo station. Mr. Dawes, the purchaser of the establishments named, is the head of a syndicate which owns a dozen or more gas properties in different parts of the country. It is understood that several capitalists are interested with him in the Waterloo property, including one of his brothers, Charles G. Dawes, president of the Central Trust Company of Chicago, and former Comptroller of the Currency; James B. Forgan, president of the First National Bank of Chicago; I. C. Elston, banker, of Crawfordsville, Ind., and I. C. Elston, Jr., president of the East St. Louis Gas Light Company. The last named gentleman will make Waterloo his home and will succeed Mr. McLean as president of the company."

DIVIDENDS.—The National Carbon Company have declared a semi-annual dividend of 2 per cent on the common stock, payable January 15. This is an increase of ½ of 1 per cent, the June dividend having been 1½ per cent. Directors of American Telephone & Telegraph Company have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ per cent. This is the usual rate that is declared in June and December, while 1½ per cent is usually declared in March and September. Directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2 per cent on the capital stock, payable January 17. assenting stocks. The regular quarterly dividend of 1¾ per cent will be paid on Metropolitan Street Railway stock January 15. Directors of American Locomotive have declared the regular quarterly dividend of 1¾ per cent on the preferred stock. Directors of the New York Air Brake Company have declared the regular quarterly dividend of 2 per cent on the capital stock, payable January 17. International Nickel Company has declared its first dividend of 1½ per cent on the preferred stock. The preferred stock is entitled to 6 per cent annual dividends. The Electric Storage Battery Company has declared a dividend of 1¼ per cent on both the preferred and common stock, payable January 2. The Hall Signal Company has declared a quarterly dividend of 1½ per cent on the common stock, payable January 2. Directors of the Union Switch & Signal Company have declared the regular quarterly dividend of 2 per cent on the common stock and 2½ per cent on the preferred stock, payable January 10. The Cleveland Electric Railway Company has increased the dividend rate from 4 to 5 per cent per annum. A quarterly dividend of 1¼ per cent is payable January 5. Directors of the Bell Telephone Company of Philadelphia have declared the regular quarterly dividend of 1½ per cent, payable January 15. The directors of the New Orleans Railway & Light Company have declared a quarterly dividend of 1¼ per cent on the preferred stock, payable January 15. This is the first dividend since the reorganization was effected. Directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable February 1. The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1[illegible] per cent, payable January [illegible]

BELL TELEPHONE BONDS.—As to the new convertible bonds of the American Telephone & Telegraph Company, it may be noted that the bonds are to be convertible in not less than two years and not more than twelve years after the date of issue. However, this point is not fixed, and the bonds may just as well be convertible after three years and not longer than ten years, or during some other period between two years and twelve years from date of issue, those being merely the limits set by law in case of convertible bonds. As yet no statement has been made as to when any of these bonds will be issued, regarding the rate of interest that they will bear, nor the rate of conversion. These are details which are yet to be settled. President Fish stated at the meeting that the directors have done nothing definite in this direction as yet. When these bonds are issued, if they are, the stockholders may, or may not, receive rights in connection with the issue. The impression gathered from President Fish's remarks at the meeting was rather to the effect that there would be no rights, at any rates in the near future, in connection with the issue. However, he made no definite statement or promise in regard to the matter. The danger of offering the bonds to the stockholders before offering them to the public in general would lie in the fact that if the stockkholders did not take their allotments the bonds would receive a severe setback in the market.

ADVANCE IN MACKAYS.—According to the *Wall Street Journal*, the sharp advance in Mackay Companies common in the outside market is due to a prospective increase in the common dividend. A 1 per cent semi-annual dividend was declared on the common this month and no increase can be looked for in the near future. However, interests in close touch with the corporation say the stock is likely to be placed on a higher basis about the middle of next year. The first semi-annual dividend of 1 per cent was paid on the common in January of this year. With the stock selling in the neighborhood of 56, the income to the investor is less than 4 per cent. The authorized capital of the Mackay Companies is $50,000,000 preferred and $50,000,000 common, of which there are outstanding $35,968,700 preferred and $41,380,400 common. To pay these dividends about $2,270,000 are required. The earnings of the Mackay Company properties are showing substantial gains, due to a large extent to the additional cables.

AMERICAN TEL. & TEL.—The stockholders of the American Telephone & Telegraph Co. have authorized $150,000,000 of convertible bonds. The bonds will be issued from time to time at the discretion of the directors, to provide funds required for the extension of the company's business. It is also possible that, according to condition, some other security may be used for this purpose, but a convertible bond is regarded as a useful form of security for use at any time. About $25,000,000 a year is required by the American Telephone & Telegraph Co. for some years to come. At the special meeting of the stockholders of American Telephone & Telegraph Co. 1,438,136 shares were voted, of which 1,234,613 were cast in favor of the proposition to authorize $150,000,000 convertible bonds; 3,523 votes were cast against it.

WESTINGHOUSE ELECTRIC IN ENGLAND.—The report of the British Westinghouse Electric & Mfg. Co. just issued for the year ending July 31, 1905, shows a gross profit of £113,409. After providing for debenture and loan interest, depreciation and some special expenditure, a loss of £15,407 is shown after deducting the balance of £2,809 brought forward from the previous year. The special expenditures above referred to are £45,549 under the Mersey Railway contract; £5,340 exhibition and sundry, and £25,000 excess cost and experimental outlay on new types of apparatus. Mr. Newcomb Carlton has been added to the board and is now in England.

POWER IN CALIFORNIA.—A special dispatch from San Francisco of December 22 has the following with regard to news already referred to in these columns: "An enterprise for supplying electric power throughout the counties of central California has just been set on foot by the issuance of bonds in Boston and New York. The project, which was proposed by local men, has been taken up by Eastern capitalists, and the construction of a power house is already under way. The company is known as the Stanislaus Electric Power Company, and a New York trust company is trustee of the bond issue, which amounts to $10,000,000."

PHILADELPHIA BELL STOCK.—The directors of the Bell Telephone Company of Philadelphia, at a meeting on December 21, decided to recommend to the stockholders that the capital stock of the company be increased from $16,000,000 to $30,000,000. The stockholders will vote on the proposition on February 20. If the recommendation is approved the new stock will be offered to stockholders from time to time in proportion to their holdings in such amounts as the requirements of the business may demand.

WESTINGHOUSE MACHINE STOCK.—At a meeting of the stockholders of the Westinghouse Machine Company last week, it was decided to increase the capital stock from $5,000,000 to $10,000,000.

SOUTHERN BELL.—The Southern Bell Telephone & Telegraph Company has filed with the Secretary of State in Albany a certificate of increase of capital stock from $1,000,000 to $30,000,000.

General News of the Week

The Telephone.

MONTGOMERY, ALA.—The incorporation of the Fayette Telephone Company, with a capital stock of $2,000, is recorded. The incorporators are W. J., V. M. and F. T. Johnson.

BLACK SPRINGS, ARK.—The Black Springs Telephone Company has been granted articles of incorporation. The capital stock is $3,000, of which $1,000 is subscribed. The company is organized for the purpose of operating telephone lines in Montgomery and adjoining counties.

NEW BRITAIN, CONN.—The Farmington Valley Telephone Company has increased its capital stock from $27,000 to $54,000.

TAMPA, FLA.—A merger of local telephone exchanges has been announced whereby the Southern Bell Company abandons the local field, its plant, equipment, business and franchises being acquired by the Peninsular Telephone Company, the independent company which has been operating here several years. The consideration has not been made public. The Bell Company will retain its long-distance toll line privileges and proposes to establish connection at once between Tampa and Jacksonville. The Peninsular Company has petitioned the City Council to repeal the clause in its franchise fixing the maximum rates so as to allow it to raise rates, claiming that present rates are not sufficient to pay the cost of operating.

THOMSEN, GA.—At a meeting of the city council the local telephone system was leased from the stockholders with the privilege of buying the property later. The capital stock of the company will be increased, and many needed changes will be inaugurated. The action of the council was in line with the views of the present administration, that all public utilities should be owned by the town.

SAND POINT, IDAHO.—Nathan Powell, of Saglo; T. P. Craig, Geo. Matthews and William McKinney are promoting a company to install a telephone system between Sagle and Sand Point.

TAYLORVILLE, ILL.—The Christian County Telephone Company has increased its capital stock from $10,000 to $250,000.

QUINCY, ILL.—F. J. Penick, J. R. Pearce and S. F. Scott have applied to the Secretary of State for a license to organize a company to be known as the Quincy Long Distance Telephone Company. The object for which the company is being organized is to build long-distance telephone lines to be connected with and used in conjunction with the Quincy Home Telephone Company. The capital stock of the preliminary organization is fixed at $2,000.

CHICAGO, ILL.—Mayor Dunne has started a movement looking toward cheaper telephone rates for Chicago. He has had a conference with vice-president and general manager A. S. Hibbard of the Chicago Telephone Company, and informed him what was in his mind and asked if the company was willing to meet the proposition half way. Mr. Hibbard said he would see the officials of the company and give the mayor an answer.

HYMERA, IND.—An ordinance has been passed granting the Hymera Telephone Company a franchise in the town of Hymera, Sullivan County.

DANA, IND.—The Indiana Telephone Company has been incorporated. The capital stock is $50,000. The incorporators are: George W. Hughes, John L. Harney and J. H. Davis.

INDIANAPOLIS, IND.—At a meeting of the directors of the New Long Distance Telephone Company, it was decided to pay the regular quarterly dividend of 1 per cent. on January 10, 1906, instead of January 1, as heretofore.

NORTH VERNON, IND.—As a result of an attempt by the Independent Telephone Company to raise rates on telephones, a movement has been started that may result in giving the Bell Telephone Company the same kind of franchise and an equal chance for the business. Originally the telephone system in this county was owned by private individuals and a 25-year franchise was secured with the maximum rate of $1 a month with $2 for business houses. Since the property was taken over by the Independent Company, improvements have been added, and the company now claims to be operating at a loss, and has petitioned the Council to amend the franchise so that an increase may be possible. There is a strong probability that the Council will grant the request, in which event the Bell company will make a fight for equal privileges.

INDIANAPOLIS, IND.—The Queen City Home Telephone Company, capitalized at $10,000, has been incorporated. The incorporators are Harry B. Gates, of Indianapolis; George W. Beers, of Ft. Wayne, and other Indiana men. The Supreme Court of Ohio recently declared the former organization of this company invalid because it had not strictly complied with the incorporation laws of Ohio. The reorganization is to overcome this. The company proposes to ask the new city council of Cincinnati for a franchise, the old council having denied the same to the old company.

INDIANAPOLIS, IND.—A meeting of the directors of the Indianapolis Telephone Company was held last week to discuss the plans of reorganizing the operating methods of the company. President Stifel, of St. Louis; J. S. Brailey, Jr., of Toledo, and C. E. Stinson, local manager, were among those present.

FT. WAYNE, IND.—An arrangement is said to be pending between the Home Telephone Company and the National, whereby the former will take over the latter. The capital stock of each company is $250,000. The National Company owns a stretch of toll lines, with exchanges at Auburn and New Haven, and has been doing a good business.

COLUMBUS, IND.—The Central Union Telephone Company has approved plans for a new exchange building in which to install a modern system in this city. This move on the part of the Bell people is thought to be due to the revolt of the patrons of the Citizens' Telephone Company which has announced an increase of rates to begin Jan. 1. A petition signed by 800 patrons declaring their intention to have the telephones taken out if the increase is adopted has not deterred the officials of the Citizens' Company, who insist on increasing the rates.

COLUMBUS, IND.—The officials of the Citizens' Telephone Company, of this city, announce an advance in the rates charged for telephones January 1. The present charge of $12, $18 and $24, for homes and business houses, will be increased to $15, $20 and $30 yearly. President Sherrin says the increase is made necessary because of the increased cost of operating a larger plant, together with the rapid growth of Columbus and the consequent call for more telephones. He says it is impossible to operate profitably on the present rates. The company will make no increase in the rate to farmers, the present contract with them will be respected.

INDIANAPOLIS, IND.—A club composed of a hundred employes of the Central Union Telephone Company in this city as charter members has been formed here. E. T. Bussele, chief inspector of the Indianapolis district, is president. The object of the club is for social pleasure and a school of instruction. The company furnishes free of rent a clubroom amply fitted up for social purposes and well equipped for a school of instruction. The club proposes giving an open reception once a month. Mr. Busselle will conduct a school of instruction in all the work of a telephone man, inside and outside, from the underground conduit system to the exchange switchboard, etc. The clubroom is open every day and night until 11 p. m., except on Sunday.

ELGIN, IA.—The Turkey River Farmers' Telephone Company has been organized.

RAKE, IA.—The Southwest Lincoln Telephone Company has been formed. H. H. Johnson is secretary.

SLOAN, IA.—Farmers near Albaton and Lossing are forming a telephone company and may start an exchange here.

LAKE MILLS, IA.—The Pike Run Telephone Company has extended its line into Leland and connected with the Leland Mutual Telephone Company.

MAYFIELD, KY.—The Mayfield Home Telephone Exchange has filed articles of incorporation for record in the County Clerk's office authorizing a capital of $50,000.

NEW ORLEANS, LA.—The Illinois Central Railroad will immediately begin the construction of a telephone system, which is to extend from New Orleans to Louisville, and from Fulton, Ky., to Chicago. The contract has already been let for this work to the Bell company and work will commence at once.

DETROIT, MICH.—The Michigan State Telephone Company will spend at least $2,000,000 in 1906 in improvements and extensions. The company will lay 5,000 miles of copper wire in the State, adding to its toll line service. It is building a new station at Delray, and another north of Gratiot, at Mutual Avenue. The capacity of the other offices is also being enlarged, and when the improvements are completed provision will be complete for the installation of 15,000 more telephones.

HANNIBAL, MO.—F. Darnell, of Carrollton, Mo., has been appointed general manager of the Bluff City Telephone Company, at Hannibal, vice H. G. Conger, resigned.

OMAHA, NEB.—The Nebraska Telephone Company has announced a reduction of 50 cents a month on business telephones and on individual and two-party line residence telephones. The company is now seeking to secure contracts at the reduced rate for the ensuing year.

ST. JOHN, N. B.—For some time negotiations have been pending between the directors of the Central Telephone Company and the Sackville Electric Light and Telephone Company and the two concerns have been amalgamated. The change will come into effect the first of January and doubtless will be the outcome of many improvements.

MILFORD, N. J.—The Delaware Valley Telephone Company has been formed; capital, $5,000. Incorporators: C. Rapp, W. H. Farrand and others.

JERSEY CITY, N. J.—The Reliance Telephone & Telegraph Company has been incorporated with a capital stock of $125,000 by Arthur Johns, Lanier McKee and Kenneth K. McLaren.

JERSEY CITY, N. J.—The Eastern States Telephone & Telegraph Company has been incorporated with a capital stock of $1,000,000 by Henry A. Bingham, Cornelius A. Cole and Alexander F. Garbe.

BATH, N. Y.—The Bath Hammondsport Telephone Company has been formed; capital, $5,000. Incorporators: Jas. H. Smellis, Wm. Dildine and others.

GLOVERSVILLE, N. Y.—A system which will accommodate between 5,000 and 6,000 subscribers will be installed in this city and Johnstown by the Independent Telephone Company. The company will form a part of the great independent system which is spreading throughout the State and country, and the local system will be operated in connection with the independent lines of Amsterdam, Troy and other cities of the State. Applications for franchises have been made to the Common Councils of Johnstown and Gloversville, and as soon as these are granted active operations will be commenced.

HAMMONDSPORT, N. Y. The name of the newly organized company which has taken over the Niver lines, as referred to last week, is the Pleasant Valley Telephone Company. The capital stock is $5,000.

GLOVERSVILLE, N. Y.—The Independent Telephone Company of Fulton County has been incorporated with the Secretary of State to operate telephone lines between Gloversville and Johnstown, Fonda, Fultonville and Amsterdam and various other places in Fulton County. The capital stock is $5,000. The directors are Frederick M. Young, A. D. Kiblee and E. M. Brown, of Gloversville, and William T. Briggs and A. J. Baker, of Johnstown.

GREENSBORO, N. C.—The North State Telephone Company, of High Point, has been granted a franchise by the City Council. The franchise was stoutly opposed by the Southern Bell Company. The establishing of this long-distance service gives Greensboro direct connection with 1,200 stations of the North State Company's lines in the lumber and cotton mill sections of Randolph, Moore, Montgomery and Davie counties.

FARGO, N. D.—The new telephone service from Jamestown to Bismarck and Bismarck to Linton, has been inaugurated and will put Fargo in touch by two lines, with all points in South Dakota.

TOLEDO, OHIO.—The Western Ohio Telephone and Telegraph Company has been formed by John G. Meilink, A. C. Stevenson, F. E. Palmer, J. W. Davis, Joshua Lindahl. Capital stock, $100,000.

CLEVELAND, OHIO.—The Cleveland Telephone Company is preparing to erect a new building on Prospect Street, to cost between $40,000 and $50,000. It is stated that during next year $1,000,000 will be expended in extensions and betterments in Cleveland.

CLEVELAND, OHIO.—A statement prepared by Mr. T. P. Cagwin, of the Cleveland Telephone Company, shows that there was a total of 153,846 Bell subscribers stations in Ohio on Nov. 1, as compared with 130,011 on Jan. 1. This is a gain of 23,835, or 18 per cent in ten months. The Cleveland Telephone Company has about 25,000 telephones.

COLUMBUS, OHIO.—By the organization of the Union County Telephone Company, which has been promoted by Frank Beem of Columbus, Dwight Sapp of Mt. Vernon and capitalists of Marysville and Columbus, all the independent companies of Union County will be brought under one corporation. The independent exchanges at Marysville, Ridgewood and other country lines will be united under the new company.

CESTOS, OKLA.—The Independent Telephone Company has been formed, with a capital of $25,000. The incorporators are: J. W. Kerns, F. C. Hoyt and others.

CORSICA, S. D.—Articles of incorporation have been filed for the Sioux Falls Rock Telephone Company at Corsica, Douglas County, with a capital of $5,000. Incorporators, Joseph D. Hofer, Anna Hofer, A. A. Wipf and John J. Wipf.

MEMPHIS, TENN.—A new long-distance telephone system will be built and operated by the Cumberland Telephone Company from Memphis to Jackson, Miss.

NASHVILLE, TENN.—The city council without previous knowledge of the public has passed a resolution practically giving the Cumberland Telephone Company the right to construct its own conduits in the up-town district. A slight reduction in rates to the public and some minor privileges are given by the company as compensation for the rights granted.

NASHVILLE, TENN.—The capitalization of the Cumberland Telephone & Telegraph Company is to be increased 25 per cent Jan. 2, 1906, which will make the capitalization something between $16,500,000 and $17,000,000. The decision was reached to allow each stockholder to purchase at par an amount of new stock not exceeding 25 per cent of his holdings, the issue to be of record as of Jan. 2, 1906, but to be issued in four payments, one dated Feb. 1, and the others April 1, July 1, and Oct. 1, 1906.

MONTELL, TEX.—The Citizens Telephone Company of this city has increased its capital stock from $1,000 to $2,000.

TEXARKANA, TEX.—Although operating on both sides of the city for more than 20 years, it was recently discovered that the Southwestern Telegraph and Telephone Company has never had a franchise on the Texas side of the city. The City Council, on making this discovery, at once served notice on the company that it must apply for a franchise. Accordingly the Southwestern, at a meeting of the council, presented a bill for an ordinance for such franchise, but the council insisted on the insertion of two clauses, one to the effect that the company must pay to the city 3 per cent of its gross earnings, and the other providing that it must permit any and all local competing telephone companies to connect with its long-distance lines. The Southwestern promptly declined to accept a franchise containing such provisions, whereupon the Texarkana Telephone Company, a strictly local concern, presented to the council a proposition in writing to pay the city $100 per month for the exclusive right to operate a telephone business in Texarkana, Tex.

LYNCHBURG, VA.—The work on the new underground system of the Southern Bell Telephone Company in Lynchburg is rapidly reaching the stage where the new telephones can be connected, thus displacing the two old companies, which have been operating here for many years. The new service is costing the company upwards of $100,000 and will be modern in every detail.

CONNELL, WASH.—The Pacific States Telephone Company will install an exchange here.

COLUMBIA, WASH.—The Citizens' Telephone Company has been organized for the purpose of supplying telephone service for the town of Columbia and suburban districts as far as Renton.

SEATTLE, WASH.—Articles of incorporation have been filed for the Citizens' Telephone Company; capital stock, $100,000. Directors, Van R. Peirson, Edward E. Webster, Algert G. Corbett, Eugene A. Marsh, Ralph D. Nichols.

TACOMA, WASH.—The city council has granted a franchise to the Independent Telephone Company, which will install an automatic system at a cost of $500,000. The company is required to expend $50,000 within six months and $100,000 within one year.

BELLINGHAM, WASH.—The directors of the Farmer's Mutual Telephone Company have elected the following officers: President, Ed. Brown, of Custer; vice-president, J. W. Sefton, of Everson; secretary, S. F. Bailey, Lynden; treasurer, J. C. Gillies, Nooksack. The Automatic Company has secured its franchise in Bellingham, and arrangements have been definitely made whereby the Farmer's Company will meet this company at the city limits of Bellingham as soon as the lines can be completed.

WAUKESHA, WIS.—The stockholders of the Eagle Telephone Company have voted to increase the capital stock from $15,000 to $20,000. The company intends improving and enlarging its several exchanges.

VANCOUVER, B. C.—The British Columbia Telephone Company will string two direct copper wires between this city and Seattle, a distance of 150 miles.

BRANTFORD, CAN.—The special telephone committee of the Brantford City Council has decided to recommend to the Council that the Canadian Machine Telephone Company be given a competitive franchise in that city. It had two companies to choose between, the Canadian Machine and the Ontario Telephone Company. The one selected is a Brantford invention, the Lorimer automatic telephone system.

Electric Light and Power.

ALBERTVILLE, ALA.—Arrangements are being made to commence work on the power plant, which is to be built by the North Alabama Railway, Light & Power Company, on Town Creek, near this city.

MOBILE, ALA.—It is understood a New York company has secured control of the lighting company of Mobile. It is reported that J. Howard Wilson, president of the Mobile Light & Railroad Company, is one of the interested parties.

ANNISTON, ALA.—The Coosa River Electric Power Company has been incorporated, with principal office at Birmingham, and a capital of $100,000, to develop and utilize the water power of Coosa River, at Ten Island Shoals, by building a dam, power house, and transmission lines to Anniston, Gadsden, Attalla, Alabama City, Pell City, Riverside and other cities. R. H. Cobb, of Anniston, is vice-president.

DARDANELLE, ARK.—The new municipal electric light plant has been completed here and the people report the service as very satisfactory.

ARGENTA,, ARK.—Bids will be received until Jan. 15 by C. J. Humphreys, Secretary Board of Improvements for furnishing all the material required in the construction of the water works and electric light plant here.

LAKE CITY, FLA.—Bids will probably soon be called for a $15,000 addition to the electric light plant. J. C. Sheffield is chairman of the Board of Public Works.

VISALIA, CAL.—A. G. Wishon, of Fresno, is said to have been granted a franchise for the construction of a power line across Tulare County.

SAN BERNARDINO, CAL.—The Mill Street power plant of the San Bernardino Electric Company has been destroyed by fire.

CHICO, CAL.—The city trustees have granted to the Northern Pacific Power Company permission to enter the city by way of Main Street.

NEEDLES, CAL.—Danl. Murphy, of Los Angeles, is interested in the construction of a power plant at Needles, to furnish light and power to the town and mines.

FRESNO, CAL.—A. G. Wishon, general manager of the Joaquin Light & Power Company, writes that it is proposed to construct a transmission line with hydraulic plants, at a cost of about $1,000,000. It will not be built by contract. D. L. Wishon, of Visalia, is engineer.

HALFMOON BAY, CAL.—W. E. Alexander has petitioned the supervisors of San Mateo County at Redwood City for a franchise permitting him to lay mains in the streets of Halfmoon Bay and to erect and maintain poles and wires for supplying gas and electricity for light, heat and power purposes.

GILROY, CAL.—On November 28, the City Council ordered that the bid of the Tracy Engineering Company, of San Francisco, of $7,943.90, for the constructing and equipping of the municipal lighting plant, be accepted. The plans call for the completion of the work within 75 days from the signing of the contract.

SAN FRANCISCO, CAL.—The California & Nevada Mining & Milling Company contemplate the installation of an electric power plant at Big Pine, Cal., which will transmit power to mines in the Goldfield and Bullfrog districts. George S. Wheatly, of this city, says that his company controls 1,000 inches of water and will spend $1,500,000 on the new system.

SAN FRANCISCO, CAL.—The Stanislaus Power Company, which has been organized with a capitalization of $10,000,000, with $6,000,000 subscribed, is making headway on its plans to transmit electric power to San Francisco. It is understood that some of the capitalists who financed the San Francisco Coke & Gas Company are behind the new power project. Hydraulic work is progressing.

SAN FRANCISCO, CAL.—The Metropolitan Laundry Company has received bids for an electric power plant and motors for operating all the machines by individual drive. About 80 direct-current motors will be required. Two 150-kw direct-current generators will be direct connected to two 250-hp engines. The estimated cost of the steam plant and electric equipment is about $60,000.

NAPA, CAL.—Attorney Raymond Benjamin, of this city, has petitioned the Board of Supervisors of Napa County, for a 50-year franchise for a light and power plant. A company is being organized by J. S. McDonald, of San Francisco, to generate power at Napa and supply electricity to Oakville, Yountville, Rutherford, St. Helena, Calistoga and Napa. Bids for said franchise will be received until January 12 at the office of W. N. Collins, Clerk, Board of Supervisors.

SAN FRANCISCO, CAL.—The Mount Whitney Power Company, which is reconstructing its transmission system, recently closed a contract through Hunt, Mirk & Co., for a complete electric generating plant to cost about $100,000, erected at Visalia, Cal. A 1,000-kw. Wesinghouse-Parsons turbo-generator will supply 3-phase current, the line voltage being 15,000 volts, with an increase to 30,000 volts proposed. The plant will be operated about five months of each year, during the dry season, being intended for a steam reserve plant. It will tie in with the company's two hydro-electric transmission plants, about 35 miles of additional pole line being required.

SALIDA, COL.—The water power plant of the Salida Light, Power & Utility Company is to be greatly enlarged and improved. It is the intention of the company to expend about $85,000 for this purpose.

GEORGETOWN, COL.—Upper Clear Creek is soon to have another electric power plant of large capacity. W. E. Renshaw, of Idaho Springs, has entered the field and expects soon to be in position to furnish power to the mines.

GEORGETOWN, COL.—E. J. Wilcox, of Denver, chief promoter of the Waldorf Mining Company, writes that bids for construction work in connection with the proposed power development will be received about April 15.

SQUIRREL GULCH, COL.—The Mount Theresa Gold Mining Company, of which W. E. Garver, Idaho Springs, Col., is manager, will erect a water power plant on Soda Creek, near Squirrel Gulch, Col., to generate electric power, etc., to run hoist and drills.

GREELEY, COL.—J. J. Hendrie, of Denver, has filed a petition with the County Commissioners for a 50-year franchise over the county roads for poles, wires, etc. It is stated that a power plant will probably be constructed at Lafayette or Louisville and transmission lines constructed from there to Greeley, Windsor, Ft. Collins, Cheyenne and Denver.

TORRINGTON, CONN.—It is understood that the Torrington Electric Light Company is shortly to build an addition to its plant on East Branch Street.

WILMINGTON, DEL.—Officers of the new Wilmington Heat, Light & Power Company, which was recently granted a franchise for the establishment of an electric lighting plant in this city, intends to begin constructing the new power plant early in the spring. Considerable detail work is now being done and the plans for the new plant are well under way.

ORLANDO, FLA.—The Orlando Water & Light Company has purchased the entire plant and business of the South Florida Gas Company and will assume the management of the same on January 1.

BRUNSWICK, GA.—Much of the machinery at the plant of the Mutual Light & Water Company was damaged by a recent fire.

ROME, GA.—The City Council has granted franchises to the Etowah Power Company, which will construct a plant at Cartersville, and to the Little River Power Company, whose power plant will be on Lookout Mountain, 30 miles from Gadsden.

DUBLIN, GA.—The work of changing the system at the electric light and power plant from a high to a low frequency system has been accomplished.

SAVANNAH, GA.—The Savannah Electric Company will erect an addition to its Indian Street station, where power for the street railway system will be generated. It is the purpose of the company to combine the two plants' generating power for both lighting and railway purposes. The machinery and the building of the extension will represent an investment of over $100,000.

NAMPA, IDA.—Frederick Irwin, manager of the Trade Dollar Consolidated Company, was in town recently securing contracts for electric power to be furnished this town and Caldwell from the company's power plant at Swan Falls.

MONMOUTH, ILL.—The Monmouth Gas & Electric Company is contemplating rebuilding its entire plant in the early spring.

CHICAGO, ILL.—The Illinois Athletic Electric Club Company, with a capital of $2,500, was recently inncorporated for the purpose of furnishing electricity for light, heat and power.

AURORA, ILL.—The City Council is considering a proposal for the installation of a new electric light plant. It is estimated that the new system would cost about $20,000.

ROCKFORD, ILL.—A petition is to be placed before the Council for an increase in the appropriation, making it $25,000, in order to provide for 15 new lights which are to be installed this next year, three in each ward.

ELGIN, ILL.—Anson B. Root, president Elgin Hydraulic Company, will organize the Elgin Hydraulic Heat, Power & Light Company, for the purpose of supplying electricity in this city.

LEWISTOWN, ILL.—The Fisher Power, Heat & Electric Lighting Company, of Lewistown, has been incorporated with a capital of $20,000. The incorporators are: Lloyd M. Condit, Theo. Fisher and H. W. Masters.

MONTGOMERY, IND.—Arrangements are under way for the erection of a new electric lighting plant here.

OWENSVILLE, IND.—The Owensville Electric Light Company has petitioned the town council for a franchise for an electric light plant.

COLUMBUS, IND.—The business men of this city are circulating a petition asking that the City Council adopt a resolution whereby a commercial lighting plant can be established.

AURORA, IND.—The Indiana Public Service Company has been incorporated for the purpose of constructing a light and heating plant. David J. Hauss is president of the new concern.

MARION, IND.—The question of establishing a municipal lighting plant is being widely discussed here. It is asserted that the city would save enough in seven years to entirely pay for the necessary plant.

PERU, IND.—Capitalists of this city are said to have obtained a franchise for an electric light plant at Arcadia. The same plant will also furnish electricity for lighting the streets of Atlanta, three miles distant.

COLUMBUS, IND.—The City Council is reported to have taken steps toward the construction and equipment of a commercial lighting plant in this city. The present service is furnished by the Columbus Street Railway Company.

LAPORTE, IND.—The city council of Laporte has entered into a ten-year contract with the Laporte Electric Company for an all-night lighting service, at $73 per light per year. The company will add new equipment and make some extensions.

RICHMOND, IND.—At a recent meeting of the City Council action was taken toward increasing the capacity of the municipal lighting and power plant. The board was instructed to employ an electrical engineer to draw up plans and specifications for the addition of another unit to the equipment.

SHELBYVILLE, IND.—The City Council of Shelbyville, Ind., is considering the putting in of a city lighting system. Mr. Chas. L. Henry, president of the Indianapolis & Cincinnati Traction Company, has offered to sell the Shelbyville power house, boilers, engines and part of the electric equipment, for $25,000.

RICHMOND, IND.—The municipal lighting question is up again in this city. The commissioners are asking for $40,000 to purchase necessary apparatus to replace old and wornout equipment. The taxpayers are almost ready to revolt. The original plant cost the city $144,000 and there has been spent since the acceptance for building and new equipment $71,891. The total income of the plant has been $121,348.28. Total excess of cost of plant, since its acceptance, over its income, $48,689.45, and now that $40,000 more is demanded municipal lighting in Richmond is much in disfavor.

ACKLEY, IA.—Mr. John Rath recently made the city a gift of a complete electric light plant.

HARTLEY, IA.—It is reported that Ira Steele is interested in the installation of an electric light plant.

MILLERSBURG, IA.—The Fairbanks & Morse Electric Company, of Chicago, Ill., is preparing to install an electric light plant in this town.

WATERLOO, IA.—The Waterloo and Cedar Falls Gas and Electric Light Company has passed over to the management of new officers and directors.

PRYOR CREEK, I. T.—This place will have an electric plant within ninety days. The Council has granted to D. E. Little, of Waggener, I. T., a 25-year franchise for the erection and maintenance of a plant.

HOLDENVILLE, I. T.—R. O. Wall and W. M. Dunn have been to Ada, I. T., on business connected with the new electric light plant. Work will begin on the buildings just as soon as the material can be gotten on the ground and it is now being placed there.

TULSA, IND. TER.—Control of the People's Gas Company and the People's Power Company, by the sale, December 15, of the stock of the Cherokee National Oil Company, in the two corporations, passed to Dan Murphy, of Los Angeles, Cal.; P. De C. Bell, of St. Louis, and P. H. Anderson, of Tulsa. Ed. C. Reynolds and other local parties are still interested. The purchase includes franchises for gas mains and city lighting service, together with seven gas wells and several miles of pipe line.

STAFFORD, KAN.—The electric light plant here has been overhauled and made practically new. The plant now has a capacity for 2,800 lights.

HERINGTON, KAN.—The Herington Light, Power & Water Company has filed articles of incorporation and applied for a franchise to establish a power plant.

LINCOLN CENTER, KAN.—The new electric light plant and water works which it is proposed to construct here, it is estimated, will cost $34,500. The office of the works committee is at Lincoln, Kan.

HARPER, KAN.—The electric light plant here is being installed and will be ready for operation by the middle of January. The company has secured contracts for wiring many homes and business houses.

OSAWATOMIE, KAN.—The Osawatomie Electric Light & Power Co. will receive bids about April 1 for the construction of an electric light plant at a cost of $10,000. The company will add an ice plant later on.

BELLEVILLE, KAN.—At a meeting held by the citizens of Belleville it was the expression of those present that the city erect a $20,000 electric plant and run it in conjunction with the water works. There is a company organized in the city whose purpose is to erect an electric light plant and it may be possible that this company and the City Council will act together.

PITTSBURG, KAN.—At its last regular meeting the City Council passed the ordinance granting a franchise to W. Milburne, of Jackson, Tenn., for the placing of an electric light plant in this city. According to the terms of the ordinance passed, W. Milburne, the contractor, has been given 30 days within which to file his acceptance of the contract, 60 days within which to commence work on the plant, and the ordinance also provides that the plant shall be completed within a period of seven months.

LOUISVILLE, KY.—Articles of incorporation have been filed by the Louisville & Northern Railway & Lighting Company, which expects to operate between this city and Indianapolis or Chicago.

FORT FAIRFIELD, ME.—A meeting has been held to discuss the project of utilizing the power at the Aroostook Falls to be developed by the Maine & New Brunswick Electrical Power Company.

TANEYTOWN, MD.—A charter has been granted to Edward E. Reindollar, D. J. Hesson, Joseph E. Reelkey and others, to construct an electric light plant here, at a cost of from $8,000 to $10,000. A 100-hp engine, 125-hp boiler and a 1,000-light dynamo will be installed.

BRUNSWICK, MD.—The electric power from the Shenandoah river plant of the Harper's Ferry Light and Power Company has been turned on in Brunswick. After a short period the power company will be in position to quote rates on cheap electric power, which will naturally attract manufacturing plants to Brunswick, as there is an abundance of good labor available.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has filed its answer in Baltimore to the bill of complaint of the Maryland Telephone Company, for an injunction restraining the Consolidated from interfering with the wires of the Maryland Company. The answer alleges that the Maryland Company is restricted to the use of certain poles in the city for telephone purposes only and not for lighting or heating.

BALTIMORE, MD.—A contract made by the city of Baltimore with the Consolidated Gas, Electric Light and Power Company, which will run for five years from September, 1905, fixes the flat rate of $67.40 per arc lamp per year. The rate for incandescent lamps used by the municipality is 6 3-10 cents per kw-hour. For five years prior to the letting of the present contract current for the arc lamps was furnished by the United Electric Light and Power Company, the predecessors of the present corporation. The price was $90.02 per lamp per year and the contract made in 1900 expired last September. For a number of years prior to that time the city had been paying $127.75 per lamp per year, or at the rate of 35 cents per lamp per night. Steam is the power used and coal has an average cost of $3.20 cents a ton.

NEW ALBANY, MASS.—The citizens have voted to issue $9,000 bonds for extending the electric light plant.

AMESBURY, MASS.—The Howarth & Rogers Co. will equip a new carriage and automobile body plant with about 55 hp of electric motors.

QUINCY, MASS.—The City Council has asked the Mayor to secure special legislation enabling Quincy to put in a plant for municipal purposes only.

GARDNER, MASS.—The Gardner Electric Light Company announces a reduction of from 20 to 15 cents per kw-hour used for residential purposes commencing January 1.

LEOMINSTER, MASS.—The extensive improvements to the Leominster electric light system, which have been under way for the past few weeks are now nearly completed.

LENOX, MASS.—The Lenox Electric Light Company is soon to make a number of improvements on its lighting system. The entire equipment will be generally overhauled, and the new transformers will replace several of the old patterns.

ADRIAN, MICH.—The Schwartz Electric Company has voted to increase the capital stock from $25,000 to $100,000. The company will erect a larger building in the spring.

FAIRVIEW, MICH.—The council has given the contract for lighting the village to the Peninsular Electric Lighting Company, of Detroit, at $67.60 per light per year. About 30 lights will be used.

LANSING, MICH.—The electric light and water board has awarded the contract for 150 enclosed, alternating current arc lights to the Adams Bagnall Electric Company of Cleveland, Ohio, for $3,801. It is expected that the new system of lighting will be in use in about three months.

TWIN VALLEY, MINN.—Work is being pushed as rapidly as possible on the new electric light plant which is being installed by Frank Magnuson.

DULUTH, MINN.—The Board of Water and Light Commissioners has asked the Council for authority to submit to the voters a proposition to issue $75,000 water and light bonds.

ST. PAUL, MINN.—The St. Paul Gas Light Company has secured the contract for maintaining 519 overhead electric lamps at $90 per light per year, and for each additional lamp $8 per month.

DULUTH, MINN.—The Great Northern Power Company, of this city, has under construction a large generating plant on the St. Louis River, which will be capable when completed of developing 80,000 horse-power.

MINNEAPOLIS, MINN.—City Engineer Andrew Rinker has been requested to investigate the matter of utilizing the water power at the falls of St. Anthony, the power to be used for lighting the city hall and other public buildings.

ST. JOSEPH, MINN.—The Sisters of the Order of St. Benedict are reported to have secured a franchise for an electric light plant. It is proposed to install the plant at St. Benedict's Academy and furnish the village, also private consumers, with electric lights.

MANKATO, MINN.—At a meeting of the directors of the Mankato Gas and Electric Light Company, H. A. Patterson resigned as president and John B. Meagher was elected to fill the vacancy. The company contemplates some radical and needed improvements in its plant here.

ST. PAUL, MINN.—A. B. Stickney, Oliver Crosby and G. T. Philleo have filed articles of incorporation for the West Side Power, Heat & Light Company, with a capital of $50,000. It is proposed to construct a plant of 2,000 or 3,000 hp to supply some of the manufacturing plants on the west side with electric light and power.

RED WING, MINN.—The Red Wing Gas Light & Electric Company, which succeeds the Red Wing Gas & Electric Company, has been organized with a capital of $250,000. The board of directors consist of O. M. Hall and P. C. Thompson, of Red Wing, A. E. R. White, Frank N. Crosby and Ralph L. Aldrich, of Detroit, Mich., and Frederick Platt, of Flint, Mich. The officers are President A. E. R. White, vice-president, O. M. Hall, secretary and treasurer, P. C. Thompson.

MINNEAPOLIS, MINN.—In connection with their plans for increasing their electrical business in Minneapolis by the improvement of the water power at Taylor's Falls, Wis., Stone & Webster, of Boston, general managers of the Minneapolis General Electric Company, announce a new management in the Minneapolis office. A. W. Leonard, manager of the Electric Light & Street Railway Companies, of Houghton, Mich., will succeed A. M. Robertson as manager of the Minneapolis General Electric Company.

BRAYMER, MO.—The question of installing a municipal electric light plant is being agitated here very strongly.

BOWLING GREEN, MO.—The Pike County Electric Light and Power Company, of Bowling Green, has increased its capital stock from [illegible] to [illegible]

JOPLIN, MO.—C. H. Barron and David D. Hoag have filed articles of incorporation for the Consolidated Light & Power Company, with a capital of [illegible]

ST. LOUIS, MO.—Charles Ware, George Kingsland and Thomas C. Henning have petitioned the House of Delegates for permission to construct a heating and lighting plant in Maplewood near the city limits.

ST. LOUIS, MO.—A bill was introduced into the Municipal Assembly, December 15, to allow a company composed of Charles Ware, George Kingsland and Thomas C. Henning to construct and operate a heating and lighting plant in Maplewood, near the city limits. The concern agrees to give to the city 1 per cent. of its net earnings for the first year.

WOOD RIVER, NEB.—Plans and specifications are being prepared for a lighting plant and water works.

CREIGHTON, NEB.—The citizens have organized a stock company, with a capital of $25,000, for the purpose of installing an electric light plant.

NEW BRUNSWICK, N. J.—The Middlesex Light & Equipment Company has been incorporated with a capital stock of $50,000. The incorporators are Louis Wolfron, William Schlessinger and William Wolfron.

PASSAIC, N. J.—At the last meeting of the Passaic city council the members of the street lights committee submitted a report recommending that the city enter into a 5-year contract with the Public Service Corporation for lighting the streets of the city and furnishing its residents with electricity for commercial purposes. The terms of this contract are as follows: Arc light, $85 per year; incandescent lights, 12 cents per kw-hour for the first two years, 11 cents per kw-hour for the second two years and 10 cents for the fifth year.

UNION, N. Y.—H. B. Sweet, of Utica, is engineer for the proposed electric light plant, which will cost about $15,000.

HENRIETTA, N. Y.—The Niagara, Lockport & Ontario Power Company is said to have purchased property in Henrietta upon which to erect a sub-station.

ALBANY, N. Y.—The Hudson River Electric Power Company, of Albany, N. Y., reports an increased demand for power from the Watervliet Arsenal. It is at present using about 300 horse-power. This has been in service during the past year and the officers of the Arsenal are so well pleased with the satisfactory service rendered that they have notified the Power Company that 200 horse-power in addition will be required, and the order has been placed for the necessary electrical apparatus.

ASHEVILLE, N. C.—The Asheville Cotton Mills have contracted for 700 horse-power from the Weaver Power Company from its plant on the French Broad River.

MORGANTOWN, N. C.—The new power house for the town has been completed, the work having been done under the supervision of the General Electric Company.

WINSTON, N. C.—The Fries Manufacturing & Power Company has secured permission to build certain additions to its system in this town.

UTICA, N. Y.—The Utica Gas & Electric Company has nearly completed the construction of the pole line between that city and Rome, over which power will be transmitted to light the streets of Rome. About 600 poles have been placed. The power for lighting Rome will come from the Trenton Falls plant of the Utica Gas & Electric Company. About 1,000 hp will be required at first, and all will be in readiness to turn the current on by January 1, it is expected.

CHARLOTTE, N. C.—The Southern Power Company has added to its already extensive properties the "99" Islands, a fine water power on Broad River, where about 12,000 hp will be developed. The company expects to spend about $1,000,000 at this point. The Southern Power Company recently awarded to the Holyoke Machine Company a contract for a water-wheel equipment to be installed in the first of the nine large hydro-electric plants which the company contemplates erecting in North Carolina. This plant will have a capacity of 30,000 hp in units of 5,000 hp each. It is to be built at Great Falls on the Catawba River, near Charlotte. The wheels will operate on a fall of 175 feet. Delivery will be made next year. The company has secured all the falls on the Catawba. An officer of the company said recently that inside of four years they expected to develop nearly 150,000 hp, with which they anticipate operating all the biggest cotton mills in the Carolinas. The electric current will be delivered over a 40,000-volt transmission line, about 180 miles long. It will cost the mills about $20 per hp-year. At present anything from $23 to $45 per hp-year is paid for energy generated by steam. Work is to commence on another 30,000 hp plant inside of the next few weeks. Before the completion of all the plants fully $5,000,000 will have been expended.

HOPE, N. D.—The advisability of constructing water works and an electric light plant is being discussed here.

LANGDON, N. D.—Liebler & Finnerty have purchased the local electric light plant and will make improvements thereto, including the addition of a boiler.

GRAND FORKS, N. D.—The Grand Forks Gas & Electric Company is making arrangements for the erection of a new power house. W. J. Murphy is general manager of the company.

COOPERSTOWN, N. D.—The equipment for the electric lighting plant has arrived and is being installed as rapidly as possible. It will probably not be long before the plant is in operation.

ALBUQUERQUE, N. M.—The Rio Grande Land, Water & Power Company has been incorporated with a capital of $1,000,000 by A. W. Hoffman, W. B. Childer and others of this city.

SILVER CITY, N. M.—The Silverton Electric Light Company, of this city, has secured the contract for furnishing current for the electric light system which is soon to be established in Aztec.

XENIA, OHIO.—The City Council has granted to the Citizens' Light & Power Company a franchise to furnish light and power to the city.

LIMA, OHIO.—J. W. Halfield, of this city, and H. L. Canfield, of Delphos, have petitioned for a franchise to construct and maintain an electric light plant here.

COLUMBUS, OHIO. Resolutions have been adopted favoring the appointment of a committee to make a house-to-house examination of meters, pipes, etc., in an effort to discover the cause of the poor quality of light furnished, about which many complaints have been made. The Columbus Railroad Company was also requested to furnish hereafter new globes for electric lights wherever needed without cost when in exchange for old ones previously purchased from it.

CLEVELAND, OHIO.—By the annexation of South Brooklyn the city has obtained possession of a large electric light plant. Mayor Tom L. Johnson has revealed his plans to extend the usefulness of the plant over a larger area and use it to compel a reduction in rates. The city is now having figures compiled with a view of lighting practically one-third of the city from the South Brooklyn plant. The aim of Mayor Johnson to obtain a municipal lighting plant has been realized in the acquisition of the suburban institution.

SALEM, ORE.—The Union Light & Power Company, of Silverton, has been sold to the Citizens' Light & Traction Company.

HEPPNER, ORE.—The citizens are discussing the question of establishing an electric light and water works.

SILVERTON, ORE.—The Citizens' Light & Traction Company, of Salem, has purchased the plant of the Union Light & Power Company, of this city. They will rebuild the dam and develop all the power possible. Mr. A. Welch is manager of the purchasing company.

PORTLAND, ORE.—The proposed power plant of the Cascade Power Company will be located about 50 miles from Portland, the water to be taken from Zig Zag, Still and Camp Creeks, to furnish about 30,000 horsepower. The cost of the proposed work will be about $650,000.

WATONGA, OKLA.—It is proposed to construct an electric light plant at a cost of $6,000. G. E. Moore is town clerk.

STEELTON, PA.—The Steelton Light, Heat & Power Company, whose plant was destroyed by fire, will rebuild on a new site.

YORK, PA.—The large hydro-electric power plant which is to be erected at McCall's Ferry by the McCall's Ferry Power Company is now fairly under way.

BIRDSBORO, PA.—An electric light plant is to be erected on the Schuylkill River at this point, but none of the details of the project have been given out as yet.

PHILADELPHIA, PA.—The Philadelphia Electric Company has secured the contract for lighting the streets by electricity for the year 1906, for a total of $1,073,272.

SALISBURY, PA.—The Citizens' Light, Heat & Power Company has been incorporated with a capital of $10,000, by John Meager, H. H. Maust, Richard B. Newman, and others.

PITTSBURG, PA.—The Chemical Light, Heat & Power Company, of Pittsburg, has been formed to construct a plant at Beaver Falls, to cost about $200,000. This company is reported to have taken over the plant of the Wooster Gas Light Company, of Wooster, Ohio; the plant of the McWatters By-Products and Gas Manufacturing Company, at Beaver Falls, and will take over four other gas and electric light plants in Ohio and Pennsylvania. Thomas McWatters is the manager.

PROVIDENCE, R. I.—The Narragansett Electric Light Company has the contract for lighting the city for six years, the first three years to be at $104.75 per light per year and the next three years at $100 per light per year.

ST. MATTHEWS, S. C.—An election will probably soon be held to vote on issuing $20,000 bonds for an electric light plant and water works.

FLORENCE, S. C.—Bids will probably be received about Feb. 1 for the development of the power of Black Creek, near Florence, for the Florence Light & Power Co. The probable cost of the work will be $150,000.

ABERDEEN, S. D.—It is stated that $35,000 municipal light bonds have been sold here.

CANTON, S. D. The Canton Milling Company proposes to install a $20,000 electric light plant and water works system for the town.

TREZEVANT, TENN.—The question of constructing water works and an electric light plant is said to be under consideration here.

GREENFIELD, TENN.—Coates Bros. & Barton have purchased the plant of the Greenfield Electric Light & Water Company, which was formerly owned and managed by Harry C. Ward.

KNOXVILLE, TENN. A statement in a local paper at Knoxville says that the city will pay $72.50 per light next year while Savannah, Ga., will pay $39,000 for the year's contract, the number of lights not being given. In Richmond, Va., $54.75 is being paid per light for 650 lights, or a total of $35,587 per year.

SOUTH PITTSBURG, TENN. Some weeks ago the South Pittsburg Electric Light & Power Company offered to sell the entire plant to the city for $3,000, payable in two years, with notes bearing 6 per cent. The Board of Mayor and Aldermen ordered an election and the proposition was accepted by 124 votes for it and 44 against.

FAYETTEVILLE, TENN. B. E. and J. W. Holman, J. H. Thompson and T. W. Caudle, of Fayetteville, have purchased the electric light plant at Dayton, Tenn., and charter has been applied for. The capital stock of the company, which will be known as the Dayton Electric Light Company, will be $10,000. Improvements amounting to $2,500 will be made on the plant at once. J. W. Holman is president; B. E. Holman, secretary and treasurer; W. J. Holman, superintendent; T. W. Caudle, general manager.

KILLEEN, TEX. McDowell & Burks, of this place, have been granted a 50-year franchise for the operation of an electric light plant.

BRYAN, TEX.—The Bryan Water, Ice & Power Company has filed an amendment to its charter, increasing its capital stock from $20,000 to $40,000.

SALT LAKE CITY, UTAH.—Frank Taylor, of this city, has filed application with the State Engineer for 200 sec.-feet of water from Weber River, in Sum

GINEE

mit County, to be
r purposes at
DGE
BEAVER, UTAH.–a str
second feet of w h
establish a plan phe
this city, Milford, F inves
Mt. Nebo, Ohio and obser

OGDEN, UTAH. ued
Power & Irrigation Co an
dam and power Phy
liminary work has nd be
account of the weath oked

SALT LAKE CIT
plication at the State .—Th
fer Lake for power own
tunnel 3 ft. wide an ny:
structed a distance of seph
The power will be ve is
and Kimberly. place

MONTPELIER, V of
& Traction Company, a ci
pleted. The plant is as
house, a boiler of 15 the
the electric generatin ngs

PORT TOWNSEND ood
baum for the operatio W

SEATTLE, WASH as L
Company has been ch Ga

WALLA WALLA, anno
secured the contract f Mr.
machinery at the Peni gas.
the machines. t offi
Mr.

PROSSER, WASH mana
Falls Land & Power his n
along the county road ive p
electric power to Sun nade

EVERETT, WASH. Eat
representing the Snoq man
also a contract for light for
The system will be in- Mr.
March 1, 1906. pany,

ARLINGTON, WA don.
superintendent and ma ell-k
of Arlington. He will nd a
miles from the town. my
& Light Company's ste ritair
Creek Company. laini
l est

PORT TOWNSEND nents
by H. M. Bennett a nents
light plant. e ho

SEATTLE, WASH. the
build a transmission l the
O. D. Colvin, of Sea ied

SOUTH BEND, W
chise to M. E. Wals ad
construction of an ele
with electricity.

KAUKAUNA, WIS IN
double the capacity of its
erator in addition to its ari

LADYSMITH, WIS S.–
Company, including th No.
been sold to G. E. erna
planned. C T

MILWAUKEE, WIS Comp
ship projects by voting n ge
tric Railway & Light the
old contract. This mea ill
for those on undergro adap

WASHBURN, WIS.– T
streets of this city are S
Electric & Power Com tic
No new contracts were Me
cut off at the option of line
pany, which has been ing
paying $11.24 for each
ing on the midnight sch PI
but it is the opinion of an
no doubt be made in th um

ARMSTRONG, B. C eq
is being formed here NGI
Vernon and from the ghte
be interested in the en,

CRANBROOK, B esigned
been registered here N ELI
ert Campbell, Moyie, I dbush A
Cranbrook, F. C. Par at and
intention of the comp is obl
power. Operations w TORS.
granted 1, des

to spend $30,000
sted.

Company will install
River near Villa de

is being formed in
ital stock has already

las Fuerzas Hidro-
with a capital stock
puato.

nen are arranging to
ct volcano near here
cent to Toluca with

concession, covering
Las Juntas and San
nased by La Electra,
he price paid for the

pany has secured the
ner light per night.

ompany is arranging
t. Bids will probably

pany has been incor-
re power machinery,
bert McKay, Gideon

Telephone Company
ipal lighting plant of
n the plant. The com-
r, while the telephone
$15 for residence and

Ottawa and the Ottawa
been cancelled by the
ity clerk. This move
ence. When the con
er of 1904, provision
me to cancel the con-
ice. Some time ago a
tion and subsequently
f which was given at

Company, of Montreal,
of $250,000. The in-
treal; G. W. Webster,

oal electric light and
Mr. Charles Brandeis,
saving to the city of
whole cost of the plant

vay.

t the demands of the
a road being projected
electric power dam of
on the Chattahoochee
net and committees put

e been closed for the
pany to H. M. Byllesby
$500,000

n filed with the State
k Brunswick Extension
ay between Yarmouth,
12 miles. The capital
c. A. B. Page, S. A.
V. Davis, of Waterville.

ansit Railway Company
Andrews, of Cleveland,
nt; John J. Stanley,
eneral manager; T. H.
John E. Duffey con-
ction of the new sub-
ompany. Contracts call
rapid transit system by
about $100,000 will be
nge of lines.

d for the Morgantown
be let for construction.
to use the single-phase
r house has not been
Thomas, of Blacksville,
vice-president and acting general manager; W. W. Smith, of Morgantown, secretary and purchasing agent; Sanford Barrickman, of Pedler, W. Va., treasurer; Prof. C. R. Jones, electrical engineer.

New Industrial Companies.

THE NATIONAL SWITCHBOARD COMPANY, of New York, has been incorporated with a capital stock of $50,000. The directors are J. F. McGuire, G. B. Garrison and T. V. Devins, New York.

THE LOCK-SWITCH MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $25,000. The directors are W. O. Courtland, D. J. Newland and W. P. Hammond, New York.

THE ELECTRIC CONFECTION COMPANY has been formed in Boston, Mass. Capital, $50,000. Treasurer, Leon B. Paton, Danvers. Directors, as above and Frank W. Few, Thornton Parker and Fred S. Kingsley, of Boston, and Chas. R. Bennison, of Winthrop.

THE TELEGRAPH NEWS COMPANY has filed an application of incorporation at St. Louis, Mo. The capital stock is $10,000, one half paid. The incorporators are John M. Grant, of Orange, N. J.; Courtland Smith, of Dobbs Ferry, N. Y.; Wm. L. Vail, of Fairview, N. J.; M. F. Germond, of Dumont, N. J.; Joseph Adridge, Roy D. Moore and Geo. P. Feis of St. Louis. The object of the incorporation is to manufacture, deal in, operate and maintain electrical instruments, etc., and to collect and disseminate news.

Legal.

ILLEGAL ELEVATED TRACK.—The Appellate Division of the Supreme Court decided that the third track of the Ninth Avenue Elevated, New York City, was illegally erected, and direct that the Manhattan Railway Company is bound to compensate the property owners along the route for easement damages. Several hundred such cases are pending. The third "express" track is an absolute necessity to hundreds of thousands of people living in upper New York and doing business downtown.

DAMAGE FROM ELEVATED.—A. P. Loring, owner of the Albany Building, sued the Boston Elevated Company for $150,000 because trains passing around the corner of the building caused annoyance. A phonograph was brought into court to reproduce the noise made by the trains as they passed. A photometer was also used to show the diminution of light due to the erection of the elevated structure, and an oscillometer showed photographs of the air waves disturbed during the passing of a train. A verdict of $45,000 was given with interest, the total making $58,267.

DRY BATTERY INJUNCTIONS.—The Columbia Dry Battery Company and the Vim Company, both of Chicago, have been enjoined from the sale of their "Columbia" dry batteries. Suit was brought by the National Carbon Company, claiming the "Columbia" trade mark, before Judge Kohlsaat in Chicago, with the result that on December 12 an injunction was issued against these concerns forbidding them from offering for sale any dry batteries not made by the National Carbon Company to which is applied the word "Columbia" or the words "Columbia Dry Battery Company." The effect of this injunction, we are advised by the plaintiffs, is to confirm the National Carbon Company in the possession of the trade mark "Columbia."

CABLE CONDUITS. The Appellate Division of the New York Supreme Court handed down last week a decision in the case of the West Side Electric Co. against the Consolidated Telegraph and Electrical Subway Co. The judgment rendered by Justice Truax at Special Term is affirmed. Justice Patterson writes the opinion of the court in which Presiding Justice O'Brien and Justice McLaughlin concur, while Justice Laughlin concurs in the result. Justice Ingraham writes a dissenting opinion. The plaintiff company sought a perpetual injunction against the defendants to restrain it from interfering with or obstructing the maintenance of certain cables and electrical conductors, located in subways or ducts in the city of New York. Justice Truax dismissed the complaint, and an appeal was taken. The Appellate Division at the same time affirmed an order dismissing and quashing an alternative writ of mandamus, which had been directed to the defendant, to enforce a right claimed by the plaintiff to lay or place other cables for electric lighting purposes in subways in the city of New York. The court says: "If it be true that the right to the use of the streets is a part of the franchise of the appellant, then it results from the Glue case that the Board of Aldermen was the legislative body having the power to grant a franchise to use the streets. In the case cited it was held that previous to 1897 the Board of Aldermen was the body which had the power to confer street franchises." The same question was involved in both the action and the special proceeding, and that question was as to the right of the plaintiff company to use the subways as claimed by it. Justice Patterson says that it is conceded that it had an apparent right, insomuch as it had received the consent and authority of the Board of Electrical Control of the city of New York. The company contended that such consent was all that is required to enable it lawfully to lay, construct wires, and maintain other appropriate appliances for conducting and distributing electricity in subways under the streets, avenues, and public places in the city of New York. The defendant insisted that the authority so derived was insufficient, and that the power in question resides only in the Board of Aldermen.

Obituary.

MR. J. W. FLETCHER.—We regret to note the death of Mr. John William Fletcher, general superintendent of the Fulton County Gas & Electric Company. He died of appendicitis at the Littauer Hospital, Gloversville, N. Y., on December 12. He was only 34 years of age, and was a graduate of Lehigh University, class of 1900. He leaves a wife and one sister.

ucational.

.. is offering technical education to its members, em-
in charge of Mr. James D. McCarthy, for eleven
nspector of Detroit, and of Mr. A. J. Crane, B. S., of
The details are set forth in circulars issued by the

NIVERSITY OF PENNSYLVANIA.—The bulletin of the
sity of Pennsylvania states that the electrical engineering de-
rown very rapidly during the last year and the equipment has
improved while other improvements are still in progress. The
aboratory has been enlarged, so that now it has more than twice the capacity that it had a year ago. Several new Westinghouse dynamos and motors have been added, also new portable indicating instruments, including a millivoltmeter with shunt, making it possible to measure from zero to 500 amperes. The machinery and shafting have all been rearranged and new marble switchboards are being constructed according to the latest and most improved designs. This is done so that more machinery and more apparatus can be in operation at the same time. The result is that many more students can be accommodated than ever before. A new mercury-arc rectifier has been ordered and is now being made by the General Electric Company, which will be used for charging a 56-cell storage battery and for experimental purposes. The classes in the electrical department this year are more than twice as large as they have ever been before, and to accommodate them the laboratories have to be in operation every school day in the week, and another assistant has been employed. According to the present outlook a further increase in equipment will have to be made to accommodate the still larger classes of next year.

Personal.

MR. F. P. FISH.—President Fish of the American Telephone & Telegraph Company will make a trip to the Pacific Coast in a few days for the inspection of the telephone companies in the West. He expects to be gone about three weeks.

MR. ISIDORE S. PRENNER, E. E., patent attorney and counsellor-at-law, has moved from Scranton, Pa., to the Betz Building, Philadelphia. Mr. Prenner gives advice in technico-legal cases and is a consulting engineer and electrochemist.

MR. E. MOORE, a freshman in the L. C. Smith College of Applied Science, at Syracuse University, is said to have received $5,200 from the Winton Company for a new automatic sparker for automobiles, and to have sold one or two inventions; while he has more on the way to perfection.

MR. W. S. KELLEY.—Mr. Walter Stuart Kelley, B. S., for nearly seven years in charge of the outside service, or power engineering for the Narragansett Electric Lighting Co., has severed his connection with the company and on January 1 will assume the duties of chief engineer of the Holtzer-Cabot Electric Company, of Brookline, Mass.

MR. F. S. DRAKE.—Mr. Frank S. Drake, formerly at the works of the General Electric Company, at Lynn, Mass., it is now officially announced has been appointed Assistant General Manager of the entire service of the Urban and Interurban Street Railway system of the Portland (Ore.) Railway Company. More latterly Mr. Drake has been connected with air brake interests.

MR. F. M FARMER, of the Electrical Testing Laboratories of New York, has been at the Westinghouse works at East Pittsburg, Pa., conducting acceptance tests on a large order of electrical apparatus, including two 1,500-kw generators, nine 1,000-kw transformers, rotary converters, smaller transformers, etc., for the Grand Rapids-Muskegon Water Power Electric Company, of Grand Rapids, Mich.

MR. W. H. McGRATH succeeds A. W. Leonard as general manager of the Houghton County Street Railway Company and the Houghton County Electric Light Company of Michigan. Mr. McGrath went to the copper country from the east to take a position under Mr. Leonard. With the appointment of Mr. Leonard to the position of general manager of the two local companies of Stone & Webster, Mr. McGrath was made superintendent of the electric light work. He has held that position since. Mr. McGrath's promotion meets with general approval on the part of the copper country patrons of the two corporations, and he is in receipt of many congratulations.

MR. C. H. B. CHAPIN has recently resigned from the New York Edison Company as manager of one of the branch offices in the Contract and Inspection department; prior to which he was manager of the Complaint department. He has now opened an office at 1170 Broadway, New York City, and is prepared to do general consulting engineering work, making a specialty of two lines that may be of interest to the central station manager. These are the developing of up-to-date methods of selling electricity, inclusive of advertising, and contracting to test meters on the circuits of such smaller companies as do not maintain a testing department of their own. Mr. Chapin's experience is such as to place him in a position of advantage to do this work.

DR. N. M. HOPKINS, professor of chemistry at the George Washington University, Washington, D. C., has been appointed chief electrical engineer, Bureau of Yards and Docks, U. S. Navy, and placed in charge of the electrical and mechanical engineering work at the various navy yards, with special reference to the consolidation of power plants. The position carries with it a salary of $5,000 a year. The appointment was authorized by President Roosevelt at the request of the Secretary of the Navy and the chief of the Bureau of Yards and Docks. The only condition was the passing of an examination before a board of experts of the Civil Service Commission. Dr. Hopkins is well known in the electrical and chemical fields as a young man of great ability and author of several books.

SIR OLIVER LODGE
in London, advanced a str
phenomena. "I hold," h
physical metaphysical phe
quality sufficient for inves
them as astronomers obse
British public," continued
to the Stock Exchange an
despise the emotions. Ph
tigation, and they will be
although they are looked
of the day."

MR. J. P NEAVE.—Th
to one of the well-known
Manufacturing Company:
decided to appoint Joseph
Department. Mr. Neave i
he would accept the place
thusiast on the subject of
around advancement of a c
throughout the country as
Grandin road opposite the
member. He also belongs
mobile Club and the Good

MR. S. E. WOLFF.—W
noted, the *American Gas L*
meeting of the Jackson Ga
company were formally anno
president, resigned, and Mr.
general manager of the gas,
naw was elected to that off
board of directors, and Mr.
secretary and general man
assumed the duties of his n
of the company's extensive p
whom Mr. Wolff has made
served promotion. Mr. Eat
pany, although a young man
thoroughly qualifies him for

MR. G. HERRING.—Mr.
Electric Lighting Company,
handsome thing in London.
Herring, formerly a well-k
commercial companies and a
given the Salvation Army
colonization in Great Britain
written to the King explaini
ing urban poor and will est
of land, farming implements
be repayable in installments
will be conveyed to the ho
It will be controlled by the
the original capital to the
Any profits will be applied

Trad

CAR JOURNAL BEARIN
pany, Baltimore, Md., has i
motive and car journal bear

WATT-HOUR METERS.—
Y., has issued price list No.
the direct-current and alterna

BELT-DRIVEN, DIRECT
of the General Electric Comp
moderate speed belt-driven ge

STEAM VALVES.—The
New York, has issued an ill
degree, and cross valves ada

AUTOMATIC CIRCUIT
General Electric Company, S
parts of type MR automatic

MOTOR DRIVES.—The
issued circular No. 18, dealin
speed motor for the driving
machinery, etc.

WIRELESS TELEGRAP
Detroit, Mich., has issued an
of wireless telegraphy. Num
with the system and of the eq

STEAM HOISTING ENG
Company, West New Bright
engines for hoisting. The en
struction and especially designe

GEORGE WEIDEMANN EL
New York, and 267 Flatbush
tractors, have issued a neat and
entitled "Debutantes" It is obl

PORCELAIN INSULATORS.
has issued catalogue No. 1, de

and telephone lines. The
rating electromotive forces

e B. F. Sturtevant Com-
ted to all classes of work
se engines are of the high-
tension sub-bases to allow

te Building, Chicago, has
t the first Jones stoker in
May 1, 189[illegible]; the latest sale
for equipping five 658-hp

lated Wire Company has
e figures on the monthly
calendar, and can be easily
colors of the company's fac-
known trade mark.

, 181 Monroe St., Chicago,
e theory and practical ap-
les. In addition to describ-
mples of their applications,
ch are especially convenient

American Steam Gauge &
has just issued a new cir-
icator with the new detent
nd there is no awkward at-
ng used. The circular illus-

La Vergne Machine Com-
lder No. 8011, giving a few
chinery. Among the several
machine connected through
Illustrations are also given

h the steam turbine is find-
own by a recent publication
ttsburg, Pa., which gives a
rbines, showing the number
gregate rated horse power of
mpleted.

Pump Company, San Fran-
evoted to centrifugal pumps.
ve met with gratifying suc-
lt driven by electric motors.
nost interesting is a 4-stage,
extremely high heads.

York City, has just issued
e large quarto "King's Views
its hundreds of pictures, is
built up by the modern ele-
could not have been created
We understand that copies

of the Marvin Electric Drill
k drills and the special
operating them. The drill
wo coils through which cur-
frequency alternator, and the
of the bipolar armature pro-

TERS. Bulletin No. 20 of the
Pittsfield, Mass., gives a com-
on of watch-case voltmeters
convenient for testing small
bells or the ignition circuits of
for physicians' batteries, or
installations.

No. 1047, of the Allis-
k transformers for in-
, according to the method
lf-cooled type the heat is
the oil-filled water-cooled type
or brass tubing immersed in
structural features of the
rations.

N. Y., have issued a very
d, "Determination," im-
st in porcelain electrical
d white embossed relief a
look of determination on
n the face of the members of
hold the trade they have
hrader.

a wide field of applica-
tremely severe. This class
Northern Electrical Manu-
line of box type motors.
as dust proof. They are
has an extremely sturdy

armature shaft and liberal bearings, and com
ment of the motor parts. Bulletin 32 is desc.

CROCKER-WHEELER COMPANY, Ampere,
with picture of its large alternator, say: "Our
in the year 1905 was our successful entrance into
current manufacture. After 17 years' experience in
on which [illegible] position
with a complete line of alternating-current generators,
etc. In a short time, still holding our place in the dire
had established ourselves in the front rank of A. C. m
example of our work in this line is shown on the enclose
for January, February and March."

ELECTRIC AND PNEUMATIC TOOLS. Catalogue No. 17 [illegible] cago Pneumatic Tool Company, Fisher Building, Chicago, is a handsomely arranged publication containing 192 pages of standard book size, 6 x 9 inches. All types of portable tools are illustrated and described. Five pages are devoted to air-cooled Duntley electric drills, which are claimed to have given excellent satisfaction. An indication of the growth of the portable tool business of this company is obtained from the fact that eleven years ago, when its first advertising literature was issued, a 16-page folder for enclosing in the regular 6¾ envelope was found sufficient to contain a description of all the types of tools then manufactured.

GEAR CUTTING MACHINES.—The Eberhardt Brothers Machine Company, 66 Union Street, Newark, N. J., has issued as a folder a reprint of an article from the *American Machinist* on "Some Interesting Generated Worm Gearing," which describes the machine work done by gear cutters manufactured by this company. The "generating" machine ilustrated is capable of cutting teeth in a worm wheel 84 inches in diameter. Bulletin No. 1 of this company is devoted to semi-automatic gear cutting machines for spur and bevel gears, especially adapted for railway motor work. The company has also issued an illustrated bulletin dealing with its 16-in. crank shaper of the single-geared and back-geared types.

"ELECTROTHERM," A SUBSTITUTE FOR THE HOT-WATER BAG. —Folder No. 3455 of the General Electric Company, Schenectady, N. Y., describes an interesting electrical novelty in the form of a substitute for the hot-water bag. The "Electrotherm" is composed of wires insulated and protected by asbestos, woven into a light and flexible sheet or pad, which, when connected to the ordinary incandescent lamp socket, offers sufficient resistance to allow the current to produce a constant and uniform degree of heat. It is the function of the "Electrotherm" to banish the deficiencies existing in other methods of applying heat locally in bodily ailments, and to introduce refinements of treatment and comforts for the sick not otherwise obtainable.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., has issued new catalogues No. 9 and No. 10, covering long-distance and interior telephone equipments respectively. These catalogues are handsomely illustrated with half-tone cuts throughout, and go into careful detail with each line. Each issue contains many new and up-to-date specialties. The Connecticut company during the last year has been obliged to considerably increase its plant and the prospects are very bright for an even larger business during 1906. The company was organized in 1893, and has manufactured telephones and electrical specialties, and since that time has grown each year to its present large capacity. The Connecticut company will be pleased to mail its new catalogues, No. 9 and No. 10, to anyone interested.

MAGNETISM OF IRON VESSELS.—In order to a better understanding of the magnetism of iron vessels, and the compensation of the compass, as explained in many of the text books, Mr. E. W. Owens, of the Liverpool Nautical College, has prepared a little work entitled "The A. B. C. of Compass Adjustment" which purports to convey in simple language, a thorough explanation of this complex problem. It contains a number of charts and diagrams, and will be found useful for students and others in understanding the subject. The price is $2, and it is issued by D. Van Nostrand Co. Another little manual of a somewhat similar nature is to be found in "The Van Nostrand Science Series." It is entitled "Magnetism of Iron Vessels and Terrestrial Magnetism" and is by Prof. Fairman Rogers, of Philadelphia.

VARIABLE-SPEED MOTOR.—Bulletin No. 1 of the Lincoln Electric Manufacturing Company, Cleveland, Ohio, describes in detail the constructional features of the Lincoln variable-speed motor with a speed range of 5 to 1, for use on ordinary two-wire, direct-current circuits. This motor is a four-pole, shunt-wound machine, and means are provided for moving the armature out or in between the field pole pieces. As the armature is withdrawn, the magnetic reluctance increases and the magnetic flux decreases, the result being increased speed. The armature is slightly larger at one end tnan at the other. This conical shape is used in order to more quickly increase the air gap, which it does as the armature is withdrawn from the pole pieces; this, with the decrease in the magnetic area gives a greater variation in speed than would otherwise be possible.

CENTRAL ELECTRIC COMPANY, East Jackson Boulevard, Chicago, has just issued the 1906 edition of the well known standard catalogue. It has [illegible] large pages, and is No. 24. It is replete with information, data, illustrations, descriptions, prices, etc., and includes all the very latest applications in the electrical arts. A great new feature is that wherever possible, the approximate shipping weight is given. Every article has also a code word and a number, and the cipher code enables correspondence and ordering to be carried on entirely by telegraph. Such a catalogue is an invaluable piece of equipment. The new and, we believe, unique idea of giving the shipping weight is admirable. It enables the customer to estimate the cost of material laid down in his own city, which is of considerable importance, particularly where freight rates are high, as in the West, and where shipments are frequently made up by purchasers with a view to securing a minimum rate. Those wishing to secure a copy of this trade encyclopædia should write for it at once.

AUTOMATIC RAILWAY.—The C. W. Hunt Company, West New Brighton, N. Y., has issued catalogue No. 0510, dealing with the "Hunt" elevated self-acting railway used for conveying coal from the front of a wharf to a storage bin. The operation of the railway is as follows: When a loaded

TK
1
E47
v.46

Engin.

Electrical world

ENGIN STORAGE

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY